Ministry of Construction and Urban Development (MCUD)

National Development Agency (NDA)

Japan International Cooperation Agency (JICA)

Sector Report on Natural and Social Environment and Water Resources for The Project for Formulation of National Comprehensive Development Plan

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ABBREVIATIONS

GENERAL

AA	Administrative Agent
AAP	Ambient Air Pollution
AR	Assessment Report
ASL	Above Sea Level
BCP	Business Continuity Plan
BI	Business Incubator
CAPEX	Capital Expenditure
CHP	Combined Heat and Power
COVID-19	Coronavirus Disease 2019
CVD	Cardiovascular Disease
CWWTP	Central Waste Water Treatment Plant
ECC	Environment and Climate Change
EFP	Environmental Fellowship Program
EG	Economic Growth
EIA	Environmental Impact Assessment
EIC	Environmental Information Centre
EMP	Environmental Management Practice
EPRMNG	Environmental Performance Review of Mongolia
ESG	Environmental, Social and Governance
ESIA	Environmental and Social Impact Assessment
EV	Electric Vehicle
F/S	Feasibility Study
FDI	Foreign Direct Investment
FSL	Full Supply Level
FWL	Flood Water Level
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information System
GW	Gigawatt
GW	Groundwater
GWL	Groundwater Level
HAP	Household Air Pollution
HCW	Health Care Worker
HDI	Human Development Indicator
HEG	Health, Education and Gender
HIC	High Income Country
HIV	Human Immunodeficiency Virus
HPP	Hydropower Plant
HSP	Human Settlement Plan
HSSMP	Health Sector Strategic Master Plan
IAOD	Industrial Accidents and Occupational Disease
IC/R	Inception Report
ICT	Information and Communication Technology
IEC	Information, Education and Communication
IEE	Initial Environmental Examination
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IT	Information Technology
IWMP	Integrated Watershed Management Program
IWP	Integrated Watershed Management
IWRM	Integrated Water Resources Management
LFC	Labour Force Coefficient
LFS	Labor Force Survey
LLC	Limited Liability Company
LMI	Low and Middle Income
LPA	Local Protected Area
LPG	Liquefied Petroleum Gas
LPR	Labour force Participation Rate
LTDP2050	Long Term Deployment Plan 2050
LWL	Low Water Level
M/P	Master Plan
MAPS	Mainstreaming, Acceleration and Policy Support
MCH	Maternal and Child Health
MCM	Million Cubic Meters
MDGs	Millennium Development Goals
MIC	Middle Income Country
MINIS	Mining Infrastructure Investment Support Project
MLIC	Mid Low Income Country
MOL	Minimum Operational Level
MSW	Municipal Solid Wastes
MW	Megawatt
MWL	Maximum Water Level

NAMA	National Appropriate Mitigation Action
NAPCC	National Action Programme on Climate Change
NC3	Third National Communication of Mongolia
NCCD	Data on School Students with Disability
NCDP	National Comprehensive Development Plan
NDC	Nationally Determined Contribution
NGO	Non-Governmental Organization
NM	Natural Monument
NP	National Park
NRW	Non-Revenue Water
NWL	Normal Water Level
OPEX	Operating Expenditure
PA	Protected Area
PAA	Protected Area Administration
PDCA	Plan-Do-Check-Action
PISA	Program for International Student Assessment
PPP	Public-Private Partnership
PUSO	Public Urban Services Organization
PV	Photovoltaic
R&D	Research and Development
R/D	Record of Discussion
RB	River Basin
RCC	Roller-Compacted Concrete
RDP	Regional Development Policy
REDD+	Reducing Emissions from Deforestation and Forest Degradation
REFP	Rural Environmental Fellowship Program
SAT	Scholastic Aptitude Test
SDGs	Sustainable Development Goals
SDPR	Social Development and Poverty Reduction
SDV 2030	Sustainable Development Vision 2030
SEA	Strategic Environmental Assessment
SEAR	South East Asian Region
SME	Small and Medium-sized Enterprises
SPA	Special Protected Area
SRH	Sexual and Reproductive Health
SRM	Sustainable Resource Management
STI	Sexually Transmitted Infection
StrPA	Strictly Protected Area
SW	Surface Water
T/A	Technical Assistance
TOR	Terms of Reference
VNR	Voluntary National Review
WBC	Women's Business Center and Incubator
WLP	Women's Leadership Program
WPR	Western Pacific Region
WWTP	Wastewater Treatment Plant
YLP	Young Leadership Program
YSP	Young Scholars' Program

ORGANIZATIONS

2030WRG	2030 Water Resources Group
ADB	Asian Development Bank
ALAMGaC	Agency for Land Administration and Management, Geodesy and Cartography
C/P	Counterpart
CEC	Community Education Council
ECE	Economic Commission for Europe
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
GASI	General Agency for Specialized Inspection
GIZ	Deutsche Gesellschaft fur Internationale Zusammenarbeit
IMHE	Institute of Meteorology, Hydrology and Environment
IOM	International Office of Migration
IRIM	Independent Research Institute of Mongolia
IRIMHE	Information and Research Institute of Meteorology, Hydrology and Environment
ISO	International Organization for Standardization
JICA	Japan International Cooperation Agency
JICE	Japan International Cooperation Center
JPT	JICA Project Team
KOICA	Korea International Cooperation Agency
MCC	Millennium Challenge Corporation
MCUD	Ministry of Construction and Urban Development
MES	Ministry of Education and Science
MEF	Mongolian Employers Federation
MEGD	Ministry of Green Development
MEGDT	Ministry of Environment, Green Development and Tourism
MET	Ministry of Environment and Tourism
MLSP	Ministry of Labor and Social Protection
MMHI	Ministry of Mining and Heavy Industry
MMRE	Ministry of Mineral Resources and Energy
MNB	Mongolian National Broadcaster
MNCCI	Mongolian National Chamber of Commerce and Industry
MOD	Ministry of Defense
MOE	Ministry of Environment
MOF	Ministry of Finance
MOFALI	Ministry of Food, Agriculture and Light Industry
MOH	Ministry of Health
MONEF	Mongolian Employers Federation
MRTD	Ministry of Road and Transportation Development
NAMEM	National Agency for Meteorology and Environmental Monitoring
NCMCH	National Center of Maternal and Child Health
NCPH	National Centre for Public Health
NDA	National Development Agency
NEMA	National Emergency Management Agency
NSO	National Statistical Office
NWC	National Water Committee
OCA	Overseas Contractors Association
OECD	Organisation for Economic Co-operation and Development
PHSIU	Public Health Surveillance and Information Unit
RBA	River Basin Administrations
RBO	River Basin Organization
SDC	Swiss Development Corporation
TAF	The Asia Foundation
UN	United Nations
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USUG	Ulaanbaatar Water Supply and Sewerage Authority
WB	World Bank
WBA	Water Basin Authority
WBC	Water Basin Committee
WHO	World Health Organization
WWF	World Wide Fund for Nature

Chapter 1 Natural Environment

Most of the updated environmental profile documents were reviewed and key aspects with a specific focus on the environmental sustainability were summarized to establish the bases of formulating National Comprehensive Development Plan (NCDP). Unless mentioned specifically, following reports are referred as the most comprehensive environmental review reports.

(a) Environmental Performance Review of Mongolia (EPRMNG), November 2018, United Nations Economic Commission for Europe (UNECE)

(b) Profile on environmental and social considerations in Mongolia, March 2014, Japan International Cooperation Agency (JICA)

(c) National Communication 3 of United Nations Framework Convention on Climate Change (UNFCCC), December 2018, Ministry of Environment and Tourism (MET)

1.1 SDV2030 Performance for Environmental Sustainability

The National Statistics Office (NSO) of Mongolia has been appointed as the central coordination unit of the Sustainable Development Goals (SDGs) monitoring. Results of the monitored/estimated SDGs indicators between 2015 and 2017, key indicators for Sustainable Development Vision 2030 (SDV2030) between 2014 and 2017, and key indicators for Green Development Policy between 2014 and 2016 are available on the NSO website of Mongolia. In addition, the latest SDGs monitoring report, "Mongolia Voluntary National Review Report 2019: Implementation of the Sustainable Development Goals, National Development Agency (NDA) July 2019", confirmed the achievements and challenges of the Mongolian SDGs. Using these indicators, the environmental development status is summarized in reference to the SDGs and the Green Development Policy in Table 1.1.1 and Table 1.1.2, respectively. These reviews provide bases for the NCDP indices to be considered.

Table 1.1.1 Status of Environmental Indicators for SDV2030 and SDG Goals

Indicator*	Unit	2014**	2015	2016	2017***	2018	2030****
8. Environmental performance index	Rank	111	-	114	-	83	90
14. Area of the land with disease free status for international trade certified by World Animal Health Organization	%	0.0	0.0	0.0	0.0	-	60.0
15. Area affected by desertification	%	17.4	76.8	-	-	-	68.0
16. Area of specially protected land	%	3.5	13.5	13.5	13.5	-	30.0

Source: Mongolian Statistical Yearbook 2017, National Statistical Office of Mongolia, Mongolia Voluntary National Review Report 2019, NDA (8. Environmental performance index of 2018)
Note: * indicator # of SDV2030, ** baseline, *** available data at NSO at the time of publication, **** target

Key achievement	- Mongolia fulfils its UNFCCC commitments - The Special Protected Areas (SPAs) network has increased from 13.8% in 2000 to 17.85% in 2018
Key challenges and bottlenecks	- The frequency of extreme weather events has doubled. - Over 60% of the land is degraded due to overgrazing and climate change. - Very high per capita emissions of greenhouse gases nearly 2.7 times greater than the global average. - The ecosystem has altered due to climate change and human activities. - There is an increased trend in environmental crimes. - Revenue from natural resource use is not properly spent.

Source: Mongolia Voluntary National Review Report 2019, NDA

Table 1.1.2 Status of Environmental Indicators for Green Development Policy

Indicator*	Unit	2014*	2015	2016	2020	2030
15. Domestic material consumption	per unit GDP, kg/million ton	3, 790.3	3, 889.9	-	-	-
16. GHG emissions	thousand ton	35,497.9	-	-	-	-
17. Percentage of fresh water reserves in streamline formation areas	%	-	-	-	-	-
18. Share of treated wastewater in total wastewater	%	100	57.2	96.9	-	-
19. Concentration of particulate matters (PM10) / (PM2.5) in urban air of Ulaanbaatar	mg/m^3	0.645 / 0.190	0.076 / 0.141	0.199 / 0.065	-	-
20. Waste recycling rate	%	0.5	0.3	16.1	20	40
21. Share of green space in Ulaanbaatar city	%	-	-	14.3	15	30
22. Share of protected area in total area of the country	%	13.5	13.5	13.5	25	30
23. Proportion of land area covered by forest (%)	%	9.2	9.2	9.2	8.5	9
24. Percentage of land that is degraded over total land area	%	6.0	6.1	4.5	-	-
25. Rehabilitated agriculture land area in total degraded land area	ha	6	6.1	4.5	-	-
26. Share of mineral extraction land area in total degraded land area	%	0.1	0.1	0.1	-	-
27. Share of area with zero and reduced tillage in total plantation areas	%	-	-	-	-	-
28. Number of enterprises certified ISO 14001 in total number of enterprises	%	0.0004	0.0004	0.0004	-	-
29. Share of dried rivers, streams, springs and fountains to total number of rivers, streams, springs and fountains	%	8.9	-	8.4	-	-
30. Share of areas experiencing very strong and strong desertification in total land area	%	-	22.9	-	-	-
31. Pasture capacity, by sheep head per 100 thousand pasture hectare land	sheep head per 100,000 ha	77	83	92	-	-
32. Concentration of SO_2 in the atmosphere of the city	mg/m^3	0.021	0.025	0.027	-	-
33. Concentration of NO_2 in the atmosphere of the city	mg/m^3	0.043	0.042	0.043	-	-

Source: Mongolian Statistical Yearbook 2017, National Statistical Office of Mongolia
Note: * main indicator # of the Green Development Policy
GHG stands for Green House Gas
ISO stands for International Organization for Standardization

1.2 Legal and Institutional Frameworks for Environmental Sustainability and Protection

1.2.1 Legal framework for green economy and sustainable development

(1) Sustainable development planning, environmental and social sustainability and governance

The Government of Mongolia has been making continuous efforts since 2012 to transform its main economic model from a conventional growth-oriented model to green economy and sustainable development, despite the change of ruling political parties following the 2014 general election. Under the present government, following three sets of the legal and policy frameworks have led the sustainable development planning:

(a) 2014 Green Development Policy and 2016 Action Plan for the Implementation of the Green Development Policy for the period 2016–2030.

(b) 2015 Law on Development Policy Planning, and

(c) "Vision 2050", Mongolia's five-year development guidelines, and Governmental Action Program for the period 2020-20242.

(2) Law for environmental protection and management

Law on environmental protection (amendment 2012)

The 1995 Law on Environmental Protection (amended in 2012) is the principal environmental law in Mongolia. The amendment in 2012 triggered the significant changes for the Mongolian environmental legislations such as introduction of higher standards of the environmental assessment and requirements, and liabilities of the violators.

Environmental assessment law

The Law on Environmental Impact Assessment (EIA) was first adopted in 1998 and amended in 2012 to strengthen the enforcement of the environmental regulatory frameworks with two new concepts followed by series of its regulations for detailed instructions to implement the Law on Environmental Impact Assessment. The amendment introduced Strategic Environmental Assessment (SEA) to be conducted for policies, development programs and plans. As of the end of 2018, only one trial SEA for soil preservation policy has been initiated by MET. In addition to the new concepts, the amendment strengthens the public participation requirements of SEA and EIA for better decision making by authorities and project proponents. A series of the relevant regulations are listed as follow:

- 2013 Government Resolution No. 374 provides general procedures for SEA, cumulative impact assessment and EIA;
- 2014 Ministerial Order No. A-03 provides procedures for public participation in EIA; and
- 2014 Ministerial Order No. A-117 provides, in support of the relevant procedures, methodological guidance on SEA, cumulative impact assessment, baseline study, general and detailed EIAs, and Environmental Management Practices (EMPs).

Other environmental laws

Other laws related to various aspects of the environment are listed below:

- Air: 2012 Law on Air (amendment), 2010 Law on Air Pollution Fees;
- Land degradation: 2002 Law on Land (ongoing process of revision in 2017), 2012 Law on Soil Protection and Desertification Prevention;
- Water: 2012 Law on Water, 2011 Law on Use of Water Supply and Sewerage System in Urban and Settlement Areas;
- Nature protection: 1995 Law on Natural Flora, 2017 Law on Fauna (amendment), 2002 Law on the Regulation of Foreign Trade in Endangered Animal and Plant Species and Derivatives Thereof;
- Protected areas: 1994 Law on SPAs (ongoing revision of the legislation in 2017) and 1997 Law on Buffer Zones of Special Protected Areas;
- Forests: 2012 Law on Forest (amendment); and
- Waste and chemicals: 2003 Law on Household and Industrial Waste, 2017 Law on Waste Management, 2006 Law on Toxic and Hazardous Chemicals.

Other sector laws and international treaties

The following laws also have clauses related to promotion of sustainable development and environmental protection[1]:

- Law on Mineral (2006)
- Law on Budget (2015),
- Law on Renewable Energy (amendment 2015),
- Law on Energy Efficiency (2015),
- Law on Crop Production (2016), and
- Law on Tourism (2000).

1.2.2 Institutional framework

As specified by the Law on the Environmental Protection, the principal authority to enforce the law on environment and environmental affairs in Mongolia is MET with support of agencies under MET as well as some other agencies under other line ministries and/or local government parties as summarized below.

(1) Ministry of Environment and Tourism

MET is the state central administrative organization in charge of natural resources management and environmental protection. The ministry responsible for environmental issues was first formed in 1987 and continuously served for the nation as a cross sector ministry despite changes in names and/or additional functions assumed depending on the ruling party's decisions. Such stability of the set up and functions of the national environmental authority as a ministry made it possible for Mongolia to consistently develop and implement environmental policies and legislation and facilitated the integration of environmental considerations into sectoral policies and legislation.

(2) General Agency for Specialized Inspection (GASI) of Ministry of Justice and Internal Affairs

The General Agency for Specialized Inspection under the Prime Minister (reporting directly to the Deputy Prime Minister) was established in 2003. It still has an essential agency of environmental inspectors covering the enforcement of legislation on forests, flora and fauna, biodiversity, water, soil, air and other issues covered by 26 environmental related laws.

(3) National Agency for Meteorology and Environmental Monitoring

The National Agency for Meteorology and Environmental Monitoring (NAMEM) is the main state organization responsible for hydrological, meteorological and environmental monitoring and for hydrological and meteorological forecasting. Its functions include early warning to prevent the impacts of natural disasters, especially on human health and livestock.

(4) Water basin administrations

Mongolia has 29 water basins covered by 21 water basin administrations which has been organized in cooperation with MET, MOFALI and local authorities. The functions of water basin administrations are to develop a water basin management plan and coordinate its implementation, carry out a water inventory at basin level, set up water supply and wastewater removal points in the basin area, maintain a sub-database of water basin information, provide information to the public and propose the establishment of a water basin council.

[1] A list of major environment-related legislation is available in Annex II List of Major Environment-related Legislation, EPRMNG, UNECE, 2018. Another list of major environment-related international treaties and commitments legislation is available in Annex I Participation of Mongolia in Multilateral Environmental Agreements from 1958., EPRMNG (2018).

(5) Protected area administrations

There are 33 Protected Area Administrations (PAAs) including three operated by non-governmental organizations (NGO). PAAs work under the supervision of the Protected Areas Management Department of MET. Each protected area does not have its own separate administration. Instead, PAAs could employ wildlife rangers for a PA.

(6) Independent agency for water management

The "Water Law" approved in 2012 was revised in January 2020. There are two major changes:

1) Revival and establishment of a national agency responsible for water dismantled in 2012, and

2) Revival and establishment of the "Water Standing Committee" dismantled in 2015 under the prime minister.

The work content of this independent agency for water management established in March 2020 is as follows.

- Implement policies on domestic water resources research, appropriate use, protection and restoration.
- Improve the consistency of water-related organizations, increase the efficiency of projects in the field and inform citizens, businesses and organizations.
- Until March 2020, MOFALI had been in charge of issues related to water supply for pastures and irrigation, MCUD had been in charge of water issues in cities and villages, and the Ministry of Mining had been in charge of water supply for mining, etc. This agency has jurisdiction over all water-related policies and programs that had been separately pursues by these ministries in charge.

(7) Sectoral ministries partially responsible for environmental protection and management

Some functions of environmental protection by sectoral ministries and their agencies are listed as follow.

<u>Ministry of Food, Agriculture and Light Industry (MOFALI)</u>

MOFALI is responsible for development and implementation of policy and legislation on protection and appropriate use of pasture, animal husbandry, crop cultivation, food safety, light industry such as construction materials, wood processing, waste recycling, and safe handling of fertilizers and pesticides. The use of pesticides and chemicals in agriculture is a joint responsibility of MET, MOFALI, and the Ministry of Health.

MOFALI is also responsible for waste management covering dead bodies of animals, wastes from agro-industries and recycling of wastes generated by light industry, and waste water management from leather industry in Ulaanbaatar for joint management by MET, MOFALI and the Municipality of Ulaanbaatar.

<u>Ministry of Roads and Transport Development (MRTD)</u>

MRTD is responsible for development and implementation of policy and legislation on roads, with a focus on public transport for use of more environmentally friendly vehicles and eco-driving, and safe disposal of vehicle batteries. It is responsible also for ensuring construction of wildlife crossings during road and railway planning and development, and establishing standard service complexes along the main tourist routes.

<u>Ministry of Mining and Heavy Industry (MMHI)</u>

MMHI is in charge of policy development on rehabilitation of mining sites and on artisanal mining, fuel quality (formally responsibility of MoE) improvement and regulation, ensuring responsible mining practices, and ensuring observance of oil product quality standards.

Ministry of Energy (MoE)

MoE is responsible for development and implementation of policies and legislation on energy including improvement of national energy efficiency, renewable energy capacity development and adaptation of the clean coal technologies.

Ministry of Construction and Urban Development (MCUD)

MCUD is in charge of development and implementation of policies and legislation on urban development, land use management, building industry, building materials, housing and public utilities for smart planning, energy and resource saving, smart construction, enforcement of sanitary facilities standards and land protection, rational use and rehabilitation.

Agency for Land Administration and Management, Geodesy and Cartography (ALAMGaC)

ALAMGaC of MCUD is in charge of state policy on land administration, land privatization, property ownership and possession and use rights.

Ministry of Health (MOH)

MOH is responsible for establishment of sanitary conditions related to water supply, sewerage and related facilities, prevention of adverse health effects on people, preparation of policy and plans to reduce/resolve the adverse effects in cooperation with related organizations, and regulation for hospital waste management.

management of the consolidated policy on population health, including hygiene, sanitation and safety of food production.

Public Health Surveillance and Information Unit (PHSIU)

PHSIU of MOH is in charge of monitor and disclosure of the public health information.

National Centre for Public Health (NCPH)

NCPH of MOH is responsible for research on human health, its socioeconomic and environmental determinants, provision of public health services and provision of information to decision-makers on health-related issues.

Ministry of Education and Science (MES)

MES is in charge of integrating education for sustainable development into the educational system.

1.2.3 Assessment and conclusion by UNECE EPRMNG2018 expert group

EPRMNG (2018) expert group's assessment, conclusions and recommendations for the further improvement of the legal frameworks were carefully reviewed and it was found that those reviewed documents are reasonable to consider them as the bases of NCDP formulation in legal aspects. Citation of the expert group's key findings and conclusions are summarized as follows.

Conclusions (Policy Making, Legal and Institutional Framework)

Horizontal coordination: "A number of mechanisms for horizontal coordination on the environment and sustainable development exist at the national level, e.g. the National Committee for Reducing Air Pollution and National Water Committee. The effective functioning of such bodies is impeded by the frequent changes of government, requiring renewal of the composition of such bodies. Strengthening the mechanisms for horizontal coordination on the environment and sustainable development is crucial for achievement by Mongolia of Target 17.14 (Enhance policy coherence for sustainable development) of the 2030 Agenda for Sustainable Development."

Legal and policy framework for the mining sector: "The 2009 Law on Prohibition of Mineral Exploration and Exploitation in Run-off Source Areas, Protection Zones of Water Bodies and Forested Areas and the 2014 amendments to the Law on Minerals represent positive steps in the *direction of decreasing the environmental impact of mining and making mining better serve the interests of local people. Nevertheless, there are still a number of deficiencies. The EIA is conducted late in the permitting process – after the issuance of the special mining licence, though before the issuance of the permit to start mining operations. The mandatory agreements between mining companies and local authorities in order to protect the environment, create infrastructure for mining operations and create workplaces are not publicly disclosed and there are concerns about the selection of priorities in such agreements. Implementation of legislation on the restoration of land affected by mining represents a huge challenge.*

The current policy documents focus on establishing a favourable investment environment for the mining sector, improving Mongolia's competitiveness in the international minerals market and creating a national processing industry for mined products. There is no policy document that would specifically address the abandoned and damaged mining areas and their rehabilitation."

Conclusions *(Greening the Economy)*

<u>*Environment-related taxes and subsidies*</u>*: "Environment-related taxes such as excises on petrol and diesel have not served any environmental protection purpose. In addition, more recently, in anticipation of social pressure, these excises have not even generated significant government revenue, due to a near general zero-rate policy. More generally, Mongolia has been pursuing a policy of providing fossil-fuel subsidies, also covering the use of coal, which should be reformed in line with SDG Target 12.c to prevent wasteful consumption of these resources."*

<u>*Funding for environmental protection*</u>*:" More generally, total environmental expenditures by the government sector appear to be rather small, raising doubts about the effective role that the public sector can play in the pursuit of the green development agenda."*

<u>*Rehabilitation of mining sites*</u>*: "Mining companies are obliged to build up financial reserves to ensure adequate rehabilitation/reclamation of mining sites after their closure. But there are lingering concerns over whether these funds are sufficient for financing the required works in such a way that they meet existing international best practice in the mining sector."*

Conclusions *(Access to Information Public Participation and Education)*

<u>*Access to environmental information*</u>*: "The Government lacks resources to set up an efficient and effective structure to handle public requests within the deadlines. The current practice and procedures in governmental institutions other than the Ministry of Environment and Tourism in providing environmental information to the public are rather fragmented. The public lacks knowledge both of its rights to information and the procedures provided in the legislation to enable people to exercise those rights and of existing mechanisms established by the authorities that hold environmental information.*

The Government has made some effort to encourage the disclosure and active dissemination of environmental information by business entities, in the framework of the Extractive Industries Transparency Initiative (EITI). However, these efforts are at their very inception and are not sufficiently visible in sectors other than mining."

<u>*Public participation*</u>*: "Mongolia is progressing towards developing the legal framework for public participation in environmental decision-making and implementing it in practice. However, numerous challenges remain to ensure effective public participation. These include the insufficient time available for public consultations on planned projects (30 working days) and for public comments on the drafts of laws and secondary legislation (15 days), which do not take into account the specificity of vast territories and the way of life of nomadic communities in the country. Company representatives in charge of public relations commonly lack the necessary knowledge and skills to ensure an effective consultation process.*

To involve the public in preparing laws and policies, the Ministry of Environment and Tourism works closely with the Mongolian Environmental Citizens Council by involving its representatives in the working groups that are established for developing laws, regulations and policies. However, not all civil society organizations are part of the Mongolian Environmental Citizens Council.

NGO representatives are rarely included in the national delegations to international environmental forums and meetings and very seldom are they involved in the preparation of the Mongolian position for these meetings.

1.3 Existing Conditions of Air and Water Pollution and Soil Contamination

1.3.1 Air pollution

(1) Air quality monitoring networks, air quality status and major sources of pollution

Air quality monitoring networks

In 2020, 25 permanent air quality monitoring stations (22 in Aimag centers and three in larger settlements) operated in Aimags to measure SO_2 and NO_2 in the air by taking samples of SO_2 and NO_2 2-3 times a day by 20 minutes average and by using chemical agents in the laboratory. PM10 is measured twice a week in seven Aimags, and everyday in three Aimags by 24-hour average depending on the availability and capacity of equipment. To check air quality in Ulaanbaatar, SO_2, NO_2, PM2.5, PM10, CO and O_3 are measured at 15 monitoring stations in Ger districts, on roads, in apartment areas and industrial districts. Ozone (O_3) and meteorological parameters are determined by automatic instruments. Information of the daily monitoring at these stations is available on the website of the Environmental Information Center (https://eic.mn/airpollution/airpollution.php) and http://www.agaar.mn."

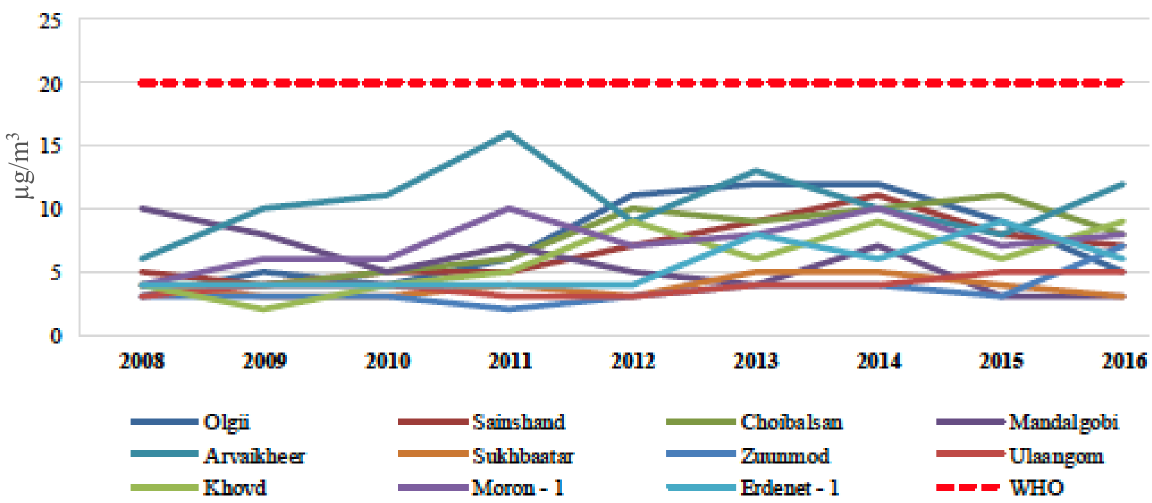
Noise and vibration

There is no official noise and vibration monitoring carried out by NAMEM or MET.

(2) Air quality status

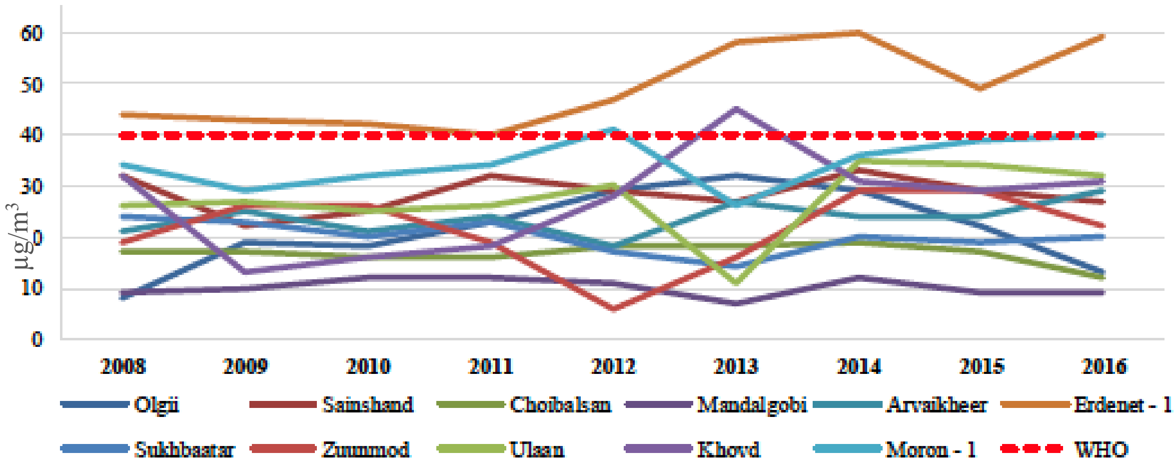
SO_2 and NO_2:

Except the NO_2 concentrations at Erdenet, both SO_2 and NO_2 concentrations were below national standards and World Health Organization (WHO) air quality guidelines (Figures 1.3.1 and 1.3.2). Erdenet is the third largest city in Mongolia, known for having the largest copper mine in the world, are likely affected by the industrial and transport activities. Excesses of national environmental standards of both SO_2 and NO_2 were also observed in Ulaanbaatar, with the highest annual mean value of 168 µg/m^3 against 40 µg/m^3 standard NO_2 value recorded in 2013 at a traffic station (UB-02) (Figure 1.3.2).



Source: MET, Environmental Statistics, EP-8.1 from Air quality standards reports

Figure 1.3.1 Average Annual Concentrations of SO_2 in Selected Cities



Source: MET, Environmental Standers, EP-8.1 from Air quality standards reports (thp://wwweic.mn) (EPRMNG)

Figure 1.3.2 Average Annual Concentrations of NO_2 in Selected Cities

<u>PM10 and PM2.5</u>

Figure 1.3.3 shows recent trend of PM10 and PM2.5 with temperature in Ulaanbaatar (upper figure) and trend in January and October 2020 (lower figure). Ulaanbaatar had been known for one of worst air quality cities in the world during winter seasons with respect to particular PM10 and PM2.5. However due to the strict enforcement of "Ban on raw coal use and trade in Ulaanbaatar City since May 2019" with the Government Resolution 62 of 2018, the concentration of the PM10 and PM2.5 has become significantly lower than past five winter seasons between 2014 and 2019. One of the most recent and reliable studies on PM10 and PM2.5 (Ganbat et al., Aerosol and Air Quality Research, 2020) concluded that "the maximum PM2.5 and PM10 concentrations in Ulaanbaatar were reduced to 46% and 55%, respectively, compared to the mean maximum values of the previous five years."

Based on the air quality monitoring results at the center of Ulaanbaatar city (UB-02, Bayangol_district) between January and October 2020 (lower figure of Figure 1.3.3), such significant improvement has continued. Compared with the national limitation level of PM10 for 24-hours (100 $\mu g/m^3$) and WHO guideline values (20 $\mu g/m^3$ annual or 50 μg/m3 24-hour), PM10-24h levels have been still higher than the national standard and roughly two to three times higher than the WHO guideline value in winter seasons 2019-20 and 2020-21, where the annual exposure of the PM10 in Ulaanbaatar had been more than 10 times higher than the WHO guideline and 4 time higher than national standard.

Apart from Ulaanbaatar, high concentrations of PM10 were also recorded outside the capital in Bayankhongor and Khovd. While in Ulaanbaatar, coal consumption for domestic heating and operation of three power plants located in the city, industry, construction works and 365,819 vehicles in 2017 are considered to be the main sources of air pollution, the lack of data in other Aimags does not provide sufficient evidence of the causes of high concentrations of certain pollutants.

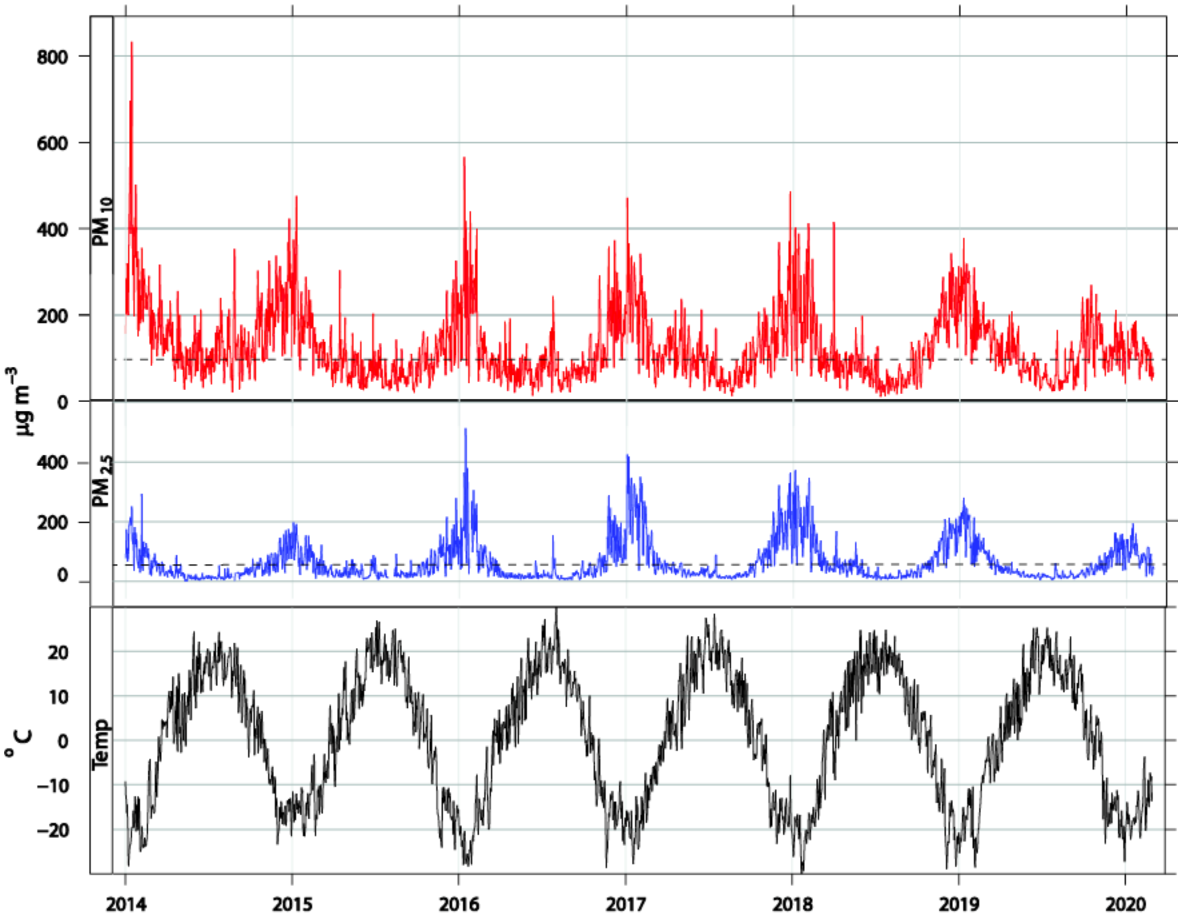
Similar to the PM10 trend, the concentration of the PM2.5 in Ulaanbaatar has also become significantly lower now than winter seasons before 2019. The average values of PM2.5-24h in 2020 have been consistently higher than 110 $\mu g/m^3$, which is at least 4 times higher than the WHO guideline values for 24h (10 $\mu g/m^3$ annual or 25 μg/m3 24-hour). The average values of PM2.5-24h in winter seasons in 2019/2020 (Jan-Apr. 2020) and 2020/2021(Sep-Oct. 2020) are 142 and 129 $\mu g/m^3$ respectively, which are at least 5-6 times higher than the WHO guideline values of 24h. Due to the existence of dry-climate conditions in Ulaanbaatar as well as continuous use of refined coals for household cooking and heating, further improvement of PM2.5 would be challenging without comprehensive approaches such as electrification of household heating/cooking in Ger districts, cleaner transport fuels, and replacement of old heat and power plants.

Ozone

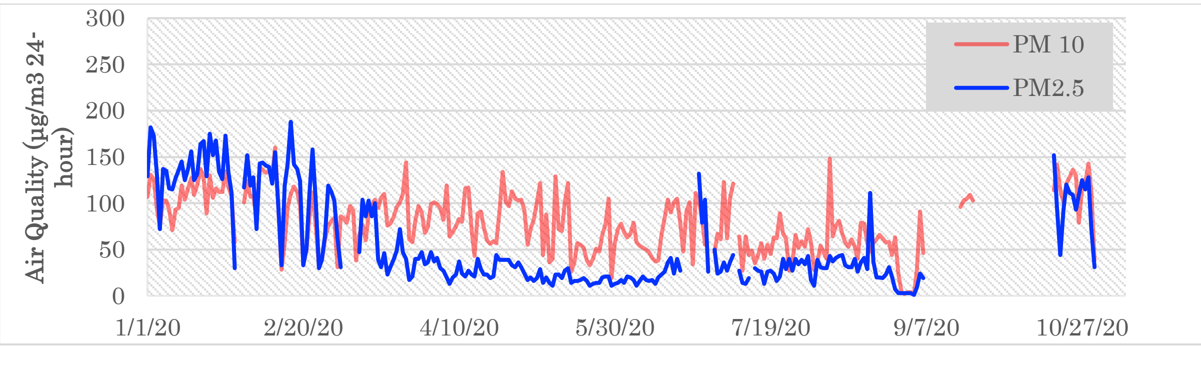
Tropospheric ozone is currently assessed at seven air quality monitoring stations all in Ulaanbaatar. All recorded values are below the national standard at100 µg/m^3 in 8-hour mean.

CO

In 2015, the average content of CO exceeded the limit value seven times at UB-02, once at UB-05, six times in the Tolgoit area and eight times in Zuragt, while in 2016, it exceeded the limit value once at UB-05, eight times in Tolgoit and seven times in Zuragt.



Source: Ganbat et al., Aerosol and Air Quality Research, 20: 2280–2288, 2020
Note: Time series of daily mean PM2.5 (blue), PM10 (red) concentrations and temperature at Ulaanbaatar (44292) station (black) for the period January 2014–February 2020. The concentrations are averaged over the air quality monitoring sites. Horizontal dashed lines indicate the 24-h average standard air pollution levels of PM2.5 and PM10 (50 µg m–3 and 100 µg m–3, respectively).



Source: Environmental Information Center[2]
Note: Time series of daily mean PM2.5 (blue), PM10 (red) concentrations and temperature at Ulaanbaatar (UB-02, Bayangol_district 17th khoroo Construction college, west 4 road) station in 2020

Figure 1.3.3 Concentrations of PM_{10}, 2014-2020

(3) Trends of air pollution, sources of pollution and health issues

Trends

There have been many studies to try identifying the sources of the air pollution and trend of the air quality levels. However, significant variation of such findings has been observed and there have not been a nationwide comprehensive study covering all aspects of the air pollutants. In January 2020, the Climate and Clean Air Coalition (intergovernmental organization[3] focusing on clean air and climate change) in collaboration with the Ministry of Environment and Tourism published a comprehensive assessment report[4] on air pollution sources in Mongolia, which finally unveiled the sources of air pollutants quantitatively. Based on the report, the household use of the raw coal and vegetation fires are the two major sources of the PM2.5 and transport, electricity generation, and vegetation fires are the three major sources of the NOx. Extraction of the key pollutants' findings is shown in Table 1.3.1.

Table 1.3.1 Emissions of Key Air Pollutants in 2017

Unit: kilo tonnes

Sectors	PM2.5	NOx	CO
All Others	0.2	0.1	0.7
Agriculture	0.4	1.6	4.6
Agriculture Forestry (Energy) Consumption	0.2	1.9	0.5
Commercial and Public Services	0.8	1.3	7.2
Electricity Generation	0.3	**24.2**	0.9
Heat-Only Boilers	0.2	11.7	0.4
Household	**36.1**	8.6	**156.4**
Industrial Process Emissions	0.1	-	-
Industry	0.8	2.9	6.5
Transport	1.1	**38.8**	**15.4**
Vegetation Fires	**81.4**	**30.9**	**680.2**
Total	**121.5**	**121.9**	**872.8**

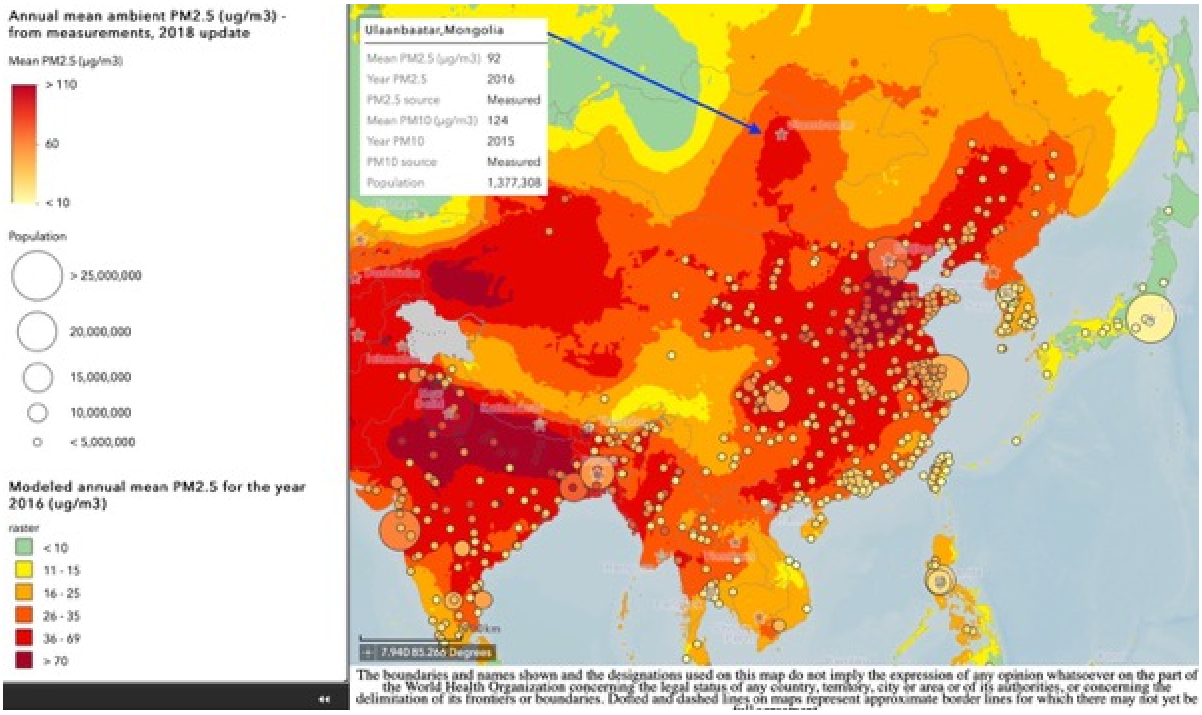
Source: Climate & Clean Air Coalition, Opportunities from taking integrated actions on air pollution and climate change in Mongolia[5], 2020

Mortality and morbidity caused by respiratory system

WHO's chronic monitoring confirmed that globally, 7 million deaths were attributable to the joint effects of household air pollution (HAP) and ambient air pollution (AAP) in 2016, and 94% of these deaths occurred in low and middle income (LMI) countries where Mongolia is categorized. The South East Asian Region (SEAR) and Western Pacific Region (WPR) bear most of the burden with 2.4 and 2.2 million deaths respectively. Mongolia ranked 9th worst deaths in SEAR and WPR and 4th in WPR (Table 1.3.2). Based on the point sampling data and metrological air quality modelling, WHO established a spatial ambient air quality database (http://maps.who.int/airpollution/). Around Ulaanbaatar, the annual PM2.5 reached 92 $\mu g/m^3$ against 10 $\mu g/m^3$ WHO air quality guideline level in 2016 (Figure 1.3.4). Complete assessment of the WHO air quality observatory report and SDG 3.9

2 https://eic.mn/airpollution/airpollution6.php?menuitem=1&count=100&page=4&search_name_mon=12801
3 *The Climate and Clean Air Coalition is a voluntary partnership of governments, intergovernmental organizations, businesses, scientific institutions and civil society organizations committed to improving air quality and protecting the climate through actions to reduce short-lived climate pollutants.*
4 Opportunities from taking integrated actions on air pollution and climate change in Mongolia
5 https://ccacoalition.org/en/resources/opportunities-taking-integrated-actions-air-pollution-and-climate-change-mongolia

monitoring data are available at website of WHO[6].



Source: WHO Global Ambient Air Quality Database (update 2018), http://maps.who.int/airpollution/

Figure 1.3.4 Annual Mean PM2.5 in Asian Region in 2016

Table 1.3.2 Ambient and Household Air Pollution Attributable Deaths

Unit: person/100,000 persons

Rank	Country	Category*	Both	Male	Female
1	Democratic People's Republic of Korea	MLIC	231	237	225
2	India	MLIC	141	147	134
3	China	MLIC	140	144	135
4	Nepal	MLIC	133	145	122
5	Philippines	MLIC	117	130	103
6	Myanmar	MLIC	116	125	108
7	Lao People's Democratic Republic	MLIC	110	106	114
8	Bangladesh	MLIC	103	112	95
9	Mongolia	MLIC	97	115	79
10	Micronesia (Federated States of)	MLIC	93	96	90
11	Papua New Guinea	MLIC	90	99	80
12	Sri Lanka	MLIC	89	104	76
13	Kiribati	MLIC	88	103	74
14	Bhutan	MLIC	88	87	89
15	Cambodia	MLIC	87	84	90
16	Thailand	MLIC	85	98	71
17	Indonesia	MLIC	81	90	72
18	Timor-Leste	MLIC	77	78	75
19	Fiji	MLIC	76	97	55
20	Vanuatu	MLIC	76	88	63
25	Japan	HIC	43	47	39
26	Singapore	HIC	39	45	34

Source: WHO SDG Target 3.9 Mortality from environmental pollution
(http://apps.who.int/gho/data/node.sdg.3-9*)
Note: MLIC: Mid Low Income Country, HIC: High Income Country

Based on the NSO statistical data, deaths caused by the respiratory system have been accounted only

6 https://www.who.int/airpollution/data/cities/en/ and http://apps.who.int/gho/data/node.sdg.3-9

for roughly 4% of the total deaths for the last 10 years while the percentage of diseases of respiratory system was 31% in 1990 and was the highest cause of deaths (Table 1.3.3). On the contrary, major cause of morbidity under 5 years old was roughly 60% in both urban and rural areas in 2016 and the worst cause of the morbidity (Table 1.3.4).

Table 1.3.3 Death by Classification of Leading Causes, 1990, 1995, 2005, 2010-2016

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
All deaths, number	16,401	16,184	15,472	15,472	17,127	17,127	16,192	16,923	16,459	16,374	16,181
Of which:											
Female	7,787	7,164	6,789	6,003	6,951	6,951	6,459	6,459	6,588	6,552	6,519
Male	8,614	9,020	8,683	9,466	10,325	10,571	9,733	10,452	9,937	9,822	9,662
Leading Causes, percent											
Cardiovascular disease	15.66	30.885	31.33	38.29	37.69	36.73	35.09	35.09	34.37	34,15	33.31
Disorders of blood and blood-forming organs and immune mechanisms	0.80	0.34	0.24	0.14	0.16	0.08	0.14	0.12	0.13	0.16	-
Cancer	16.37	18.52	19.57	18.86	20.79	20.65	21.22	23.44	24.32	24.60	25.60
Disorders of injury, poisoning and external causes	4.83	8.69	11.74	18.26	16.14	18.23	18.88	17.22	16.72	15.65	15.02
Disease of respiratory system	31.32	15.79	8.83	4.52	4.37	3.88	3.78	3.40	3.55	3.74	4.32
Disease and digestive system	13.94	7.93	7.20	8.07	8.47	8.95	8.93	8.38	7.72	8.01	7.45
Infectious and parasitic disease	4.54	5.54	3.24	3.06	2.14	1.75	1.78	1.86	1.89	2.00	2.86
Disorders of the urinary system	2.35	2.65	2.28	2.00	1.65	1.46	1.22	1.06	1.27	1.63	1.52
Disorders occurring in the perinatal period	5.24	2.55	2.85	2.92	3.77	3.35	3.70	3.81	4.20	4.49	3.60
Diseases of the nervous system	3.99	1.78	1.61	1.51	1.84	1.63	1.88	1.78	1.91	1.87	2.04

Source: Table 15.2 of EPRMNG 2018, NSO

Table 1.3.4 Causes of Infant and Under 5 Years Old Morbidity in 2016

Unit: %

	0-1 age		Under-5	
	Rural	Urban	Rural	Urban
Disease of respiratory system	54.3	63.9	57.5	68.8
Disease of digestive system	9.9	9.7	8.7	12.6
Conditions originating in the perinatal period	7.9	3.7	4.0	2.3
External causes of morbidity and mortality	1.9	0.7	7.0	1.9
Infectious and parasitic diseases	12.6	7.9	7.6	3.3
Disease of skin and subcutaneous tissue	4.9	3.7	9.6	4.8

Source: Centre for Health Development, Health Indicators 2016, 2017 (Table 15.1 of EPRMNG 2018)

(4) Pressures on air quality

Energy

Mongolia depends on coal fired energy production making it very carbon intensive economy. Seven coal-fired power plants have a total capacity of about 1,000 MW, while only 100 MW are the combined installed capacity of renewables. Due to high fluctuations of the renewable energy production, the coal fired power generation will remain the primary sources of energy and air pollutants unless intensive investments are made to upgrade the existing old plants by clean coal plants and smart grid systems with large scale energy storage integration in the national grid.

Industry

Inventories of industrial sectors are missing in Mongolian emission inventories. Industrial impacts on air quality have been elaborated through various studies supported by donors, which found the construction industry is a major source of air pollution due to dust emission. Two of the major sources would be brick and cement industries. Combustion of coal and handling of coal and ash made them significant contributors to air pollution. In addition, the leather industry is another major industry and sources of air pollution due to organic solvents emission.

Transportation

According to the 2016 Emission Inventory Report, the transport sector is the major sources of CO and NOx emission accounting for 43.6 % and 21.5 % of the total emission respectively, while impacts of SO_2 and PM10 emissions are minimal compared to other sources.

Household air pollution from Ger district

Due to relaxation of occupational choices and settlement after shifting to the market economy, rapid migration to urban centers has happened without adequate land use plans and social infrastructure development. It is estimated that approximately 736,000 residents (61 % of Ulaanbaatar population) live in the Ger district. Unlike buildup residential and office districts in urban area, raw coal is the primary source of energy for heating and cooking due to unavailability of steam for heating during winter seasons and natural gas for cooking throughout the year. Particularly during winter, combustion of coal is very intensive, which has been one of the major sources of air pollution in the Ulaanbaatar area. In addition to the coal combustion in winter seasons, waste burning for heating has caused significant negative impacts on air quality due to inability to purchase coal and stoves by some extremely poor residents.

(5) Recent policies and actions to combat air pollution

Particularly in Ulaanbaatar city area, air pollution in winter seasons has been one of the most critical issues and challenges of the Mongolia's sustainable development. Despite continuous regulatory efforts by the Government, the critical status of the air pollution had remained for long time. As a result, improvement of the Ulaanbaatar air quality had been one of the essential campaign pledges by the opposition parties. In order to change the prolonged air pollution issues, the ruling party instructed significant institutional reforms for environmental management and implemented an ambitious regulation to control the sources of the air pollutants. Particularly, the following two cabinet resolutions (orders) have led to significant changes in institutional frameworks and would be able to lead to the significant improvement of the air quality in Ulaanbaatar from the fall of 2019. Based on some media reports[7], air quality in Ulaanbaatar had successfully improved during the winter season of 2019-20. Since the enforcement of "Ban on raw coal use and trade in Ulaanbaatar City" with the Government Resolution 62 of 2018, during the period of October 2019 to March 2020, the concentration of the PM2.5 in Ulaanbaatar was reduced by 52% from 2016-2017 period, by 48% from 2017-2018 period, and by 41% from 2018-2019 period.

Government Resolution 97 of 2017 National Programs on Air and Environmental Conservation: Significant reform for the institutional framework to regulate air pollution and environmental conservation

Government Resolution 62 of 2018 Liability of Energy:

- Complete ban on raw coal transport and use in Ulaanbaatar city effective as of May 15, 2019

[7] https://ccacoalition.org/en/news/mongolia-increases-climate-change-ambition-actions-improve-air-quality-and-human-health

- Adequate pricing and supply of "refined coal" arranged/coordinated by the Ministry of Environment and Tourism, Ministry of Energy, Ministry of Finance, and Ulaanbaatar City
- Public awareness programs for ban on raw coal use, transport and sales and promotion of "Refined coal use" for the environmental and human health improvement
- Coordinated enforcement and monitoring by relevant agencies including the Ministry of Environment and Tourism, Ministry of Energy, Ministry of Justice and Home Affairs, Ulaanbaatar City, and General Agency for Specialized Inspection

1.3.2 Water pollution

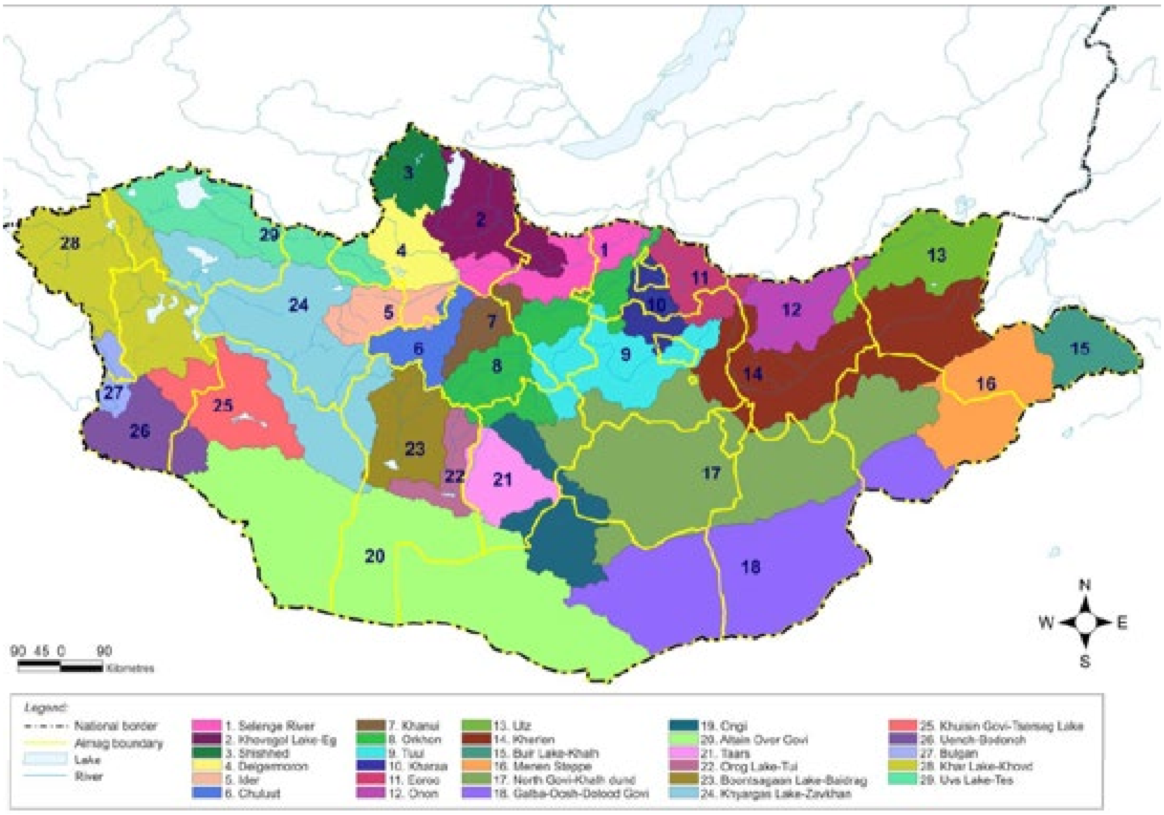
(1) Water resources

Of the total water resources in Mongolia, 88.5 % accumulates in lakes, 3.4 % in glaciers, 6.1 % in river systems and 1.91 % in groundwater respectively (Table 1.3.5). Three drainage basins comprise the territory of Mongolia. The total length of rivers and streams is approximately 67,000 km. Roughly 60 % of the rivers flows to the Russian Federation and People's Republic of China and 40 % flow into the Gobi Desert lakes. Major river systems are the Kherlen (1,213 km), Orkhon (1,124 km), Selenge (1,095 km), Tuul (898 km) and Zavkhan (808 km) Rivers (Figure 1.3.5). All Mongolian rivers freeze for 140–180 days annually with depths of 80–120 cm ice. As a result, Mongolian economy and life heavily depends on groundwater.

Table 1.3.5 Total Water Resources and Its Ratio

Resource	Amount (billion m^3)	Ratio of each water resource to total water amount (%)
Lakes	500	88.53
(Saline water)	90	-
(Fresh water)	410	-
Rivers	34.60	6.13
Glaciers	19.40	3.43
Groundwater	10.80	1.91
Total	564.80	100

Source: MET 2017 (Table 9.1 of EPRMNG2018)



Source: MET

Figure 1.3.5 River Catchment Areas

(2) Water quality, use and sources of water pollution

Water supply systems

According to the "Water Source Quality and Safety in Rural Areas" prepared by MOH, MET, and Mongolia's Association of Occupational Hygienists in 2020, about 40 % of the population in Mongolia uses drinking water from centralized water supply systems, 20 % from portable water distribution services, 35 % from water kiosks, and 5 % from springs and rivers etc. nationwide. In 2014, 79.6% of drinking water wells did not have certificates or documents with technical specifications, while as of 2019, 41% of the wells did not have necessary documents.

Out of 1,431 wells in Aimags recorded by the MET in 2014, 61 (4.2%) are no longer in use due to not meeting the drinking water quality requirements, damaged well pumps and equipment, dried up source water, and permafrost etc. For rural water supply, water supply sources have been found for 70 Soums and settlements, and additionally some 170 Soums are located in areas where there are favorable hydrogeological conditions and access to water as of 2019.

Sanitary protection zones were established, and cameras and fences were installed at wells of Aimag centers. However, most of Soum wells still had no or unclear sanitary protection zones, no fence/protection was installed even though protection zones were determined, and the environment was still very polluted when compared to 2014. Disinfection is not conducted for centralized water supply systems in Govisumber, Dundgovi, Khovd, Khentii, Uvurkhangai, Zavkhan, Arkhangai and Uvs.

Water quality and use

The groundwater quality in Mongolia is generally suitable for human use. Groundwater characteristics depend on the frequency of groundwater renewal and the nature of terrestrial rocks except human activities. The total water use is estimated at 500 million m^3 per year on average. Since the implementation of the revised 2012 Law on Water, water used and consumed is recorded on the basis of formal agreements between the authorities and customers, known as "Conclusions." The water abstraction reached 168 million m^3 in 2016. On average, for the period 2013–16, 95.5 % of the water abstracted is from groundwater resources. It is estimated that about 39 % of the water is used for industrial, 24 % for animal husbandry, 18 % for irrigation, 18 % for drinking and domestic purposes and 1 % for other purposes.

To ensure quality of water for human use, a questionnaire was developed based on the Water Safety Plan (WSP) of WHO and submitted to 21 Aimags and water suppliers to prepare assess the water quality with 24 indicators and report the results of assessment covering the following steps: 1) Assemble the WSP team, 2) Describe the water supply system, 3) Identify hazards and hazardous events and assess the risks, 4) Develop, implement and maintain an improvement/upgrading plan, 5) Define monitoring of the control measures, 6) Verify the effectiveness of the WSP, 7) Prepare management procedures, 8) Develop supporting programs, and 9) Plan and carry out periodic review of the WSP, and revise the WSP (Progress Report of Water Safety Plan Implementation in Rural Areas, 2017).

<u>Water pollutant sources</u>

According to the results of recent studies, the main sources of natural water resources pollution are listed as follows:

- Municipal water treatment facilities,
- Industrial treatment facilities,
- Inadequately treated wastewater discharged from private and government-owned sanitation facilities and
- Utility, industrial and household solid and liquid wastes (Watercourses, rivers, pipes, etc. are clogged by those element).

Based on the findings of the integrated water management national assessment report (2012), potential sources of water pollution by either households or industry are summarized in Table 1.3.6.

Table 1.3.6 Water Pollutions by Origin

Water pollutants	Examples	Households	Industry
Biodegradable organic pollutants	Food remains, excreta	✓	✓
Persistent organic pollutants	Pesticides, solvents, polyvinyl chlorides, pharmaceuticals/medicines, hormones	✓	✓
Nutrients	Nutrients Nitrogen, phosphorus	✓	✓
Heavy metals	Heavy metals As, Cd, Co, Cr, Cu, Hg, M n, Ni, Pb, Sn, Tl		✓
Solid particles; objects	Plastic, toilet paper, cans, tampons, hairs, condoms, twig	✓	✓
Solid particles; sediment	Sand, silt, sludge, colloids	✓	✓
Pathogens	Bacteria, viruses	✓	
Oil and grease	Oil, grease, fats	✓	✓
Salts	Sodium, chloride, sulphate		✓

Source: Integrated Water Management National Assessment Report, Ministry of Environment and Green Development, 2012 (Table 9.6 of EPRMNG1)

<u>Protection of water sources</u>

In order to ensure groundwater recharge and avoid surface water contamination, some areas are designated as water protection zones by limiting access and economic activities. The water protection zones are also located along each river not less than 5m from the river bank where human impacts including cattle grazing are prohibited. Despite 44.5 % of the total area of riverheads had been placed as water protection zones by 2016, increasing discharges from inadequate wastewater treatment not only by industries but also public sewage treatment facilities have been evident for recent years. As described in the wastewater treatment in the following section, contamination of the surface and groundwater has been caused by lack of treatment facilities or operational capitals. Such missing links need to be tackled by systematic approaches such as strict enforcement of penalty codes, lifecycle assessment of operational costs and their assurance before award of their construction, and water discharge monitored by third party approved by designated regulatory authorities.

Ambient water quality monitoring

Surface water: NAMEM undertakes regular water quality monitoring for surface waters as well as impacts of discharges of urban wastewater. The Information and Research Institute of Meteorology, Hydrology and Environment (IRIMHE) provides data to NAMEM.

Groundwater: There are 287 approved water deposits/abstraction sites, of which 25 are for drinking water and the remainder for industry and mining. There are 193 monitoring wells (boreholes). MET sets up and manages a groundwater monitoring system allowing regulatory authorities to monitor temperature and water levels at some key industrial sites, which allows authorities regulate the groundwater use by industries.

Water quality monitoring for water supply systems

In order to verify the effectiveness of water supply systems and control measures, a water supplier is expected to conduct monitoring and water quality control. The water supplier shall develop a monitoring plan which consists of water quality control and observation measures. Acceptable range for water quality parameters (chlorine residuals, pH, and turbidity), control measures (protection fence, ventilators, and cleaning etc.), monitoring locations, frequency of monitoring, and the responsible parties shall be reflected in the monitoring plan.

A compliance monitoring plan shall be prepared by the health or inspection agency and the water supplier in each Aimag. Compliance monitoring is an important part of the verification process to show whether water is meeting national water quality standards. Arkhangai, Bayan-Ulgii, Govi-Altai, Darkhan-Uul, Dornogovi, Dornod, Zavkhan, Umnugovi, Sukhbaatar, Selenge, Uvs, Khuvsgul and Khentii have compliance monitoring plans, although documentation is limited. Dornogovi, Umnugovi and Sukhbaatar Aimags started to conduct consumers' water quality satisfaction surveys regularly. Only Umnugovi has developed and approved an internal auditing plan. Chemical and microbial contaminants were detected in drinking water of Govi-Altai, Govisumber, Dornod, Umnugovi, Sukhbaatar and Khentii Aimag (Progress Report of Water Safety Plan Implementation in Rural Areas, 2017).

Wastewater treatment

On average, 200 million m^3 of wastewater is transported by public sewerage systems annually. Untreated wastewater has been dumped into the environment and become source of surface and groundwater contamination. Treated wastewater increased from 60 million m^3 in 2012 to almost 88 million m^3 in 2016. Some wastewater treatment plants (WWTPs) in large cities, Aimag centers and Soum centers are operating under Public Urban Services Organizations (PUSOs). Most water supply and water disposal networks were created during the period 1960–1990 and now they are outdated. As of 2015, there were 125 WWTPs, of which 51 were functioning, 47 not working and 27 partially functioning. WWTPs treat both household wastewater and industrial discharges. The lack of financial resources has delayed repair, maintenance, restoration and reconstruction of WWTPs.

(3) Detailed quality of drinking water

The Specialized Inspection Agency on Mongolia conducts an annual inspection of drinking water access in Aimags, Capital City, and Soums. During 2012-19, 12,119 samples were taken, and chemical and microbiological analyses have been done.

Microbiological analyses

For the central water supply systems of Aimag centers, and Capital City using wells as sources, an average of 835 samples are taken annually from water distribution facilities. Results for Capital City by microbiological analysis for bacteriological parameters show that the maximum permissible standard is exceeded by 9.1% in 2014, 5.2% in 2015, 1.3% in 2016, 1% in 2017, 1.8% in 2018, 4% in 2019. Results of analysis for the Aimag central water supply systems, the maximum permissible standard is exceeded by 18.8% in 2014, 10.3% in 2015, 12.7% in 2016, 5.1% in 2017, 3.7% in 2018, and 3.9% in 2019.

According to the results of bacteriological analysis of wells at the Soum level, the allowable standard is exceeded by 25.6% in 2014, 20.4% in 2015, 22% in 2016, 24.9% in 2017, 11% in 2018, and 13.5% in 2019. Bacteriological analysis of water sources in rural areas showed that 44 (24.7%) borehole wells, 148 (68.2%) ordinary wells, and 1 (14.3%) of mechanized wells exceeded the standard number of bacteria.

Chemical analyses

Drinking water quality is analyzed for level of hardness, magnesium, calcium, iron, sulfate, chloride, ammonia, nitrate, nitrite, uranium, arsenic, lead, fluorine, iodine, and pH. Magnesium of drinking water in Capital City is in the range of 0.73~12.6 mg/liter depending on sources but 35.0 mg/liter in the source of the Bagakhangai district. Average magnesium contents are high in Aimags of Dornogovi, Govi-Altai, Sukhbartaar and Dornod. Average magnesium contents for rural water vary for different types of sources: 28.4 mg/liter for hand-dug wells, 18.4 mg/liter for bored wells, 14.4 mg/liter for river water and 11.1 mg/liter for springs.

Of the eight drinking water sources for Capital City, only the source in the Bagakhangai district exceeds the standard at 72.09 m/liter. For iron contents, the Baganuur district source exceeds the standard of 0.2 mg/liter. For water supply in Aimag centers, average iron contents only in Bayankhongor and Dornod exceed the standard.

In 2016, the Specialized Inspection Agency organized the inspection of uranium, arsenic, lead, fluoride, iodine analysis of 843 wells in drinking water from 21 Aimags and 299 Soums were analyzed by the Central Geological Laboratory. Arsenic contents in the water of 34 wells in Dornogovi, Sukhbaatar, Dundgovi, Govisumber, Dornod, Uvurkhangai exceeded the maximum allowable standard of 0.01 mg/liter. Uranium contents in the water of 68 wells of 42 Soums of Bulgan, Govi-Altai, Govisumber, Dornod, Zavkhan, Hovd, Uvs, Dornogovi, Sukhbaatar, and Dundgovi exceeded the maximum allowable standard of 0.03 mg/liter. Lead contents in the water of 29 wells of 22 Soums of Arkhangai, Bayan-Ulgii, Bulgan, Govisumber, Dundgovi, Tuv, Khentii, Selenge, and Khuvsgul were higher than the maximum allowable standard of 0.01 mg/liter.

Risk factors for water contamination

Comparison between 2013 and 2018 results has revealed contamination of water sources for Capital City increased by human wastes. Both ammonia and nitrite contents are significantly higher in Capital City than water supply in Aimags and Soums. It is found also bacterial pollution in Soums has not been decreased.

The length of the Ulaanbaatar's water supply line is 619 km, of which 285 km is 5-15 years old, 23.3 km 15-25 years old, 213.6 km 25-35 years old, 36 km 35-45 years old, the 61.5 km has been used for 45-55 years. The iron concentration of the water associated with the aging of the line is 3.8 times higher than that in the water sources at the consumer level.

(4) Recommendations by Specialized Inspection Agency

Recommendations to improve quality of drinking water are summarized by area as follows.

Capital City

(a) Establishment of land control system for hygienic zone to regulate location of industries and other facilities discharging pollutants with conditions for eviction and liability of those responsible;

(b) Measures to replace obsolete pipelines in the central water distribution systems;

(c) Connection of unconnected apartments and service buildings to the central system; and

(d) Measures to assess and improve the safety of water pipelines and other equipment owned by Housing and Public Community Authority supplied water by USUG.

<u>Aimags and Soums</u>

(a) Measures to replace obsolete pipelines in the central water distribution systems of Aimag centers;

(b) Resolution of financial issues of Govisumber, Dundgovi, Khovd, Khentii, Uvurkhangai, Zavhan, Arkhangai and Uvs with centralized water supply systems for installing disinfection equipment;

(c) Installation of water treatment and softening equipment for wells with the high level of hardness of toxic chemicals and heavy metal standards in drinking water; and

(d) Installation of wells with adequate structure for provision of safe drinking water to herders.

In addition, uranium substance in drinking water should be monitored at regular intervals. As the National Food Safety Reference Laboratory does not currently have a uranium determination tool, an ICP-MS tool for uranium detection in drinking water needs to be procured. Also, establishment of a microbiological laboratory for the detection of viruses in drinking water and wastewater should be addressed.

1.3.3 Soil contamination

(1) Soil and land degradation

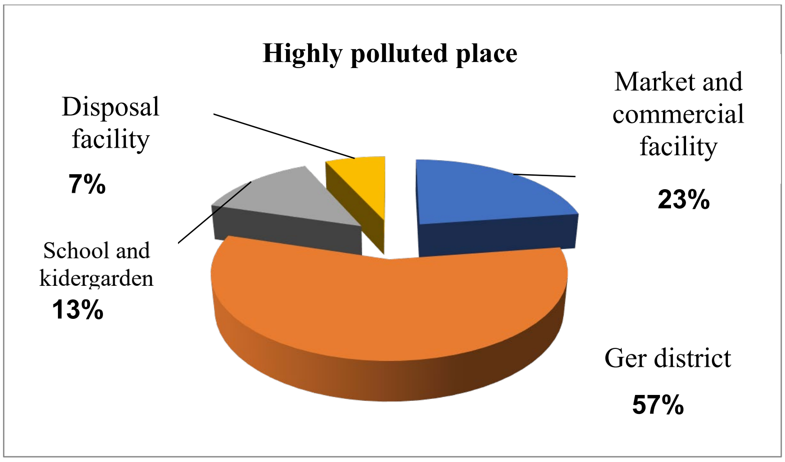
NAMEM operates a soil quality monitoring network. Since 2000, soil monitoring has been undertaken every five years across the Country. The variables tested include pH, ammonium (NH_4), phosphorus oxide (P_2O_5), nitrate (NO_3) sulphate (SO_4), and 11 chemical elements (cadmium, tin, mercury, bromine, chromium, copper, cobalt, strontium, rubidium, zircon and chlorine). Challenges include insufficient soil analysis equipment and lack of human resources at the Central Laboratory of Environment and Metrology as well as insufficient use of international methods and standards.

(2) Soil contamination

In urban areas, soil pollution is mainly bacteria pollution from the Ger district sanitation facilities (latrine and wastewater), while rural soil pollution is mainly from mining wastes and discharges. Areas surrounding processing factories, car repair shops and waste collection points have a high content of heavy metal pollutants such as lead, chrome and zinc. In principle, there are no consistent monitoring activities and published studies, but some studies[8] found soil contamination by heavy metals in Ulaanbaatar and other industrial cities. Pollution by heavy metals comes from different sources such as tanning, mining activities, traffic zones and heat and power engineering.

According to the data collected for 10 years by soil contamination inspection conducted by the State Professional Inspection Agency (SIA), targeting the capital area, Ger district is dominant as highly polluted place as shown in Figure 1.3.6. As a countermeasure, the National Reference Laboratory (NRL) and Inspection Bureau affiliated laboratories will be equipped with detectors for heavy metals contained in urban soil to improve certification services with more indices.

[8] Tserennyam, B. et al. (2010). Assessment of metals contamination of soils in Ulaanbaatar, Mongolia, Journal of Hazardous Materials, Volume 184, Issues 1–3, 15 December 2010, 872-876., and E. Kosheleva, et.al. (2011) Soil Pollution with Heavy Metals in the Industrial Cities of Mongolia, Mongolian Journal of Biological Science, Vol. 9. No1-2 (2011)



Source: SIA data from 2010 to 2020

Figure 1.3.6 Highly Polluted Area Distribution in Capital City

Key challenges regarding soil contamination are poor management of wastewater treatment and disposal, and improper open-pit latrines in not only Ger district, but also in rural areas. Many health-care facilities are not connected to central water supplies and sewer systems. Some still use open-pit latrines.

According to "Progress Report of Water Safety Plan Implementation in Rural Areas (2017)" published by State Professional Inspection Agency, water suppliers are expected to conduct monitoring and water quality control. A water supplier shall develop a monitoring plan consisting of water quality control and observation measures. Acceptable range for water quality parameters (chlorine residuals, pH, and turbidity), control measures (protection fence, ventilators, and cleaning etc.), monitoring locations, frequency of monitoring, and the responsible parties shall be defined in the monitoring plan. These are related to soil contamination control. A present, no database is available on the location and characterization of polluted soil in Mongolia.

It would be desirable that Aimag can play a key role for monitoring plan preparation and its implementation. Although some Aimags already have complied with monitoring planning, they have not established sufficient number of monitoring points yet and they lack proper documentation. In other Aimags, even indicators used for conducting surveys with satisfactory quality are insufficient.

1.4 Solid Waste Disposal and Management

1.4.1 Current situations of solid waste management

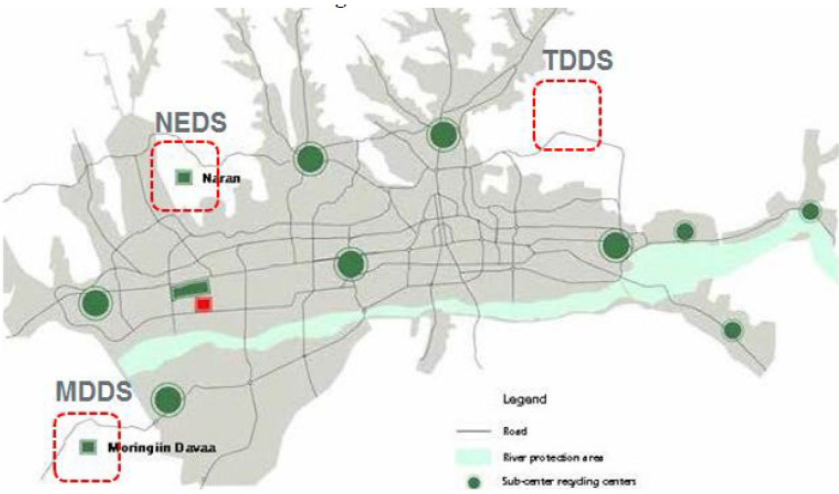
(1) Current issues in Ulaanbaatar and other cities

In Mongolia, capacity shortages of planning, technology and facilities related to a series of solid waste disposal processes is a major problem. In addition, aging of equipment and lack of effective institution in the process of collection, transportation and final disposal are also main problems. Current issues are listed below:

- There is a reclaimed land that is already full;
- In most cases, garbage separation is not done, which makes it difficult to collect recyclable raw materials;
- There are a couple of plastic factories in Mongolia but no adequate designated recycling plant exists;
- Garbage scatters by strong wind in grazing land, because garbage is not adequately disposed of; and
- Efforts on raising citizens' awareness and education on waste management and separation of wastes are largely inadequate.

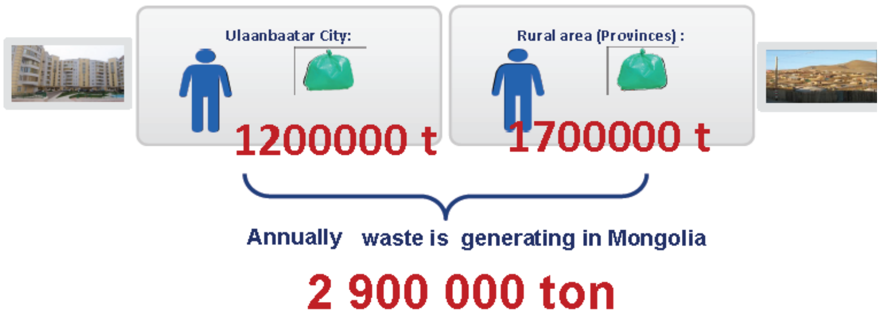
Three sites serve Ulaanbaatar as solid waste dump sites (DSs): Narangiin Enger (NEDS), Tsagaan Davaa (TDDS) and Moringiin Davaa, located in the northwest, northeast and southwest of Ulaanbaatar respectively (Figure 1.4.1). The Moringiin Davaa dump site (MDDS) is the smallest of three landfills, receiving approximately 400 tonnes of wastes daily since 2015, compared to 1,700 ton at Narangiin Enger, and 1,200 ton at Tsagaan Davaa.

Disposal of solid wastes at final disposal sites is not by sanitary landfill but by simple dumping as an economical reclamation method. The annual amounts of wastes generated in Ulaanbaatar and other Aimags are found to be roughly proportional to the population as shown in Figure 1.4.2 and Figure 1.4.3.



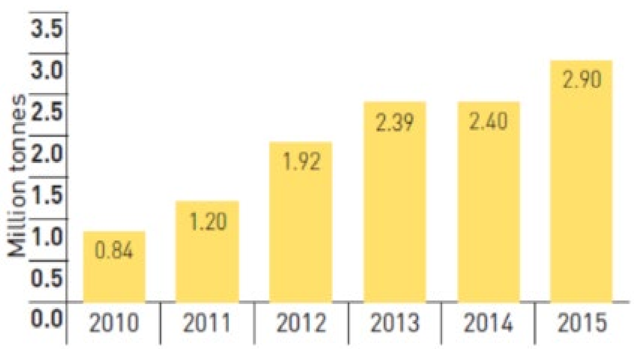
Source: EBRD

Figure 1.4.1 Landfill Site in Ulaanbaatar



Source: MET

Figure 1.4.2 Amount of Waste Disposal of Ulaanbaatar and Other Areas



Source: United Nations Industrial Development Organization (UNIDO)

Figure 1.4.3 Total Amount of Waste Disposal Generated in Ulaanbaatar and Other Areas

With the rapid increase in the population and the change in consumption style accompanying the transition from traditional lifestyle to the market economy in several years ago, the amount of wastes discharged has increased, and the problems related to waste management are getting worse. Collection and transport services cannot catch up with the increasing amount of wastes, and illegal dumping of garbage has become a serious problem, especially in the Gel district where nomadic people have flown in from rural areas and began to settle using mobile tents.

Currently, wastes collected from Ulaanbaatar urban areas are disposed in three main dumping sites, while the wastes from isolated three districts are dumped and landfilled in their respective sites. Narangyn Enger (Grade 2 as explained later) in sub-district 26 of Songinohairhan district, one of three centralized landfill sites in Ulaanbaatar, was established by assistance from the Government of Japan in 2008. Also, the Moringyn Davaa site (Grade 3), located in sub-district 12 of Khan-Uul district, has been used since 1970. In 2007, the municipality installed truck weighting equipment at Moringyn Davaa and open dumps were covered with soil. Meanwhile, the Tsagaan Davaa site (Grade 3), located in sub-district 24 of Bayanzurh district, was established in 2011 in order to landfill wastes collected from eastern part of the city.

Source: JICA Project Team

Photo: Dumping Site in Songinohairhan District

(2) Composition of solid waste

The project "Study for Developing Ulaanbaatar City Solid Waste Management Master Plan" and the project "Technical Cooperation for Improving Ulaanbaatar City Solid Waste Management" were implemented supported by JICA during 2005-12, respectively. JICA carried out a study in 2010 on the sources and composition of wastes generated by households and the findings are summarized in Table 1.4.1 and Table 1.4.2.

Table 1.4.1 Solid Wastes Generation by Source in Ulaanbaatar

Classification	Unit	Waste Generation
Apartment residents	g/person/day	312
Ger residents (households waste)	g/person/day	164
Ger residents (ash)	g/person/day	870
Ger, total	g/person/day	1,034

Source: Technical Cooperation for Improving Ulaanbaatar City Solid Waste Management, 2012

Table 1.4.2 Composition of Wastes Generated in Ulaanbaatar

Structure of solid waste	Percentage (2007)*	Percentage by weight (2019)**
Food waste	15.7	15.7
Paper	8.5	5.3
Tetra pack cartons	N/A	0.8

Cloth	2.9	N/A
Grass and wood	0.6	N/A
Grass	0.6	9.6
Plastic	12.8	N/A
Plastic bags & packaging	N/A	3.0
Hard plastic (HDPE, LDPE, PVC, etc.)	N/A	1.7
Leather and rubber	0.3	N/A
Combustible waste	45.8	N/A
Metal	2.5	1.0
E-waste	N/A	0.2
Bottles	9.3	3.6
Porcelain and stone	2.3	N/A
Bathroom waste	N/A	5.6
Fabric & woven products	N/A	1.3
Batteries	N/A	0.0
Other	3.3	4.0
Incombustible waste, no ash	17.4	N/A
Waste percentage (%)	63.2	N/A
Ash percentage (%)	36.8	N/A
Total	100.0	-

Source: * Master Plan for Ulannbaatar City Waste Management and Technical Cooperation Project for Improving Waste Management of Ulaanbaatar City
** Ulaanbaatar Household Waste Composition Study Report 2019, The Asian Foundation, 2020

1.4.2 Current solid waste management

(1) Overview

Annually, wastes of 1.2 million tons have been generated in Ulaanbaatar as mentioned above. Of the total amount, 70% is discharged to treatment plants. In other areas, there are annual wastes of 1.7 million tons generated and 40% of them is discharged to treatment plants. In Mongolia, 93.5% of the general wastes is disposed of by using the landfill method. There is a total of 396 central waste disposal sites in Mongolia with a combined area of approximately 125,000 ha.

The percentage composition of each type of wastes generated is different in summer and winter. Especially, ash waste produced by coal stoves and so on accounts for 50 % in total waste amount in winter. In summer, kitchen wastes constitute a majority, accounting for 36 % in total waste amount.

A noteworthy aspect is that, a very significant proportion of recyclable items, plastic (22%), paper/cardboard (21%), glass (9%), and metal (6%) still piles up in the disposal sites. These valuable recyclables should have been segregated, collected and treated for recycling rather than disposed.

(2) Practices and trends in municipal solid wastes management

Data management: Detailed inventories of annual solid and hazardous waste as well as waste reuse and recycling are available only for the latest fiscal year on environmental information center (EIC) websites (https://eic.mn/box/box6.php), and waste database is available on another EIA website (https://eic.mn/waste/). In addition to the waste volume information, economic data on waste related activities are well reported in Mongolian Statistical Yearbook (NSO, 2019). Key information related to the waste management taken from the Yearbook 2019 is given in Table 1.4.3.

Table 1.4.3 Waste Management Trend, 2010-2019

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Gov. Tax: Waste services (mil. tugriks)	-	-	-	11081.0	13246.4	15965.4	15750.4	18064.6	18927.0	18520.5
Number of solid waste trucks (number)	551	603	681	733	753	773	810	836	848	855
Export products: Iron scrap (thousand ton)	1.0	1.3	1.6	1.1	0.8	0.7	0.7	0.7	0.7	0.3

Export products: Lead waste & scrap (thousand ton)	1.0	0.6	0.1	0.4	0.5	0.9	-	-	-	-
Production: Waste of the used cereals (thousand ton)	11.1	4.5	14.4	10.0	6.8	6.1	7.2	8.8	12.2	11.1
Gross industrial output: Waste collection, treatment and disposal activities; materials recovery (mil. tugriks) / (%)	18582.1 / 0.3%	31913.6 / 0.4%	50470.0 / 0.5%	73943.7 / 0.7%	91009.3 / 0.6%	112852.5 / 0.8%	135879.3 / 0.9%	115815.7 / 0.6%	125306.6 / 0.5%	136112.5 / 0.4%
Gross industrial output: remediation activities and other waste management services (mil. tugriks) / (%)	1292.6 / 0.0%	1391.7 / 0.0%	1626.0 / 0.0%	1067.7 / 0.0%	6445.7 / 0.0%	7481.2 / 0.1%	892.8 / 0.0%	1246.5 / 0.0%	3214.6 / 0.0%	2095.3 / 0.0%

Source: Mongolian statistical yearbook 2019

Solid waste volume: Amount of municipal solid wastes is on an increasing trend due to the combined impact of increasing capacity of municipal services to collect wastes, improving quality of reporting, collection companies' interest in securing funding for their operations and an actual increase in generated wastes.

Disposal: Collected municipal solid wastes are disposed of in dumpsites adjacent to residential areas. These sites were created randomly, and only later municipal authorities began to declare official disposal sites. Data on official and illegal disposal sites and their estimated area are available from 2005. There are about 400 official disposal sites covering 3,500–4,500 ha in Mongolia. The number of illegal dumpsites is unknown but during the last decade (2006–16), more than 4,000 illegal sites covering 500,000 ha were cleaned and 1.1 million tons of illegally disposed of waste were transferred to designated sites. Disposal sites receive all municipal, industrial and hazardous wastes. Ban on open burning of wastes introduced in the 2012 Law on Wastes was supplemented by a ban on burning wastes on disposal sites in the 2017 Law on Waste Management.

Recycling: Recycling of municipal wastes in Mongolia follows international practices. Recycling is focused on high-value wastes such as metals, plastics, paper and cardboard and there is limited domestic reprocessing capacity for some of these materials. The majority of separated wastes used to be exported, mainly to the People's Republic of China. However, gradual restriction on Chinese foreign waste import, in particular after the enforcement of Chinese ban on foreign waste import in 2018, export of recyclable wastes/resources have been reduced and gross industrial outputs of waste management and recycling sectors have been increased (Table 1.4.3). The annual capacity of recycling in Ulaanbaatar alone in 2015 was 87,600 ton of metals in six plants, 200,000 ton of aluminium alloys in three plants, 120,000 ton of plastics in five plants, 1,000 ton of paper in four plants, and an additional two waste tyres and used oil processing plants, a bracketing plant and a glass processing plant (Table 1.4.4). A complex waste management facility called Eco-Park, is planned for Ulaanbaatar in the Narangiin Enger and Tsagaan Davaa areas. Responding to the increasing demand for sustainable waste management in Mongolia, many waste management assistance programs have been initiated in 2020, such as Sustainable Plastic Recycling (2020-24)[9] by CARITAS, Participatory Food Waste Recycling[10] and Solid Waste Management[11] by ADB.

Table 1.4.4 Separate Collection and Recycling of Wastes, 2008-2016

Unit: ton/year

	Paper		Glass		Aluminum		Metal scrap		Plastic	
	Separate	Recycle	Separate	Recycle	Separate	Recycle	Separate	Recycle	Separate	Recycle
2008	855	-	136	-	64	-	476,307	-	532	356

9 https://mongolia.charita.cz/what-we-do/Ongoing%20projects/sustainable-plastic-recycling-in-mongolia/
10 https://www.adb.org/news/mongolia-adb-sign-grant-develop-participatory-food-waste-recycling
11 https://www.adb.org/news/adb-mongolia-sign-projects-covid-19-shock-response-economic-cooperation-zone-solid-waste

2009	20,598	9	4,131	1	923	7	2,544	732	20,539	77
2010	43,282	40	6,053	102	103	5	1,206	779	15,196	317
2011	32,429	31	17,355	66	1,1388	1,317	9,948	7,264	23,081	12,743
2012	9,432	717	3,734	710	131	17	301,845	300,617	5,223	2,939
2013	168,849	22	55,187	4,111	3,875	2,271	30,494	1,120	177,394	4,132
2014	91,340	21	66,654	34	984	56	134,084	1,371	17,802	318
2015	136,526	18	41,309	1,395	1,687	59	116,141	932	121,536	861
2016	127,292	15,029	51,974	1,1709	5,371	31	141,341	120,848	93,076	49,084

Source: MET,2017 (EPRMNG)

(3) Practices and trends of solid wastes management in other sectors

Manufacturing wastes

Detailed information on the types of manufacturing wastes is not available. The main sectors of manufacturing are production of food products and beverages, manufacturing of textiles, clothes, leather and fur, manufacturing of coke and refined petroleum products and manufacturing of basic metals and other non-metallic mineral products. Wastes from the production of food products and beverages and the manufacturing of textiles, clothes, leather and fur are similar to municipal wastes and mostly disposed of on municipal disposal sites. Wastes from the manufacturing of coke and refined petroleum products and the manufacturing of basic metals and other non-metallic mineral products are disposed of at dedicated sites within or near respective company compounds.

Wastes from energy sector

More than 90 % of energy in Mongolia is generated from coal. Amount of coal ash are between 10–30 % of the burned coal, which is significant volume and potentially major threat to the soil contamination. Ash is stored in designated ash ponds. Ulaanbaatar covers its demand for electricity and heat using three combined heat and power（CHP）plants (CHP-2, 21.5 MW; CHP-3, 198 MW; CHP-4,700 MW). Smaller CHP plants are located in Darkhan, Choibalsan, Erdenet and Dalanzadgad. The generation of bottom ash and fly ash from energy generation in Mongolia is estimated to be 600,000 ton/year. Information on deposited ash in the ash ponds and generated ash from the daily operation are not available. There are some efforts to utilize the coal ash such as road or concrete material, but commercial use of coal ash has not been started yet.

Mining and quarrying wastes

There are 400 large mining companies in Mongolia. Mining is typically done by open pits, so large amounts of soil/earth are moved to access the minerals. Extraction of metals from ores is done by flotation, resulting in large amounts of tailings. After the stricter requirements set by the Law on Mineral, Law on Budget and Law on Environmental Impact Assessment, more attention has been given to rehabilitation of stockpiles by covering them with topsoil and planting grass, trees and bushes. All mines must prepare an annual environmental management plan that addresses the impact of mining activities as well as waste management. Artisanal mining activities and their impacts are not well documented, and their waste management practices are not known.

Construction and demolition wastes (CDW)

The construction industry is booming in Mongolia, particularly in Ulaanbaatar. In addition to new construction, demolition wastes of old buildings in urban areas have been growing parallelly. Construction wastes account for 20–25% of all solid wastes generated in Mongolia. Illegal disposal of construction and demolition wastes are still common. There are no regulated waste management systems with material inventories so that construction companies are easily able to dump illegally at this moment. There are some donor funded efforts to convert to energy and resource efficient construction including recovery of valuable materials and their use in construction (Ref. SWITCH-Asia programme).

Since 2017, EU (SWITCH-Asia program), EBRD, and CARITAS of Czech Republic have actively contributed to management of CDW in Mongolia, particularly in Ulaanbaatar with loan and technical assistance projects[12]. They cover improvement of legal frameworks, capacity development of construction sector for reduction and separation of CDW, and CDW processing sector for safe handling and recycling. Czech Republic provides co-financing for wastes treatment and disposal.

Agricultural wastes

Wastes from agriculture have not been considered as a significant problem in recent years due to nomadic style farming or advanced waste management practices brought to Mongolia. The latter include chicken farms in Ulaanbaatar treating chicken manure in an anaerobic reactor, generating heat with processed manure used as fertilizer. With continuous technical assistances for agricultural fields, proper management of agricultural wastes are common.

Hospital wastes

Ulaanbaatar produces 2.65 tons of healthcare wastes per day. Out of them, hazardous medical wastes account for 0.78 tons, and general wastes (non-hazardous) 1.87 tons. Hazardous wastes have to be dealt with by strict method (Figure 1.4.4). However, the city does not have appropriate facilities for proper management. For example, anatomic wastes (0.36 tons per day) need to be incinerated, but there is a shortage of facilities in Ulaanbaatar. Also, in rural areas and Aimags, almost 90% of medical facilities have incinerated their wastes in primitive low temperature incinerators, without any air filter or even practicing open burning.

Source: UNIDO

Figure 1.4.4 Hazardous Waste Management

Hazardous wastes

Information on other hazardous wastes is limited although such information should be managed and disclosed as per the law. Due to the international treaties and prohibition of hazardous wastes' border crossing between Russia, China, and Mongolia in 2012, Mongolia has faced critical challenges for appropriate treatment and safety disposal of these wastes. Known sources of hazardous wastes are sludge from tanneries, wastes from processing and use of crude oil, soil containing cyanide and mercury from gold ore processing, and hazardous wastes derived from end-of-life vehicles including batteries. It is estimated that about 27,000–54,000 ton of hazardous wastes are generated annually throughout the Country. Presently, majority of hazardous wastes are sent to common disposal sites without proper

[12] EBRD: GrCF Ulaanbaatar Solid Waste Modernisation Project, https://www.ebrd.com/work-with-us/projects/psd/grcf-ulaanbaatar-solid-waste-modernisation-project.html
EU (SWITCH-Asia program), CARIATS and others: Improving Resource-Efficiency and Cleaner Production in the Mongolian Construction Sector, https://mongolia.charita.cz/what-we-do/Ongoing%20projects/improving-resource-efficiency-and-cleaner-production-in-the-mongolian-construction-sector-through-materials-recovery/

disposal.

E-wastes

E-wastes is one of the fastest growing waste streams in Mongolia. The amount of generated e-wastes per year grows rapidly. Life span of computers and other electrical equipment have been reduced since 1990s to just two years or shorter at present. Mobile phones have a lifespan of even shorter than two years. Mongolian population is about 3 million but the number of mobile phone users is about 3.5 million and since 2007 mobile phone user growth rate is around 120% annually. However, there exist no data and inventory for mobile phone wastes generation in Mongolia. Also, from 31 July 2014 Mongolia transferred to the digital broadcast system and generation of cathode ray tubes waste is extremely growing in the last few years. There is a pressing need to address e-waste management challenge. E-wastes are collected with municipal wastes and some e-wastes end up in unreported and largely unknown destinations.

1.4.3 Policy and programs

(1) Related laws

Mongolia law on wastes, 2012

This law is originated from the "Sanitation and hygiene law (1998)". Through some changes, the law on wastes was approved in 2012, and amended in 2017. The law regulates relations arising from collection, transport, storage and landfill of household and industrial wastes as well as promoting the re-use of wastes as an alternative to virgin 12 materials. The current law describes that dumping sites are classified into three grades. Grade 1 is a landfill site built according to approved design, with high quality equipment such as linings, cleaning leaches and so forth. Grade 2 must be equipped with leach storage, but not filter cleaner and has not lining preventing from filtration. Grade 3 has no facility comparable to Grades 1 and 2, but it must be fenced around to prevent wastes by winds and landfill machinery.

Green development policy (2015-2030)

This policy describes the target figure on waste management for "share of waste recycling" at 20% by 2020 and 40% by 2030 (40%). A strategic objective to "reduce solid wastes in landfills 20% by 2020, and 40% by 2030" is shown, by improving waste management system by promoting efficient technology, providing knowledge and ensuring healthy habits and lifestyles".

National waste management improvement strategy and action plan (2017-2030)

This strategy and plan include five objectives as follows:

- Objective 1: Improve the legal framework for facilitating better enforcement of the law to achieve sustainable waste management;
- Objective 2: Reduce the amount of final waste disposal by 30% through the use of economic incentives for recycling and recovery of wastes;
- Objective 3: Establish holistic waste management for hazardous wastes;
- Objective 4: Reduce waste generation at source by providing public education to ensure habitual waste segregation; and
- Objective 5: Reduce greenhouse gas by transitioning to environmental-friendly technologies for final waste disposal.

Mongolia Sustainable Development Vision 2030 (SDV2030) and SDGs

Reflection of SDGs in the SDV2030 is summarized in Table 1.4.5 related to solid waste management.

Table 1.4.5 SDV2030 and SDGs Related to Solid Waste Management Sector

SDV2030	SDGs
- The principle of environmental sustainability - Promote education of local residents and people at large to ensure environmental sustainability. - Use resource efficiently and effectively (3R) - Support clean technology and encourage low-waste and sustainable production and consumption	- 3.9 By 2030, substantially reduce the number of deaths and illness from hazardous chemicals and air, water and soil pollution and contamination - 9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes - 11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage - 11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management - 12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse

Source: JICA Project Team

(2) Long-term development policy 2050

Mongolia's long-term development policy 2050 will pursue the green development as one of the pillars. In the green development vision, introducing state-of-the-art and efficient green technology to improve consumption and production efficiency, save natural resources, and establish a waste-free recycling economy are suggested as follows:

- Promotion of sustainable green cities, green construction, green lifestyle and resources promoting eco-friendly green habits such as saving money,
- Introduction of state-of-the-art green technology, machines with low wastes and natural resource conservation,
- Promotion of ISO14000 standard for environmental management and green approval, and
- Promotion of the system for proper production and consumption habits.

In order to increase the amount of recycled wastes, 3R comprehensive management that reduces, reuses and recycles should be implemented as follows:

- Thorough separation of wastes before collection, rework, and build an environment-friendly facilities that produce electricity,
- Phased construction of dedicated landfill facilities that meet the standards in Ulaanbaatar City, regional centers and other settlements, and facilities for temporary storage and treatment of hazardous wastes, and
- Support of the recycling industry, which treats solid wastes in the construction, road and transportation fields in an environmentally friendly manner.

1.4.4 Current efforts for proper solid waste management

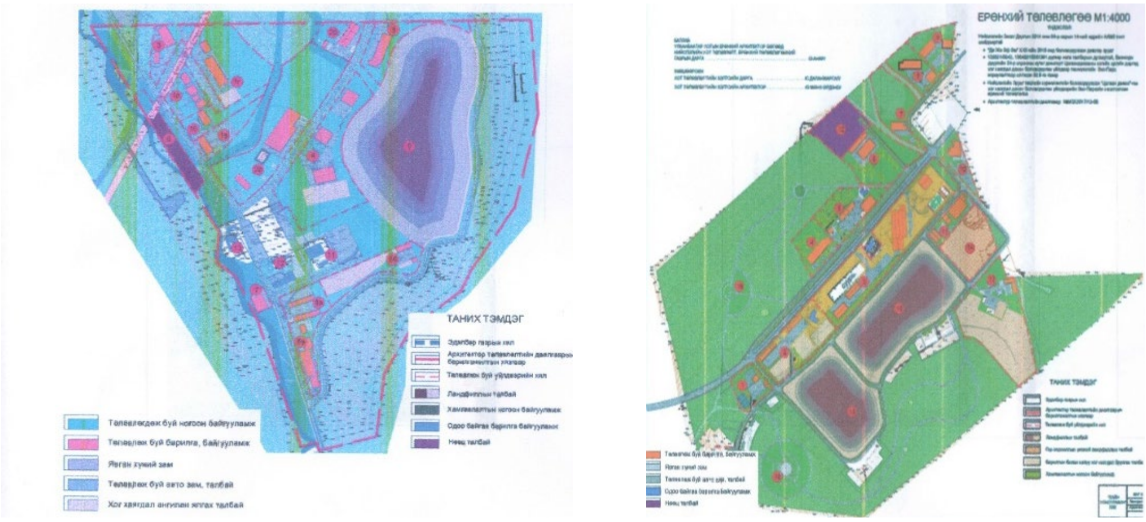
(1) Eco-park project

The Ulaanbaatar municipality plans to establish an eco-park for waste recycling as part of proper solid waste management. This project is composed of several recycling facilities such as wastes to energy station, organic wastes to diesel plant, waste glass recycling plant for artificial stone and so forth. Outline of this project is shown below. However, due to budget constraint, the completion date has not been published so far.

<u>Outline of eco-park project</u>

Project goal: Eco-park would be established as a world standard and high technology waste sorting and recycling plant complex at centralized waste collection sites of Narangiin Enger (174.6 ha) and Tsagaan Davaa (92.6 ha) (Figure 1.4.5). The eco-park enables the construction of 20 waste recycling plants with capacity to recycle wastes, produce value-added end products and sell them on domestic and foreign markets, and to reduce environmental pollution and adverse impact on public health.

Responsibility of construction:	Ulaanbaatar municipality
Responsibility of operation:	Eco Park Ulaanbaatar LLC, consisting of 17 private companies, members of the Mongolian National Recycling Association will be in charge of operation.
Budget:	Initial construction cost is MNT 292 billion (about US$108 million)
Social and environmental impact:	The rational recycling of wastes and production of end products enable a significant reduction in air, soil and water pollution. Waste pickers residing at waste disposal sites of Narangiin Enger and Tsagaan Davaa shall be employed at recycling plants, allowing them to improve their living and working conditions.
Main stakeholders:	Mongolian National Recycling Association; Ulaanbaatar Development Corporation JSC, which is supporting project development ; Ulaanbaatar City Mayor's Office, which is responsible for providing with project site and infrastructure; Ulaanbaatar Power Distribution Network (electricity, heat); and private suppliers of energy efficiency measures (e.g., construction companies).



Source: Ulaanbaatar Mayor's Office

Figure 1.4.5 Eco- Park Proposed in Narangiin Enger and Tsagaa Davaa

(2) Promotion of 3R (Reduce, Reuse, Recycle)

3 R is a generic term for Reduce, Reuse, and Recycle, commonly used around the world. "Reduce" means reducing the amount of resources used to make products and reducing the generation of wastes. Providing highly durable products and devising a maintenance system to extend the product life are part of the promotional efforts. "Reuse" is the repeated use of used products and their parts. Providing products that make it possible, developing repair and diagnostic technology, and remanufacturing are included in the initiatives. "Recycle" is the effective use of wastes as raw materials and energy sources. Product design, recovery of used products, and development of recycling technology and equipment that make it possible are positioned under the initiatives.

In Mongolia, there are several issues related to recycling to be tackled as follows:

- Lack of incentives for recycling with inadequate funds;
- No concrete policy and system concerning recycling;
- Presence of scavengers as it is said that there are about 200 scavengers in Ulaanbaatar, and separated usable metals seem to be brought to China; and
- Limited technical and financing capacity, and unstable market for export to China etc.

(3) Improvement of waste management in Ulaanbaatar

By expanding landfill capacity and building a construction and demolition waste plant, the Ulaanbaatar city would be in a position to dispose of a significant part of its wastes in line with EU standards, while new equipment will help to improve waste collection, transportation, recycling and disposal services and lead to higher environmental and hygiene standards. The contents of the support (2018-19) are shown as below:

- EBRD (European Bank for Reconstruction and Development) loan of US$9.7 million and EU funding of US$6.0 million to improve municipal waste services in Ulaanbaatar, and
- Financing investments in new landfill and better waste management and introduction of new plant to treat wastes from construction and demolition.

1.5 Protected Areas, Biodiversity and Forest Management

The most updated comprehensive review of protected areas, biodiversity and forest management is available in Chapter 11 biodiversity and protected areas and Chapter 13 forestry and environment of EPRMNG2018 (2018). Key findings and bases for the NCDP formulation are summarized below.

1.5.1 Protected areas

(1) Current situation

The SDV2030 sets an ambitious target to designate 30% of Mongolian territory as “Area of specially protected land by 2030” and 25% by 2020. As per the NSO’s MDGs monitoring data, the area of the protected land is still 17.9% in 2017 (Report of Unified Land Territory of Mongolia, by main type, by national, Aimag and capital city, by year, Mongolian Statistical Information Service). However, combination of the state protected areas (17.9 %) and local protected areas (LPAs) (12.0%) have already achieved 29.9% of the territory coverage (Table 1.5.1). As legal definition, management, and restriction of land use in LPAs are significantly different from those of state protected area, there would be significant challenges to transform the LPAs or create additional state level strict protected areas. In order to expand the protected area and “sustainably and adequately” maintain the protected areas, consistent budgetary arrangement and consensus among existing land users, management authority/agencies and interested organizations to exploit the natural resources in the areas such as mineral exploitation. The NCDP together with RDP and HSP would facilitate the processes to materialize such arrangement toward the ambitious targets.

The protected area system is governed by the Law on SPAs. The law defines four categories of protected areas, namely i) Strictly Protected Area (StrPA), ii) National Park (NP), iii) Nature Reserve (NR), and iv) monument. The monument category includes historical and cultural monuments, and Natural Monuments (NMs). The protected area system also includes local protected areas (LPAs), i.e. areas taken under special protection at the local level.

Present protected areas: In 2017, the state SPA system includes 20 StrPAs encompassing a total area of 12,411,057.44 ha (7.93% of the Country’s territory), 32 NPs encompassing a total area of 11,884,605.59 ha (7.6%), 36 NRs encompassing a total area of 3,528,824.17 ha (2.26%) and 14 NMs encompassing a total area of 128,962.78 ha (0.08%). In total, the system encompasses 27,953,449.98 ha (17.87% of the Country’s territory), apart from buffer zones and LPAs designated by the local authorities. In addition to the SPAs, over 1,000 LPAs have been set and managed accounting for 12.0% of the national territory. The SPAs are shown in Figure 1.5.1 and area summaries for both SPAs and LPAs are shown in Table 1.5.1.

Table 1.5.1 State and Local Protected Areas, 2017

Protected area category	Number	Total area (ha)	Share (%)
State protected area	102	27,953,449.98	17.87
Strictly protected area	20	12,441,057.44	7.93
National park	32	11,884,605.59	7.6
Nature reserve	36	3,528,824.17	2.26
Monument	14	128,962.78	0.08
Local Protected area	1,108	18,837,459.75	12.04
Total	1,210	46,790,909.73	29.91

Source: MET, ECE secretariat calculations (EPRMNG)

In general understanding, the land use of the SPA is summarized as follow:

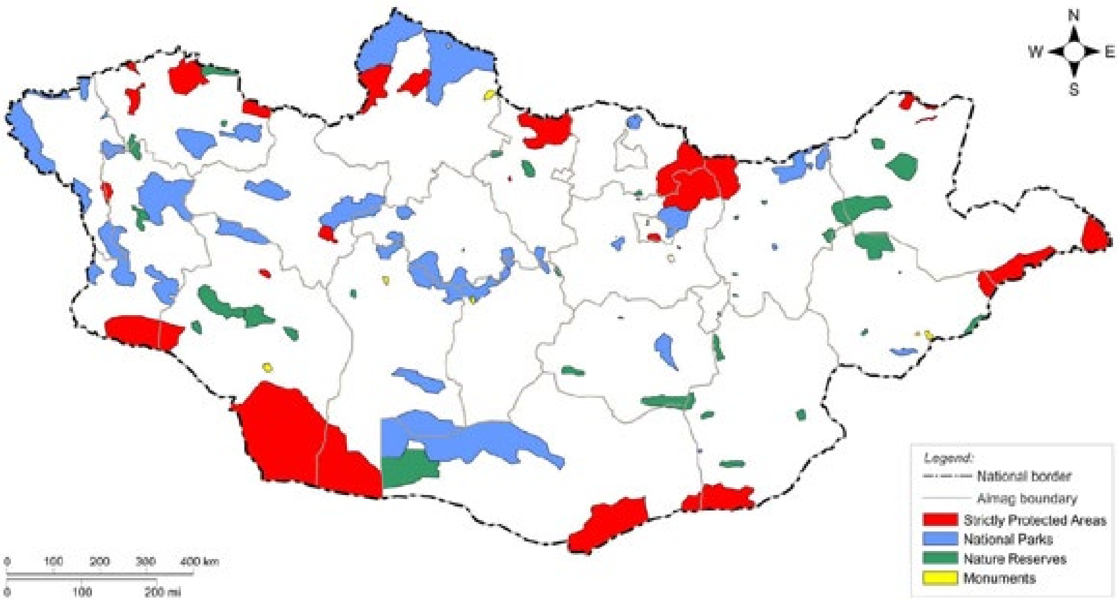
- StrPAs and NP: no development and use
- NRs: only traditional economic activities
- NMs: some restricted uses of the monument without changing the core values of NMs, no use of cultivation and mining
- LPAs: protection of ecosystem stability and promotion of sustainable land use in areas of natural, historic and cultural significance along with the empowerment of Aimag or soum interests

Depending on the main subject of protection, LPAs are classified as either forest, wildlife, plant and water reserve land, or natural and historical heritage reserve land. The designation of LPAs by local authorities is renewable but effective for 10 years only. Due to the flexibility of the LPAs development and management by the interests of the local authorities/politicians or landlords, there have been criticism to abuse LPAs and conflict of interest between state authorities and local governments (ex. Mining concessions in LPAs without consent of local governments). However, such flexibility could be suitable for smart arrangement between the national interests of the SDV2030 and local demands for sustainable economic growth. According to MET, the LPA network in 2016 included 1,108 LPAs (omitting the uncertain ones), encompassing a total area of 18,837,459.75 ha (12.04 per cent of the country's territory).

(2) Challenges

The land management policy (ALAMGaC 2019) highlighted the issues of the sustainable management of not only planned new SPAs but also existing SPAs. Some of the key recommendations to realize the proper management of existing SPAs and development of further SPAs are as follow:

- Stable and sufficient budgets for SPA management by the Ministry of Finance
- Clarification of the legal obligations and powers of the PA rangers and their empowerment
- Appointment of legally responsible entities to ensure the management of the SPAs as per the purpose of the area
- Establishment of a PA management plan and its adequate implementation
- Establishment of the revenue collection systems and their management by the appointed PA management entities



Source: Annex V Mapt4 State Special Protected Area network, 2017

Figure 1.5.1 State Special Protected Areas

1.5.2 Biodiversity

(1) Monitoring and protection

MET is responsible for monitoring and protection of the biodiversity in the nation. For the regular monitoring part, the Institute of Biology of the Mongolian Academy of Sciences has been conducting surveys on the ground and provides information on protected areas and endangered, rare and ecologically important species to MET for years. In addition to the regular monitoring by national authorities, there have been some donor funded projects focusing on biodiversity. However, due to the constant shortages of national budget allocations, the biodiversity monitoring and protection activities have been inconsistent. In cooperation with international partners, several Red List assessments have been undertaken. These studies provide essential information on the magnitude and importance of threatened biodiversity and help track endangered, vulnerable and threatened species.

(2) Current situation, trends, and advantages

Despite the insufficient budgets and inconsistent studies, some studies could identify unique species with critical stages or conclude the extinction of some species in Mongolia. Overall distribution of the biodiversity ecological services had already been extinct in Mongolia. Despite recent development activities, those studies also found that Mongolia is still one of the most favorable lands for the biodiversity conservation in the world due to the relatively limited disturbance to the ecosystems by human impacts and exotic spices (Figure 1.5.2). It has been one of the top global interests to protect and develop sustainable strategies for unique genome, particularly for the adaptation to climate change impacts for the long term. Revaluation of the Mongolian biological resources may find unique advantages of the nation and could guide original sustainable development strategies of Mongolia unlike other developing countries and neighboring counties due to the unique status of the biodiversity and unspoiled natural habitats. Soil erosion by wind and water scarcity are also shown in Figures 1.5.3 to 1.5.5.

(3) Major threats to three ecoregions

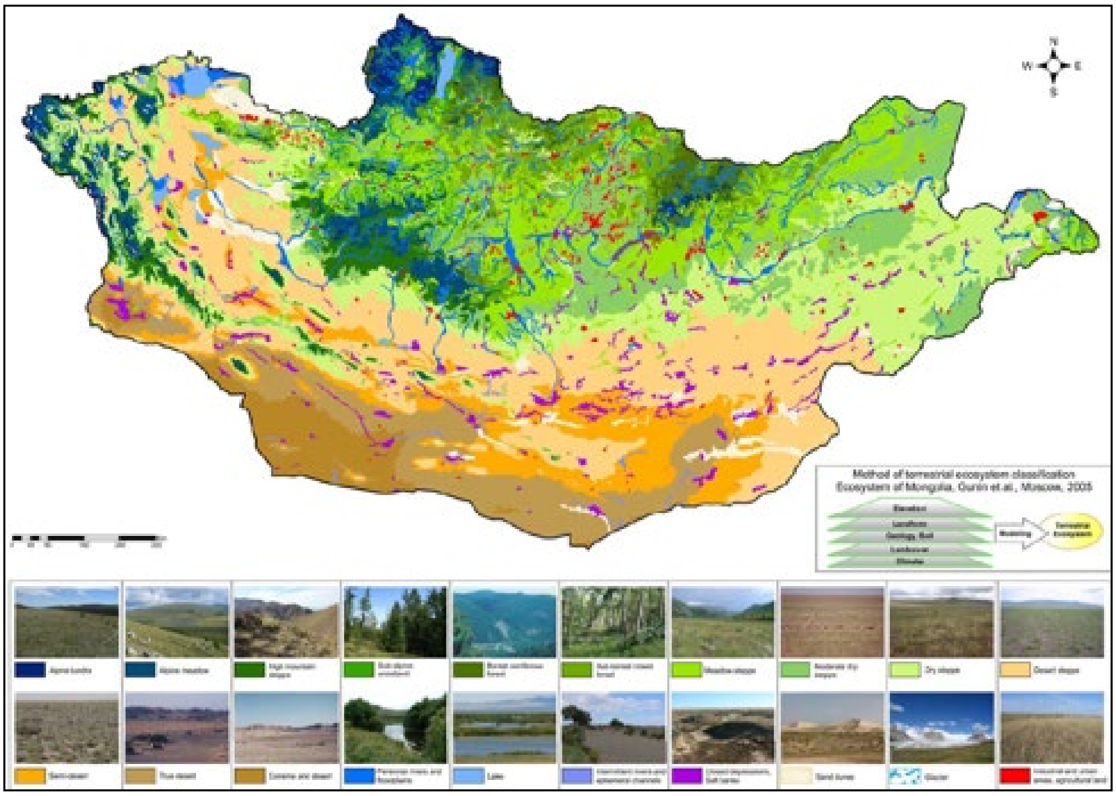
All the natural ecosystems of Mongolia's four ecoregions are currently threatened as a result of both natural factors (ex. climatic changes) and growing manmade factors. Major threats to the four ecoregions are summarized as follow: 5

(a) Altay-Sayan ecoregion: deterioration of habitats due to overgrazing and overharvesting of biological resources (timber, wildlife)

(b) Khangai ecoregion: further concentration of human settlement areas (densely populated compared with other regions)

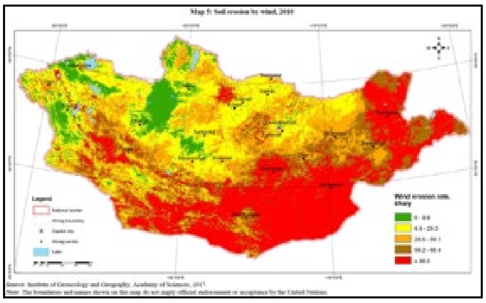
(c) Steppe ecoregion: decreasing wildlife, ongoing degradation of the grasslands as a result of overgrazing, in particular by goats, excessive hunting, overfishing, mining and oil extraction and associated infrastructure development

(d) Central Asian Gobi desert ecoregion: scarcity of natural water resources, still aggravating due to current climate change, overgrazing of rangelands caused by goats, uncontrolled motor vehicle use, and increasing mining activities with associated infrastructure development resulting in habitat fragmentation and isolation of wildlife populations.



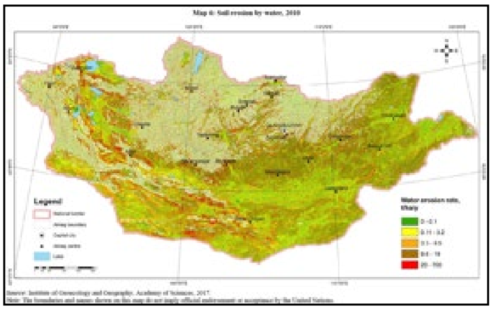
Source: World Wide Fund for Nature (WWF) Mongolia, Filling the Gaps to Protect the Biodiversity of Mongolia (2019). The map is based on gunim et al. (2005), Method of Terrestrial Ecosystem Classification: Ecosystem of Mongolica, Moscow, Annex V Map 3 Ecosystems

Figure 1.5.2 Ecosystem of Mongolia



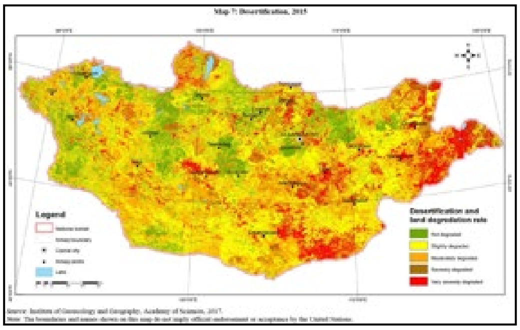
Source: Institute of Geoecology and Geography, Academy of Science ,2017, Annex V Soil erosion by wind

Figure 1.5.3 Soil Erosion by Wind



Source: Institute of Geoecology and Geography, Academy of Science ,2017, Annex V Soil erosion by water

Figure 1.5.4 Soil Erosion by Water



Source: Institute of Geoecology and Geography, Academy of Science ,2017, Annex V Desertification

Figure 1.5.5 Desertification

1.5.3 Forest management

In order to balance protection and sustainable use of forest land and resources, the present government distributed the responsibilities and powers among ministries and agencies as follow.

Ministry of Environment and Tourism	Development of policies in rational use of forests, regeneration and protection
Ministry of Food, Agriculture and Light Industry	Development of timber production and processing
State Specialized Inspection Agency	Enforcement of relevant laws, regulations, and standards
National Emergency Management Agency	Prevention and management of forest fire
Forest Units	Implementation of forest rehabilitation and protection policies

* Newly established by Government Degree 255 (2016) and Cabinet Resolution 76 (2016)

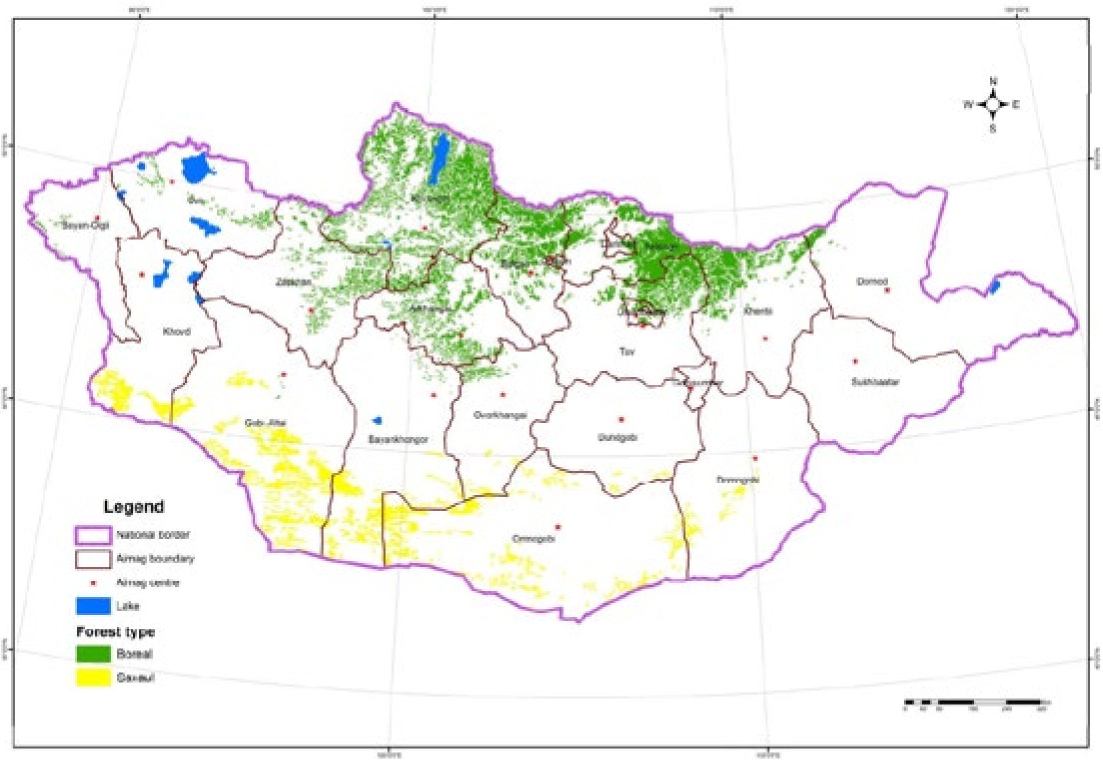
MET is now responsible for monitoring forests. Regular monitoring is undertaken of forest areas and their changes, forest reserves and their changes, forest harvest, forest fires, forest rehabilitation, forest ownership and forest expenditure with the help of rangers using checklists, supported by periodic forest inventories. The Forest Research and Development Centre was established in 2012 to provide analytical and research support to the Ministry. It worked with GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) to prepare the Multipurpose National Forest Inventory (2014–2016) (chapter 13), which was published and is available in Mongolian and English.

(1) Current situations

Forest land includes forested areas with woods (natural and planted), bush and shrub stands, logging areas, damaged area with/without woods due to steppe fires, insects and diseases, and glades, and the buffer areas 100 m outside the forest edge, and seedlings and tree nursery areas. Non-forest areas include grasslands, shrub lands, wetlands and agricultural areas. In 2016, forest land was roughly 18.45 million ha (11.8 % of national territory). Unstocked forest areas are expected to be regenerated. Classification, size and their location are shown in Figures 1.5.6 and 1.5.7 respectively.

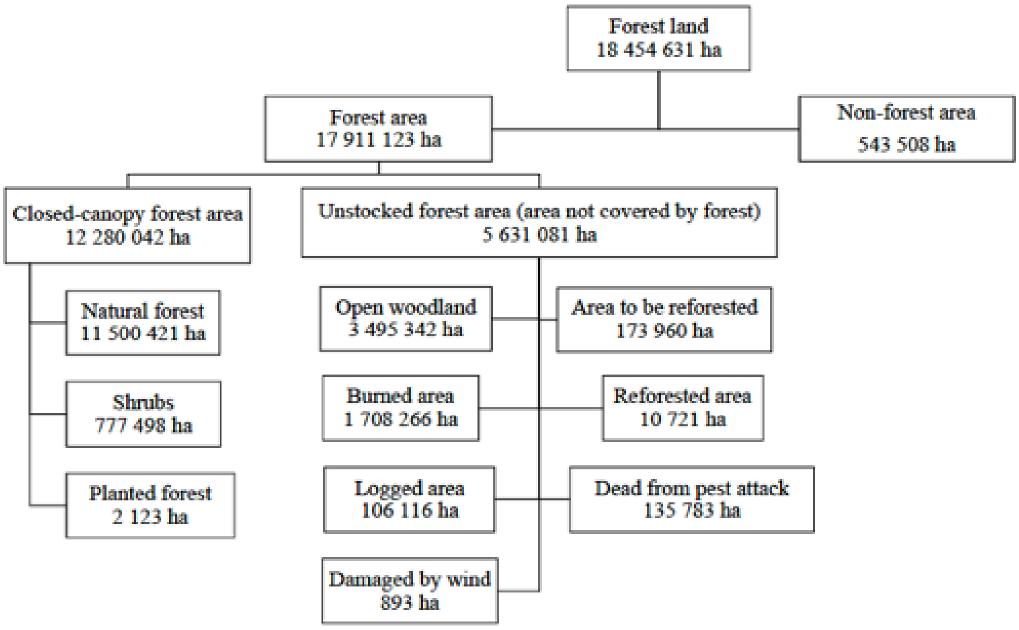
Among 513,214 ha of the forest damage reported in 2016 (PNTP-2016), primary causes of the damages were i) disease and pests (78.8%) followed by ii) fire (16.1%), iii) logging including illegal (3.7%), iv) mining (0.01%), and v) others (3.7%) respectively.

Compared to the scale of the forest destruction by both natural and human causes, recovery of the forest resources has been insufficient due not only to the shortage of budgets but also to inadequate follow up activities of the planted trees. Although tree planting programs have been active historically, shortages of the quality seedling supply and continuous regular maintenance for planted seedlings have caused poor recovery of the forest resources for years.



Source: Forest Research and Development Center, 2017, Annex V Forest distribution, EPRMNG, UNECE

Figure 1.5.6 Forest Distribution



Source: Forest Research and development Center, MET, 2017. EPRMNG, UNECE

Figure 1.5.7 Classification and Areas of Forest Land 2016

(2) Distribution

There are two types of forests: i) northern coniferous and deciduous forests (84.7% of the total forested area) and ii) southern saxaul forests (15.3% of the forest area).

(3) Administrative zones

As per the Law on Forests (2012), there are two types of forests, namely protected forest (79.5% of the total forest land) and utilization forest (20.5%). Any activity other than construction of roads and bridges, electrical and telecommunication lines, forest maintenance work and use of non-timber forest products is not allowed in a protected forest zone.

(4) Reforestation and afforestation efforts and new directions

Between 1980 and 2016, 201,145 ha of land were reforested in areas where logging operations had been carried out or affected by fires, forest strips were created, and natural regeneration was supported in the forests and tree nurseries were developed for the preparation of seeds and seedlings for plantation. A study in 2006 found that the mean survival rate of the seedlings was as low as 12% due to the harsh climate, cattle grazing, forest fires and the quality of plantation operation, which could be technically improved. Considering the afforestation, the Government of Mongolia has made great efforts to build new forests under the Green Belt Afforestation program (2005-2035) evenly divided by three stages. These efforts aim to reduce soil erosion and halt desertification in the southern part of the Country by building a green belt. As a result of the first stage, 5,302 ha have been afforested.

Due to the harsh environmental conditions for forest area development in Mongolia, the Government has carefully studied the "suitability" of the reforestation area and focused on "sustainability" of the reforestation programs. Particularly, in addition to the rehabilitation of degraded forests, the Government has actively been working on multipurpose forest development for sustainable use of forest land and forest products. The most updated forest land management policies and action plans among relevant agencies are summarized in the subsection 4.2 of the forest land management in the land management policy (ALAMGaC 2019). Based on the land management policy, examples of the multipurpose forest development plans are listed below.

Fire, insects and disease control strips,	• Creation of grass land strips to prevent entire forest fire, insects and disease spread

	• Forest cleaning for fire prevention
Wind wall,	• Prevention of topsoil erosion by strong wind adjacent to agricultural land • Dust control for urban and residential areas
Agroforestry,	• Invitation of private sector for agroforestry to contribute to the sustainable economic growth and forest coverage growth, including cash crops and fruit production • Access road infrastructure development for adequate quality control and resource management and competitive market access
Pastureland rotation, and	• Stricter control of overgrazing and planned proportional fodder production
Community forests	• Participation and ownership of the sustainable forest management by interested parties including private and civil societies • Development/improvement of reassuring space and tourist attraction

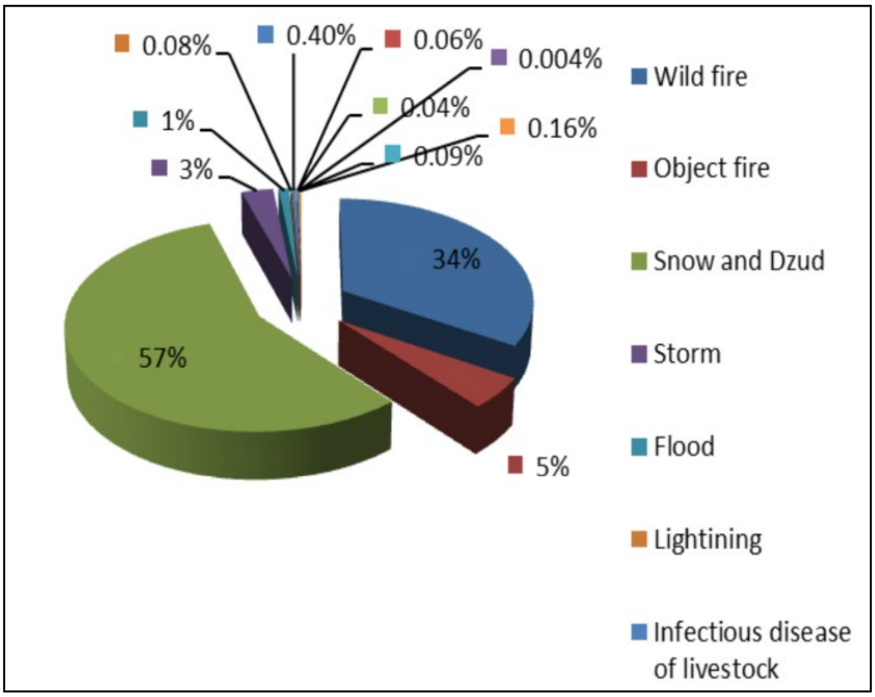
1.6 Natural Disasters and Climatic Change

1.6.1 Natural disasters

(1) Overview

Mongolia is exposed to several types of natural hazards, the most severe of which are droughts, Dzud, seismic incidents, desertification, snow and dust storms, and steppe and forest fires. Dzud is caused generally by a summer drought followed by a severe winter, although there are several types of Dzud phenomena.

The economic losses caused by disasters and hazardous phenomena in Mongolia increased by 10-14 times in comparison with the previous decade, negatively influencing the Country's social and economic development (Figure 1.6.1).



Source: NEMA[13]

Figure 1.6.1 Economic Loss Percentage in Mongolia due to Natural Disasters

[13] Agriculture and Drought In Mongolia (2018) published by Information And Research Institute Of

(2) Droughts and floods

The most recent extended drought in Mongolia lasted from 2000 to 2010 and resulted in major livestock die-offs and a massive migration of nomadic herders to the capital city. More than 10% of Mongolia's territory including large parts of Bayankhongor Aimag in the southwest, and some Soums of Aimags in the east, suffered from the severe drought. Mongolia has a large nomad population of which 40% are dependent on rain-fed agriculture and animal husbandry for their livelihoods. Therefore, droughts have been causing severe damages for them since long time ago. A drought occurs every year affecting 30 to 70% of the total area, resulting in inadequate pasture conditions, and poor hay and fodder availability. Drought in summer followed by Dzud in winter causes most serious livestock losses.

Occasional heavy rains occur across some parts of Mongolia, causing flooding in some areas. In Mongolia, there are three types of floods: 1) rise of water level and over bank flow in relatively long period due to snow and ice melting called spring or snow melting flood, 2) quick rise of water level and over bank flow caused by intensive rainfall called rainfall flood, and 3) flash flood- high intensive turbulent flow with rocks and sediment and other surface materials due to heavy rain along the steep dry beds and small rivers. In addition, inundation of roads occurs sometimes in Ulaanbaatar even with relatively light rains due to poor drainage.

(3) Dzud

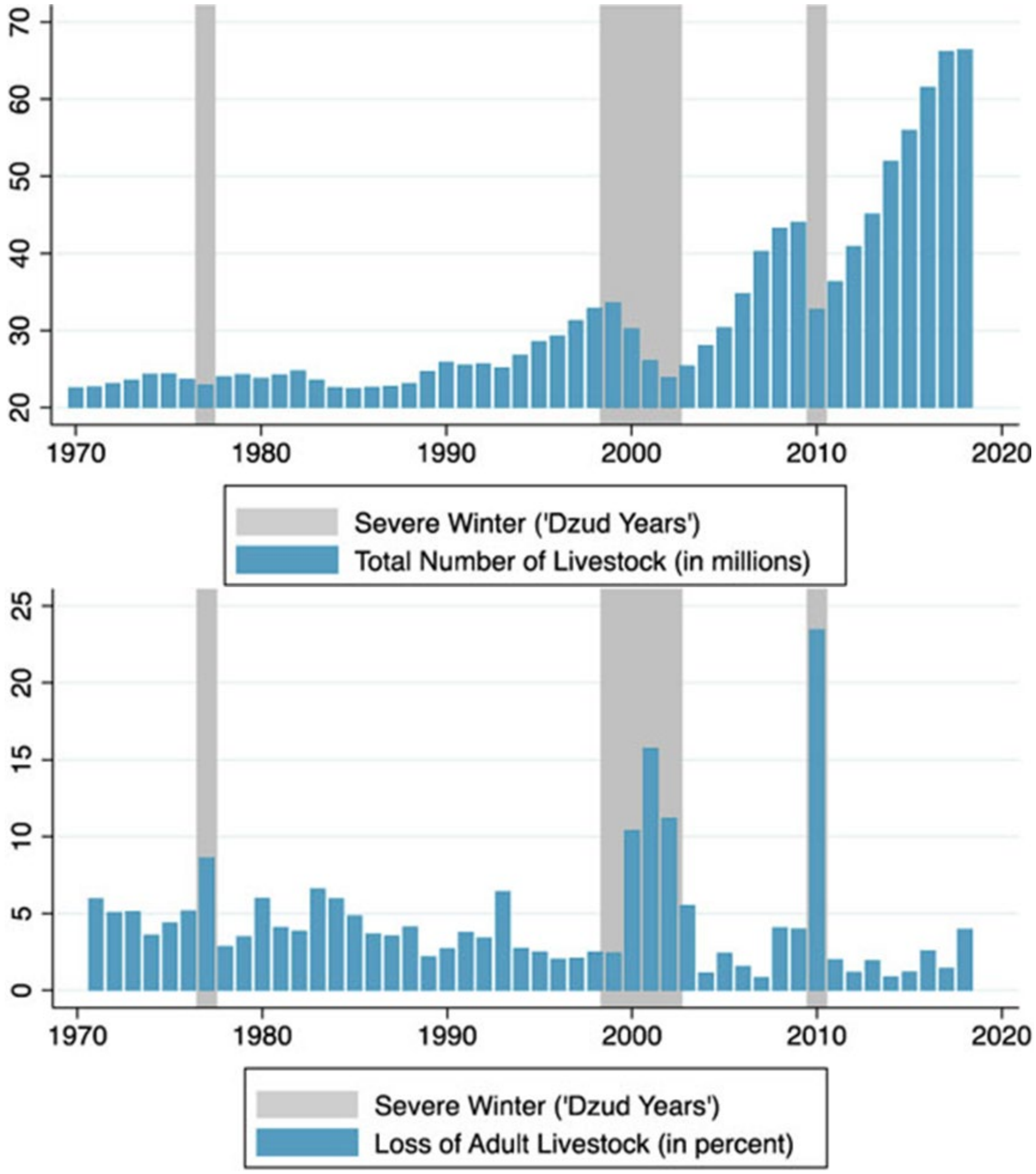
Severe winters that kill large numbers of livestock are very common in Mongolia, and therefore there is a local term for the phenomenon, called Dzud. Winter in Mongolia is turning evermore longer and bitterly colder. Summer is becoming shorter and more parched. This phenomenon leaves animals without enough food and herding opportunities.

Over 50,000 people are estimated to have moved to Ulaanbaatar directly after the 1999- 2001 Dzud, and another 70,000 people 2-3 years thereafter as herder families struggled to rebuild their livelihoods. Mongolia was again harshly affected by severe Dzud in 2009/2010, when more than 15 million heads of livestock died, and around 20,000 herders were forced to migrate towards Ulaanbaatar (Figure 1.6.2).

In the 2016 – 2017 Dzud, 157,000 people were affected. In the previous year, more than 1.1 million livestock were lost due to Dzud. After an unusually hot summer and cold winter, parts of rural Mongolia experienced a Dzud in 2018 as well. The consensus among the nomads is that Dzud has been occurring more frequently in recent years, and it seems to be getting worse.

Dzud is difficult to predict, since the conditions that give rise to the disaster are many and interrelated in a complex manner. It is difficult to capture how long these conditions are going to persist. The Information and Research Institute of Meteorology, Hydrology and Environment (IRIMHE) of Mongolia has developed a GIS based multi-criteria decision analysis model to predict distribution of Dzud risk and is developing an early warning system to distribute relevant information through the National Emergency Management Agency, ministries and local meteorological offices. The Ministry of Environment of the Japanese government has also developed an early warning system for Dzud, that can be operated with proper data in Mongolia.

Meteorology, Hydrology And Environment



Source: IMF calculation based on NSO

Figure 1.6.2 Total Number of Livestock and Losses of Adult Livestock

(4) Forest steppe fires

The forests of Mongolia cover approximately 13 million ha (roughly 11% of the Country) mainly in the northern part of the Country, and these forested lands are at increasing risk from wildfires. Local foresters and politicians are eager to enhance the capacity of the fire management capabilities in the Country and are seeking international support on how to prioritize their efforts.

(5) Seismic incidents

According to Building e-Resilience in Mongolia[14] published by Economic and Social Commission for Asia and the Pacific (United Nations Economic and Social Commission for Asia and the Pacific: ESCAP), the number of earthquakes near Ulaanbaatar increased by two times in 2005, four times in

[14] Enhancing the Role of Information and Communications Technology for Disaster Risk Management, 2016

2012, and 10 times in 2013 than the respective previous years. In the first three months of 2015, earthquakes occurred 328 times, and there is no sign of the number of earthquakes decreasing. In recent years, three active faults have been found near Ulaanbaatar, where about half of the population is concentrated. There are concerns that the risk of severe earthquakes will be raised by an increase in perceivable or unperceivable earthquakes in Ulaanbaatar, especially.

(6) Institution and organization

In 2004, the Government of Mongolia established the National Emergence Management Agency (NEMA) by merging the State Board for Civil Defence, the Fire Fighting Department and the State Reserve Agency. NEMA is headquartered in Ulaanbaatar and is represented in all 21 Aimags of the Country. Organization of NEMA is shown in Figure 1.6.3.

Main duties of NEMA are to:

- Develop the legislative environment on disaster protection,
- Provide strategic management,
- Evaluate disaster risk and vulnerability,
- Implement activities on disaster prevention,
- Undertake disaster reduction and disaster preparedness at all levels,
- Organize search and rescue work, and response efforts,
- Restore the main infrastructure,
- Facilitate rehabilitation,
- Strengthen the capacity of national disaster protection,
- Cooperate with foreign countries and international organizations in the disaster protection field, and
- Monitor laws and legislations, and policy implementation on state reserve.

In order to strengthen the NEMA's capacity for earthquake disaster prevention and emergency responses, JICA recently completed a technical cooperation project: "The Project for Strengthening the National Capacity of Earthquake Disaster Protection and Prevention in Mongolia (November 2016-December 2019." To achieve the project purpose under the overall goal to reduce the seismic risk and strengthen the emergency response capacities, NEMA had successfully collaborated with the key national authorities for earthquake disaster management as follow.

- Ministry of Construction and Urban Development (MCUD)
- Ministry of Education and Science (MES)
- General State Inspection Agency (GASI)
- Emergency Management Department of the Capital City (EMDC)
- Construction Quality and Safety Department, Urban Development Agency of Capital City (UBUDA)

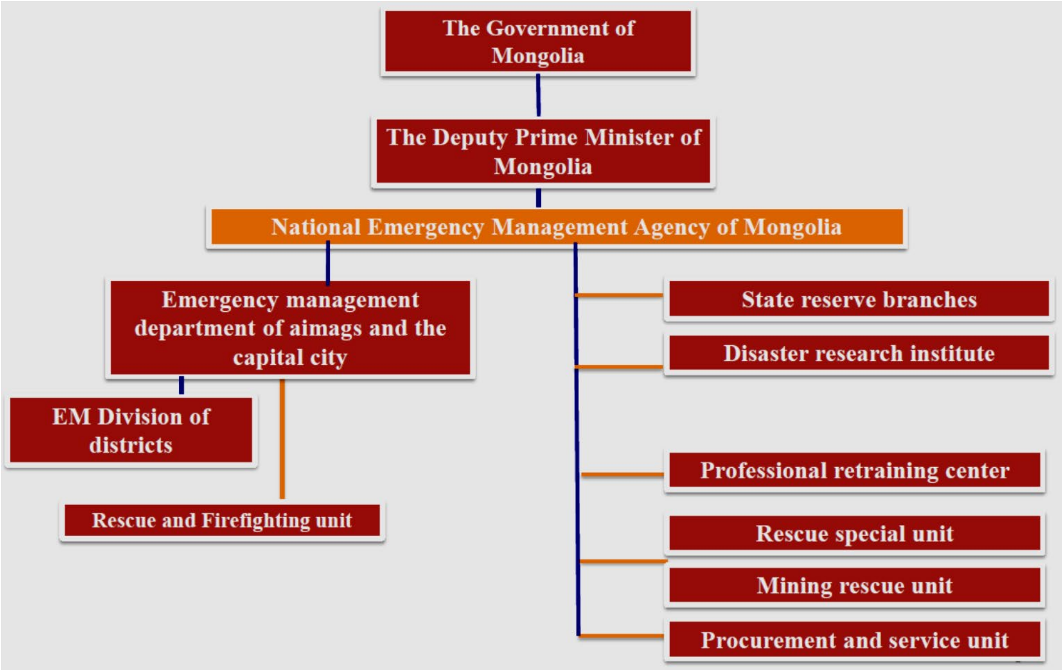
The project purpose has been successfully achieved with verifiable indicators/outputs shown below. Even though natural disasters are immediate threats to the nation, while climate change impacts are considerably threats to take effects slowly, there are lots in common for prevention and response approaches and institutional frameworks. Therefore, the successful processes of coordination with relevant authorities and the guideline preparation together with technical trainings on the guidelines for the relevant/implementation officers shall be adapted to prevention of other immediate natural disasters as well as climate change adaptation.

Overall Goal: Seismic risk will be reduced.

Project Purpose: The Capacity of the National Emergency Management Agency will be enhanced through the activities for strengthening the countermeasures for seismic risk.

Objectively verifiable indicators	**Outputs**
1. The formulation of Disaster Protection Plans at Regional Level will be continued by referring to the guidelines developed through the activity in the Project.	• Earthquake Disaster Risk Assessment GL • Regional Level Earthquake Disaster Protection Planning GL,
2. The White Paper for Disaster Risk Reduction will be developed every year based on the system established through the activity in the Project.	• Manual of the Disaster Risk Reduction White Paper
3. The implementation of Seismic Evaluation for public facilities will be continued across the country by referring to the guidelines developed through the activity in the Project.	• Seismic Evaluation Guideline for Buildings
4. The implementation of Seismic Evaluation for infrastructures and lifelines will be continued across the country by referring to the guidelines developed through the activity in the Project.	• Seismic Evaluation Guideline for Infrastructure and Lifelines
5. The fostering engineers who have expertise in Seismic Strengthening of buildings will be continued based on the system established through the activity in the Project.	• WG of the Project conducted three ToTs to foster seismic diagnosis engineers during the project implementation period.
6. The implementation of School Disaster Risk Reduction Education will be continued across the country by referring to the guidelines developed through the activity in the Project.	• The Program for Life Safety Education • The Guidebook for the program of Life Safety Education • Conducting training for the school teachers
7.The Activity of Disaster Risk Reduction Education and Raising Awareness for the public will be continued across the country under NEMA's initiative based on the system established through the activity in the Project.	• DRR Training Materials for the Community • Conducting ToT for EMA, MRCS Volunteer etc. • Development of website for the Comprehensive Training Schedule.

Source: Project Completion Report, The Project for Strengthening the National Capacity of Earthquake Disaster Protection and Prevention in Mongolia



Source: NEMA

Figure 1.6.3 Organization Chart of NEMA

(7) Policy and program

Law on Disaster Protection, 2003

This law regulates matters relating to the principles and full powers of disaster protection organizations and agencies, their organization and activities as well as the rights and duties of the State, local authorities, enterprises, entities and individuals in relation to disaster protection and preparedness. It establishes the main principles of disaster protection activities and training, and also contains provisions ensuring transparency in disaster protection activities.

Building e-resilience in Mongolia: enhancing the role of ICT for disaster risk management (United Nations Economic and Social Commission for Asia and the Pacific: ESCAP)

A research has been developed in the light of the adoption of the Sendai framework for disaster risk reduction 2015-30 in March 2015, and the adoption of the SDGs, particularly SDG 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation. The research examines the readiness, quality and resilience of the ICT infrastructure in Mongolia in terms of providing early warnings, withstanding disaster events and helping in recovery. The study looks at the current condition of fibre optic connectivity networks and broadband, which are critical infrastructure for disaster risk management.

Law on Forestry, 2007

The purpose of this law is to regulate the relations arising from protection, possession, sustainable use, restoration and reproduction of forests in Mongolia. Forest resources are defined as a state property under the sole authority of the people.

Action program of the Government of Mongolia for 2016-2020

Improvement of the legal environment and management of disaster prevention is suggested in this program. The objectives are to carry out disaster prevention, disaster risk reduction and early warning activities on a scientific basis, broaden public participation and enhance the disaster management capacity.

Mongolia Sustainable Development Vision 2030 (SDV2030)

In this vision, natural disaster prevention is related to climate change such as to "establish national capacity to cope with climate change and strengthen the system to prevent from meteorological hazard and natural disaster risks". From 2016 to 2030, stepwise measurements have been suggested. Initially, early detection and early warning system would be introduced, and organized for national level activities on disaster risk and vulnerability reduction on a regular basis.

Five-year general guidelines for the development of Mongolia in 2021-2025

In terms of green development, the guidelines suggest the low carbon and high productivity in society. Especially, the following two measures are described regarding disaster reduction,

- Strengthen climate adaptation and response capabilities and reduce potential risks;
- Enhance meteorological observation and environmental monitoring networks, and
- Strengthen disaster prevention, weather prediction and warning capabilities for the reduction of the risk of natural disasters.

These measures are mostly consistent with the NCDP strategy for disaster reduction and respond to climate change.

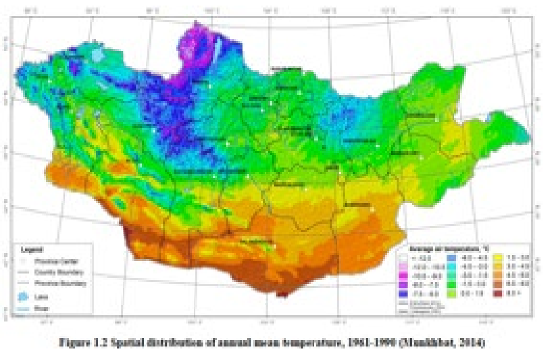
(8) Long-term development policy 2050

The Mongolian long-term development policy 2050 describes that measure to increase resilience to climate change is one of the most important factors, that should be reflected promptly in all sectors of society and economy. Further, as mentioned in the policy, it is also necessary to implement green projects, introduce best environmentally friendly technologies, increase efficiency and productivity, and promote widespread ICT and use of renewable energy. In order to mitigate disaster risk and damage potentials, the NCDP also suggests that utilization of ICT and green infrastructure development.

1.6.2 Climate pattern and trend of climate change

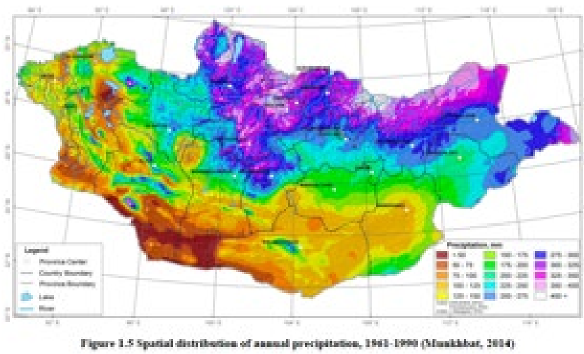
(1) Climate

The climate of Mongolia is harsh and very sensitive to climate change due to the geographical location in the center of the Eurasian continent and high altitude. Special distribution of annual mean temperature and annual precipitation are shown in Figures 1.6.4 and 1.6.5.



Source: Spatial distribution of annual precipitation, 1961-1990 (Munkhbat), NC3, UNFCCC

Figure 1.6.4 Spatial Distribution of Annual Mean Temperature 1961-1990



Source: Spatial distribution of annual precipitation, 1961-1990 (Munkhbat), NC3, UNFCCC

Figure 1.6.5 Spatial Distribution of Annual Precipitation 1961-1990

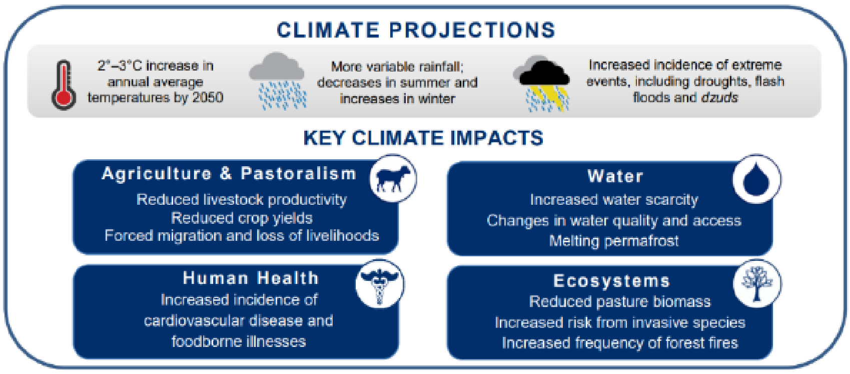
The annual precipitation exceeds 400 mm at high mountain belts and becomes 50-150 mm in Gobi and desert region. Roughly 85% of total precipitation falls from April to September and among them, 50-60% falls only in July and August. Winter precipitation by snow is very low. Precipitation amount during the cold season is as low as 30 mm in the mountain area and less than 10 mm in the Gobi region.

(2) Climate change risk

Mongolia's unique geographical location and dependence of the nation's rural population on animal husbandry make Mongolia more vulnerable to environmental changes and severe weather events (Figure 1.6.6). The increasing trend of rural to urban migration in Mongolia has been linked to factors resulting from climate change such as declining livelihood opportunities in rural areas that have been amplified by increasing incidences of severe droughts and Dzud. If the trends continue, the increasing incidences of disasters would drive higher rates of rural to urban migration into Ulaanbaatar or other major cities where government officials are already facing significant challenges to accommodate new arrivals.

It is said that future climate projections indicate the likely increase of intensity of droughts and Dzuds in Mongolia. Livestock losses and decline in livelihood by extreme droughts and Dzud are expected to especially adversely affect herders located far away from the market. This would induce further migration to the center, and increased concentration and burden on the capital and other urban areas.

Mongolia was ranked 8th in the global climate risk index of 2014. Over two-thirds of the land has been affected by desertification and average temperatures have risen by 2.24 degrees C between 1940 and 2015.



Source: United States Agency for International Development (USAID), climate risk profile in Mongolia

Figure 1.6.6 Climate Projections and Key Climate Impacts in Mongolia

(3) Present climate change effects

The most updated comprehensive review of the climate change impacts, adaptation and mitigation of Mongolia is available in the third National Communication of Mongolia[15] (NC3) to the United Nations Framework Convention on Climate Change (UNFCCC) by the Climate Change Project Implementing Unit of Environment and Climate Fund, MET. There is also relevant information in the part III sectoral issues of EPRMNG2018. Key findings and bases for the NCDP formulation are summarized below.

Near-surface temperature and its annual mean over Mongolia have increased by 2.24°C during 1940-2015 periods according to 48 meteorological stations, which are evenly distributed in the territory. Warming intensity is higher in a mountainous region and less in the steppe and the Gobi region. Some clear evidences of the climate changes have already been observed (Table 1.6.1). On the contrary, no significant change of annual precipitation has been observed for last 76 years. However, winter snow has increased by 22% since 1940 and by 40% since 1961. Due to the distinct physical and climate patterns among different regions shown above, sensitivities of climate change vary depending on the type of the climate regions.

[15] https://unfccc.int/documents/66255

Table 1.6.1 Climate Extreme Indices Change, 1971-2015

	Indices	Unit	Change value (maximum and minimum)
1	Frost days	Days	-15 (-28 <> -3)
2	Summer days	Days	24 (4 <> 37)
3	Maximum of daily maximum temperature	°C	2.6 (1.0 <> 5.4)
4	Minimum of daily minimum temperature	°C	0.3 (-4.1 <> 3.7)
5	Number of very heavy precipitation	Days	-0.2 (-2 <> 1)
6	Consecutive dry days	Days	-0.1 (-2 <> 2)
7	Consecutive wet days	Days	-22 (-77 <> 19)

Source: Table 3.2 Climate extreme indices change, 1971-2015, NC3 (20)

Droughts and Dzuds are main extreme climate events in Mongolia, which have caused significant socio-economic damages. Due to the extreme climate status of Mongolia at this moment, warming climate has actually brought milder climate and it is expected to continue.

(4) Future climate change projection

The most updated and comprehensive climate change study was conducted by the leading climate change scientist for the Fifth assessment report of Intergovernmental Panel on Climate Change (AR5, IPCC), released in 2013 and 2014. Based on AR5, NC3 assessed future projection of climate change in Mongolia. Due to the complexity of the climate change globally, there are still great uncertainties in the results, but trend of warming and increased intensity of winter precipitation match the observed trend for recent years.

(a) Near future (2016-2035): Temperature change +2.0-2.3 degree C; Annual precipitation change +6-8%

(b) Far future (2016-2035): Temperature change +2.0-2.3 degree C; Annual precipitation change +8-24%

Summaries of current and future climate change impacts are given in Table 7.1 of EPRMNG (2018) and Executive summary (1.4. Climate change impact, vulnerability, and adaptation assessment) of NC3 (2018).

1.6.3 Climate change adaptation

As part of Mongolia's commitments to combating the climate change, the Government of Mongolia prepared the intended national determined contribution (INDC2016) to UNFCCC as the Government's initial plan and submitted to UNFCCC in 2016. Then, the Government submitted the first NDC to UNFCCC in October 2020 as the first official statement for the climate actions. The Government's intended adaptation targets and challenges in 2016 are summarized in Table 1.6.2 and the first adaptation in NDC in 2020 (NDC2020) are given in Table 1.6.3. NDC2016 principally follows the INDC2016, but NDC2020 only state goals and targets in qualitative manners without specific target numbers and relevant financial needs with wider field such as public health and social safeguards.

Table 1.6.2 Adaptation Targets and Needs in Intended Nationally Determined Contribution (2016)

Sector	Adaptation goals	Adaptation targets	Capacity needs	Technology needs	Financial needs (US$ Million)
Animal husbandry and Pastures	To implement sustainable pasture management	Reduce rate of pasture degradation; Regulate headcounts and type of animals, including wild animals, to match with pasture carrying capacities.	To create regulations for pasture use; To set up taxation system for pasture use; To increase community participation in proper use of pasture, their monitoring and conservation.	To build an warning system for drought and clouds to prevent animal loss; To improve livestock quality and breeds; To improve livestock health (epidemic and infectious diseases) management.	46
Arable farming	To increase cropland, reduce soil water loss and decrease soil carbon emissions.	To reduce bare fallow to 30 per cent; to introduce crop rotation system with 3-4 routes and 3-5 crops. To expand irrigation cropland by 2-2.5 times.	To create regulations on soil protection (Soil texture, nutrient and moisture).	To diffuse zero-tillage technology; To increase variety of crop and rotation; To introduce effective drip irrigation technology, reducing water use by 2.5-5 times.	150
Water resources	To maintain the availability of water resources through protection of run-off formation zones and their native ecosystem in river basins.	30 percent of the territory will be protected as national SPAs by 2030 and the sustainable financial mechanism will be introduced.	To implement integrated water resource management systems; To coordinate multi-stakeholder relations through improved legal and policy measures and efficient management; To strengthen human resource capacity to deal with technical issues.	To implement ecosystem-based technologies; To support ecosystem services through hydrological monitoring construction of water diversion canals to drying lakes located in flood plains and re-forestation actions.	5
	To construct reservoirs for glacier meltwater harvesting; To regulate river streams and flow.	To create water reservoirs at river and at outlets of lakes, and to construct multipurpose systems of water usage.	To enhance hydrological monitoring and research for river flow regulation; To construct water reservoirs and water diversion facilities to transfer water resource to dry regions.		1,300
	To introduce water saving and water treatment technologies.	To find solutions for sustainable water supply of Ulaanbaatar City and industries and mining in the Gobi region, and subsequently implement.	To conduct a study and introduce sustainable water supply with closed systems preventing evaporation loss.	To introduce river technologies for water saving, and treatment.	605
Forest resources	To increase the efficiency of reforestation actions.	Forest area will be increased to 9 per cent by 2030 through reforestation activities.	To build the capacity of community forestry groups to conduct modern technologies for forest seedling and tree plantations.	To introduce technology to plant seedlings.	11

	To reduce forest degradation rate.	To reduce forest degradation rate caused by human activities, fires, insects and diseases.	To set up fully equipped stations fighting forest fires and insects outbreaks and capacity-building.	To use aircraft to fight fires; To introduce biological technologies against insects and pests.	13
	To improve the effectiveness of forest management.	Resilient forests that are adapted to climate change, highly productive and have appropriate composition and structure will be created.	To provide equipment and machinery to carry out forest cleaning activities; To train human resources for forest management practices.	To improve the efficiency of forest cleaning technologies.	7
Natural disaster management	To enhance early warning and prevention systems for natural disasters.	To strengthen early warning system for natural disasters.	To establish early detection and prediction system. To conduct disaster risk assessment at the local level.	To improve forecasting quality through increasing supercomputer capacity; To establish Doppler radar network covering the entire territory of the country.	65.4

Source: Intended Nationally Determined Contribution of Mongolia, 2016

Table 1.6.3 Adaptation Plans in the First Nationally Determined Contribution (2020)

Goals	Targets
Animal husbandry and Pasture Increase the productivity of the animal husbandry sector while ensuring the sustainable development of the sector and reducing the impacts and risks associated with climate change.	➢ Maintain the ecosystem balance by strengthening the legal environment and pastureland management; ➢ Sustainable use of pastureland by increasing the forage cultivation and water supply for livestock; ➢ Enhance the disaster prevention system against drought and dzud.
Arable farming Enable the sustainable supply of healthy food for the population, fodder for livestock, raw materials for the light and food industries through the agricultural products, by properly utilizing the positive impacts and reducing the adverse impacts of climate change in the agriculture sector.	➢ Save water for irrigation by using plastic-films/mulches on potato and vegetable fields; ➢ Reduce water use and irrigation costs by applying drip and infusion systems in irrigated potato, vegetable, fruit, and berry productions; ➢ Protect the soil from wind, water erosion and damages, and sustain a high yield by applying straw mulches for non-irrigated crop and forage fields; ➢ Reduce soil moisture loss and damage of mechanical structure soil and reduce direct tillage costs by eliminating mechanical tillage and implementing zero-tillage technologies.
Water resources Increase efficient water use methods, enhance the adaptive capacity of the water sector.	➢ Strengthen the legal and institutional frameworks for integrating sectoral coordination to ensure water security; ➢ Enhance the resilience of the water sector through the utilization of appropriate technologies for conservation, restoration, sustainable use and increase water resources.
Forest resources Create forest ecosystems well adapted to climate change and enhance carbon sink by implementing sustainable forest management.	➢ Implementing forestry measures such as thinning and deadwood removal to improve forest structure and conditions and to create a highly productive and climate change-resilient forest; ➢ Increasing non-carbon and socio-economic benefits of forests by implementing sustainable forest management.
Biodiversity Enable adaptation opportunities and adaptive capacities for vulnerable biodiversity to climate change	➢ Maintain the long-term adaptive opportunities for vulnerable biodiversity to climate change by increasing special protected areas through the better management of protected areas' border and connectivity; ➢ Determine vulnerable dry-land ecosystems and soil organisms to climate change, and identify and evaluate vulnerable functional groups, indicator species, and develop and implement a relevant plan for action; ➢ Implement protection and sustainable management measures for enhancing the recovery capacity of vulnerable and unique ecosystems; implement a pilot research project on climate change in different landscapes covering high mountain, forest, meadow, fresh water, wetland,

Goals	Targets
	peatland, steppe, Gobi Desert, etc.
Natural disaster Build resilience to natural disasters by reducing the risks and adapting to impacts of climate and weather-related hazards and disasters.	➢ Conduct and regularly update risk assessments for natural disasters, and reduce the disaster risks based on the partnership of various stakeholders; ➢ Reduce disaster-related losses and damages by strengthening the capacity of early warning systems for climate, weather-related hazards and disasters, and by enhancing the system for effective and timely dissemination of climate and disaster-related information; ➢ Integrate disaster risk reduction measures into development policy planning, introduce techniques and technologies in disaster risk reduction, and increase investment and financing.
Public health Strengthen healthcare services and capacities for early warning of potential health risks, and provision of proactive and response measures through the comprehensive study of climate change impacts on public health	➢ Assess the risks and impacts of climate change on public health, and conduct research specifically focusing on the risk of spreading tropical diseases and infections from other regions with endemic diseases due to a possible shift of climate zones, while considering the common immune system of Mongolian people; develop plans to reduce potential risks; ➢ Build knowledge and awareness regarding climate change impacts and adverse effects on human health, and empower the general public for adopting protective behaviors; ➢ Strengthen the readiness and capacities of health institutions and organizations to respond to public health risks induced by climate change.
Livelihood and social safeguard Establish a system providing social safeguard, insurance and prevention measures to reduce the vulnerability of social groups and build their resilience to climate change impacts by identifying groups vulnerable to climate change.	➢ Identify social groups vulnerable to climate change and build their resilience to overcome the risks; ➢ Reduce vulnerability by diversifying economic activities, increasing income, expanding income sources and supporting sustainable livelihoods; ➢ Ensure equality for the vulnerable groups and increase employment by providing knowledge and education.

Source: Nationally Determined Contribution (2020)

1.6.4 Climate change mitigation

Similar to the adaptation plan, the Government of Mongolia submitted intended mitigation commitments in INDC2016 and updated in NDC2020. The big challenge for Mongolia due to major change between INDC2016 and NDC is the GHG reduction target in 2030 against no mitigation commitments (BAU: business as usual) scenario. Now, the Government of Mongolia set 22.7% GHG reduction in 2030, which was 14% in INDC2016. The Government's intended mitigation measures and estimated costs in INDC2016, are summarized in Table 1.6.4. Updated mitigation measures and necessary support for those adaptation and mitigation measures in NDC2020 are shown in Table 1.6.5 and Table 1.6.6 respectively.

According to its Nationally Determined Contribution (NDC), by 2030, Mongolia intends to contribute to global efforts to mitigate GHG emissions by implementing the policies and measures described in Table 1.6.4 EPRMNG (2018), in the energy, industry, agriculture and transport sectors, contingent upon the continuation of international support to complement domestic efforts.

Table 1.6.4 Mitigation Measures in Intended Nationally Determined Contribution

Sector	Measure	Specific measures	Investment needs (US$ million)	Policy document
Energy (power and heat)	Increase renewable power capacity from 7.62 per cent in 2014 to 20 per cent by 2020 and to 30 per cent by 2030 as a share of total power generation capacity	Installation of 675 MW capacity large hydropower facilities	1,350	2015 State Energy Sector Policy 2014 Green Development Policy
		Installation of 354 MW wind power facilities	584	
		Installation of 145 MW solar PV power facilities	573	
	Reduce electricity transmission			

	losses from 13.7 per cent in 2014 to 10.8 per cent by 2020 and to 7.8 per cent by 2030			
	Reduce building heat loss by 20 per cent by 2020 and by 40 per cent by 2030, compared with 2014 levels	Improve insulation for existing panel apartment buildings of 18,184 households in Ulaanbaatar	90	
	Reduce internal energy use of CHP plant (improve plant efficiency) from 14.4 per cent in 2014 to 11.2 per cent by 2020 and by 9.4 per cent by 2030	Improve efficiency of coal-fired plants	900	
	Implement advanced technology in energy production such as super critical pressure coal combustion technology by 2030			
Energy (Transport)	Improve national paved road network; upgrade/pave 8,000km by 2016 and 11,000km by 2021			2011 National Action Programme on Climate Change (NAPCC) 2015 Urban Public Transport Investment Programme 2010 National Appropriate Mitigation Action (NAMAs) 2010 Mid-term New Development Programme
	Improve Ulaanbaatar City road network to decrease all traffic by 30-40 per cent by 2023			
	Increase the share of private hybrid road vehicles from approximately 6.5 percent in 2014 to approximately 13per cent by 2030			
	Shift from liquid to LPG for vehicles in Ulaanbaatar and aimag (province) centers by improving taxation and environmental fee system			
	Improve enforcement mechanism of standards for road vehicles and non-road based transport			
Industry	Reduce emissions in the cement industry through upgrading the processing technology from wet to dry processing and through the construction of a new cement plant with dry processing up to 2030			2010 NAMAs 2011 NAPCC Building Materials Programme (2012 Government Resolution No.171)
Agriculture	Maintain livestock population at appropriate levels according to the pasture carrying capacity			2010 National Mongolian Livestock Programme

Source: Intended Nationally Determined Contribution of Mongolia, 2016 and EPRMNG

Table 1.6.5 Mitigation Actions and Measures in the 1st Nationally Determined Contribution (2020)

Actions	GHG emission reduction (Gg t CO_2-equivalent)
GHG reduction grand total in 2030 against no mitigation measures (BAU)	**16,888.1**
1. Energy sector total	**11,264.6**
1.1 Energy sector (production) **Use of renewable energy sources:** - Hydro Power Plants - Wind Power Plants - Solar Power Plants	8,340.5

Actions	GHG emission reduction (Gg t CO_2-equivalent)
- Heat pumps for heating utilities **Improved efficiency of energy production:** - Reduce electricity and heat transmission and distribution grid losses - Reduce the internal use of combined heat and power plants (CHPP) - Improve the efficiency of power plants - Improve the heat supply in cities and towns (improving the efficiency of heat only boilers)	
1.2 Energy sector (consumption) **Transportation:** - Switch to Euro-5 standard fuel - Switch the coal export transportation to rail transport from auto transportation - Switch the heating of passenger train to electric heating	1,048.8
Construction: - Insulate old precast panel buildings in Ulaanbaatar city - Limit the use of raw coal in Ulaanbaatar city and switch to the use of improved fuel	830.1
Industry: - Energy saving measures	1,045.2
2. Non energy sector total	**5,623.5**
Agriculture: - Regulate and reduce the livestock number - Improve the livestock manure management	5,283.3
Waste: - Reduce the waste volume for landfill through the improved waste treatment and recycling process - Increase the share of the population with access to improved sanitation and hygiene facilities	106.1

Source: Nationally Determined Contribution (2020)

Table 1.6.6 Need for Support in the 1st Nationally Determined Contribution (2020)

Financial Support	The financial needs for the NDC implementation are estimated initially as US$11.5 billion, of which US$6.3 billion for mitigation, and US$5.2 billion for adaptation.
Technology Transfer	In order to solve problems, the focus has to be made on soft approaches rather than solely relying on hard ones, including indigenous knowledge of local communities, combining traditional practices with modern know-hows. For determining the most suitable, efficient, and effective technologies, Mongolia needs to conduct the technology needs assessment.
Capacity Building and Knowledge Sharing	Building capacities to disseminate and transfer scientific information and knowledge and educating the public and various stakeholders on climate change, its impacts, as well as potential mitigation and adaptation measures are an essential precondition for the successful implementation of Mongolia's NDC.

Source: Nationally Determined Contribution (2020)

1.7 Application of Strategic Environmental Assessment to NCDP

1.7.1 Rationale for SEA

SEA is applied at higher levels of any development intervention such as policy and program levels as against project-wise environmental assessment such as IEE and EIA. Naturally, SEA is applied from an early stage of development interventions typically for policy formulation and master planning.

SEA assesses a wider range of possible impact both temporally and spatially, while project wise environmental assessment looks mainly at marginal effects. That is, SEA assesses long-term effects as well as short- and medium-term effects, and effects on a larger geographic area. SEA is applied also to a wider scope of works, covering all different sectors and aspects that may be affected by any development intervention. SEA assesses also cumulative and complex effects.

In sum, SEA represents effectively planning for environmental development, where environment is taken in the broadest sense. This is in sharp contrast with other economy-oriented developments, where environmental and social concerns are put on the side lines at best. SEA, on the other hand, puts environmental and social concerns on the front of development.

To satisfy all these conditions effectively, SEA is conducted by involving a wide range of stakeholders from an early stage of any development intervention. This is realized effectively through (1) stakeholders' meetings and (2) disclosure and sharing of relevant information.

1.7.2 Application to NCDP

As the NCDP is a long-term development plan, application of SEA in its preparation is imperative. Legal requirements for SEA have been established in Mongolia by a series of laws and regulations stipulated by the Ministry of MET: Law on Environmental Impact Assessment (2012), MET Regulation on SEA (2013), MET Regulation on Public Consultation (2014) and MET Methodology of SEA (2014). For any formal development policies and plans, it is mandatory that designated legally qualified entities carry out SEA. Results of SEA applied to the NCDP are presented in Chapter 9 of the Main Report.

The NCDP is to be prepared by the JICA Project to support the preparation of the HSP by MCUD and the RDP by NDA respectively as formal policy documents. The NCDP itself, however, is not a formal policy document, and its legal base for SEA application appears to be weak. On the other hand, SEA is to be conducted for the NCDP in principle according to the JICA Guidelines for Environmental and Social Considerations (2010) as stipulated in the R/D of the JICA Project agreed between representatives of the Mongolian Government and JICA.

Mongolian legal requirements for HSP/RDP's SEA as per the Law on EIA (2012) and the JICA Guidelines for Environmental and Social Considerations (2010) are similar in the following aspects:

(a) Applicable for Policy, Plan and Program (PPP) during their development stages

(b) Involvement of stakeholders to address relevant stakeholders' concerns/priorities and improve the draft PPP contents

(c) Overall flow and key area of impact assessment

(d) Overall contents of SEA

Differences between the SEA requirements of the Mongolian law and the JICA guidelines are summarized in Table 1.7.1.

Table 1.7.1 Comparison between JICA Guidelines and Mongolian Law for SEA

JICA Guidelines / R/D / JPT ICR	Law on Environmental Impact Assessment (2012)
1) Not a legal process	1) Legal process approved by MET only
2) Applicable for both legal and none legal documents NCDP: Applicable but no legal status as per relevant laws in Mongolia	2) Only applicable for legal policy, plan or program NCDP: Not applicable due to no legal status HSP/RDP: applicable as per relevant laws in Mongolia
3) SEA conducted by MUCD/NDA/JICA Project Team officers/experts in charge	3) SEA conducted by an authorized EIA consultant by MET with support of relevant technical experts and institutions => Costly to hire an authorized EIA consultant
4) Flexible methodologies and defined by MUCD/NDA/JICA Project Team officers/experts in charge	4) Draft methodologies prepared by the authorized EIA consultant only Final methodologies approved by MET only
5) Applying SEA for i) scenario planning (only development concept) and ii) primary programme/project selection	5) Whole policy, plan or program

Source: Law on Environmental Impact Assessment, JICA Project Team

Based on the discussions with the Mongolian counterpart (C/P) Team, the JICA Project Team (JPT) has decided to conduct SEA as planned according to the R/D. Once MCUD and NDA decide to engage legally qualified entities for the HSP and the RDP respectively, they can benefit from the SEA carried for the NCDP.

While the methodology of the SEA specified by MET (2014) requires analyses almost as detailed as project level environmental impact assessment, the methodology of the SEA as per the JICA Guidelines does not specify detailed analyses as shown in Box 1.1. Thus, specific methodology of the SEA for the NCDP shall be defined by the proponent (NDA, MCUD and the JPT). As per the definition of the JICA Guidelines, IEE-level environmental and social consideration studies will be conducted based on easily available information including existing data and simple field surveys.

BOX 1.1 Description of the SEA by the JICA Guidelines (2010)

3. Procedures of Environmental and Social Considerations
3.4.3. Full-scale Study Stage (Master Plan Study)

2. JICA collects relevant information and conducts field surveys covering a wider area than that of the detailed plan preparatory study stage, holds consultations with project proponents etc., and prepares scoping drafts.

3. For Category A studies, after the disclosure of the scoping drafts, project proponents etc. conduct consultations with local stakeholders based on stakeholder analyses. JICA incorporates the results of such consultations into its TOR. The consultations cover the needs of projects and the analysis of alternatives. For Category B studies, project proponents etc. consult with local stakeholders after the disclosure of scoping drafts when necessary.

4. TOR includes understanding of needs, impacts to be assessed, study methods, analysis of alternatives, a schedule, and other items. JICA applies a SEA to such studies.

5. In accordance with TOR and in collaboration with project proponents etc., JICA conducts IEE-level environmental and social considerations studies, and analyzes alternatives, including "without project" situations. During studies, JICA incorporates its results into related reports prepared accordingly.

6. For Category A studies, when preparing a rough outline of environmental and social considerations, a series of stakeholder consultations are conducted after information disclosure when necessary. JICA incorporates the results of such consultations into such studies.

7. Based on the aforementioned procedure, JICA prepares draft reports incorporating the results of environmental and social considerations studies, explains them to project proponents etc., and obtains their comments. For Category A studies, draft reports are disclosed and consultations with local stakeholders are conducted. JICA incorporates the results of such consultations in its final reports. For Category B studies, consultations with local stakeholders after the disclosure of draft final reports are conducted when necessary.

8. JICA prepares final reports incorporating the study results and submits them to project proponents etc. after confirming that the reports meet the requirements of the guidelines.

Definition of IEE level study by JICA Guidelines

An "Initial Environmental Examination (IEE) level study" is a study that includes an analysis of alternative plans, a prediction and assessment of environmental impacts, and a preparation of mitigation measures and monitoring plans based on easily available information including existing data and simple field surveys.

Considering uncertainties involved in the IEE level evaluation with indicators required due to the areal and temporal coverage and scope of works of NCDP, there are limitations in using quantitative or precise values for the policy, PPP stage evaluation. On the contrary, it is very important to maintain the accountability of decision making to avoid interventions by personal or unjustifiable political interests.

In addition, as a common communication tool among a wide range of stakeholders, indicators for the NCDP SEA should be easily understood by the concerned stakeholders. In short, widely recognized indicators are preferable for the SEA at this stage. Among many environmental and social indicators, indicators of the SDGs serve for most recognized and common tool to evaluate the impact not only in Mongolia but also throughout the world.

The scoring methodologies of each indicator are made available on the United Nation (UN) SDGs website[16] and availability of the indicators in Mongolia is shown in the SDGs monitoring site[17] by the National Statistic Office. Based on the most updated SDGs monitoring report[18] by NDA in 2019, Mongolia has methodologies and information sources for 118 indicators out of 244 indicators under 169 targets and 17 goals.

While the scores of the SDGs indicators are calculated based on factual or monitored data, it is not possible for PPP level future projections to be "quantitative" at this stage. However, "relative evaluation" among NCDP alternatives could be possible based on prospects of achieving targets by the NCDP alternatives with simplified indices as follow:

Sore	Expected influence
+/- 2	positive (+) or negative (-) significant changes
+/- 1	+/- changes
0	No change or negligible changes

In order to simplify the comparative analysis among NCDP alternatives, following indicators are proposed based on combinations of SDGs goals.

Indicator	Combination of SDGs Goals
SDPR (Social development and poverty reduction)	Goal 1. End poverty in all its forms everywhere Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture Goal 10. Reduce inequality within and among countries Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
HEG (Health, education and gender)	Goal 3. Ensure healthy lives and promote well-being for all at all ages Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all Goal 5. Achieve gender equality and empower all women and girls
SRM (Sustainable resource management)	Goal 6. Ensure availability and sustainable management of water and sanitation for all Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all Goal 12. Ensure sustainable consumption and production pattern
EG (Economic growth)	Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation Goal 17. Strengthen the means of implementation and revitalize the global partnership for sustainable development
ECC (Environment and climate change)	Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable Goal 13. Take urgent action to combat climate change and its impacts Goal 15. Protect, restore and promote sustainable use of terrestrial

[16] https://unstats.un.org/sdgs/metadata
[17] http://sdg.1212.mn/EN/Home/Availability
[18] Mongolia Voluntary National Review Report 2019, NDA (2019) < https://sustainabledevelopment.un.org/index.php?page=view&type=30022&nr=1217&menu=3170>

	ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Source: JICA Project Team

Comparative analysis among development alternatives should be conducted after defining the agreeable comparative indicators by relevant government organizations and stakeholders. Complete results of the SEA conducted for the NCDP are contained in Chapter 9 of the Main Report.

1.8 Development Objectives and Strategy for Natural Environment

1.8.1 Development objectives of environmental management

Five major environmental problems are enumerated by the problem structure analysis at macro level reported in sub-section 6.2.1:

(a) Unsustainable mining development and its improper waste management,
(b) Over-concentration of population and economic activities in Ulaanbaatar,
(c) Degradation of grazing areas due to over-use,
(d) Serious urban environmental problems due to air pollution, soil contamination, traffic congestion and others in Ulaanbaatar, and
(e) Desertification threat of vulnerable land.

The problem structure analysis also identified inherent problems that Mongolia faces: vast national land territory, extremely harsh winter climate, maldistribution of limited water resources, and land locked status. Climate change is another environmental challenge that Mongolia faces. Sector analysis of environment discusses also additional issues such as soil contamination, solid waste management, protected areas, biodiversity and forest management.

Given these existing conditions and issues, the objectives of environmental management for national comprehensive development of Mongolia are defined as follows:

(a) To maintain and enhance quality of natural environment as most important capital to be used continually for sustainable and inclusive development in line with alternative socio-economy;
(b) To establish ownership for indigenous resources endowed in regions and the Country by raising awareness of people and strengthening institutions for environmental management; and
(c) To realize pleasant and comfortable living environment for residents in urban and rural areas throughout the Country.

1.8.2 Development strategy for environmental management

To realize the objectives of environmental management, the strategy for environmental management is established with the following components:

(a) Enhancement of quality of natural environment by:
- ✓ Proper management of pastureland,
- ✓ Protection of forest areas, watershed areas and other vulnerable areas,
- ✓ Proper land use planning and implementation for mining, infrastructure and settlement, and

- ✓ Promotion of responsible mining and environment-friendly economic activities such as zero-waste processing.

(b) Establishment of ownership for indigenous resources by:

- ✓ Raising awareness of people for environmental resources, and
- ✓ Establishing locally based environmental monitoring system involving local people and administrations.

(c) Realization of pleasant and comfortable living environment in urban and rural areas by:

- ✓ Proper planning for cities and rural settlements,
- ✓ Provision of basic life infrastructure for water supply, sewerage, energy and waste management and disposal, and
- ✓ Generation of decent employment opportunities based on use of indigenous resources.

(1) Objectives and strategy for climate change adaptation

As mentioned above, climate change is another serious environmental challenge that Mongolia faces. Most visible effects are higher temperature and increase in winter snow as reported in this chapter 3.7. Higher temperature may have some positive effects in the cold country of Mongolia. While winter snow increases, no significant changes in annual precipitation are observed. This implies that precipitation during summer has decreased, resulting in higher risk for droughts. More serious is increased risk for Dzud. With smaller precipitation during summer, pastureland is exposed to higher stress reducing carrying capacity for animals. This makes animals more vulnerable to cold weather during winter.

In addition, due to the warming trend of air and surface water temperatures, glacier retreat and shrinkage have intensified after 1990th and most intensive ablation occurred in last 10 years (Davaa G, 2015). As a result, down stream flow of glaciers during spring to fall seasons and their ice thickness in winter seasons have temporally increased for recent years. On the contrary, water levels of the other rivers and lakes without influences of the glaciers have either gone dry or become lower year by year. The third national communication of Mongolia for United Nations Framework Convention on Climate Change (UNFCCC) found that "Increasing trend of evaporation predicts entirely dry conditions for Mongolia and water resource is expected to be one of crucial challenges for Mongolia."

Given these situations, the following objectives are defined for adaptation to climate change:

(a) To take comprehensive measures for climate change adaption as proposed by the Environmental Performance Review of Mongolia (EPRMNG) by United Nations in November 2018, and

(b) To strengthen monitoring and early warning system for Dzud and droughts by regular communications between local administrations and people in remote rural areas including nomads.

Specific goals, targets and needs proposed by EPRMNG are summarized in Table 1.9.5. Strategy for climate change adaptation should emphasize the following aspects:

- Improvement of pasture management including designation of controlled grazing areas,
- Adoption of better farming techniques such as zero-tillage farming,
- Proper water resources development and management to meet specific needs in different regions,
- Protection and expansion of forest areas to enhance water and vegetation retention capacity, and
- Establishment of effective communications system based on ICT application between local administrations supported by the Central Government for database and people in remote rural areas including nomads.

1.9 Recommended Measures for Natural Environment

1.9.1 Directions for management of natural environment

The recent and still ongoing COVID-19 pandemic has made the mankind realize vulnerability of the civilization. Probably for the first time in the modern history, human health concerns have surpassed the economic development concerns. This is natural as any development presupposes generally healthy human beings and the pursuit of economic development does not automatically guarantee human health ensured for all. That is, the renewed recognition or insight obtained by the COVID-19 pandemic as a turning point is NOT just economic development per se but rather what kind of development should be pursues and how.

This recognition, however, is actually not original. It is exactly the recognition behind the sustainable development goals (SDGs) initiative. The SDGs call for a shift in development paradigm away from what is called the 20th century development model characterized by intensive (abusive) resource use and economic efficiency orientation as discussed repeatedly in preparing the NCDP. The recognition, however, remains just an idea, but not action until something unusual happens like the COVID-19. Before the initial recognition of the pandemic in February-March 2020, it was hardly possible to imagine that something could "suddenly" change the human behavior from infinitely economic growth oriented one.

There are similarities between the COVID-19 and climate change in terms of silent incubation period and drastic and harsh changes after the tipping point, known as "no return point" for climate change issues. The Paris agreement and SDGs represent commitments by the present generations to present and future generations to sustain the civilization and hopefully ensure the survival of human beings. The commitments demand significant and fundamental changes in human behaviours. The climate change issues have not been successful in changing the economic growth first behaviours due to disagreements between those who have enjoyed the 20th century development and those who have started to enjoy fossil fuel resources dependent growth.

Concerted efforts by all the nations are necessary to deal with climate change just as to overcome the COVID-19, but most countries and people still tend to give higher priority to "present" economic growth and immediate satisfaction rather than taking drastic actions before crossing the "no return point" to avoid catastrophic events. Pursuing an alternative socioeconomy paradigm as advocated by the NCDP represents Mongolia's smart choices based on Mongolia's comparative advantages and unique position in the world.

1.9.2 Conditions for environmental sustainability

(1) Limiting factors

In order to ensure sustainability of the Mongolian civilization, the essential limiting factors are focused for examining development activities to be undertaken. Water in general constitutes the most essential limiting factors for development of any civilization. Particularly in Mongolia, maldistribution of renewable water resources defines its fragile natural environment and dictates the range of possible development options. Details of the universal limiting factors defined by water resources and management strategies are discussed in the water resources sector, but such limiting factors are discussed here related to environmental sustainability. In particular, such limiting factors should be commonly considered in different sectors in pursuing the Mongolian alternative socioeconomy paradigm. Conflicts over, and competition for the water resources among different sectors by their respective promising wish lists will result in unsustainable development if not depletion of the limited resources.

The Government of Mongolia completed the "Integrated Water Management Plan (IWMP)" in 2013. Implementation of IWMP shall be carefully monitored and any long-term policy, plan and program shall strictly follow IWMP, in particular the given quota for the target sectors. In order to fulfill the development needs, regular quota arrangements among different sectors and periodical updates to balance conventional and new needs by the top decision makers shall be ensured.

(2) Resources availability

Despite having fragile environmental set up, Mongolia has some comparative advantages against other nations and such advantages shall be utilized in sustainable manners. Based on the observed facts, three different kinds of resources are noted with the viewpoint of sustainability as summarized in Table 1.9.1. Use conditions for each kind of resources are described below.

Table 1.9.1 Available Resources for the Mongolian Alternative Socioeconomy Paradigm

Nature	Availability	Resources	Use conditions
Finite availability	- Stable and preserved - Disproportionate but high concentration	- Coal, crude oil, natural gas	- Coal/oil: increasing risk for FDI and investors due to the mandatory trend of responsible investment principles and least finance from major financial institutes - Vulnerable and only controlled by international energy market - Shared and responsible properties with future generations of Mongolia - Primary economic engine of the Mongolian economic development for a while - Necessity of balanced exploitation among economic needs for both industry and artisan and preservation of ecosystems
Limited availability & renewable	- Stable and reservable - Disproportionate and low concentration	- Water, land, nomad culture	- Difficulties to achieve consensus among stakeholders, particularly between conventional and new interested parties - Necessity of long-term management plans and strict implementation to maintain the sustainability and competitiveness or advantages of the target resources - Necessity of behavioral changes and redistribution of the available resources for the alternative paradigm
Vast availability & renewable	- Unstable and non-reservable - Disproportionate and low concentration	- Solar energy, wind energy, geothermal energy	- Recognized as one of the most competitive areas for renewable energy generation and market access - Appropriate capacity as local energy - Limitations of linking to national grid systems for domestic consumption and international markets - Importance to ensure mutually beneficial partnership with international technical providers, investors and financiers - New challenges to balance between conventional land use and renewable land use - Difficulties to ensure environmental and social sustainability/safeguards without proper planning and due diligence due to significant land requirements

Source; JICA Project Team

(3) Responsible use of finite resources

It is important to take advantages of coal and other mineral resources to transform Mongolian economic paradigms from 20th century model to the alternative socioeconomy model in sustainable and responsible manners. Smart use of such mineral resources is discussed in mining and industrial sectors.

Proposed approaches for the known issues are summarized in Table 1.9.2.

Table 1.9.2 Recommended Approaches to Finite Resource Usage

Known issues	Recommended approaches
- Coal/oil: increasing risk for FDI and investors due to the mandatory trend of responsible investment principles and least finance from major financial institutes	- Follow the national master plan and acuminate the financial and technical capitals. - Gradually shift financial dependency from foreign investors to national entities to ensure the necessary development and exploitation for the domestic use and national income generation.
- Vulnerable and only controlled by international energy market	- Process resources and add values of the mineral resources before export.
- Shared and responsible properties with future generations of Mongolia	- Gradually shift financial dependency from foreign investors to national entities to ensure the necessary development and exploitation for the domestic use and national income generation.
- Necessity of balanced exploitation among economic needs for both industry and artisan and preservation of ecosystems	- Follow the national land management plan to avoid catastrophic destruction of ecosystems and limited artisanal livelihood. - Carefully monitor the secured budget for restoration and ensure not only the budgetary but also technically appropriate restoration measures after the mining activities. - Take advantages of the national income from mineral resources for Mongolian transformation toward the alternative socioeconomy paradigms.

Source; JICA Project Team

(4) Responsible use of limited and renewable resources

Smart use of renewable resources in competitive and sustainable manners would be the key to realize the recommended alternative socioeconomy paradigms. In order to depart from the unsustainable exploitation, proposed approaches for the known issues are summarized in Table 1.9.3.

Table 1.9.3 Recommended Approaches to Limited Renewable Resource Usage

Known issues	Recommended approaches
- Difficulties to achieve consensus among stakeholders, particularly between conventional and new interested parties - Necessity of long-term management plans and strict implementation to maintain the sustainability and competitiveness/advantages of the target resources	- There would be no short cut. Take time to involve concerned parties and define priorities in line with SDV2030 and LTDP2050. - Achieve consensus and distribute responsibilities among concerned parties to clarify the ownership of the resource management and monitor each other. - Involve and improve outreach and monitoring activities of SDGs, SDV2030, LTDP2050 and other national policies for inclusive planning and participation of the implementation.
- Necessity of behavioral changes and redistribution of the available resources for the alternative paradigm	- There would be no short cut. Involve concerned parties to ensure the ownership of the management plans and responsible behavioral changes. - Promote necessity and benefits of the alternative paradigm. - Share the benefits of the limited renewable resources.

Source; JICA Project Team

(5) Responsible use of vast available renewable resources

Mongolia has been known as one of the most preferable destinations for renewable energy projects due to its unique geographic and climate set up. There have been active efforts to take advantage of such renewable energy resources from policy levels to actual project levels, and yet there would be further attentions and coordination needed due to relatively new technological challenges for the alternative paradigms. Proposed approaches for the known issues are summarized in Table 1.9.4.

Table 1.9.4 Recommended Approaches to Vast Available Renewable Resource Usage

Known issues	Recommended approaches
- Limitations of linking to national grid systems for domestic consumption and international markets	- Coordinate with international donors to finance national and international grids for the realization of the east Asian energy partnership for SDGs and transition of low carbon dependent civilization. - Pay more attentions to the issues of the international energy trading and extend further collaboration with neighboring countries to accommodate energy export from Mongolia. - Clarify the roles of the public and the private sectors for renewable energy development, in particular low risk power generation and non-profitable grid system development. - National: Develop smart grid systems to accumulate unstable renewable energy generation with conventional thermal power plants and energy storage systems (dams, battery, etc.). - International: Implement high voltage and high efficiency transmissions between Russia and China throughout Mongolia, possibly extended to South Korea and Japan, known as the Asia super grid.
- Importance to ensure balanced partnership with international technical providers, investors and financial institutes	- Ensure ownership of the renewable energy projects and placement of Mongolian skill and unskilled labors from the initial stages for further development of the renewable energy sectors in Mongolia and technology and skilled labor export in the future. - Avoid imbalanced conditions of contracts for renewable energy development due to the availability of the necessary technologies (interictally protected and owned by foreign companies and/or investors) as same practices as mineral exploitation. - Take advantages of past and existing donner programs related to the renewable energy, SDGs, and/or ESG and promote green investment opportunities through their network to attract reliable sources of finance.
- Land use competition - Assurance of environmental and social sustainability or safeguards	- Explore co-benefit/multi-layer use between renewable energy projects and existing/conventional land use to avoid unnecessary competition. - Adapt the international sustainable/safeguard standards to ensure the sustainable use of limited land and ownership of the Mongolian territory.

Source; JICA Project Team

1.9.3 Inter-sector programs for environmental management

In consideration of the essential limiting factors and available advantages mentioned above, possible sector programs are discussed in line with the environmental objectives and strategies presented in Section 1.6. Based on the problem structure analysis for the NCDP presented sub section 3.3 in the Main Report, following five challenges are identified:

(a) Environmental problems associated with mining development,

(b) Over-concentration of population and economic activities in Ulaanbaatar,

(c) Degradation of grazing areas,

(d) Serious urban environmental problems in Ulaanbaatar, and

(e) Desertification threat of vulnerable land.

Also, based on the latest comprehensive assessment report, the 3rd national communication for UNFCC by MET in 2018, there would be higher risks for livestock animals due to longer droughts and extreme cold weather. In order to address to these identified issues, more specific objectives and strategies along with possible sector programs are shown in Table 1.9.5.

Table 1.9.5 Possible Inter-sector Programs for Environmental Management

Objectives of environmental management	Strategy	Possible intersectoral programs
1) To maintain and enhance quality of natural environment as most important capital to be used continually for sustainable and inclusive development in line with alternative socio-economy	- Enhancement of quality of natural environment by: - Proper management of pastureland, - Protection of forest areas, watershed areas and other vulnerable areas, - Proper land use planning and implementation for mining, infrastructure and settlement, and - Promotion of responsible mining and environment-friendly economic activities such as zero-waste processing.	- Responsible mining and circulation of national incomes for other sectoral development and social welfare needs - Planned/controlled nomadic farming with ICT - High quality stock raising with intensive livestock farming - Agroforestry - Multipurpose dams for hydro power and water supply - Wind and solar power project with the national smart grid development and high voltage international grid system development
2) To establish ownership for indigenous resources endowed in regions and the Country by raising awareness of people and strengthening institutions for environmental management	- Establishment of ownership for indigenous resources by: - Raising awareness of people for environmental resources, and - Establishing locally based environmental monitoring system involving local people and administrations	- Protected forest management for conservation and rural employment - Community forest and agroforestry for involvement of rural communities and transformation of uncontrolled artisanal practices to sustainable artisanal practices
3) To realize pleasant and comfortable living environment for residents in urban and rural areas throughout the Country.	- Realization of pleasant and comfortable living environment in urban and rural areas by: - Proper planning for cities and rural settlements, - Provision of basic life infrastructure for water supply, sewerage, energy and waste management and disposal, and	- Clean air projects for UB city such as cleaner fuel switching (coal and transport fuels), introduction of EVs

		- Generation of decent employment opportunities based on use of indigenous resources.	- Continuous forest programs throughout the lifecycle of the forest management (protected, community, agroforestry) for decent and continuous employment opportunities in rural communities
4)	To take comprehensive measures for climate change adaption as proposed by the Environmental Performance Review of Mongolia (EPRMNG) by United Nations in November 2018	- Improvement of pasture management including designation of controlled grazing areas, - Adoption of better farming techniques such as zero-tillage farming, - Proper water resources development and management to meet specific needs in different regions, - Protection and expansion of forest areas to enhance water and vegetation retention capacity	- Planned/controlled nomadic farming with ICT - High quality stock raising with intensive livestock farming - Responsible mining and circulation of national incomes for other sectoral development and social welfare needs - Multipurpose dams for hydro power and water supply - Protected forest management for conservation and rural employment
5)	To strengthen monitoring and early warning system for Dzud and droughts by regular communications between local administrations and people in remote rural areas including nomads	- Establishment of effective communications system between local administrations supported by the Central Government for database and people in remote rural areas including nomads - Environmental problems associated with mining development - Over-concentration of population and economic activities in Ulaanbaatar - Degradation of grazing areas - Serious urban environmental problems in Ulaanbaatar - Desertification threat of vulnerable land	- Planned/controlled nomadic farming with ICT - Community forest and agroforestry for involvement of rural communities and transformation of uncontrolled artisanal practices to sustainable artisanal practices - Responsible mining and circulation of national incomes for other sectoral development and social welfare needs

Source; JICA Project Team

1.9.4 Formulation of inter-sector programs

Various measures proposed in different sectors should better be packaged into inter-sector programs for effective and more substantive contributions to SDGs and SDV2030. Such programs should coordinate planned or ongoing initiatives by donors to realize complementary results by synergy effects with generation of employment opportunities for decent works as shown in Table 1.9.6 for two examples: agroforestry program and renewable energy program. Other programs should also be formulated.

Table 1.9.6 Selected Intersectoral Programs with Emphases on Partnership and Employments

Characteristics	Agroforestry Cluster	Renewable energy power with smart grid and international grid
Notable programs	- UNDP REDD+19 - Green Belt Afforestation program (2005-2035) - ALAMGaC the land management policy (2019) (the most updated and comprehensive land management plan) - MET National Forest Inventory (2016)	- Clean Energy Asia LLC20 (Newcom Group & Softbank Energy Japan) Tsetsuii 50MW wind firm (JICA loan) - Japan/Mongolia/Russia/China/South Korea Asia Super Grid Initiatives21 - ADB T/A Strategy for Northeast Asia Power System Interconnection22
Potential employment opportunities	- Steady skilled and unskilled labour opportunities around agroforest sites (rural communities) - Varied direct and indirect employment opportunities primary in rural area - Matured industry yet competitive industry against others with introduction of recent technologies	- Steady skilled and unskilled labour opportunities in UB, regional centres and around energy firms (southern rural communities) - More employment opportunities than conventional fossil fuel energy sectors23 - Fast growing and cutting-edge hardware and ICT technologies as well as fintech
Possible synergy	- Agroforestry cluster development - Mechanical maintenance services for forest machineries - Other commercial services in base camp villages	- Wind and PV power cluster development - Smart energy cluster (smart grid, power storage, energy efficiency, energy trading, etc.) development - EV Bus commercial operation (currently test drive24 with Yinlong EV buses (Chinese major supplier) - Mega-solar (PV) and wind farm integration
Possible contribution by Japanese parties	- Transfer of Japanese institutional system development for agroforestry sector development - Technical cooperation for capacity development in private sectors	- Participation of projects as a supplier or system integrator of the smart grid systems - Investment and/or finance

Source; JICA Project Team

19 http://reddplus.mn/eng/
20 http://www.newcom.mn/en/company/55
21 https://www.unescap.org/sites/default/files/Session%201-2.%20KEPCO.pdf, https://www.unescap.org/sites/default/files/Session%201-3.%20Renewable%20Energy%20Institute.pdf, https://www.unescap.org/sites/default/files/Session%201-4.%20GEIDCO.pdf, https://www.unescap.org/sites/default/files/Session%203-3.%20Ministry%20of%20Foreign%20Affairs%2C%20Mongolia.pdf
22 https://www.adb.org/projects/48030-001/main
23 https://www.irena.org/publications/2019/Jun/Renewable-Energy-and-Jobs-Annual-Review-2019
24 https://news.mn/en/790857/

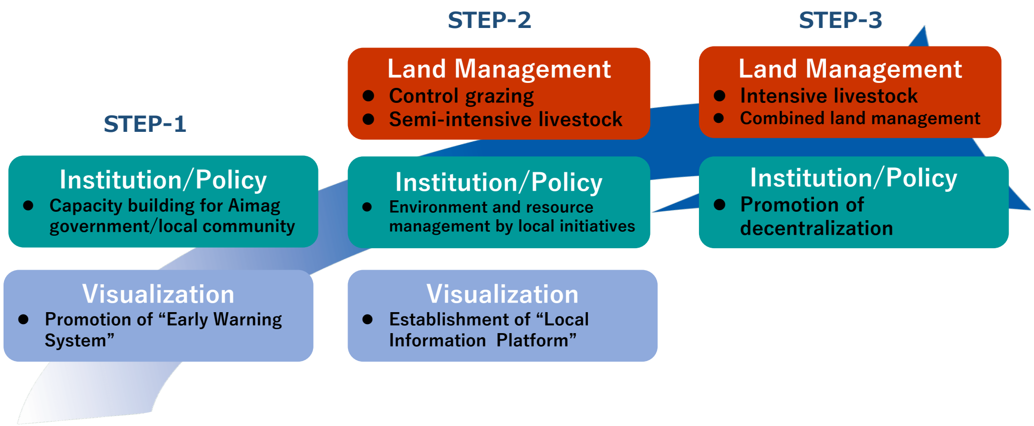
1.9.5 Proposed measures for natural disaster management

(1) Dzud risk management

1) Promotion of visualization

In order to mitigate the Dzud risks by taking appropriate measures, visualization is a key for effective information delivery and implementation of several measures expected. The Mongolian Government has already established an "Early Warning System" (EWS) with a new Dzud risk map prepared under the grant aid support from Japan. This system aims to strengthen Mongolia's capacity for proactive Dzud management and disaster reduction through effective early preparedness as well. Based on the early warnings by the system, the Government and decision-making organizations can take actions promptly to make nationwide preparations. The Government has allocated funds for winter preparedness covering distribution of hay/fodder to risky areas, coordination of herders' movements to available pastures and improvement of social services to herders on the move.

The next step for the promotion of the visualization would be an establishment of a "Local Information Platform" (LIP). NDA has already commenced the early preparation for this initiative supported by JPT. This platform is to provide information to local people living in rural areas on a sustainable basis to enable the communication and information exchange within their local communities as well as among the local businesses, local governments and government agencies. This platform can handle the communication issues between public organizations such as weather forecast agency and nomads, and supplement the EWS through directly exchanging information regarding early signs of Dzud, drought and other disaster phenomena.



Source: JICA Project Team

Figure 1.9.1 Step by Step Approach for Dzud Risk Management

2) Institutional measure and policy

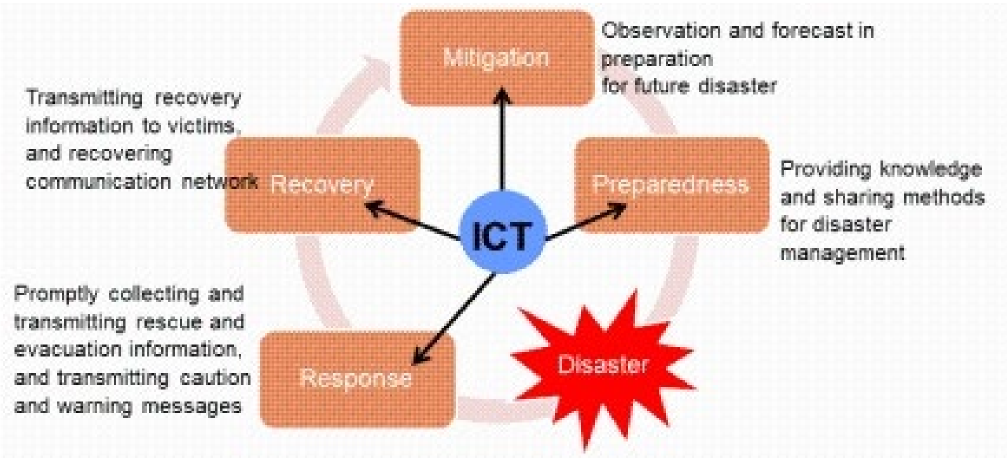
The NCDP has emphasized the importance of Aimag government and local community initiatives on environmental and resource management. During the first phase (up to 2025) defined by the NCDP, local government capacity should be enhanced steadily, and in the second phase (for 2026-30) environmental monitoring by local administrations will be strengthened by involvement of local people with enhanced awareness. In line with these scenarios, capacity building for local governments shall be achieved as a first step, followed by community capacity. As a next step, environment and resource management by local initiatives would be promoted for the purpose of the preventive management of pasture, hay/fodder and surrounding environment. In order to achieve these goals, institutional framework should be established in line with the EWS. Among the issues to be clarified are who can organize the entire system, how the prioritization of several measures should be determined, and where main and related facilities should be located.

3) Land management

Proper land management planning is vitally important for the risk management in the view of disaster prevention. The NCDP has prepared an indicative land use plan considering disaster risk management, conservation of forest areas, controlled use of vast pasture, enhancement of agricultural activities and other factors. The indicative land use plan covering the entire territory of Mongolia may be used to guide broad policy making or to set overall direction for land management rather than determining specific land use reflecting local conditions.

(2) Utilization of ICT

Mongolia has strong advantage of ICT adopted in terms of high penetration rate of mobile phones and Internet service throughout the Country. In order to mitigate serious damages to livestock and agriculture by Dzud or drought, it is effective to introduce the system that farmers and herders are able to receive quality information contributing to prompt and effective actions when disaster happens. As an example, Figure 1.9.1 shows the effort by the Japanese government for disaster reduction utilizing ICT.



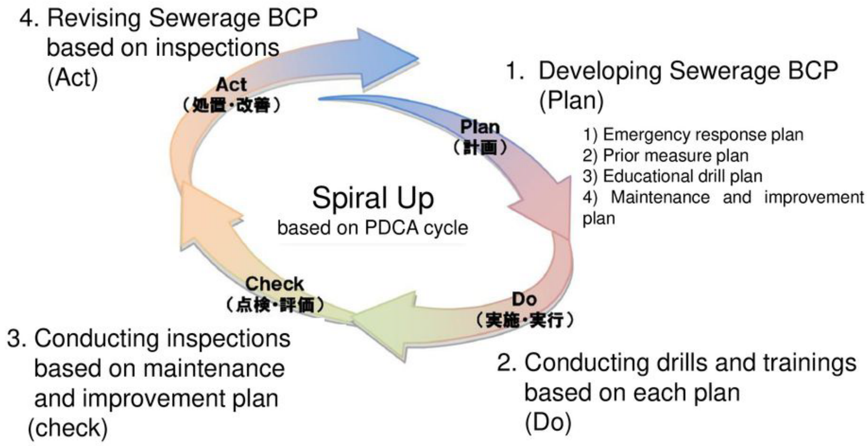
Source: Homepage of Ministry of Internal Affairs and Communications, Japan

Figure 1.9.1 Role of ICT for Disaster Reduction Activities in Japan

Considering the current situation of COVID-19 or influence of climate change, remote work (working from home) could be so effective in not only urban areas but also rural areas by utilizing ICT, especially for the people who have a difficulty to commute to cities, living in remote areas.

(3) Business continuity plan

Preparing a business continuity plan (BCP), which can minimize loss and restore normal operations as quickly as possible following a natural disaster, major fire, terrorist attack or other such occurrence, have become increasingly popular in Japan in recent years. After hit by the Great East Japan Earthquake in March 2011, many people became unable to commute due to traffic paralysis in the metropolitan area and other urban areas and subsequent planned power outages, forcing them to stay at home. There were some governments, organizations and companies that had to give up their works. However, for example, if they have an environment where they can do a remote work according to a BCP prepared in advance, they can continue working because they can work without commuting to the offices. From the perspective of the BCP, remote work is receiving increasing attention recently, especially due to the situation of COVID-19. Implementation structure of the BCP is illustrated in Figure 1.9.2 for the case of sewerage works based on the plan-do-check-action (PDCA) cycle.



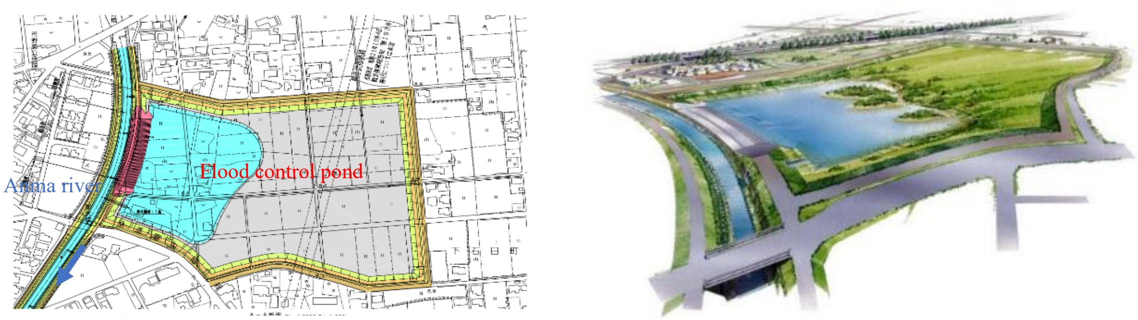
Source: Yokohama city in Japan, HP

Figure 1.9.2 Implementation Structure of Sewerage BCP Based on PDCA Cycle

(4) Green infrastructure development for disaster management

Green infrastructure may be formulated for both hard and soft infrastructure. For hard infrastructure associated with disaster management such as flood control facilities, resilient building construction in cities and so forth. A community development fund may be created as one of soft infrastructure based on revenues from mining development or large-scale tourism development for use to develop community infrastructure. It is effective to integrate soft and hard infrastructure for disaster management.

For instance, the regional government of Shizuoka Prefecture in Japan is now constructing flood control pond along the Anma River, which has been frequently causing floods since long time ago. The pond will be utilized not only for flood control, but also for recreation and tourism attraction (Figure 1.9.3). The plan and design of the area around the pond as a public park had been prepared by a participatory approach with residents, experts on river and environment, and government officials through many discussions. Such an example and process of participatory approach may be introduced to enhance the consciousness for importance of green infrastructure.



Source: Shizuoka Prefecture HP

Figure 1.9.3 Design and Image of Multipurpose Flood Control Pond

1.9.6 Strategic measures for solid waste management

(1) Construction of sanitary landfill sites

At present, all the final disposal sites are operated for simple dumping. In order to prevent environmental deterioration and diseases caused by improper management of solid wastes, it would be necessary to shift to sanitary landfill or controlled landfill practice step by step. At the initial stage, a project to construct sanitary landfill sites should be launched in Erdenet and Darkhan as second or third largest cities respectively. Unmanaged open dumping has been in service in both cites since 50 or 60 years ago. In parallel, appropriate operation system and methodology should be established.

Source: JICA Project Team

Photo Existing landfill site in Erdenet

Source: JICA Project Team

Photo Existing landfill site in Darkhan

(2) Establishment of the eco-park

The eco-park project must be proceeded as soon as possible in Ulaanbaatar in order to 1) select wastes that can be recycled, 2) convert wastes into new recycled resources, and 3) recycle construction wastes, used large waste tires, and hazardous substances discharged from companies and factories.

(3) Promotion of traditional nomadic culture

Mongolian nomadic culture is closer to the basic principles of the ecological culture in the modern sense. The culture has advantages with respect to ecologically sound agriculture with environmental care, sustainable utilization of grasslands, and sustainable human, social and economic development in rural areas. Nomads procure most of the food, clothe and shelter raw materials by using all of the meat, milk, bones, furs, dung, etc. of livestock with little wastes.

In order not only to preserve but more importantly to extend and spread this culture and tradition, environmental education in the regions should be promoted starting at kindergarten or primary school. Gradually, modern lifestyle should be modified adapting to nomadic lifestyle in view of waste management awareness.

(4) Establishment of the system promoting residents' consciousness

In rural areas of Mongolia, comprehensive 3R measures are required including the construction of appropriate solid waste treatment systems and disposal control. In order to establish a sustainable waste treatment system, environmental management capacity must be enhanced, and specific environmental actions such as recycling of garbage should be demonstrated. The transfer of knowledge also enhances the environmental management ability, but the specific targets also need to be introduced.

Ultimately, in line with "Promotion of traditional nomadic culture" mentioned above, zero waste system may be established. A case of Kamikatsu town in Japan may be representative (Photos below). "Zero waste" means "eliminate wastes, extravagance and trash." The concept is to promote the recycling and reuse of products without wasting them, and to eliminate the harmful wastes that are incinerated and landfilled by making products which are easy to handle from the production stage. This concept was introduced and implemented in the site as a part of "Knowledge co-creation program in Japan" in November 2019.

Source: JICA Project Team

Photo Training at segregation factory in Kamikatsu Town

Source: JICA Project Team

Photo Training at segregation factory in Kamikatsu Town

Chapter 2 Social Environment

Most of updated social profile documents have been reviewed and key aspects with a specific focus on the social development and sustainability to establish the bases of formulating NCDP summarized. Unless mentioned specifically, following reports are referred to as the most updated reports.

- Environmental Performance Review of Mongolia, November 2018, United Nations Economic UNECE
- Profile on environmental and social considerations in Mongolia, March 2014, JICA
- National Communication 3 of United Nations Framework Convention on Climate Change (UNFCCC), December 2018, MET
- Mongolia Voluntary National Review Report (VNR) 2019 – Implementation of the Sustainable Development Goals, Government of Mongolia

Since the beginning of 2020, the COVID19 pandemic has had increasingly significant impact on all socioeconomic sectors throughout the world and Mongolia has not escaped effects despite early efforts by the Government to control them. In the social sector, new challenges have arisen, and resilience has been tested in all aspects of everyday life. The impact and its response in Mongolia have been assessed through literature[25] and on-line discussions with the JPT and the Mongolian counterpart team.

2.1 Overall social sector environment

2.1.1 Definition and concepts

Social environment as against natural environment is generally understood as a totality of physical, institutional and human settings in which people live and something affecting people occur. In this sense, urban environment is certainly part of social environment. However, boundaries between urban and rural environment and between rural and natural environment are not clearly distinguished. Moreover, even in urban environment, nature exists or people are affected by natural conditions. Therefore, social environment in a broadest sense is understood as an entire sphere of human-nature interactions, excluding only pristine nature that is already extremely rare on the globe.

Social development or development of social environment, therefore, is a very broad concept encompassing all the factors affecting human-nature interactions. These factors are related to human communications, institutional and social fabrics and physical infrastructure. Social services including education, health care and other public services affect ability of human beings to communicate each other, which may be augmented or sometimes obstructed by institutional and social fabrics. Physical infrastructure facilitates human communications in various ways.

It is said that mankind has survived and developed by organizing societies to help each other and create better relationships with nature. Development in an ultimate sense is understood as human development or development of human capacity of people. People can develop their capacity most effectively through communications with other people. Such relationships lead collectively to community development. Social development is a broader concept encompassing many and varied communities that are themselves interacting one another in multiple layers of communities.

In the context described above, social environment and social development are essential part of the HSP, in which urban environment, social services and institutional and social fabrics are particularly important. Institutional and social fabrics may be expressed as culture in a broad sense. The ways people pursue healthy physical and mental conditions, higher or adequate education, worthy livelihood

[25] United Nations in Mongolia, United Nations Mongolia Socio-Economic Response Plan for Covid19 – Response, July 2020

and pleasant life are prescribed by culture, cultivated through human communications over long period of time. Respecting unique and traditional culture is a fundamental condition in planning for development of any kinds, and this applies to the NCDP and the HSP.

2.1.2 Social sector in SDGs and SDV2030

The comprehensive social sector is of particular importance to SDGs or agenda 2030, established by United Nations in 2015 for the next 15 years, and in the SDGs the focus is on the individual capacity and preparedness. Besides the SDGs addressing each individual capacity and conditions such as poverty, food security, education and health, all the 17 SDGs relate to the human and social side of the technical or substantive fields concerned such as how sustainable use of natural resources will impact human life and culture. As the motto of SDGs is to leave no one behind, the SDGs in particular are rooted in social side of development and human dimensions.

Aligning with the recently adopted SDGs, Mongolia in 2016 adopted the Sustainable Development Vision 2030 (SDV2030) with clear goals and targets for each sector. The SDV2030 is built on three pillars: economic, environmental, and social. The social pillar is an integral part of achieving the SDV2030 goals, and closely inter-linked with the other two pillars.

Mongolia took very fast actions in adopting SDGs into the Country's own set of goals by establishing the SDV2030. The NCDP does not intend to address the goals and targets which are missing in the process of SDG localization in Mongolia. Instead, it will be meaningful to 1) operationalize the goals and targets defined in the SDV 2030 with clarified prioritization, budgeting and timeline, 2) pay attention to three areas which were found as still weak in the SDV 2030, namely gender analysis and concerns, environmental impact assessment, and inter-linkages and causal relationships between the sectoral goals for achieving synergy and cross fertilization.

By analyzing the SDGs and the SDV 2030, it is reported that while most of the goals are included, some are only mentioned as general principles, and without detailed objectives and actions. In reviewing the budgetary allocation in 2018 in relation to SDGs, a third of the budget is allocated to servicing debt repayment, indicating the focus on financial recovery, and 'planned expenditures for economic sectors, energy and other infrastructure accounted for 22.8%, social welfare, health and education together accounted for 28.5% of the budget (MAPS Mission report, UN and ADB, 2018).

The reflection of SDGs in the SDV2030 is summarized in Table 2.1.1.

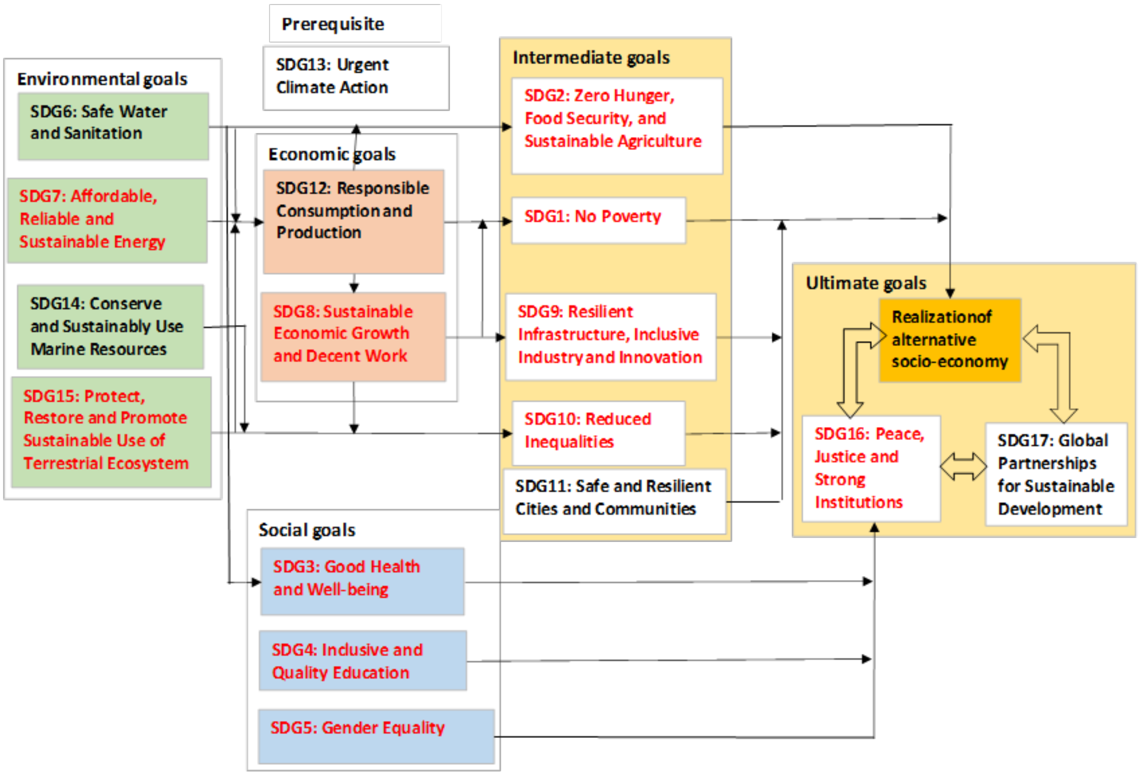
Table 2.1.1 Relevance between SDV 2030 and SDGs

SDF not relevant to SDV 2030	SDGs commonly adopted in SDV 2030	SDGs reflect partly in SDV2030
14. Life below water	1. No poverty 8. Decent work and economic growth 10. Reduced inequality 11.Sustainable cities and communities 12. Responsible consumption and production 13. Climate action 14. Life on land	2. Zero hunger 3. Good health and well-being 4. Quality education 5. Gender equality 6. Clean water and sanitation 7. Affordable and clean energy 9. Industry, justice and infrastructure 16. Peace, Justice and strong institution

Source: JICA Project Team

Relationships between the SDV2030 and the UN SDGs are perceived generally as shown in Figure 2.1.1. As indicated in Figure 2.1.1, SDGs call for a shift in development paradigm away from the 20th century development model characterized by intensive resource use (abuse) and economic efficiency-oriented activities. The new development paradigm is shown in Figure 2.1.1 as alternative socio-economy.

SDGs present challenge to local administrations with respect to both development planning and implementation and data collection, monitoring and evaluation of development effects. Planning for the NCDP and its implementation should naturally contribute to SDGs implementation. Several efforts are going on to collect and compile micro data necessary to evaluate the implementation of SDGs and monitoring and evaluation of effects of SDGs implementation. NSO has established a system to collect micro data by preparing more detailed forms with additional indices for three kinds of regular sampling surveys: quarterly labor survey, annual household socio-economic survey and social indicator sample survey conducted every five years. NSO is cooperating with Asia Development Bank (ADB) and United Nation Development Programme (UNDP) for SDGs monitoring and evaluation. ADB started a new project in August 2018 to utilize non-conventional data sources such as big data, Google, Facebook, data from financial institutions and cellular phone services etc., initially aiming at poverty situations quantifying with 25 indices.



Source: JICA Project Team
Note: SDGs denoted in red are explicitly reflected in SDV2030

Figure 2.1.1 Structure of SDGs and SDV2030

2.1.3 Progress of SDV2030 key indicators for the social development and sustainability

Results of the monitored/estimated SDGs indicators between 2015 and 2017, key indicators for the SDV2030 between 2014 and 2017, and key indicators for Green Development Policy between 2014 and 2016 are available in the special monitoring site of NSO. Table 2.1.2 and Table 2.1.3 provide the overall views of the present social development status. Those indices are considered as the bases of the NCDP key indicators.

Table 2.1.2 Status of Social Indicators for SDV2030

Indicator*	Unit	2014**	2015	2016	2017***	2018	2019	2030****
3. Human development index	rank	90	92	92	92	92	92	70
4. Life expectancy	years	69.6	69.89	69.57	69.89	70.19	70.41	78.0
5. Poverty rate	%	21.6	-	29.6	-	28.4	-	0
9. Share of the population covered by social insurance in the total economically active population	%	84.4	79.5	80.6	76.3	70	-	99.0
10. Gini coefficient of inequality	-	0.32	-	0.32	-	0.33		0.30

Indicator*	Unit	2014**	2015	2016	2017***	2018	2019	2030****
score								
11. Infant mortality ratio per 1,000 live births	ratio	15.1	15	17	14	14.5	15	8.0
12. Maternal mortality ratio per 100,000 live births	ratio	30.6	26	49	27	46	-	15.0
13. Number of students in a class at high school, (national average)	number	27.3	27.8	27.0	28.3	28	29	20.0
18. Share of the households using reliable electricity	%	89.0	99.2	99.2	99.1	99.2	99.3	100.0

Source; National Statistical Office of Mongolia
Note: * indicator # of SDV2030, ** baseline, *** available data at NSO at the time of publication, **** target

Table 2.1.3 Status of Social Indicators for Green Development Policy

Indicator*	Unit	2014**	2015	2016	2017	2018	2019	2020	2030
9. Unemployment rate	%	7.9	7.5	10.0	8.8	7.8	5.1	-	-
10. Labour productivity	2010 current prices, MNT thousand	13,338.1	13,099.3	13,252	13,640.73	14,457.72	16,621.10	-	-
11. Poverty level	%	21.6	-	29.6	-	28.4	-	24	15
12. Percentage of population accessible to safe drinking water	%	-	-	-				80	90
13. Percentage of population connected to improved sanitation facilities	%	-	-	-				40	60
14. Health and Safety Life Index (UB City)	-	0.4849	-	-				-	-

Source: National Statistical Office of Mongolia
Note: * main indicator # of the Green Development Policy

It is noted that the Mongolian Parliament approved the Long-term Development Policy 2050 or Vision2050 on 13 May 2020. This policy has now officially replaced SDV2030 with related indicators. The NCDP has taken steps to align the plan with the on-going transition, while stressing the importance of building the planning on the monitoring of goals and indicators established between 2015 and 2020 so that the results inform the next phase of development planning and implementation.

2.1.4 Social sector in NCDP

In the NCDP, the scope of social sector development is both wide and cross-cutting as well as fully integrated into all other technical or substantive sectors. The main focus is that its definition, impact and measurement of success will be based on the individual, on every woman, man and child who is Mongolian citizen, in a dynamic and progressive mode for the timeframe with baseline of 2019, in medium term up to 2030 and longer term up to 2050, in alignment with the Vision 2050, and in the further future. Therefore, it has both broad and wide dimensions as well as rooted in the human scale at the level of individual person. In terms of planning, social dimensions will have implications on budgeting, prioritization, human resource planning, capacity development, institutional restructuring, infrastructure, investments, private sector partnerships, and transport networks, among others.

Among the characteristics of Mongolia, one can note the spatial dimension with vast territory and the urban-rural dichotomy. In this context, the NCDP will pay particular attention to the process and progress of decentralization of authority, decision making, and local governance capacity.

The social sector in the NCDP deals with the structure of social sector development in Mongolia covering education, health, labor, social-protection and social- security each with dedicated ministerial oversight. The NCDP will examine the prevailing policy, strengths, weakness and gaps in the current delivery of policies, recommendations, adjustments needed, and means of monitoring and reporting for each of the main sectors as well as cross cutting areas of gender, inclusion of vulnerable groups, and spatial and localized considerations for Ulaanbaatar and the Ger district, and for rural development in general.

There are many interlinkages of the social development sector with most other sectors in the NCDP, and there are sectoral linkages with both environmental sustainability aspects and with tourism development. In conducting the SEA, the social dimensions will be integrated into the assessment criteria to harmonize the analysis and to avoid duplication and repetition. Tourism sector is closely linked to the environmental sustainability, social dimensions of poverty reduction, capacity development and human capacity development, and is supervised under the umbrella of MET.

The localization of the SDGs into Mongolian state policy through the SDV2030 takes place in a layered process, where the SDV2030 was adopted in February 2016. The Parliament, prior to the SDV 2030, had adopted the Green Development Policy (GDP) in June 2014. SDV 2030 has been accompanied by an Action Plan dated January 2016, to be implemented in two phases: 2016-20 and 2021-30. As mentioned above, SDV 2030 has been superseded by the Long-term Development Policy 2050.

It has been determined that Mongolia, influenced by the legacy of centrally planned economy, has in-depth experience and knowledge of top-down planning, including sector master planning, which is still being practiced as mainstreamed approach in many sectors. In fact, there seem to be many layers of sometimes overlapping planning and policy documents in each economic sector with various timelines, and sometimes contradicting contents, including the social development subsectors. This may lead to the classical ‘silo' approach. NDA is coordinating the systematic and comprehensive review of policies for each sector and appears to have made progress on a comprehensive assessment.

At the same time, for working level staff there seems to be a sense that the existing “plans” and “policies” remain too much at high level, without concrete directives and specific guidance that can support the discharging of their daily tasks. The NCDP will attempt to fill some of the gaps to operationalize the existing plans and targets, conduct prioritization, re-examine the timelines and make recommendations for allocation of budgets and human resources. Perhaps the other challenge is in implementation, or roll-out of the formulated plan, monitoring and integration of results into the subsequent planning.

The concrete methods for monitoring the progress of existing plans within the SDV2030 still need fine tuning. As recognized[26], it will be of paramount importance to establish monitoring indicators, accountability for reporting, and system of feedback into the senior managers to support the proper implementation of LTDP2050.

2.1.5 Scope of social sector planning in NCDP

Social sector planning in the NCDP encompasses the following scope:

(a) Integration of social development considerations into all sectoral planning process and exercise,

(b) Introduction and enforcement of budgeting for gender, vulnerable groups, for inclusive society and for social considerations,

(c) Review of existing policies, plans and performance of implementation in education sector,

(d) Recommendations and suggestions for policies, planning, budgeting, resource planning and implementation in the education sector,

[26] United Nation Development Programme (UNDP)-Asia Development Bank (ADB), Mongolia SDGs Mainstreaming, Acceleration and Policy Support (MAPS) Mission Report, Ulaanbaatar 2018

(e) Review of existing policies, plans and performance of implementation in health sector
(f) Recommendations and suggestions for policies, planning, budgeting, resource planning and implementation in the health sector,
(g) Review of existing policies, plans and performance of implementation in labor and social protection sector,
(h) Recommendations and suggestions for policies, planning, budgeting, resource planning and implementation in the labor and social protection sector,
(i) Recommendations for policies, further integration of gender concerns as well as for vulnerable groups and persons,
(j) Review of impact, policy amendments and lessons of COVID-19 pandemic, and
(k) Other relevant observations and recommendations.

2.1.6 Methodology in social sector development

As methodology in social sector planning, the following are considered:

(a) Desk review, particularly of sector review documents, established SDG/SDV 2030 targets and their recommendations,
(b) Continued consultation with direct counterparts and stakeholders, to reach a shared understanding of the goals of social sector development through NCDP, and to obtain feedback,
(c) Group discussions and feedback from Aimag visits,
(d) Review of impact, policy amendments and lessons of COVID-19 pandemic,
(e) Sub-working group meetings, workshops, seminars and field visits,
(f) Gap analysis,
(g) Cross referenced analysis and review of overlapped areas with other sectors in the NCDP,
(h) Recommendations for “add-on’s” and “phasing out” of targeted assistance for efficiency gains,
(i) Operationalization of sectoral targets in the SDV 2030 and road map to attain the targets,
(j) Suggestions for monitoring and evaluation,
(k) Monitoring of overall progress of the social sector with the SDV2030, and
(l) Concordance with the Vision2050, Regional Development Policy and other newly defined policy documents.

2.2 Education

2.2.1 Education system, early childhood education, and basic education

In Mongolia, positive aspects of policies taken during the socialistic regime are still seen in some social indices, and education and health indicators are examples. In education sector, literacy rate is high, 98.3% as of 2013, and 84.8% of the population completed secondary education. These rates are much higher than the levels in developing countries at comparable economic development levels. The Human Development Index (HDI) of Mongolia is high, 0.741 as of 2017, higher than the average of countries in Asia-Pacific region. It is noteworthy that HDI is higher for women than for men in

Mongolia. Enrolment rates in primary and secondary education are similar for men and women indicating little gender disparity.

Early childhood education is critical for the socialization, overall performance in formal education and development of children. Yet, current early education and kindergarten infrastructures are not sufficient to cover the population fully according to targets: of covering 100% of children from 3 years of age. There were 91% of pre-school age children enrolled in kindergartens nationwide in 2017-18, however for herders' household, this ratio drops to 43.2%[27]. Urban areas, particularly the capital city of Ulaanbaatar lack sufficient number of kindergartens and staff to cover the population. Some households may resort to private kindergartens for better facilities, with less regulated curricula and varying standards. In rural areas, there may not be adequate number of kindergartens to act as catchment for dispersed population, and particularly for nomadic households, making rural children's entry into formal school at a disadvantage.

Gross enrolments in percentage figures at primary and secondary education are compared by Aimag in Table 2.2.1. Gross enrolment ratios at primary and secondary education are generally high in all the Aimags, except in Tuv Aimag where the gross enrolment ratio was 88.2% at primary and 91.2% at secondary education in 2017. The reason may be explained by the mobility of families, often involving migration from rural areas and particularly to Ulaanbaatar city, and new migrants may not have enrolled the children in schools at the beginning of the school year. The gross enrolment ratios at the primary education decreased slightly from 2016 to 2017 in 18 out of 21 Aimags. The ratios increased only in Dornogovi and Dundgovi in Central Region and Sukhbaatar in Eastern Region. The gross enrolment ratios at the secondary education decreased only in Govisumber and Tuv in Central Region and Dornod and Khentii in Eastern Region.

Table 2.2.1 Gross Enrolment Ratios at Primary and Secondary Education by Aimag

Area	Primary (1-5 grades)		Secondary (6-9 grades)		Basic (1-9 grades)	
	2016	2017	2016	2017	2016	2017
Total	-	98.6	-	103.3	-	98.8
Western region	-	97.5	-	104.3	-	97.7
Bayan-Ulgii	96.8	96.7	101.4	109.7	93.6	97.3
Govi-Altai	97.7	96.9	98.4	99.9	96.3	96.8
Zavkhan	100.8	100.6	101.8	104.2	99.9	100.6
Uvs	97.3	96.2	99.7	102.3	96	96.7
Khovd	98.7	97.6	98.2	102	96.6	97.6
Khangai region	-	97	-	100.4	-	97.1
Arkhangai	96.6	94.9	94.5	96.3	94.1	93.6
Bayankhongor	99.6	98	97.6	97.6	97.5	96.6
Bulgan	90.6	88.8	89.6	90.7	89.1	88.6
Orkhon	104.1	102.8	111	113.3	105.3	105.37
Uvurkhangai	96.5	95.1	95.3	98.3	94.9	95.3
Khuvsgul	99	98.9	99.8	103	98.1	99.2
Central region	-	96.2	–	98.8	-	95.9
Govisumber	100.5	99	106.1	104	100.7	99.2
Darkhan-Uul	106	103.6	111.3	112	106.2	104.7
Dornogovi	97.9	98.3	95.7	98	96.4	97.6
Dundgovi	95.2	95.5	95.1	96.7	94.1	95
Umnugovi	96.8	96.5	100.8	100.1	97.6	96.9
Selenge	95.3	94.3	93.7	93.7	93.5	93
Tuv	89.7	88.2	91.9	91.2	89.1	88
Eastern region	-	98.6	-	100.9	-	98.2
Dornod	101.2	99.2	103.8	102.7	100.1	99.1
Sukhbaatar	97.8	98.6	102.3	103.5	98.7	99.6
Khentii	99.9	97.9	98.4	97.3	97.9	96.3
Ulaanbaatar	-	100.4	-	106.6	-	101.1

[27] MECSS, World Bank, Toward's Mongolia's Long-Term Development Policy 2050 – Advancing Education Equity, Efficiently and Outcomes, 2020, page 15

Source: Statistical Yearbook 2017, National Statistical Office of Mongolia
Note: Definition of indicators:
Gross enrollment ratio refers to the number of students enrolled in a specific level of education regardless of age divided by the population of the age group which officially corresponds to the given level of enrolment expressed as a percent. Therefore, it can exceed 100 in case of the number of students enrolled is greater than the population of the age group. Reasons may be repeaters, return following school dropouts, children enrolling late to school, etc.

Pupils to teacher ratios are compared by Aimag in Table 2.2.2. Pupils to teacher ratios at the primary education vary widely among Aimags ranging from 20 in Bayan-Ulgii to 34 in Orkhon in 2017. The ratios did not decrease (improve) in any Aimag between 2016 and 2017. Pupils to teacher ratios vary much less at the secondary education ranging mostly between 16 and 20 in 20 Aimags and 15 only in Bayan-Ulgii in 2017. The ratios improved slightly but consistently for all the Aimags except in Dornogovi where the ratio increased only marginally. It is reasonable that the pupils to teacher ratios are generally smaller at the secondary education than at the primary education, considering increasing complexity of curricula as the grades increase.

The fact that the pupils to teacher ratios did not increase at the primary and the secondary education practically in all the Aimags clearly reflect the government policy to improve the basic education in Mongolia. Reasons for slight decreases of enrollment ratios at the primary education in many Aimags from 2016 to 2017 are not clear, but they may be related to increasing mobility of Mongolian families in recent years affecting the enrolment rates at the place of departure reflecting children to attend primary schools after moves. This point should be carefully examined as it may undermine social stability in Mongolia.

It is noted that the school system has undergone reforms during the past years with the length of the compulsory education changed from 10 to 12 years in 2008 and the school entering age for children changed from 8 years old to 6 years old in a phased introductory period. For herders' children, this resulted in a necessity of putting young children in public boarding schools, or to leave them with relatives. While a child may enter primary school up to age of 8, the compulsory education has also had an effect that a child becomes 18 to 20 years old when he or she finishes high school, and this may be perceived as late to begin working and may have led to some cases of drop out.

Table 2.2.2 Pupils to Teacher Ratios by Aimag

Area	Primary education		Secondary education	
	2016	2019	2016	2017
Western region	-	25	-	-
Bayan-Ulgii	19	21	15	15
Govi-Altai	21	23	16	16
Zavkhan	25	27	16	16
Uvs	24	26	17	18
Khovd	27	30	18	18
Khangai region	-	30	-	-
Arkhangai	26	28	18	18
Bayankhongor	27	30	18	18
Bulgan	25	26	17	17
Orkhon	32	36	18	19
Uvurkhangai	28	28	19	19
Khuvsgul	28	30	18	18
Central region	-	30	-	-
Govisumber	29	31	19	19
Darkhan-Uul	31	33	19	19
Dornogovi	30	32	21	20
Dundgovi	24	24	16	16
Umnugovi	30	32	19	19
Selenge	28	29	18	19
Tuv	27	27	19	19
Eastern region	-	30	-	-
Dornod	29	32	19	19

Sukhbaatar	30	30	20	20
Khentii	26	27	19	20

Source: Statistical Yearbook 2017 and 2019, National Statistical Office of Mongolia

2.2.2 Education performance in view of SDV2030

Mongolia has a well-established education system as inherited from the socialistic regime before 1990, but today the performance is still less than optimal both in coverage, quality and delivery of services. Many primary schools operate in shifts with 2 or 3 shifts per day especially in Ulaanbaatar where the ratios of children to teacher are also above the recommended level. The current ratio or national average of students in a classroom at high school, as a baseline in 2014 is 27.3. In contrast, in some remote primary and high schools, the critical mass of student numbers may not be reached due to migration to urban areas and de-population, not offering the experience of holistic education through group interaction with peers. The target in the SDV 2030 by year 2030 is 20 students per classroom for high school.

The Mongolia's education system has undergone in the recent past a succession of restructuring in short cycles, which is considered rather disruptive and unstable. In 2008, the Mongolian Institute of Education Research (MIER) conducted an assessment of education performance at primary and secondary education with the aim of developing education performance indicators. It has recognized a number of shortcomings, including:

- Teachers lack sufficient capacity for preparation and planning classes;
- The children in both primary and secondary education did not perform satisfactorily with the average achievement below 60% in knowledge and skills;
- The curricula and their cycle were not adequate;
- The series of rapid restructuring has negatively impacted the quality and availability of textbooks;
- Classroom sizes were uneven, with overcapacity in urban areas and less than required in remote rural areas resulting in multi-grade schools, not offering the full range of elective subjects;
- Education sector investment lacked efficiency as used mainly for repairs and maintenance; and
- Some Soum and Bagh day schools and dormitories lack adequate hygiene and health standards,
- School development and mapping were not aligned with regional development.

Overall, it pointed to inadequate policy coherence, and insufficient attention to the human security and holistic education. Some of the shortcomings were addressed, for example through the JICA Project on Curriculum Management Cycle implemented in 2014-18, but the lack of adequate evaluation and assessment methodology was recognized.[28]

As Objective 2 of the SDV 2030 2.2.3, the following is stated: "Improve the general education system to the international benchmark levels to educate Mongolian citizens and ensure impartation of quality education". In Phase 1, by 2020, the goal is set as follows: "Arrange for the preparations to be evaluated by the Program for International Student Assessment (PISA), build an environment to ensure that all general education schools have two shifts[29], develop and implement an education program that also fits the traditional nomadic lifestyle, and assure that every child with high school education has a professional orientation".

PISA assessment will require some major shifts to the competencies and skills as well as creation of favorable, enabling environment including, but not limited to the infrastructure and management of the schools where the children study. PISA assessment measures children's ability in reading, mathematics and science, but also how they are able to use the knowledge. The new skills and competencies reviewed depart from traditional knowledge and rote-learning and include critical thinking, financial literacy, global competencies such as effective communication and respect for cultural values and diversity.

28 MECSS, MIER, UNESCO: Education in Mongolia, A Country Report, Ulaanbaatar, 2019
29 To be reduced from 3 shifts per day, as occurs in some schools

PISA as philosophy considers equity in education for upward mobility, open choice of schools for families and children, incidents of segregation by population segments into particular schools[30]. PISA promotes 'positive school climate', providing an enabling and safe environment for the physical and emotional health of students, and encouraging cooperation as well as academic competition and excellence, thus requiring capacity of teaching staff in supportive approach and attitudes.

This goal has a short deadline which is being surpassed. As the "general education system" refers to the compulsory education system, the attainment of the goal will require strong injection of continued Government supports in the form of subsidies and budget allocation.

To implement the support policy by the Government, three general conditions need to be satisfied. On the first point, PISA is a global assessment conducted under auspices of Organisation for Economic Co-operation and Development (OECD) and is defined as follows:

The PISA is a triennial international survey which aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students who are nearing the end of their compulsory education. [31]

The PISA evaluates, in addition to the performance of students, overall standard of education in the country, including the quality and equity of the school system. In 2018 the evaluation covered mathematics, reading and scientific skills, financial literacy and global competencies as well as policies in education, wellbeing of students. In addition to the 36 members of OECD, voluntary testing is conducted in schools in non-member countries, while countries, schools, or students may be excluded from the assessment for specific reasons. To prepare for the PISA, both the school systems and infrastructure, capacity of teaching and the curriculum, and focus on critical thinking by the students will need to be strengthened. The NCDP team understands that an agreement has been reached for Mongolia to participate in 2021 PISA assessment and financial and technical support have been secured. Conducting the PISA will be an excellent benchmark on which to align the reform efforts in the education system.

Then two further assumptions are; 1) all schools will conduct 2 shifts; this requires additional teaching staff hours and rehabilitation and re-furbishing of some schools; and 2) primary and high schools will cater to the nomadic population and lifestyle. This will require some shifts in the approach to education, and models of schools. Already, the schools are accepting later enrolment, of up to 8 years of age. Perhaps such school models will include options such as mobile education, home schooling, long distance learning for older children, or boarding schools during the winter season, in a possible blended approach in line with SDG 4 targets, and the Vision 2050 goal of providing basic education to all citizens and for lifelong education to be accessible. There could be some pre-feasibility assessments, whether on-line and distance learning through technology will be a realistic option, or investment into cluster- and boarding school, especially to ensure that these schools offer child-friendly education and environment.

The subsidy to children in low-income households to continue education will be critical. Or, perhaps the option might be to revise the compulsory education to 9 years instead of 12, and to improve options for vocational training, starting from year 10.

The third assumption is that each graduating child, after 12 years of education, will be oriented to a profession. This could imply various options. First, the child has been trained in a profession, with a craft or a trade such as carpentry, electrical engineering, car mechanic, seamstress and sewing, cooking and kitchen staff, accounting, agriculture and herding, plumbing, hospitality, nursing and medical support, etc. Second, the child has received guidance and counselling on a profession and has received advice on further training pathways. Third, the child has been accepted as a trainee, or for an internship. Fourth, the child has been successful in obtaining an entrance to higher education. Fifth, the child has an employment.

It is advisable that the goals for Phase 1 might be evaluated, and those not attained should be revised, or

30 Executive Summary | READ online (oecd-ilibrary.org)
31 http://www.oecd.org/pisa/aboutpisa/

partially postponed to Phase 2. The goal of introducing 2 shifts in all schools may be achievable partly. However, the alternative model of schooling for nomadic children has not been fully developed and a workplan needs to be established to review options during Phase 2, from 2021 to 2025. Likewise, the goal of having all high school graduates linked, or oriented to profession is a worthy goal to be pursued, but to attain it by 2020 may be unrealistic.

Basic education in Mongolia has been affected particularly severely through the response to COVID-19 in 2020. From the end of January 2020, all basic education has shifted to TV lessons, considered to be a relevant alternative not only as a one-time emergency measure against the pandemic, but a relevant option for seasonal closure of schools frequently experienced due to inclement weather, or to seasonal influenza outbreak. The strengthening of remote learning is reflected as indicator 2.1.1.0 in the Mongolian Government's Five-Year National Plan 2021-25, which operationalizes the LTDP2050 as a medium-term planning document.

According to a UNICEF study[32], while the TV lessons were efficient in providing continued education to vast majority of children, they tend to have deepened the vulnerability of children in remote areas without coverage of TV broadcasting, and families without equipment, poor households, minorities and migrant children. It is reported that 5% of children did not have access to such technology as TV, mobile phone, or computers, and 22% were without access to Internet, thus exacerbating the digital divide.

There needs to be stronger linkage with the private sector and with Small and Medium-size Enterprises (SMEs), both domestic and joint ventures, and the entrepreneurship in domestic business market needs to mature. A further multi-pronged approach may be required, involving not only the education sector, but business sector and public administration training.

There are various reasons for children not completing education. In poorer and nomadic families, children seem to drop out for reasons of the need to support the family in economic activities, to participate in herding, and for reasons of illness of the child or the family members including parents. Boys may have higher drop-out rate than girls and this aspect will be elaborated in the section on gender disparities. On the other hand, many of the new settlers in the Ger district of Ulaanbaatar seem to have given up herding and chose to settle in the city for reasons of children's education, so the education seems to be also functioning as a pull factor and a priority for the family. It is also a matter of concern that education, or concentration of better education in urban environment is a major driver of rural to urban migration and this aspect needs to be considered, when devising plans for decentralization of social services to regional centers, including schools and educational infrastructure. The education cycle is also not aligned with herding seasons, where especially boys are required as a workforce in their families respectively.

The Government has included some flexibility in the starting age of education and children may start education at 8 years of age. This makes the school graduation age based on 12 years of education to 20 years of age, which may also be considered too old to be a non-earning member of the family.

As part of the NCDP a number of pilot activities were conducted in 2020 in support of its strategy, including a pilot project on applying distance education to children out of school. The limited study just completed implementation at the beginning of school year 2020-21, has demonstrated certain level of success in applying mobile technology to distance education, to children from remote areas, including children in monastery, nomadic households, poor and vulnerable households and to children with light motor disability.

It seems to indicate that indeed distance learning modality is effective in delivering education content to children out of school in the two Aimags of Selenge and Bulgan surveyed to enable their learning. However, while the technology allows to overcome distance and remoteness, in the event of epidemic outbreaks or otherwise, it will not replace the attention, support and follow up required by teaching staff. Therefore, it will not address the shortages of staff and capacity in informal learning centers and the

32 UNICEF Assessment of Effectiveness of Distance Education (TV Lessons) in Response to Climate-Change Related Emergencies

need for capacity to support such system.

Mongolia is recipient to a number of fellowships and scholarships, especially to complement the specializations which are not offered in the country. The performance and experience from these fellowships seem positive, and the tradition needs to continue, until the types of relevant subjects can be offered in the Country.

There are also various opportunities for further training, providing opportunities for lifelong learning. Some on-going programs related to lifelong education in Mongolia supported by other donors have been compiled by the JPT as shown in Annex to Chapter 2.

One of the inefficiencies of the education policy seems to be universal cash allowance for every school age child. As recommended by several existing sector reviews, the NCDP will recommend to halt the distribution of cash to those above the poverty line, or at least to those who are in the high income category. Reducing the subsidy will generate savings to state budget as well as sharing of responsibilities in supporting the education system and aiming for a more equitable society. While the long-term viability of children's allowance is being debated, the allowance was increased as a temporary measure and in response to COVID-19 from MNT 20,000 to 100,000 for six months in 2020.

2.2.3 Towards inclusive education

In recent years, the awareness has increased for the need to include all segments of society in all aspects of daily life, in part thanks to government and donor support programs being implemented. In the Vision2050, a fully inclusive education is being proposed, with inclusion of children with disability into regular classrooms. In practice, however, there may be unresolved bottlenecks for implementation, for example as teachers are still instructed to limit the number of children with disability in a classroom. A planned period of transition may be required, with comprehensive training of school headmasters and teachers, as well as allocation of budget for required infrastructure improvements, transport and logistics arrangements as well as classroom capacity.

It is noted the NCDP has conducted a successful distance learning pilot project in two Aimags, Bulgan and Selenge[33], in which some children with light motor disabilities were included. It has led to observation that a simple technology based on distribution of tablet computers and use of common platforms such as Google Class could be effective to deliver educational content to the children who participated. In fact, the connectivity had created rare opportunity for children with disability to be able to interact with teachers and peers outside of the household which was observed as a positive outcome of the pilot, and all children adapted quickly and well to the introduced mobile technology. A hybrid use of on-line learning and inclusion of children in regular classroom, perhaps on line initially, could help to facilitate acceptance and inclusion of children with some disability into on-going basic education classes.

It will be critical to conduct training of school teachers to build capacity for inclusive education on one hand, and to review the structural issues at schools such as size of classroom in relation to the number of children in a respective catchment area as well as allocation of related costs on the other. Also, it has been suggested to organize staggered classes for children with disability according to the types and severity of disability so that they can accommodate the children with disability.

A bottleneck for inclusion of children with disability in the formal school system seems to be lack of updated and standardized criteria for identification and classification of disability[34]. Regarding the school drop outs and out-of-school children, there is evidence that a major proportion of children not attending the schools are those with physical, functional or mental disability[35].

As reported in the 2019 study, there is continued stigma regarding children with disability in regular

33 Final Report, Strengthning of Distance Learning, NCDP Pilot Project (to be published following a completed draft), January 2021
34Ibid
35Interview with Save the Children Japan

schools, and lack of welcoming environment[36]. Further campaign towards inclusion of persons with disability at all levels of society may help to ease the stigma.

2.2.4 Higher education

The university education in Mongolia seems skewed in a few manners. There is a gender imbalance with larger number of girls than boys attending university. This causes both the problem of shortage of highly qualified males, and the problem of women perhaps not meeting their full potential in employment, as they may not have access to the types of work which is commensurate with the level of academic training obtained, or may be able to reach the seniority in an organization, firm or institution based on current employment culture, tradition or system of appointments. The percentage of women in managerial positions is reported as 36.7% (VNR 2019) and share in the Parliament is 17.1% in 2016, representing some gaps to gender parity.

In order to redress these imbalances, several inter-linked policies may be needed: to facilitate more males to continue their academic education by offering relevant and practical areas of studies as well as wider options in specializations, including business and management studies, finance and public administration, economics, as well as appropriate scholarships and loan subsidies on one hand, and by offering leadership and managerial training to women, internal career paths for promising women to reach beyond the senior officer/section chiefs/Division advisor levels, and to increase awareness of the leaders for more diverse work environment in both the private and the public sectors on the other.

The choices of university study subjects have remained more classical and traditional, without inclusion of emerging subjects. The 2018 Report on Barometer Survey on Labor Market Demand[37], published by MLSP, lists following areas where labor shortage was reported, implying the employers were not able to hire the staff needed: wholesale/retail, processing industry, construction, vehicle or motorcycle repair, (hotel) accommodation, housing, catering, management, support services. These are areas where specialized staff are in demand both at higher education, and at technical and vocational training levels. The NCDP strongly recommends preparing to establish faculties of higher education in the fields which have been identified through the review of other sectors through the Project; including entrepreneurship and management skills for SMEs, banking, finance, tourism and hospitality management, and also to train human resources to fully take advantage of the mining, energy and fossil fuel sectors, either in extraction, processing, export-import, marketing or any of the peripheral industries. Environmental sustainability and natural resource management will be sectors requiring attention, and human capacity development may be reviewed in tandem. Development of alternative and renewable energy and related products will also be an area with potential for development.

There are discussions on decentralizing university faculties, or clusters of research centers outside of Ulaanbaatar, to avoid over concentration of institutions, but real decentralization has not taken place. The law (No. 149) for relocating the university from Ulaanbaatar to local area was approved in 2010 and was revised in 2011; the law, however, has not been enforced. There is a medical university campus in Botanic District, and the German Technical University campus in Nalaikh District, both within Ulaanbaatar city but on the outskirts.

Emphasis on some soft skills and group dynamics, working in teams in addition to individual attainment, sharing longer-term vision in organizational objectives, role of individual to groups, are some of the feedback and expectations that are heard from corporate management. These skills may be incorporated into the pedagogics at high school and tertiary education, for the medium term objective of generating resilient and sustained workforce.

For higher education and levels of university and above, capacity for research needs to be strengthened and established so that institutions can play the much needed role in R & D for industrial, scientific, and social advancement, and enhanced role of Mongolia in the international arena.

36 Support for Inclusive Education Project : A Survey Report, 2019, MECSS, ADB, IRIM
37 Ministry of Labor and Social Policies, Report on Barometer Survey on Labor Market Demand, Ulaanbaatar, 2018

It is recommended to promote an enabling environment to establish linkage between universities, research institutions, and the private sector. A starting point could be to institute and strengthen regular discussion with entities such as Mongolian National Chamber of Commerce and Industry, Business Council of Mongolia, and sectoral associations in fields of construction, manufacturing, agriculture and agri-business, tourism, or possibly based on commodities such as sea buckthorn. Opportunities for active cooperation and identification of collaborative initiatives could be explored, while strengthening the capacity of the associations themselves in such roles.

The NCDP has noted one area where inter-sectoral coordination will be beneficial. The medical university admission and administration are under the auspices of the Ministry of Education. A strong inter-ministerial cooperation will be recommended to ensure quality of the curricula, control of the number of admissions and qualifications to address the issue of disproportionate number of doctors (2,000 per year) obtaining certificates, whereas the number of nurses and paramedical staff has decreased and is insufficient to meet the needs of primary health care.

2.2.5 Pre-school education

Preschool may be one of the most critical areas to ensure 1) preparation of children for the formal education and 2) the retention of young mothers in the job market, and both private and public institutions need to be expanded.

The SDV2030 states under 2.2.3 ‘Knowledge-based society and a skillful Mongolia’ as Objective 1: Ensure that every child is enrolled at pre-school education facilities, meeting the standard requirements and providing the basis for learning the Mongolian language and culture.

The goals for preschool education are divided in three phases. In Phase 1, by 2020, 70% of all pre-school age children are enrolled at pre-school education facilities. This in fact leaves eight months to reach this goal, if the target is to be achieved by January 2020, and 20 months, if the timeline is by December 2020.

In terms of budgetary and human resources implications, Mongolia will require a number of new preschools, fully equipped, with increased number of staff each (i.e. head, teacher, assistant, cook and kitchen staff, janitor/guard) in particular, there needs to be additional new teachers and head teachers with qualifications.

In Phase 2, by 2025, 80% of all pre-school age children should be enrolled in preschools, and the ratio of children per pre-school teacher should be 25. In general, the quality of preschool education should be improved with additional equipment and facilities so the budgetary increase is necessary.

In the final, Phase 3, by 2030, the average number of children per pre-school teacher needs to be decreased to 20 per teacher, and 90 % of all pre-school age children and to be enrolled at pre-schools.

In the Ger district, preschool for children between 2 and 5 years of age may play a critical role for young children’s safety, health and well-being as it will offer a clean and hygienic alternative to staying in a house with poor heating, exposure to toxic coal heating and poor sanitary conditions, or being on the street with exposure to traffic, dust and other hazards, as there are very few parks and green areas for play. Some children are also involved at the city’s garbage collection areas in picking through the garbage, which is dangerous and unhealthy and unhygienic activity. Through the preschool, children will also receive warm and nutritious food, and proper supervision and socialization during the day.

2.2.6 Life-long and continuous education

With significant number of students, in particular boys, dropping off school for economic, family livelihood including herding, health and other reasons, providing a second chance to complete or further education is an on-going theme in the education sector. All types of incentives and facilitation are being made, nevertheless it is still a challenge to attract, and retain students to return to education and complete it.

Vocational schools, especially at Aimag level may not offer adequate range of skills and training partly due to the insufficient economy of scale as the number of students in one vocational training school may not be large enough. Concerted efforts are needed to establish linkage with the employers and corporations, for a scheme to compensate for gaps in skills training that can be offered at Aimag level. This is critical, as Mongolia suffers from disproportionate unemployment rate among the youth. The unemployment rate among youth aged 15-24 years (25.3% in 2018) is three times higher than the national average[38].

Despite a number of vocational schools offering practical training, it is difficult for students to find employment after completion of the course. A close relationship of the educational institutions with the employers in the private sector and a closer pairing will be needed to assure employment to the young people with particular attention to the areas of labor shortage reported above[39].

2.3 Health

2.3.1 Overview

Health sector has undergone an overall sector review in 2013[40] which provides a technical and managerial review, and analysis of the gaps and needs. It is undergoing a comprehensive process of master planning under ADB assistance through a team of consultants, based on the Mongolian Law on Development. The action plans are outlined in the Order of the Minister of Health A/103 approved on 28 February 2020.[41] A working copy of the Policy Implementation Plan matrix in English is included in the Annex. The health sector is also undergoing a pilot process of results-based budget reform. Yet, many challenges remain and an immediate action plan, prioritization and budget allocation are all to be defined, and operationalization, monitoring and reforms are to be further clarified with principles on good governance.

On the technical side, the SDV 2030 lay out very clear targets for main areas of both communicable and non-communicable diseases and delivery of health care services, which will help to reduce mortality and morbidity, and help to ultimately improve quality of life and life expectancy of men and women in Mongolia. There remains a process of prioritization, allocation of resources, budgetary planning, and roadmap with timelines to be defined.

The SDV2030 set for the objectives in health sector as below.

Objective1: Create national disease preventable system, increase the access to diagnosis services and increase life expectancy of the population.

Objective2: Reduce factors affecting preventable maternal and child mortality by improving the quality and accessibility of reproductive health care services and decrease maternal and child mortality and malnutrition.

Objective3: Reduce the main non-communicable diseases, reduce health risk factors, and preventable deaths through an active and inclusive partnership of individuals, families, communities and organizations.

Objective4: Decrease the spread of communicable diseases through prevention, early detection of communicable diseases, and preparedness to treat them, through improving the capacity of health services for fast response actions and ensuring access to extremely necessary vaccines for everyone.

The health sector was directly and particularly strongly affected by the COVID-19 pandemic in 2020, and service delivery has been tested severely. It is noted that 'Early intervention and the numerous measures undertaken by the Government greatly helped minimize the spread of COVID-19.[42]'

38 Mongolia Voluntary National Review Report 2019.
39 The Report of Barometer Survey on Labor Market Demands, 2018.Annex
40 WHO, Mongolia Health Sector Review, 2013
41 https://www.mohs.mn/uploads/files/ea1096ce489850f08ae81e9a468a675f5ae71ede.pdf
42 United Nations in Mongolia, United Nations Mongolia Socio-Economic Response Plan for COVID19, July 2020

Following the declaration of the state of emergency in January, Mongolia has adopted a whole-of-government approach with multi-sectoral strategies, policies and plans. The Ministry of Health and the National Centre for Communicable Diseases led the health sector response.

According to an IMF Report (IMF Country report, Request for Purchase under the Rapid Financing Instrument), the Mongolian Government was allocating MNT 1,045billion as additional resources to the health sector in 2020 as the General Government-COVID-19 Fiscal Response[43]. Most of the additional allocation was financed by donor funding and Government reserve funds.

2.3.2 Issues for health sector planning

There exist some overall strategic and structural matters that need to be addressed in the NCDP.

(a) Shifting of the focus and investment from secondary and tertiary treatment to primary health care and preventative care

(b) Currently, the status and performance of primary health care are neither fully functional nor sustainable. By re-establishing functional primary health care delivery and quality, the overcrowding in the hospitals, lack of space and beds, and the burden of spending state budget on curative care and medicines will be reduced.

(c) Reducing the disparity of health care between rural and urban areas

The rural areas are suffering from chronic shortages of qualified medical staff and health care delivery. Provision of monetary incentives and promotions to encourage doctors to go on duty for a certain period in rural areas does not seem to produce results. There may need to be institutionalized measures such as making a short tour of duty of 1 to 2 years compulsory for the doctors to be qualified.

On the other hand, the graduates of medical school and young doctors are often lacking practical experience following their formal training. There has been reports of serious complaint of inexperienced doctors being assigned at Aimag level. A JICA project for Strengthening Post-graduate Training for Health Professionals in Primary and Secondary Level Health Facilities addresses the gap between formal theoretical medical training and practicing skills.

In the longer term, however, assigning of quota and ceiling for intake of medical students may be considered, also in view of lack of paramedical, support and nursing staff quantity creating an imbalance. Some students may be guided to the support capacity in health care, for example.

(d) Redressing the balance of the number of nurses and support staff in relation to doctors

Current number of nurses is at 3.32 and doctors at 2.71 per 1,000 residents, and the ratio of doctor to nurses is almost 1 to 1. International standard is supposed to be 3 to 1. Although salary structure results in significant difference in salaries and benefits between the doctors and nurses, or the salaries and benefits of nurses to be non-attractive. The pay package of nursing staff needs to be maintained at certain level to make the profession sustainable. There may need to be a cap of the number of doctors, to ensure that it is not the only attractive option for promising young students. There may be other schemes, including exchange programs and invitation of doctors from abroad, to work in remote areas of Mongolia.

(e) Reducing leakage of the insurance payments by better auditing the administration of health insurance payments for reimbursement of excessive use of hospitalization

There appears to be a tendency to overclaim the days a patient spends in hospital and releasing of the patient in shorter number of days than prescribed to generate income for the hospital. By better administration of the insurance fund, the resulting savings may be used for better investment, or re-

43 ibid

distributed to the hospitals as general income for infrastructure, equipment, and staff costs.

Other issues include the following:

(a) Control of illegal and counterfeit medicine,

(b) Capacity enhancement of management staff at hospitals and institutions,

(c) Medical infrastructure such as roads, transport and access to be improved within respective catchment areas for the rural residents, and

(d) Teaching hospitals and training curricula for medical students need be reviewed.

It has been reported that the percentage of the population with health insurance is 78.6%, reduced by 13.5 percentage points from the survey findings in 2013. About 75.6% of men and 81.5% of women had health insurance.[44]

2.3.3 Review of recent health performance

Significant improvement of health services in Mongolia since the democratic reform in 1990 is typically seen in the infant mortality rates per 100 live births shown in Table 2.3.1. In Mongolia as a whole the rate improved from 64.4 in 1990 to 13.6 in 2017 per 100 live births. The improvement has been particularly conspicuous after 2000. It is noteworthy that the significant improvement of the infant mortality is observed in all the Aimags, and the variance between Aimags is relatively small ranging from smaller than 10 per 100 live births in Orkhon (5.0), Govisumber (7.2) and Dundgovi (9.1) to smaller than 20 in Khentii (19.4), Ovs (18.7) and Sukhbaatar (17.3). The Government policy on health appears to be quite successful in recent years.

Table 2.3.1 Comparison of Infant Mortality Rates by Aimag

(Unit: per 100 live births)

Area	1990	1995	2000	2005	2010	2015	2016	2017	2019
Total	64.4	44.4	32.8	20.7	20.2	15	16.8	13.6	13
Western region	58.8	45.4	30.3	22.7	26.9	21.6	21.3	16.1	17
Bayan-Ulgii	50.6	38.2	20.3	20.7	24.9	24.7	27.9	13.3	21
Govi-Altai	53.5	52.6	37.6	25.2	22.3	13.1	16.2	16.4	15
Zavkhan	67.5	44.6	29.9	18.7	27.7	25.7	15.5	16.6	16
Uvs	57.9	48.9	28.2	31	33.7	20.4	21.6	18.7	14
Khovd	64.7	42.9	35.7	18.2	24.9	20.7	18.9	16.7	18
Khangai region	63.5	43.3	31.8	21.9	25.3	15.8	20.5	14.8	14
Arkhangai	71.3	47.6	25.3	20.6	25.1	14.1	18.9	16.8	15
Bayankhongor	90.5	58.8	38.5	28.5	28.3	14	23.9	15.5	13
Bulgan	51.9	22.8	18.4	18.5	15.8	17.1	13.8	10.8	18
Orkhon	38.2	37.5	41.8	13.8	16.2	12.1	12.6	5	8
Uvurkhangai	55.1	35.4	28.7	24.9	29.9	14.1	20.6	16.1	15
Khuvsgul	74.2	57.7	38.2	25.5	30.2	22.3	28.3	22	18
Central region	48.1	39.8	30.6	14.7	13.5	11.2	15.7	11.4	11
Govisumber	n.a.	45.5	49.6	8.5	2.9	13.4	15.6	7.2	12
Darkhan-Uul	69.8	43.2	34	12.3	9.7	10.1	12.5	10.6	18
Dornogovi	48.2	49.9	28.7	17.9	23.8	12.2	14.6	12.8	7
Dundgovi	57.6	37.4	23.9	17.7	19.5	7	16.8	9.1	7
Umnugovi	60.4	47.6	45.8	29	22.4	16.6	19.2	16.1	21
Selenge	56.3	37.2	18.2	10	6.8	8.1	14.7	11	10
Tuv	56.3	18.1	14.2	7.8	12	13.3	20.5	10	15
Eastern region	70.3	51.7	34.4	24.4	19.3	13.8	15.3	16.3	11
Dornod	89.9	67.5	43.2	25.6	20.5	7.6	11.1	13.4	7
Sukhbaatar	56.5	51.9	14.6	23.4	20.5	18.6	22.2	17.3	10
Khentii	64.6	35.7	45.5	24.2	17.1	17.1	15.3	19.4	16

[44] FOURTH NATIONAL STEPS SURVEY ON THE PREVALENCE OF NON COMMUNICABLE DISEASE AND INJURY RISK FACTORS-2019 BREIF SUMMARY

Ulaanbaatar	75.6	46.6	39.9	20.8	18.2	14.3	15	12.7	13

Source: Statistical Yearbook 2017 and 2019, NSO of Mongolia

Availability of health services by Aimag may be seen in the number of people per physician, which varies rather widely between Aimags, ranging from 301 in Govisumber to 548 in Arkhangai in 2017 as shown in Table 2.3.2. Aimags in Khangai Region have relatively large number of people per physician as well as remote Aimags such as Bayan-Ulgii, Uvs and Dornod. Most Aimags in Central Region are better off except Selenge and Tuv, probably due to population increase. Despite general trend of population increase, the number of people per physician decreased from 2016 to 2017 in 15 out of 21 Aimags. The number increased in Zavkhan, Uvs, Arkhangai, Darkhan-Uul, Dornogovi and Sukhbaatar. This seems combined effects of remoteness and rapid population increase.

Patients of infectious diseases per 10,000 people decreased significantly from 2016 to 2017 in all the Aimags except in Dornod as shown in Table 2.3.2. Again, this is an outcome of the Government policy on health services. The situation in Dornod should be separately looked into. Nevertheless, there exist large variance in the number of infectious diseases per 10,000 between the Aimags ranging from 33 in Byan-Ulgii to 208 in Khentii and 367 in Dornod.

Table 2.3.2 Comparison of Physician Availability and Infectious Diseases by Aimag

Area	Number of people per physician		Infectious diseases per 10,000 people	
	2016	2019	2016	2019
Western region	423	381	-	72
Bayan-Ulgii	534	436	62	39
Govi-Altai	320	313	170	71
Zavkhan	389	399	111	98
Uvs	479	423	88	75
Khovd	410	334	143	86
Khangai region	447	403	-	113
Arkhangai	508	464	157	55
Bayankhongor	490	414	264	184
Bulgan	510	459	123	87
Orkhon	314	278	137	89
Uvurkhangai	447	406	193	77
Khuvsgul	544	490	170	171
Central region	372	353	-	107
Govisumber	326	264	172	95
Darkhan-Uul	351	366	317	148
Dornogovi	299	280	262	162
Dundgovi	356	305	141	87
Umnugovi	350	306	154	110
Selenge	454	437	173	67
Tuv	466	437	130	76
Eastern region	427	412	-	169
Dornod	447	410	331	272
Sukhbaatar	395	430	215	157
Khentii	446	400	155	69

Source: Statistical Yearbook 2017 and 2019, NSO

2.4 Other Important Social Sector Issues

2.4.1 Labor issues

For labor, results of some preliminary analyses are shown below.

(1) Employment by gender

Table 2.4.1 shows employment rates for women are generally slightly lower than rates for men, while unemployment rates are consistently lower for women than for men. This reflects consistently lower labor participation rates for women than for men.

According to the UN Mongolia Socio-economic Response Plan for COVID-19, during the first quarter of 2020, the labour participation for women decreased to 51.8%, while for men it had remained at the similar level of 67.1%. This has resulted in further widening the gap in gainful employment between women and men.

Table 2.4.1 Employment Indices for Men and Women

Indicators	2014			2015			2016			2017		
	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male
Economically active population, thous. persons	1206.6	567.8	638.7	1243.9	585.5	658.4	1275.7	592.4	683.3	1357.4	635.5	721.9
Employed	1110.7	526.3	584.4	1151.2	546.5	604.7	1147.8	544	603.9	1238.3	585.7	652.7
Unemployed	95.9	41.5	54.3	92.7	39.0	53.7	127.8	48.4	79.4	119.1	49.8	69.3
Economically inactive population, thous. persons	735	442.4	292.5	779	471	308	831.4	499.8	331.6	863	515.1	347.9
Labor force participation rate, %	62.1	56.2	68.6	61.5	55.4	68.1	60.5	54.2	67.3	61.1	55.2	67.5
Employment rate, %	57.2	52.1	62.8	56.9	51.7	62.6	54.5	49.8	59.5	55.8	50.9	61
Unemployment rate, %	7.9	7.3	8.5	7.5	8.2	6.7	10	8.2	11.6	8.8	7.8	9.6

Source: Socio-economic Situation of Mongolia 2017/17 page 28, Table 1.2
* Labor force participation rate=the number of persons who are employed and unemployed but looking for a job divided by the total working-age population.

(2) Percentage of active labor force

Table 2.4.2 shows there exists a large variance in recent increases in economically active population among Aimags and Regions. The economically active population increased between 2014 and 2017 by 13% nationwide and 16% in Ulaanbaatar, but it is smaller in Regions varying 16% in Central Region, 8% in Khangai Region, 9% in Western Region and 5.0% in Eastern Region.

Table 2.4.2 Economically Active Population in Aimags and Regions

Unit: 1,000

Aimag	2014	2015	2016	2017
Total	1,206.6	1,243.9	1,275.7	1,357.4
Western region	178.2	183.5	180.6	194.0
Bayan-Ulgii	46.4	49.5	43.9	53.2
Govi-Altai	26.7	27.5	26.4	28.3
Zavkhan	37.3	32.1	33.6	34.6
Uvs	34.2	38.5	36.6	38.2
Khovd	33.6	36.	40.1	39.7
Khangai region	260.9	261.3	274.6	282.7
Arkhangai	45.3	42.3	44.6	45.2
Bayankhongor	40.	41.7	45.1	43.3
Bulgan	28.1	28.3	28.2	30.8
Orkhon	40.3	39.2	42.7	42.1
Uvurkhangai	54.4	53.4	54.4	59.7
Khuvsgul	52.7	56.5	59.7	61.6
Central region	202.8	208.2	215.2	234.4
Govisumber	5.1	6.3	6.2	7.7

Darkhan-Uul	36.7	39.8	38.	42.5
Dornogovi	28.7	27.1	31.2	33.4
Dundgovi	22.1	21.2	22.2	23.7
Umnugovi	30.3	29.	28.4	30.3
Selenge	35.9	37.4	40.2	46.5
Tuv	44.	47.3	49.	50.3
Eastern region	88.5	96.7	93.7	92.7
Dornod	28.7	31.7	31.1	31.5
Sukhbaatar	27.7	29.6	30.	29.3
Khentii	32.1	35.4	32.6	32.
Ulaanbaatar	476.1	494.1	511.5	553.6

Source: Socio-economic Situation of Mongolia 2017/17 page 29, Table 1.4

(3) Types of employment

As shown in Table 2.4.3, the total employment in Mongolia increased by 11% between 2014 and 2017, and rates of increase in employment by sector during the same period were 15.0% for agriculture, 27% for mining, 9% for manufacturing and 10.6% for services. The employment share is the largest for services with 53.5% in 2017, followed by 28.9% for agriculture. The shares are much smaller at 8.0% for manufacturing and only 4.0% for mining in 2017.

Table 2.4.3 Total Employment by Sector

(Unit: 1,000)

Divisions	2014	2016	2017	2018	2019
Total	**1,110.7**	**1,147.8**	**1,238.3**	**1,253.0**	**1,146.2**
Agriculture, forestry, fishing and hunting	310.72	348.49	356.42	334.1	290.2
Mining and quarrying	40.93	38.21	52.02	57.7	57.9
Manufacturing	85.5	86.1	93.06	100.8	90.4
Electricity, gas, steam and air conditioning supply	15.45	16.16	17.46	16.3	19.3
Water supply; sewerage, waste management and remediation activities	7.14	6.03	4.86	6.9	10.8
Construction	81.13	71.48	70.6	76.6	68.8
Wholesale and retail trade; repair of motor vehicles and motorcycles	170.23	172.67	204.47	211.2	160.4
Transportation and storage	69.82	65.93	72.7	73.6	61.1
Accommodation and food service activities	36.55	32.14	36.45	37.4	36.3
Information and communication	17.8	18.13	14.49	14.1	13.0
Financial and insurance activities	22.92	21.86	24.12	25.7	24.3
Real estate activities	1.08	0.77	0.38	0.8	1.2
Professional, scientific and technical activities	12.53	12.68	12.74	14.6	18.0
Administrative and support service activities	12.01	15.04	20.83	18.2	20.2
Public administration and defense; compulsory social insurance	66.14	74.18	82.24	76.2	86.0
Education services	89.55	94.99	98.88	98.7	96.1
Activities of households as employers	37.49	40.98	39.97	49.4	44.4
Arts, entertainment and recreation	10.6	10.09	10.1	13.8	18.0
Other service activities	20.11	19.75	22.73	23.4	24.5
Activities of households as employers	1.41	1.06	2.29	1.2	3.3
Activities of extraterritorial organizations and bodies	1.61	1.1	1.51	2.3	2.0

Source: Socio-economic Situation of Mongolia 2017 page 31, Table 1.7; Statistical Yearbook 2019, NSO

(4) Employment services

The Ministry of Labour and Social Policy (MLSP) is providing unemployment support to those seeking jobs as well as payment of unemployment benefits. However, unemployment benefits are paid based on certain conditionality, such as having had steady employment for at least past three years. Employment services are provided by representatives of the MLSP Agency at Aimag centers.

Besides the formal employment support, there are informal agencies and middlemen, who recruit the candidates for work abroad or for employment by corporations, construction sites, farms, etc. The type and quality of employment is not regulated and there is no assurance that the jobs provided constitute 'a decent work.'

For the least skilled, lower level jobs, for example for recently arrived migrants in Ulaanbaatar from the Ger district, the unemployed may resort to any informal job, including car wash and repair, working at corner shops or water kiosks, small restaurants, hairdressing, construction etc. Small business owners typically complain that 1) Job seekers are without any training or job skills, and 2) Retention is difficult, and workers tend to leave at first opportunity. It is said that a waiting staff at a restaurant earns on average MNT600,000/month, for 12 hours work per day, which does not leave much free time, or care for family members. The indices for the planning in labor market development and employment are found under Section 2.6 in the National Five-Year Plan 2021-25.

(5) Social protection, pensions, unemployment, insurance and social security

MLSP provides pensions, social security payments, and benefits to multiple categories of people in need. The March 2019 edition of the Socio-Economic Situation of Mongolia reports that there are 31,800 active job seekers, and among the registered job seekers, 68.3% were unemployed. The official unemployment rates, the percentage of persons without employment within the economically active, have been relatively low consistently during 1995-2017. It ranges from 3.3% in 2005 to 10.0% in 2016. It improved to 8.8% in 2017. Among the unemployed, 52.1% were women, and 33% of the unemployed are in Ulaanbaatar.

The Law on Development in Mongolia, or the policy on the SDV 2030 stipulates that by 2020, labor participation rate will increase to 66% and unemployment rate will decrease to 6%. Support fund (presumably public) to SMEs will be in the amount of MNT 100 billion. The SDV 2030 sets the target for the period 2021 – 25 as follows: to increase labor participation to 68%, decrease unemployment to 4 %, and increase funding to SMEs to MTN200 billion. For the period 2026-30, the SDV 2030 targets are to increase the labor participation to 70%, decrease unemployment to 3 %, and increase funding to SMEs to MNT 300 billion.

The gap to the targets to be achieved within 2019 and 2020 may seem marginal, but some concerted efforts may be needed to achieve these numbers. Taking, for example the number of economically active population in 2017, which is 1,357,400, this would require having 8,144 persons becoming employed and entering into the active labor force, based on new jobs and provision of vocational training. Currently the expected increase in employment may be largely based on natural attrition, with current workforce retiring or leaving jobs with few opportunities for new jobs.

There exists large variance in unemployment rates between Aimags ranging from smaller than 5.0% in Tuv (3.3%), Zavkhan (4.4%) and Dundgovi (4.4%) to 23.5% in Orkhen and 16.4% in Umnugovi as shown in Table 2.4.4. The unemployment rates are over 10% in 2017 in all the three Aimags in Eastern Region, and they vary widely in the other Western, Khangai and Central Regions. Clearly, this is a reflection of presence of limited number of large employment generators such as major mines in limited Aimags in the three regions, while Aimags of rural-oriented economy have smaller unemployment rates.

Table 2.4.4 Comparison of Unemployment Rates by Aimag

Area	Unemployment rate		
	2016	2017	2019
Western region	-	-	12.4
Bayan-Ulgii	9.3	12.4	27.5
Govi-Altai	10.1	8.6	11.8
Zavkhan	11.4	4.4	6.2
Uvs	14.2	13	8.5

Khovd	15.1	13.5	8.5
Khangai region	-	-	7.4
Arkhangai	5	5.4	5.1
Bayankhongor	11.2	5.6	8.7
Bulgan	8.2	10.7	5.1
Orkhon	22.4	23.5	8.7
Uvurkhangai	8.9	7.6	6.6
Khuvsgul	8.5	8.5	9.4
Central region	-	-	8.1
Govisumber	18.1	7.8	11.7
Darkhan-Uul	15.4	14.2	18.0
Dornogovi	9.9	6.1	5.2
Dundgovi	5.1	4.4	7.5
Umnugovi	14.3	16.4	6.1
Selenge	8.1	6.6	3.4
Tuv	2.7	3.2	5.4
Eastern region	-	-	11.9
Dornod	11.2	10.1	20.5
Sukhbaatar	9.9	10.9	6.2
Khentii	12.9	10.3	8.8

Source: Statistical Yearbook 2017 and 2019, National Statistical Office of Mongolia

Labor related indices are summarized in Table 2.4.5 for Mongolia and by Aimag. Labor force coefficient (LFC) or the ratio of working age population to the total population often indicates degree of employment seeking migration. LFC in Mongolia is 63.2 in 2017. LFC is lower than the national average in nine Aimags: Bayan-Ulgii, Uvs, Khovd, Arkhangai, Govisumber, Drakhan-Uul, Tuv, Dornod and Khentii. Most of them are out-migrating Aimags losing working age population, and hence low LFC. Govisumber may be different. As the mine development proceeds, relatively young families with small children may be moving in to increase the youth population, resulting in decrease in LFC. The case of Tuv may also be the same.

Labor participation rate (LPR) or the ratio of economically active population to the working age population often distinguish urban- and rural-oriented socio-economy. If number of people engaged in agriculture is comparatively large, LPR tends to be large due to high participation rate of women. On the other hand, in urban-oriented society, comparatively more people seek higher education opportunities and stay away from employment, and hence low LPR. LPR is a composite outcome of these and other factors. LPR in Mongolia is 67.6 in 2017. LPR is lower than the national average in six Aimags: Bayankhongor, Orkhon, Darkhan-Uul, Selenge, Dornod and Khentii. Only three Aimags of Darkhan-Uul, Dornod and Khentii have both LFC and LPR lower than the respective national averages. Dornod and Khentii are out-migrating Aimags and have more urban-oriented economic activities. The case of Darkhan-Uul needs further investigation.

Table 2.4.5 Comparison of Labor Related Indices by Aimag

Area	Labor participation rate		Labor force coefficient	
	2016	2019	2016	2017
Western region	-	63.8	-	-
Bayan-Ulgii	63.2	43.7	59.9	59.5
Govi-Altai	74.3	74.2	64.3	63.9
Zavkhan	76.2	69.7	64.1	63.9
Uvs	76.6	68.2	61.9	61.4
Khovd	73.4	77.1	62.7	62.3
Khangai region	-	67.3	-	-

Arkhangai	74	76.7	63.9	63.1
Bayankhongor	71.1	59.6	64.2	63.7
Bulgan	73.4	73.2	65.3	64.9
Orkhon	67	56.6	66.0	63.2
Uvurkhangai	75.5	68.7	63.9	63.3
Khuvsgul	61.4	69.5	65.6	63.5
Central region	-	65.1	-	-
Govisumber	52.4	74.6	62.2	61.6
Darkhan-Uul	51.5	59.4	63.0	62.2
Dornogovi	70.7	68.9	63.9	63.5
Dundgovi	73.3	74.8	64.4	63.7
Umnugovi	69.7	71.0	64.0	63.8
Selenge	62.7	56.1	64.0	63.5
Tuv	80	67.9	64.2	62.9
Eastern region	-	63.1	-	-
Dornod	52.9	55.6	63.4	62.2
Sukhbaatar	77.1	73.2	64.5	63.8
Khentii	62.3	63.6	62.9	63.1

Source: Statistical Yearbook 2017 and 2019, NSO

2.4.2 Social protection and social welfare[45]

According to the March 2019 edition of Socio-economic Situation of Mongolia, published by NSO, following three major types of social security benefits are being disbursed by respective offices. The Social Insurance Fund had a revenue of MNT640.0 billion during the first quarter of 2019, and expenditure of MNT574.6 billion. During this period, a total of 323,000 persons received various allowances and pensions from the Social Insurance Fund, which is established through the contributions from employers, insured salaries for the payment of unemployment benefits, pensions and social welfare allowances. These include the allowance for guardians of 0 to 3 years old, and benefits to pregnant women.

During the period up to 2019, 52,800 persons received social welfare pensions, out of which 68.5% for the disabled, 26.6% for orphaned children under 18, 4.7% for the elderly, and 0/2% for those suffering from dwarfism. During the same period, 72,200 persons received social welfare allowances, of which 67.7% were nursing allowances, and 32.4% for emergency and livelihood support.

During 2020, as response to the COVID-19 pandemic, Mongolia implemented a number of commendable social protection measures. Following the approval of Resolution on Supporting the Livelihood of Citizens during the Disaster of Coronavirus Pandemic (COVID-19) and Social Protection Measures to Activate the Economy in May,[46] various additional benefits were approved, including child support, food stamps, and subsidies for herders' products.

Following are reported outbreaks in the cities, and measures taken in response.

<u>COVID outbreaks in the cities</u>

As of January 10, 2021, total confirmed cases are 1442, total recovered 896, and total deaths 2 in Mongolia. Confirmed cases consist of 616 in Ulaanbaatar, 217 in Selenge, 45 in Darkhan-Uul, 32 in Dornogovi, 25 in Darkhan-Erdenet, 4 in Govisumber, 3 in Arkhangai and 500 imported by persons

45 For the purpose of this report, terminology follows those in English used in the NSO publication, including social insurance, welfare, pensions, benefits (Socio-economic Situation of Mongolia, 2019). Types and classification of social welfare services have been revised following the amendment of Social Welfare Code of Mongolia, as of January 2019.

46 https://www.legalinfo.mn/law/details/15358?lawid=15358

coming from abroad (Source: MOH).

Measures undertaken by the Ministry of Health, MLSP, and MOES.

From 11 January 2021, the strict quarantine has been eased throughout the Country. However, the governors of territory units such Ulaanbaatar and Aimags have issued their own order for continued measures.

Ulaanbaatar:

- Entities can run their business except 18 types of business activities, which are trades in non-food goods, any gathering activities, all kinds of bars, exhibitions, all kinds of playgrounds, sport activities such as gyms, fitness, religious activities, art and cultural activities, hairdressing and beauty, tourist camp, hotel, fast food points, home cleaning service, video recording, and training for more than five people.
- The limitation of the traffic to Ulaanbaatar has been eased. People can enter into Ulaanbaatar, but the persons coming from the Aimags having COVID-19 are required to bring the result of PCR test.
- The limitation of the traffic out of Ulaanbaatar is still strict. In general, people are not allowed to go out from Ulaanbaatar except people conducting special duties and having respectful reasons.

Ministry of Health:

- One member of each household in the infected areas is being PCR tested. Many temporary test centers are organized in the school buildings
- Measures raising public awareness have been taken such as developing various advice on how to prevent, protect, take immediate actions. One good practice is that citizens receive text messages every day from the MoH during 2020. Messages remind to wash hands, ventilate for fresh air, wear mask, conduct wet cleaning of the home, consume food for supporting immune system, among others.

Ministry of Education:

- According to the academic year plan, the spring semester will start from the 1st February. The Ministry has not announced yet whether the spring semester will proceed online or in-person. The Minister said that they are planning to organize lessons in hybrid version including online and in-person in the Parliament.

MLSP:

- According to MLSP, the measures undertaken in 2020 will be continued as follows (from January 1-July 1, 2021):
- Social insurance premiums: employee will pay 1% out of 9.5% and employer will pay 1% out of 9.5%. Employees are completely exempted from other premiums related to insurance like unemployment
- Social welfare: child money for every child-MNT100,000/per month (1.2 million children); allowance for children under 16 years of age in need of permanent care increased by MNT100,000 and then it becomes MNT288,000/per month (total persons covered 11,800); social welfare pension increased by MNT100,000 and then it becomes MNT288,000/per month (total persons covered 59,300);
- They will continue food and non-food support to the vulnerable households
- Under the World Bank's Employment Support Project, MNT7.6 billion soft loan will be provided to 1,000 micro businesses.

Other measures undertaken by the Government:

All households are exempted from the payment of utilities (electricity, heating, water, and waste) from December 1, 2020 to July 1, 2021. For households in the Ger area, the improved fuel for cooking and heating payments are reduced by 50%.

In addition, the Government of Mongolia has introduced social insurance contribution exemptions from

April 1 to October 1, 2020. However, a risk of budget shortfall for social welfare due to reduced budget revenues and increased spending is reported as follows.

"…people who fully rely on social welfare, such as elderly people, persons with disabilities and unemployed persons, will be left behind, as the Government will not be able to continue providing topped up social protection benefits after 1st of October. In addition, social insurance contribution exemption reduces the undue financial burden for employees and employers who otherwise may lapse on their payments, which could make the employees ineligible to obtain pensions and other benefits such as unemployment benefits in the future, as well as for the Social Insurance Fund (SIF) that still needs to pay out the recurrent pensions and benefits from the social insurance contribution revenues.

Pensions and social benefits account for about 40% of income for the poorest quintile and about 8% for the richest quintile, showing significant reliance of poor households on cash transfers provided by the Government as well as lack of other means of monetary income. Yet, the richest 20% of households in Mongolia benefit similarly or even more from pensions and social benefits (20%) as the poorest nearly 20% of households (17%). Since contributory pensions might account for a larger fraction in this current analysis, there is a need for deeper study of social benefits for household groups, including the possibility of better targeting of social welfare measures."[47]

Mongolia's social security services are extensive, but it may not be as efficient because of its broad coverage rather than targeted approach. It is explained that four broad types of payments are made: social welfare payments including unemployment, pensions for old age, disability, social insurance for industrial accidents and occupational disease (IAOD) that prevents someone from working, temporary payments, for example for pregnancy, but also for care of elders or the disabled. The bulletin states that a total of MNT18.2 billion were provided to 911,000 children under the age of 18 years of age as children's cash allowances. This comprises 0.6 % of the social welfare payments, and it increases the entire social security payments to 1.4 % of the GDP.

There is a debate if all citizens should receive this payment regardless of the household income. Although there may be philosophical sensitivities about all citizens being respected/recognized for the child, based on the principle of departure that the gap between the rich and poor needs to be reduced, also in the approach, this point needs to be debated.

In the 4th category of cash benefit for particular conditions, there is a wide range of criteria for coverage, including the elderly, military, pregnant and lactating mothers, caring for elderly, caring for disabled, adoption of children and adoption of orphans, honorable citizens, mothers with more than four children, to name the few. All social benefits and insurance payments are administered by MLSP except for health insurance, which is managed by the Ministry of Health. Such detailed distribution of benefits is not only a burden on the state budget, but also an administrative burden to the Ministry.

Some of the benefits may no longer be relevant for the socio-economic status of Mongolia as Middle Income Country (MIC) (or at some point higher MIC), and may be either substituted by other sources of salary supplement or benefits, for example through paid maternity leave instead of pregnancy money, or administered based on the factor of poverty and lower income households. A comprehensive information and communication technology (ICT) system to manage the benefits in an integrated, one single system may be beneficial.

There is currently one shortcoming to the administration of social security and benefits, which is the issue of unregistered internal migrants. A formal registration is necessary for land ownership, housing contract, education, health coverage and social security payments, and especially following the ban on registration of newly arrived migrants in the Ger district. Since 2017, estimated 21,000 annual new arrivals in Ulaanbaatar city are not formally registered. As the population in the Ger district is reaching around 25% of the population of Mongolia, this is fast becoming a major risk and threat to the welfare of this group of population.

There exist alternative schools of thought for social security: universal coverage vs. self-help. The social security is based on the concept that everyone should be assured basic levels of living and income,

47 UN Mongolia Socio-economic Response to COVID19.

and cash distributions are made to the poorest households. This is in line with the socialistic way of thinking. How to introduce self-help elements in the social security is an important issue to be addressed in the NCDP.

Preliminary discussion and feedback obtained by the NCDP team indicate that there are private sector entities, that may be capable and interested in handling some of the social insurance, management of pensions and unemployment benefits, for example. Reviewing the institutional arrangements of social benefit functions in other countries, the Government of Mongolia could consider a step-by-step path to autonomous management and privatization of some of the functions by separating the current agencies dealing with social welfare, insurance and pension administration as autonomous entities. The current workforce may continue to manage the administration, but with gradual infusion of private sector management and re-investment of the funds in a secure manner.

2.4.3 Persons with disabilities

The Vision2050 aims to create an inclusive society by 'ensuring high quality social security, environment conducive to happy family lives, and high quality education as the foundation of national development in order to attain HDI at 0.9 and 10th rank by happiness index. For this goal, seven objectives are established to cover education, health care, population management, research and development, social services, employment and inheritance[48]

It is noted that as of 2018, 3.3% of the total population of Mongolia, or 105,730 citizens, are registered as people with disabilities and 33.7% are living in Ulaanbaatar.[49] Regarding the school drop outs and out-of-school children, there is evidence that a major proportion of children not attending the schools are those with physical, functional or mental disability[50]. The Ministry of Labour and Social Policies issued the White Paper on Disability in 2017-18 with the support of JICA in three languages: Mongolian, English and Japanese through the 'Project for Promoting Social Participation of Persons with Disabilities in Ulaanbaatar City'. The White Paper may serve to raise general awareness on the need for inclusion of disabled persons, providing guidelines for accessibility in public facilities and workplaces as well.

An important step for inclusion of persons with disability is a role played by vocational training institutions, or TVET. As of 2018, learners with disabilities represented only 5% of all TVET students. As stated in the Law on TVET 2009, every Mongolian citizen has the right to take on TVET in accordance with their previously acquired education, skill level or area of interest. The immediate challenge, as outlined above, is that some people with disabilities miss out on the opportunity to complete basic education. Developing an interest in an area is challenging for groups that are excluded from many aspects of society.[51]

In order to assure a truly inclusive society, and participation of persons with disability into all aspects of social life, following the clear declaration of policy statement in the Vision 2050, and necessary legal framework, an action plan may need to follow with reforms of institutions, supporting mechanisms, allocation of budget, training of staff, and most importantly a creation of a public consensus and enabling environment regarding the inclusion of persons with disability in all areas of daily life instead of seclusion. It is noted that there may be logistic challenges considering the distances, and physical access to public service providers and institutions, and good practices from around the world may serve as reference.

2.4.4 Poverty and inequality

Profile of poverty in Mongolia has been described by the World Bank (WB) and the NSO in 2016 as

48 JICA Project Team
49 Education Sector Medium Term Development Plan 2019.
50 Interview with Save the Children Japan
51 World Bank, Advancing education equity, efficiency and outcomes

follows[52]:

(a) Incidence of poverty increased by 8% between 2014 and 2016, cancelling the downward trend in poverty the Country experienced since 2010;
(b) The poverty rate however remains below that of 2010;
(c) Incidence of poverty is higher in rural areas (34.9%) than in urban areas (27.1%), however the difference has narrowed from 15.9 to 7.8 percentage points;
(d) Of all the poor, 62.1% live in urban areas, and 37.8% in Ulaanbaatar; and
(e) Household consumption fell by 8% compared to the boom years between 2010 and 2014, due to rapid increase in unemployment, decrease of wage income (15% between 2014 and 2016) and shift to family business and informal economy; pensions, unemployment benefits and other transfers did not compensate for the loss in cash income through wages.

Based on lessons for the recent trends, the following are recommended:

(i) More stable economic environment is needed that sound business opportunities flourish and steady source of employment are created to avoid wide oscillations in standards of living; and
(ii) A more flexible social assistance mechanism is needed that reacts to changes in economic conditions (e.g. a recession) and provides transfers to population groups based on their means and needs rather than based on their population general characteristics."[53]

Poverty situations in Mongolia in 2016 are compared by Aimag in Table 2.4.6. As seen from the table, there exists wide variance in poverty incidence or headcount between Aimags ranging from 15.4% in Umnugovi to 52.4% in Govisumber in 2016. The national poverty incidence was 29.6% in 2016. The poverty incidence is relatively high in Aimags in Western Region and Eastern Region.

Poverty gap measures the extent to which standard of living of the poor is under the poverty line, i.e. depth of poverty. Poverty severity is the degree of inequality among the poor or severity of deprivation of absolute poverty. Three Aimags of Dornod, Sukhbaatar and Khentii have not only high poverty incidence, but poverty gap is large and poverty severity is also high. Govisumber has the highest poverty incidence, largest poverty gap and highest poverty severity as well. Except Govisumber, Aimags in Central Region are relatively better off with respect to poverty, followed by Khangai Region.

The other important aspect in the consideration of poverty is inequality and growing gap between the rich and the poor, and its perception. The VNR on SDG achievement in 2019[54] reports the following:

"During 2000-17, the Country's Human Development Index improved by 20.5%, increasing from 0.589 to 0.741. However, the Inequality-adjusted Human Development Index was 0.639 in 2017, which is lower than the overall index, reflecting a loss of 13.7% due to inequality in education, health and income levels."

The VNR explains that there are six groups of persons who are considered particularly vulnerable:

"Along with poverty and inequality, certain groups of people are systematically excluded from being able to benefit from overall development. Specific groups at risk of being left behind are children, youth, elderly, people with disabilities, herders and internal migrants to urban areas that require the government's prioritized social policy."

52 World Bank and NSO Mongolia Poverty Profile 2016
53 ibid
54 Mongolia Voluntary National Review Report 2019

Table 2.4.6 Comparison of Poverty Indices by Aimag

Area	Poverty headcount ratio	Poverty gap	Poverty severity
National average	29.6	7.7	2.9
Western region	36	9.7	3.7
Bayan-Ulgii	34.4	9	3.4
Govi-Altai	43.3	12.2	4.7
Zavkhan	47.5	14.6	5.7
Uvs	24.2	6	2.3
Khovd	36.8	9.3	3.4
Khangai region	33.6	8.2	2.9
Arkhangai	37.6	8.4	2.8
Bayankhongor	38.8	8.2	2.8
Bulgan	31.4	7	2.2
Orkhon	23.5	6.6	2.5
Uvurkhangai	41.1	11.7	4.4
Khuvsgul	29.1	6.9	2.4
Central region	26.8	7	2.7
Govisumber	52.4	17.5	7.9
Darkhan-Uul	33.4	8.1	2.9
Dornogovi	23.2	6.3	2.6
Dundgovi	22.9	5.4	1.8
Umnugovi	15.4	2.6	0.8
Selenge	36.4	11	4.6
Tuv	17.3	3.7	1.3
Eastern region	43.9	12.5	4.8
Dornod	41.5	12.3	4.8
Sukhbaatar	47	13.7	5.4
Khentii	43.8	11.7	4.3
Ulaanbaatar	24.8	6.4	2.5

Source: Statistical Yearbook 2017, National Statistical Office of Mongolia

Under the COVID-19 pandemic, poverty incidents in Mongolia has exacerbated, and also new categories of vulnerable persons have emerged. There are 28% of the population below the poverty line, and 15% who are just above it. NSO has categorized the vulnerable groups who may risk being ‘left behind’ as: households with multiple children, headed by youth, single parents, people with disability and disease, herders with small number of livestock, those receiving food stamps, with low education, unskilled, unemployed,

The UN indicates following as vulnerable: SMEs, women, workers in informal sector, crop and vegetable farmers who rely on purchase of inputs, survivors of gender-based or domestic violence, those with disabilities, elderly, with recent migration, landless, non home owners with high rent, migrants and returnees from abroad.

In the Five Year National Plan 2021-25, the Mongolian Government is spelling out comprehensive targets for inclusive human development, and outreach to vulnerable population including persons with disability. Continued efforts for poverty reduction are included in the Plan as the goal for reaching zero poverty will require sustained and targeted interventions.

2.4.5 Socio-cultural aspects and ‘nomadic’ lifestyle

The nomadic life is a characteristic of Mongolia as well as an intangible cultural heritage. Along with the degradation of grassland, impact of climate change and natural disasters such as Dzud and drought, the shrinking possibilities for herding and herders abandoning the nomadic life for migration into urban areas, there is a sense of crisis about losing the national heritage of the nomadic way of life. As cultural heritage, nomadic lifestyle will be an important resource for tourism in Mongolia. Although there is a consensus about the need to preserve the culture of nomadic life, the hardships, and risks associated with the herding lifestyle would have to be taken into account.

The livelihood of herding is not protected or assured as it is highly dependent on natural conditions, and it is increasingly under pressure by degradation of land and loss of pasture, as well as impact of Dzud. On one hand the life of the nomads needs to be assured through improvement in animal herding including semi-intensive livestock, and agricultural insurance. Access to services such as healthcare, education, and social benefits need to be facilitated. The keen interest to provide the children with education is prompting internal migration to the cities, in particular to the capital Ulaanbaatar, and also for the families to be split: the men herding widely, while the mother and children remaining at Soum centers for the children to attend school. There is considerable pressure on the family, resulting in some breakdown of family structures.

For the urban dwellers, the herding and nomadic lifestyle are quickly becoming a legacy of the past, and there are generations which have not experienced the herding lifestyle closely. There are suggestions to incorporate summer school and camping for children from the cities to herding communities, to experience the nomadic way of life closely in a safe and enjoyable manner. As the society is becoming more divided – between the rural and urban, nomadic and city dwelling, the distance needs to be minimized, through shared experiences from both sides.

2.4.6 Gender concerns and stress on the family

The gender concerns in Mongolia are sometimes described as "hidden" due to the overall positive outcome of indicators in gender matters, which makes Mongolia stand out both among countries of similar income group, and regionally among the countries in Asia and Pacific as described above.

Regarding gender concerns in employment, there is evidence that "compared to men, women on average are better equipped with income- generating characteristics in general and a high level of education in particular. At the same time, women are less likely to make use of their educational attainment by actively participating in the labor market."

The World Bank report in 2016 states "With the exception of a short period of time around the year 2006, labor participation rates in Mongolia have generally been much higher among men than among women. Between 1996 and 2015, the gender gap in labor participation rates more than doubled from 4.8 percentage points to 12.6 percentage points. In addition, employed women have consistently had lower average earnings than employed men. In 2015, men on average earned MNT856,000 per month and women MNT760,700. As a result, the relative gender earnings gap stood at 12.5%. Marked differences also exist in the types of jobs typically pursued by men and women. A relatively large share of women—particularly in rural areas—is employed in precarious informal work and unpaid family work, women's participation in entrepreneurial work is far lower than that of men."[55]

Qualitative data on gender disparities in employment and labor markets should be compiled and analyzed to confirm the previously held perception as follows.

"Women of various age groups and levels of education speak of pronounced gender-specific difficulties in accessing jobs and career opportunities. Again, according to the perceptions of participants in focus group discussions, many women that do hold jobs frequently feel trapped in precarious working conditions. Many employees perceive their workplaces to be dependent on norms and values that could be characterized as traditional, hierarchic, and at times even authoritarian. Open mistrust and even fear of managers and employers is widespread. Many workers complain of a lack of long-term job security and an absence of secure wage payments and access to health insurances and pension systems."[56]

It is reported that working conditions are in particular precarious and renders women vulnerable in the

55 ibid
56 ibid

private sector, especially in construction sector, and in general in informal sector. There appears limited social protection of both genders, but in particular women with the “hire and fire” mentality of employers in the informal sector. Some issues are more specific, such as the inflexibility of working hours without sufficient consideration of the women’s responsibilities in childcare and household chores.

For new graduates at different levels of education, there appears to be insufficient support and guidance, and availability of information on career choices, availability of employment, and opportunities of network support. There are structural issues such as lack of adequate legal framework and advice, inadequate childcare, as well as societal expectations in women’s gender roles regarding dedicating support to the household and childcare.

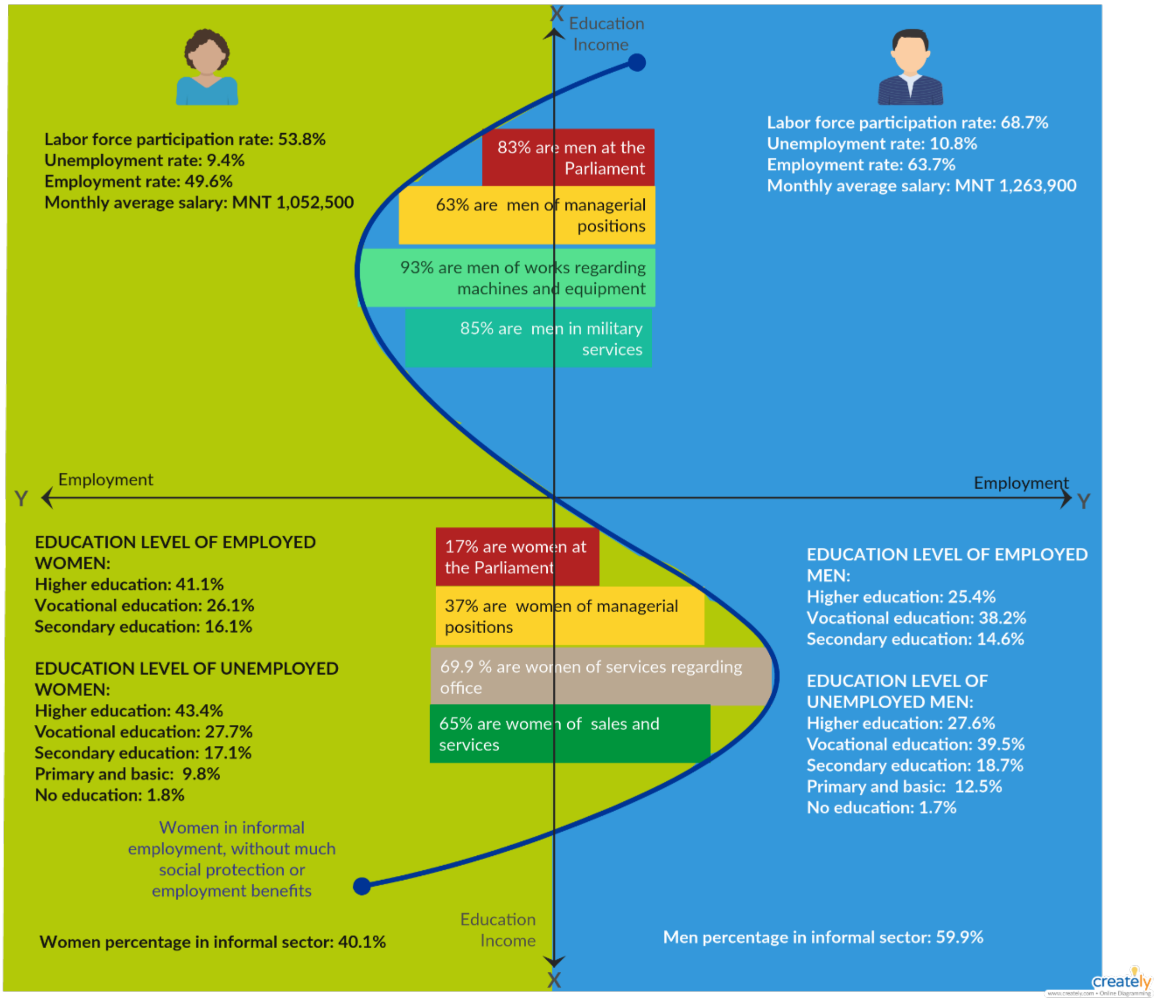
In the public sector as well, there is a general perception that there are highly competent and dedicated women, whose careers usually oscillate at senior officers of heads of departments level and not at senior management level. There may also be an incidence of the lack of leadership and role models for young women to aspire to and perpetuate, defending their careers among the peers and at family level.

Outside of the career and employment field, there are a number of gender issues that need to be taken into consideration in the NCDP. These include: attention to the female headed households and single mothers, which constitute over 8% of all households[57], growing incidence of Gender-based-violence against women, and reproductive health issues including teenage pregnancies.

The gender issues are affecting both men and women, at all levels of education, socio-economic status, and employment. The NCDP team reviewed the range of impacts from the perspective of economic gain and loss, either to the society as financial and opportunity cost, or to individual as financial, social or costs in status.

In Figure 2.4.1, the vertical axis indicates the levels of income, education and economic status of persons, with the top level earning most income and the bottom the least. The horizontal scale measures gainful employment and opportunities to engage in labor activity as a result of previous investment in education and preparation.

57 Socio-economic Situation of Mongolia 2017 - tbc



Source: JICA Project Team

Figure 2.4.1 Gender and Employment "S" Shaped Curve

The field to the left indicates female population, and the right, male population. At the top end of bottom half, it is seen that women are dominant in the labor market. This is caused by the higher number of male students dropping out of school or university, and abandoning education. While the males are able to obtain gainful employment immediately as a result, the salary may be lower than those earned by people in the same age group who have completed their education. This is causing a loss of investment and opportunity cost to the private and public education institutions and universities, as both sexes are not participating in education equally.

Women at this level of vertical axis have good labor participation and are often enjoying positions with responsibility and certain level of managerial responsibility. Due to the higher qualification and professional status of women, there are anecdotal reports that men find difficulty in marrying women of similar age group, and vice versa.

However, at the top level of organizations, whether the public or the private sector, the senior leaders and management are almost always male. The ratio of women in managerial positions is reported as 37.6%, and at the Parliament 17%, depending on the level of seniority. Here, the women may be frustrated, and there is an economic loss of not realizing the full potential of their academic investment.

At the bottom end of the spectrum, women are often engaged in informal employment, often without much social protection or employment benefits. These are also categories of employees who may be hired and fired at the employer's will.

Men in this category, who are herders may have higher level of labor participation and they may also have access to cash income. They are, however at risk of not having regular health care and checkups or other formal benefits and social security.

For both men and women at all levels of education and economic status, it will be ideal to have a win-win situation to avoid economic loss both to the society and individuals as well as stress to the family, such as difficulty in finding marriage partners.

The gender imbalance has an impact on the institution of family as well. At the mid-career level, men may find it difficult to identify partners and spouses who are willing to marry someone who has less education. The frequent divorce increases the single parent and female headed households, reaching 8% which would deserve attention. Families are often split up, especially among the herder families, with men and boys engaged in moving with livestock for grazing often at long distance, and women and children remaining at Soum center where children attend school. In some cases, children from 6 years onwards are enrolled at boarding schools at Soum centers, separated from the family.

Families may become separated when some member leaves for work in another city or abroad. It is reported that children are often subject to abuse at the time of parents' re-marrying or finding another partner. Gender-based and domestic violence is also on the increase which may be linked to partners' unhealthy coping mechanisms including alcohol use. In reproductive health field, teenage pregnancies and abortions are increasing the cases of at-risk young women and teenagers.

At the same time, attention will need to be paid to disabled children and persons, for the education to become inclusive. The inclusive approach needs to be followed from pre-school up to higher levels of education, vocational and specialized training as well as life-long learning.

2.4.7 Population aging

Mongolia, similar to the world-wide trend and to the pattern in East Asia, will see its working age population shrinking, and the elderly population increasing by 2040, in gradual ageing of the society with a shift of the population pyramid (Figure 2.4.2). According to the official projections, the overall population will increase from 3,278, 292 in 2020 to 4,089,199 in 2040. With increased life expectancy, the burden on working age population is expected to grow.

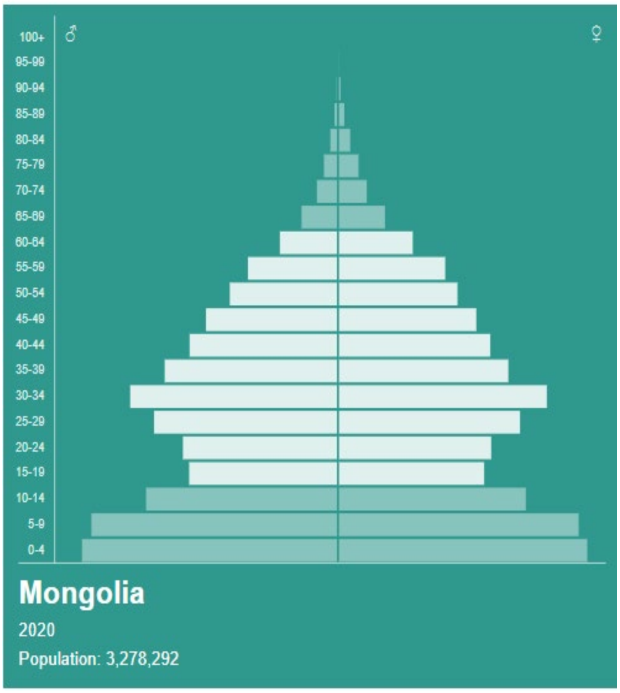


Figure 2.4.2(a) Population Pyramid in Mongolia for 2020

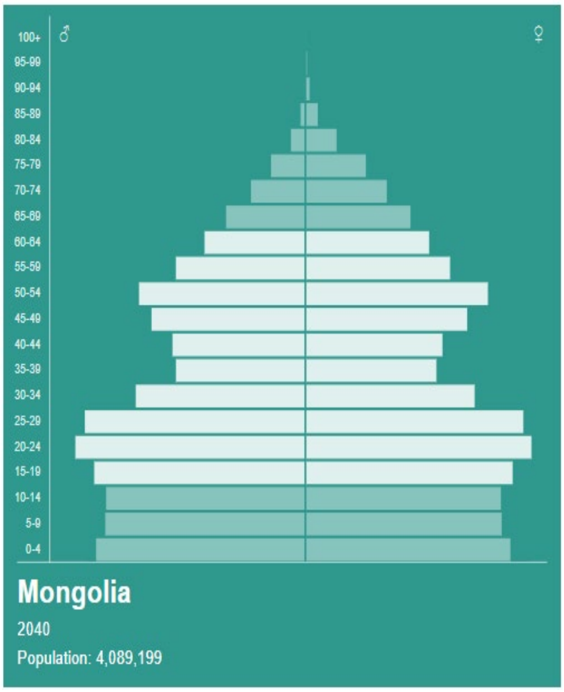
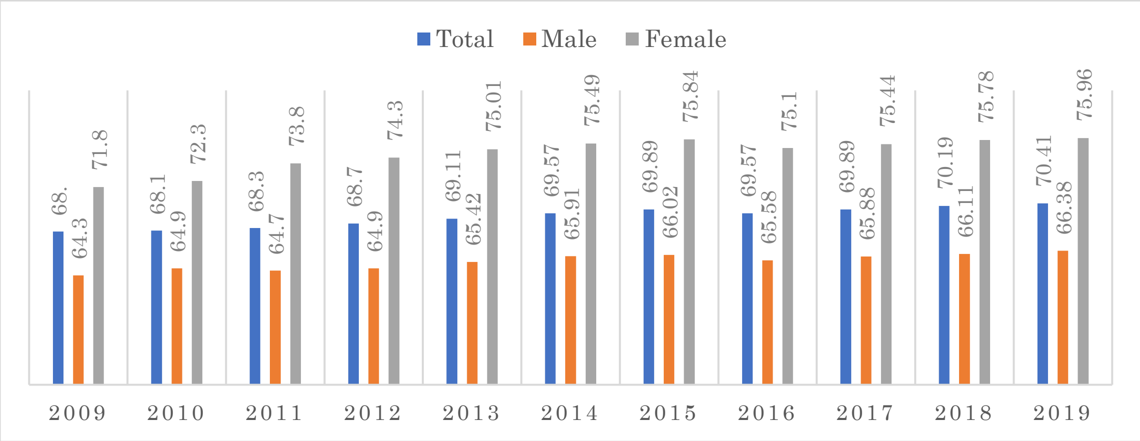


Figure 2.4.2 (b) Population Pyramid in Mongolia for 2040

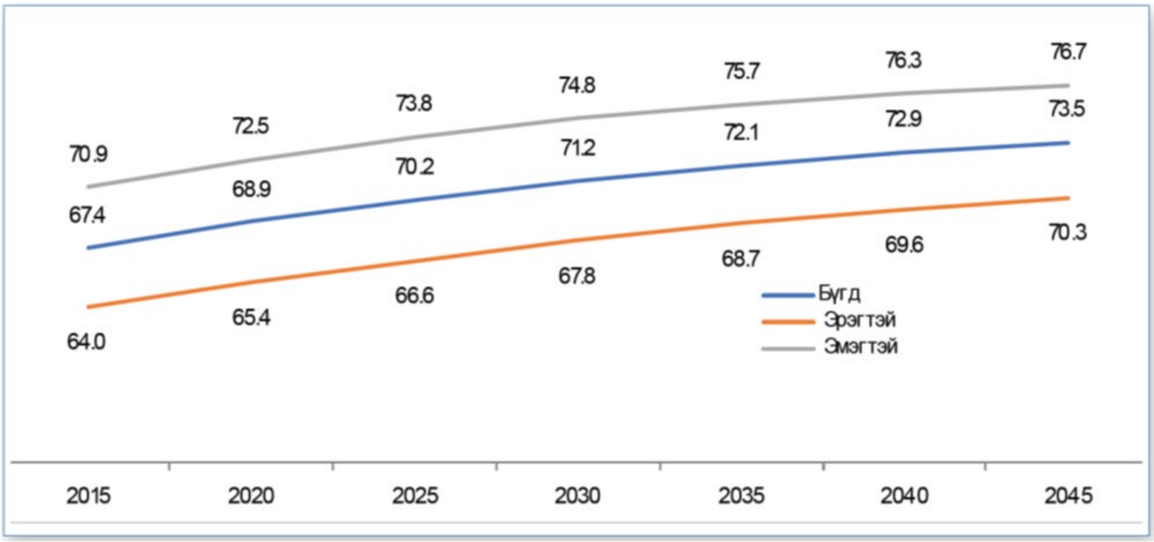
Mongolia has been preparing for the shift in demographics, as the Parliament amended the Elderly Law in 2017. There are various benefits for the elderly such as free public transport, medical care, discount at designated rehabilitation centers or resorts. There are various categories of monetary benefits for the elderly as well. In addition, there are many non-monetary supporting services. For examples, trade, transportation, communications, health and public services will provide priority services to the elderly.

Life expectancy in Mongolia has been increasing consistently in recent years (Figure 2.4.3). According to the NSO projection made in 2017, the life expectancy will be as follows in 2040: 76.3 years for both sexes, 72.9 years for female and 69.6 years for male (Figure 2.4.4).



Source: NSO

Figure 2.4.3 Changes in Life Expectancy in Mongolia, 2009-19



Source: NSO

Figure 2.4.4 Projection of Life Expectancy in Mongolia to 2015-45

Based on the NSO data of population projection in 2040, there are gaps between male and female populations in each age category. According to this assumption, women will be widows for around 13 years (76.3-50=13). It is concluded that 15% of women aged from 50 to over 70 will be widowed in 2040. Currently there are no pension for widows from the deceased husband/wife (widow's pension). However, it is the one of pension reform topics and it may be expected to be introduced in near future.

As a way of life, elders may stay with their family, relatives, or alone. Organized support or communal activities with others in their age group such as elderly group activity as seen in some countries such as day care, or volunteer companion's support for errands and home-based care may not be very common in Mongolia. Elders without relatives looking after them live in specifically built nursing home.

There are eight local nursing homes in Aimags, and one nursing home at the national level.

It is recommended to develop strategies for increased involvement of the elderly in society for the coming future, in view of the more active and longer years of retirement expected, for the well-being, mental health, and fulfillment of their quality of life. Some elderly may require assistance in income-generating activities. Management of such care could be decentralized to regions, and at community level. There are successful practices in Asia and Pacific that can be reviewed and replicated.

There have been a series of workshops organized through a regional project by ADB to raise awareness regarding comprehensive care for the elderly, in addition to provision of pensions and benefits. This is the area that is expected to undergo further development.

2.4.8 Internal and external migration

According to the study published in 2018 by the International Office of Migration (IOM), most of internal migration in Mongolia of last 30 years occurred from rural areas to Ulaanbaatar, both de-populating the rural communities and resulting in overcrowding and congestion in urban areas, in particular the Ger district.[58]

Between 2011 and 2018, around 126,143 people moved from rural areas to Ulaanbaatar, increasing the percentage of national population living in the capital city from 26.8% to 47%. Today, over 60% of the population of Ulaanbaatar are living in the Ger district.[59] " Most moved in search of jobs, better living conditions, educational opportunities, better health services, or to reunite with family members."[60]

In the second study conducted by NGO Ger Community Mapping Centre, much of the vulnerabilities of the migrant community are described.[61] Both studies have been funded by the Swiss Development Agency (SDA).

For internal migration, the IOM and Swiss Development Corporation (SDC) have published Mongolia Internal Migration Study in 2018, which analyses the reasons for herders to migrate to Ulaanbaatar city. The reasons for migration are often complex, and it involves individual's desires and aspirations as a base, but decisions are often taken by the family collectively rather than by individuals.

The desire to have the children obtain education, and to have access to health care rank high among the reasons to migrate. The NCDP has established that there are 'push' factors, and 'pull' factors for migration. The push factors prompting migrants to leave their place of origin, may be considered negative factors impacting their livelihood and well-being, and these include the impact of Dzud and loss of livestock, loss of grazing areas, climate change, and financial hardships, or illnesses and health issues. The pull factors which attract the migrants to move to a new destination, usually a city and particularly the capital, Ulaanbaatar, may be access to jobs and income, education for children, health care, and compounded family reasons such as joining family members who are already at destination, or illnesses. The qualitative survey indicates that the migrants are comparatively self-aware and skilled in self-management, which may also be traits attributed to 'nomadic lifestyle.'

Currently, many challenges are facing the newly arrived migrants in Ulaanbaatar City. Since 2017, registration of migrants in the capital has been banned, as the Ulaanbaatar City authorities attempt to curb the massive migration into the city exhausting the resources in housing and social service provision, and also to stem the informal settlement and claims to land[62]. Instead of halting or discouraging completely the flow of migrants into Ulaanbaatar City, this has resulted in 'illegal' migrants settling in the outskirts of the city, expanding the Ger district even further. IOM reports that 'Many inhabitants

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58 National University of Mongolia and International Office of Migration: Mongolia Internal Migration Study, 2018

59 ibid

60 ibid

61 Urban Migrant Vulnerability Assessment

62 According to Mongolian law, a citizen may claim land by settling, living, or constructing a house on a plot of land. This makes it theoretically possible for a migrant to settle in a premium land in cities such as Ulaanbaatar, jeopardizing the real estate market.

of the Ger district of Ulaanbaatar do not have access to water, electricity, heating, and health care, and their condition is worsened by high levels of pollution.[63]

The other long-term reverse impact of internal migration is the de-population of the rural areas. Often the out-migrating population comprises more educated, dynamic, and enterprising members of the community. Instead of such individuals contributing and investing their efforts in the place or origin, the local community loses the inputs which could drive the local economy. IOM and SDC recommend that conditions in the place of origin be improved, so that the migrants may return in the future with newly acquired skills, experience and knowledge through 'return' migration.

The migrants are recognized as one of the six vulnerable groups in the monitoring of the SDV 2030[64], but specific policies addressing the migrants, especially those who have newly arrived in Ulaanbaatar are still in the making. A policy brief 'The Way Forward to Internal Migration Management in Mongolia' states: " … the lack of mainstreaming internal migration into the various policy, sectors and national development planning, or the absence of a comprehensive migration policy are causing serious economic, social, and environmental issues in rural and urban Mongolia."[65]

International migration has significantly increased with an estimated one in eleven Mongolians living abroad (2011). International migration and mobility of Mongolians is growing exponentially with approximately 65% of Mongolians migrating for economic reasons (IOM, 2010). It is estimated that 130,000 Mongolian migrants were living abroad in 2016, with many in an irregular situation.

Normally Mongolian migrants to foreign countries are young people educated and skilled who are in search of higher paid jobs and a better quality of life for themselves and their families. These migrants are mainly males and traveling to other Asian countries (with the majority to China, Russia, Republic of Korea and Japan), some countries in Europe (i.e., Belgium, Czech Republic, Netherlands, Norway, Sweden and Switzerland), and the United States.

Concerning migration towards Mongolia, according to the Mongolia Immigration Agency, as of June 2016 there were more than 42,000 migrants from 128 countries residing in Mongolia regularly. Migrant workers come mainly from China, the Democratic People's Republic of Korea, Russia and Central Asian countries.

2.4.9 Cross cutting goals and linkages

There are strong inter-linkages of the social development sector goals with planning in other NCDP sectors. They include the following.

(a) Infrastructure planning and investment

Construction, renovation and budgeting of major infrastructure facilities related to various social services are of utmost importance. They should ensure safe and appropriate schools and pre-schools, boarding facilities, vocational education and higher education facilities, universities, scientific institutions, adequate hospitals and clinics, proper offices and equipment for labor and employment agencies, social service agencies, training institutes and facilities, etc. as well as easy and inclusive access to essential services.

(b) Services and utilities facilities

Social service facilities should be provided with adequate water supply, sewerage, heating, electricity, waste management and other basic services and facilities

(c) Transport infrastructure

63 Policy Brief, The Way Forward to Internal Migration Management in Mongolia, IOM and SDC
64 The vulnerable groups identified include: Specific groups at risk of being left behind are children, youth, elderly, people with disabilities, herders and internal migrants to urban areas that require the government's prioritized social policy. P. 18, Mongolia Voluntary National Review Report 2019.
65 IOM and SDC

For providing access to social services and facilities such as schools, hospitals and other basic service facilities, adequate transport networks are vital.

(d) Tourism development

Tourism related activities will be vital for capacity and skills building, local employment creation, and poverty reduction.

(e) Environmental sustainability

Many of the criteria for evaluating the environmental impact and conducting assessments are related to levels and quality of social services as manifested in the SDV2030.

2.5 Conclusions and Recommendation

The social sector may be the sector which is most difficult to quantify, in terms of investment, impact and returns. Nevertheless, there is an awareness among policy makers that it is consuming more or less 25% of the state budget in terms of salaries and operating costs, and both structural re-organization and management reform will be called for. The combined efforts of the SDV 2030 and the NCDP present an unprecedented opportunity, to place the emphasis on human development, and to put the well-being and realization of full potential of individuals in focus. There are strong thematic and substantive linkages to both the HSP and the RDP.

Although it is still too premature to draw conclusions from the literature review and data collection carried out so far through focus groups and interviews, stakeholder consultations, and workshops, some preliminary trends may be noted. Corrective measures in the investments in education, health and labor, insurance, pension system and social protection will bring long-term dividends to the economic and social development by increasing productivity and generating efficiency gains. Setting up appropriate incentives, and financing selected line items in the health sector, could have positive effect on improvement of the quality of primary health care, shift to preventative from curative care, health and quality of life for all citizens, and ultimately improvement in the life expectancy, in particular of males. Strengthening the enforcement of the disincentives and deterrents already in place, for example by raising the taxes and tariffs on alcohol and tobacco, reinforcing awareness raising and advocacy against these items may help as a deterrent to the consumption habits having net negative impact on the health and well-being of Mongolian citizens.

Improvement in the education sector will require a longer time span for planning and implementation, in both improvement of infrastructure, training of qualified teachers, and shift in the business/management models for education. Shifting and re-casting of targets, in particular between Phase 1 and Phase 2 of the master planning for education sector seems to be necessary.

Some elements of the social welfare payments, subsidy and cash allowance, for example for each child needs to shift from the “blanket” provision, or full coverage, to targeted coverage to exclude high income families. The value of education seems to be well engrained in most families and citizens, and the shift could be to facilitate education of disadvantaged children in all aspects, i.e. financially, socially, logistically.

At higher education, a number of practical areas required for Mongolian economy need to be introduced urgently such as business studies, SMEs start up, finance, tourism, hospitality and agri-business. Business schools in advanced countries may be invited to set up a campus in Mongolia (as is the case in many Chinese cities and Hong Kong, for example) should there be sufficient demand – though private financing may be needed. This may prevent brain-drain of graduates, while establishing and maintaining links with the respective schools overseas. On the other hand, bright and aspiring students may be encouraged to pursue their studies abroad to acquire excellence in the fields of their choice, and to help lift the level of scientific research and knowledge in Mongolia. This is encouraged for highly qualified women students as well, for example medical students, where employment situation may not be matching the expectations of these students.

In employment, social protection, insurance and pensions, while maintaining the tradition of generous social protection for all citizens of Mongolia, with renewed impetus of "leaving no-one behind", a gradual shift needs to be envisaged of more targeted coverage, and transfer of functions such as internships and apprenticeships, vocational training, and employment creation to the private sector.

There are criticisms that the generous social welfare provision is outdated and counter-productive by creating a dependency and passive behavior in the general public, rather than being an active player in the socio-economic development. This may be considered in conjunction with general 'decentralization' of managerial authority and re-vitalization of rural areas, as observed by the NCDP team during the Aimag consultation.

Concurrently, the basic needs and essential social protection of the migrant population, especially in Ulaanbaatar, will need to be urgently met. These refer to SDG 10.7:

> *Facilitate orderly, safe, and responsible migration and mobility of people, including through implementation of planned and well-managed migration policies – Indicators and a Monitoring Framework.*[66]

Planning instruments such as the NCDP offer an excellent window and platform to integrate the protection of internal migrants into all aspects of sector planning.

To reduce poverty to the target of zero incidence by year 2030 declared in the SDV 2030, the economy requires to become resilient as well as stable to counter shocks that could arise from the fluctuation in extractive industries, and to be able to generate income from diversified sectors including agriculture and agro-industries, private sector businesses including SMEs, finance and service sectors generating opportunities for transfers. The increasing poverty rates in urban areas, in particular in Ulaanbaatar concentrated in the Ger district needs urgent attention, as well as comprehensive integration of the Ger district dwellers in full range of social services, as the dwellers are manifesting the multi dimension of poverty including the service poverty as well as income and ability for consumption. The elimination of poverty is continued as a principle in the Vision2050.

At the same time, the de-population of the rural areas need urgent attention so that a minimum standard of reasonably well functioning communal, township or municipal life could be sustained for the residents. In this regard, full collaboration and knowledge sharing with the JPT experts for the NCDP working in the area of infrastructure and human settlement plans will be appreciated.

Towards the people-cantered development, it should be recognized 'citizens as most valuable asset and resource in socio-economic development.' Given the relatively small size of population in Mongolia, there should be an effort to increase its population, and to nurture the growth of the future generation. Yet, the socio-economic planning up to date has neglected the focus on people themselves, and their well-being and safety, as it can be seen for example from the physical environment, including air pollution, difficult traffic and transport, and infrastructure which is not prioritizing the needs of pedestrians. The NCDP will advocate for a major paradigm shift, which is to put the welfare and safety of citizens at the forefront of the development so that each citizen can fully enjoy and realize the potential offered by the state, and be able to contribute to its socio-economic and environmental development.

The COVID-19 pandemic has had significant impact on Mongolia as all nations in an unprecedented manner since 2020. As a landlocked country located directly on a regional transport corridor, the slowdown of trade and economic activity has had a major impact on livelihood of Mongolian families. The vulnerabilities have become more acute, and health sector indicators are witnessing negative trends from the possible disruption of regular health care deliveries. While the socio-economic resilience of Mongolian society will be challenged in the post-pandemic period, it will be an opportunity to 'build back better' through the assessment of systemic bottlenecks and service delivery.

It is noted that the health sector may be the sector most in need of strengthening, and the newly established Five-Year National Plan 2021-25 contains relevant and pragmatic indicators. While with resolute action of border closure and school shut down, a major outbreak of the pandemic was once mitigated, the sector will need to withstand the challenge of continued risk to the service provision and to service staff. In education and social services, the established mechanisms and institutions have

66 https://indicators.report/targets/10-7/

demonstrated a robust, if not fully satisfactory coverage in the response.

Early lessons from 2020 will be critical, as the use of technology in business management, education and service provision has been significant, particularly in urban areas. The impact on informal job market may become an impetus to regularize informal employment into more sustainable form of employment, and to facilitate shifting the burden of social protection and guarantees from the State to private sector employers. The vulnerability of external and internal migrants, children and youth who are studying in monasteries or working abroad, and the need for a support network to facilitate repatriation are all excellent lessons to prepare for the future.

2.6 Development Objectives and Strategy for Social Development

2.6.1 Development objectives of social development

As social environment in a broadest sense is understood as an entire sphere of human-nature interactions, social development or development of social environment encompasses all the factors affecting human-nature interactions. These factors include social services affecting ability of human beings to communicate each other, institutional and social fabrics to facilitate human development, and physical infrastructure to support community development through human interactions. With these concepts, the objectives of social development in the NCDP are defined as follows:

(a) To improve social environment in urban and rural areas with provision of adequate social infrastructure and services and decent employment opportunities;
(b) To enhance capacity of individual human beings by basic social services including education and health care and training for employment in viable economic activities; and
(c) To strengthen communities with self-reliant institutional and social fabrics through development planning and implementation for community facilities with participation of local people.

2.6.2 Development strategy for social development

To realize the objectives of social development, the strategy for social development is established with the following components:

(a) Further reform of education system with respect to education performance reflecting PISA evaluation, increasing enrolment rate at pre-school, alternative schooling for nomadic people, curricula at higher education oriented to new job opportunities etc.,
(b) Provision of basic education in inclusive manner in line with Objective 2.1, Vision2050.
(c) Health services oriented more to primary and preventive care, reducing disparity between urban and rural areas, and improving distribution of health personnel,
(d) More focused provision of social protection and welfare,
(e) Rectification of gender gaps in potentially high earning positions to be assumed by qualified women,
(f) Continuous training and lifelong education,
(g) Improving matching between education and job opportunities,
(h) Step wise decentralization of development administration to re-vitalize rural areas and participatory planning and implementation of community facilities involving local people, and

(i) Comprehensive response to impact of COVID-19 and resilience.

2.7 Projects in Social Sector

Based on the analysis reported in previous sections, projects in social sector are proposed as described below.

2.7.1 Community-based early childhood education for children of herders in remote rural areas

(1) Background

A significant proportion of remote rural children enter schools without preparation. Save the Children Japan with the Ministry of Education and Science (MES) successfully implemented a home-based school preparation program for herders' children under the World Bank's Japan Social Development Fund. A new type of preschool education was piloted in 30 Soums of four Aimags. Five-year old children successfully completed the program and have been performing well in school. The number of 6-year old children enrolled in school dormitories has increased.

(2) Project components

- Community- and home-based early childhood education programs
- A variety of afterschool development activities targeting herders' children living at dormitory or relative's family
- Home based primary grade compensatory education programs for out-of-school children for ill health disability, or other reasons

(3) Implementing arrangements

MES will be the main implementing agency and the Aimag Education Departments and Lifelong Learning Centers will be the implementers of the project in their localities. Save the Children Japan will be providing technical and capacity building support during for the first 2-3 years of the project to assist MES in coordinating the implementation and gradually taking over the management.

At Soum level, the Community Education Council (CEC) will be set up under the project which will consist of volunteer representation of the Soum government, school, kindergarten, lifelong learning center, community and parents who will play an important role.

2.7.2 Bridging the gap between youth and employers

(1) Background

Mongolia is a particularly young country with 63.8% of the total population are under 35 years of age (NSO 2018). One third of Mongolia's population, or 33.7% consists of young people from 15-34 years old. The youth of Mongolia, therefore, form a highly significant part of its economy. Nearly one-third of unemployed youth cannot find appropriate jobs due to skills mismatch and lack of experience (LFS,2018).

The challenges in labor market demand in 2018 also indicate that the common barrier to employing new employees as well as employers is "incompatibility of job candidates". In 2018, as a result, 14.7% of employers were not able to find qualified workers, which resulted in labor shortage. As a result of the "Youth Unemployment and Economic Inactivity Survey" conducted in 2017, the unemployed youths said that they had "lack of job information"; and they were willing to choose some type of apprenticeship, internship programs to work with the employers' (52%).

Employers also pay attention to attitude and soft skills of job candidates and not only to professional knowledge and skill. Over half of employers weren't satisfied with the practical skills of new employees

(Survey on employer requirement for employees, 2017).

Therefore, Internship Exchange Program and capacity building activities are beneficial for both Japanese and Mongolian side to meet the growing needs; as it is crucial to increase youth's employability competencies at employers' workplace while benefiting both sides. It will give particular advantage to Mongolian youth by learning from Japanese rich culture, know-how and best practices while supplying the need of growing Japanese employers.

(2) Project components

There will be following components:

- Training on Japanese language and culture to improve Mongolian youth language and culture barrier before Internship exchange
- Training on basic job skills and developing soft skills before Internship exchange
- Internship program in international and domestic companies that match participants' qualifications. The internship focuses on learning practical and professional hard skills
- Internship Exchange Announcement and Selection
- Internship Manual for Youth
- Internship Manual for Employers
- Employment agreement: At the end of the internship, youth who completed successfully will sign an employment agreement for 1 year mutually committing themselves. Contract fulfilment will be monitored by project.

(3) Implementing arrangements

Two to four cycles will be implemented per year. MONEF and JICE will provide overall guidance and technical advice based on recognized international best practices and identifying domestic demand. MONEF-YOUTH and YMPA will implement accordingly.

2.7.3 Skills training/job creation for youth and adults, in particular in Ger district

(1) Background

According to the Labour Force Survey (LFS) of 2018, the unemployment rate of young people between the age of 15-29[67] is higher than the overall unemployment rate by 3%-16.5%. In terms of education level, the unemployment rate is higher among educated youth with secondary and higher education. Nearly one-third of unemployed youth cannot find appropriate jobs due to skills mismatch and lack of experience (LFS,2018). Therefore, capacity building activities are crucial.

Employers also pay attention to attitude and soft skills of job candidates and not only to professional knowledge and skill. Over half of employers weren't satisfied with the practical skills of new employees (Survey on employer requirement for employees, 2017). Capacity building will give advantage to job seekers by better match of job skills.

(2) Project components

There will be four components:

- Training on job skills and developing soft skills
- Internship program in international and domestic companies that match participants' qualifications. The internship focuses on learning practical and hard skills.

67 Unemployment rate is 24.5% for age 15-19, 19.4% for age of 20-24, and 10.8% for age 25-29.

- Employment agreement: At the end of the internship, youth and adults who completed successfully will sign an employment agreement for 1 year mutually committing themselves. Contract fulfilment will be monitored by project.
- An incentive to firms: Firms which agree to hire youth from marginalized areas will be provided grant or microfinance in connection with the number of hired youth for the initial 2 years.

(3) Implementing arrangements

Two cycles will be implemented per year. MEF will provide overall guidance and technical advice based on recognized international best practices and identifying domestic demand.

2.7.4 Young women's career development and support network

(1) Background

According to the National Statistical Office, the labor participation rate in Mongolia has been lower among women than men at executive/managerial level. As of 2018, gender gap in labor participation is 16.1%. Although 58-59% of total students in universities are female, they are less likely to fully apply their education by reaching the top level of careers. Orientation and information for females to prepare and develop career path is lacking. Particularly, they are not informed of the skills demanded in the labor market and how to identify a job without having help or connection (WB, 2018).

(2) Project components

The project will be designed for female students of university/high school through three components:

(a) Career orientation and development program:

Trainings for female students of the university: on skills demanded by the labor market, and other supporting skills for creation of level playing field. Soft and hard skills include leadership, critical thinking, self-confidence, communication, public speaking, negotiation skills, awareness of barriers to career development, people management and analytical reasoning

(b) Career guidance activities for female students of high school:

- ✓ Career guidance activities, such as consultation sessions in secondary schools targeted at both students and their parents, visits to international/foreign universities, and preparation to internationally accepted examinations
- ✓ The course for career orientation will be introduced in the secondary school curriculum (introduction of occupations, identification of abilities, occupation choice, skills, labor market trend, etc.)

(c) Serial meetings/seminars of successful women leaders will give opportunities for female students of university/high school to hear from women leaders, about their experience, success and challenges

(d) Industry and organizational site visits: interaction with women leaders in their workplaces to obtain experience in the field.

(e) Support program for women and girls in science and technology. The program will provide scholarship/fellowship to girls studying in science and young women working in science sector

(f) Discussion and consultation on work-life balance - a discussion forum in view of the traditional roles and expectations on women and family obligations, and creation of support network

(3) Implementing arrangements

Independent Research Institute of Mongolia (IRIM) will provide overall guidance and technical arrangement based on recognized international best practice and identifying domestic demand.

2.7.5 Establishment of health information center

(1) Background

Health care in Mongolia faces a number of challenges, including integration and management of all activities undertaken by 4,300 departments, hospitals, health centers and other units under the Ministry of Health. Over the years various Information Technology (IT) systems are operating for particular branches or discipline. The new WB project of US$19.5million will help coordinate e-Health IT architecture, however a coordinating central function is missing. There are approximately 23,000 users (computers) in the IT systems of Ministry of Health (MoH), affiliated agencies and units which need to be connected in a single network. The single information platform will enable the Department of Policy and Ministry top management to monitor and manage all operations and activities of public health care, including assets, investment, budget, human resources, patient case documentation, referral history, R & D (Research and Development) following international best practice and standards. For patient data management, privacy and confidentiality standards will be maintained. Mongolia has relatively developed network of internet connections in Aimags and Soums for health care patients.

(2) Project components

The project will be built on on-going policy initiatives in MoH, including: Health Sector Strategic Master Plan (HSSMP)[68], IT projects funded under China (installation of Desktops), WB, Luxenburg-funded telemedicine projects in MCH and Cardiovascular departments, WHO-supported m-Health[69] initiative in the Aimags and Soums, and miscellaneous IT platforms. Desk review and formulation of consultancy Terms of Reference (TOR), recruitment of staff, agreeing on roles and responsibilities.

(a) Procurement, Selection of implementing partners, consultants
(b) Testing, Pilot installation in the Department of Policy, network connection to 1st set of selected departments and hospitals, GO LIVE
(c) Connection of second round of units, Aimags/Soums
(d) Midterm evaluation and recommendation

Components:

- Establishment of health information center
- Assessment and analysis of needs, workplan
- Coordination of IT solution, users' consultations and buy-in
- Procurement, development & customization of IT solution
- Management Committee of MoH officials and partners and clients (NSO, Cabinet, etc.) to monitor progress & in relation to the SDV 2030 achievements
- Coordination with operational partners/stakeholders including WB, WHO, ADB

(3) Implementing arrangements

- Director, Department of Policy, MoH will be the overall supervisor/coordinator of the project
- Consultant will be responsible for management of the project, selection and hiring of IT supplier

68 HSSMP 2019-2026 (tbc) is being formulated by a team of ADB consultants, through funding of Japan Poverty Fund.
69 Mobile-based health care consultation based on group chats

- Coordination with Health Development Centre[70] and NSO
- Close collaboration with WB IT project, ADB and other relevant donor partners

2.7.6 Strengthening telemedicine and electronic and mobile health for diagnostic purposes and building capacity for high quality health service delivery

(1) Background

ADB Action Plan for the Implementation of the State Policy on Health (2019 – 2026), through the draft Health Sector Master Plan supports strengthening e- and m-health. Primary health care in Mongolia lacks quality of delivery due to lack of equipment, capacity of medical and nursing staff and poor information and knowledge management. In addition, huge distances and remoteness of Aimags create logistics barriers to access quality health care. Telemedicine will be established/reinforced for the patients in Aimag hospitals to access high quality health care remotely.

(2) Project components

- Based on an implementation plan, the equipment for telemedicine facilities will be installed at central level in Ulaanbaatar, connected to five regional diagnostic and treatment centers, and gradually to Aimag hospitals.
- A project monitoring unit will be established, responsible for a training program of doctors, nurses, medical staff, and technicians. Study tours will be conducted to third countries with experience in telemedicine.
- 1st year, setting up of initial project sites at regional diagnostic centers, feasibility review for Regional Diagnostic and Treatment Center.
- Training on communication skills for involved staff in 'soft skills', correct communication with the patients organized.
- A midterm evaluation will be conducted on the results of implementation, patient satisfaction, improved diagnostics and reduction of unnecessary referrals.

(3) Implementing arrangements

MoH and its diagnostic centers will be the main implementer of the project. A team of experts will draw up an implementation plan based on on-going initiatives and provide guidance and advice regarding the introduction of telemedicine, procurement of equipment and training program.

2.7.7 Strengthening of primary health care

(1) Background

The primary health care provided at Aimag level is insufficient, both materially, technologically and in the quality of services. The clinics are lacking in human resources, equipment, and adequate nursing care. Qualified doctors and nurses are reluctant to take an assignment in regions, for family reasons, isolation and hardship. There needs to be a rotation of qualified medical staff with adequate support and incentives.

The quality of medical services needs to be upgraded through introduction of technology, capacity in delivery, and provision of materials. Knowledge and information need to be managed in efficient manner.

70 Responsible for health-related data

(2) Project components

(a) Establishment of centers of excellence and support capacity at the five regional diagnostic and treatment centers, which are today functioning as tertiary hospitals, based on the principle of subsidiarity in support of Aimag-level general hospitals
(b) Training, capacity development, coaching, shadowing of experienced and/or specialized doctors by young doctors, including those who may be trained as general practitioner to be stationed at Aimag general hospitals.
(c) Study tours, fellow ships and scholarships
(d) Procurement of equipment and training
(e) Provision of necessary medicines and materials, with training in inventory management, enforcing the discipline of insurance, outpatient and inpatient care segregation and management
(f) Introduction of information and knowledge management, patient feedback and surveys
(g) Training and management of work standards and benefits to nursing staff

(3) Implementing arrangements

WHO will provide overall guidance and technical advice based on recognized international best practice on provision of health care services and standards. Training-of-trainers will be introduced, where appropriate to provide support and guidance to young doctors and medical staff.

2.7.8 Prevention of mother to child transmission of HIV, syphilis and hepatitis

(1) Background

Mongolia has made major progress in reducing maternal and new-born deaths, through the project supported by the WHO in the last two decades. The Country has a potential to reach health related Sustainable Development Goals (SDGs) by 2030, however, SDGs 3 and 5 on the universal access to Sexual and Reproductive Health (SRH) would require significant investment, considering Country's extremely high rate of Sexually Transmitted Infections (STIs) including syphilis among reproductive age and pregnant women. According to study conducted in 2019 by (Nationally Consistent Collection of Data on School Students with Disability (NCCD), the viral hepatitis B, C, and D infections among pregnant women was 6.5%.

Mongolia is one of the few countries to have achieved the targets for Millennium Development Goals 4 (reduce child mortality) and 5a (reduce the maternal mortality ratio) and is an ideal candidate to achieve triple elimination of mother-to-child transmission in the region.

(2) Project components

- Situation analysis/review of three disease programs, establishment of regulatory framework and development of strategy on triple elimination at sub-national level/selected sites.
- Training of Health Care Workers (HCWs) at primary health care level
- Procurement of rapid tests, supplies and equipment
- Information, Education and Communication (IEC) materials development and distribution

(3) Implementing arrangements

The proposed "Prevention of mother to child transmission of HIV, syphilis and hepatitis sub-national pilot proposal" will be implemented for the duration of two years from 2020 to 2021, and WHO Country Office in Mongolia will act as the Administrative Agent (AA) for the coordination and management of the project among implementing organizations including the NCCD, National Center for Child Health and Development (NCMCH) and Health departments of Khuvsgul Aimag and Khan-Uul district of Ulaanbaatar city. The overall day-to-day project management will be overseen by the WHO Country Office in Mongolia that will facilitate policy dialogue and advocacy with active engagement of the Government at provincial and district levels for all proposal activities. Project monitoring will be undertaken in accordance with WHO monitoring and reporting procedures. The Program implementation status will be reported annually by WHO to potential resource partner.

2.7.9 National cardiovascular center

The project is to establish a cardiology center in one location at the third general hospital named after Shastin, instead of 12 separate wards as it is at present. Cardiovascular disease ranks as top cause of mortality in Mongolia. Despite of its importance, the care functions for cardiovascular disease is now spread out among 12 different locations, floors, corridors in the third general hospital making it necessary for patients to be moved between various stations of diagnostics, treatment and laboratory in separate wards, while being treated for serious ailments. A single cardiology center will become a one-stop-shop for the critical care, from prevention to treatment, of this important health disease burden. Details of the project are given in Annex.

2.7.10 Screening of adult population in Aimags and Soums for hypertension and cholesterol

Hypertension and cholesterol are leading causes of cardiovascular diseases. By screening the adult population and setting triggers for check-ups, costly surgeries and other interventions can be avoided.

Details of the project will be provided by the Department of Cardiology.

2.7.11 Screening of children for streptococcus as prevention of rheumatic heart disease

Through diagnosing streptococcus induced tonsillitis, a cause of rheumatic heart diseases at level of primary health care center and home, children with infection can be diagnosed early and completely treated. This will help the care of severe infection to move to preventative rather than curative care as at present.

Details of the project will be provided by the Department of Cardiology.

Chapter 3 Water Resources

In this chapter, existing conditions of water resources endowment, use and management are first examined. Then, water demand and supply balance is analyzed and measures are proposed to solve the water shortages and also to improve availability of water for various purposes, covering the following:

- Issues for water resources,
- Existing measures for water resources,
- Water balance analysis by river basin, by Aimag and in Ulaanbaatar, and
- Measures to solve water issues.

As for the water balance analysis, the Integrated Water Management Plan (IWMP) 2012 analyzes the water demand by 2018 and the water balance for each river basin. However, the IWMP did not perform water balance analysis by administrative unit and provide forecasts only up to 2018. Therefore, in this chapter, water demand is forecasted by the administrative unit (Aimag level) up to 2040, and the water balance analysis was conducted. In the subsequent stage, the latest meteorological and hydrological data will be used to evaluate the water potential, the surface water potential will be evaluated using a Tank model etc., and the groundwater potential will be evaluated based on the results of the Tank model etc.

3.1 Overview of Water Resources in Mongolia

3.1.1 Context of water resources sector

Mongolia is mostly in arid and semi-arid zones climatically with the mean annual precipitation in 200-400mm. The precipitation decreases further in the Southern Gobi desert (Yoshizawa et al., 2008). Of the total precipitation, some 60% falls in summer. Water resources are very scarce and its availability is severe throughout Mongolia (Davaa et al., 2006). The water use situation in Mongolia is likely to become more severe in the future. Most of the Mongolian territory is a river-free basin, and tends to make progresses from steppe, through degraded semi-desert to desert as it goes south (Kaihotsu et al., 2007).

The total amount of water resources endowed in Mongolia is estimated at 599 km^3 per year, consisting of 500 km^3 for lake water and 62.9 km^3 for glaciers and 34.6 km^3 (5.8%) for surface water (Davaa et al., 2006), and the amount of renewable groundwater recharged in a relatively short time is estimated to be 10.8 km^3 (Jadambaa, 2002). While surface water and groundwater constitute very low portion of total water endowed in Mongolia, they are very important as water resources for agriculture, livestock, industry, and households.

The number of livestock in Mongolia was relatively small during the socialism period and serious overgrazing problems could not occur. The population of domestic animals did not continuously increase at least since the mid-20th century even after the socialist era (Oniki and Konagaya, 2006). However, the transition from the socialist economy to the market economy since 1990 liberated economic activities, which led to a sharp increase in the number of livestock population grazing on the vast pastureland. In particular, the increase in goats and sheep is remarkable. Pastoralists concentrated around public wells, and overgrazing exceeds the production of grassland in some areas (Oniki and Konagaya, 2006). Therefore, it is necessary to consider the way of water use from both aspects of climate change and changes in grazing and grassland utilization.[71]

71 Yoshizawa Shintaro, Study on sustainable water use in arid and semi-arid regions of Mongolia, 200821221, January 2010
University of Tsukuba, Department of Environmental Science, Graduate School of Life and Environmental

The population growth and water demand increase in the capital Ulaanbaatar are significant, and there is a concern that water shortages will occur in the future. To reduce the population pressure on the capital city, regional development is necessary based on available water resources. Therefore, it is important to estimate the future water demand in each region and estimate the water supply potential and analyze the water balance.

3.1.2 Overview of water supply and sewerage

(1) Overview of sewage management

In Mongolia, out of 330 Soums only 10% Soums have a sewage management system. In urban areas and Aimag centers, sewerage related facilities are partly provided, but population increase and aging facilities become serious concerns, and it is necessary to update, expand and improve the facilities.

Of Mongolia's total population, 58.9% use sewage facilities that do not meet the adequate conditions. Among them, about 40% use pit toilets and drainage, and 18.8% do not have even sewage facilities.

At present, 148 km of sewerage pipe network is laid collecting the sewage of about 97,000 households (about 400,000 people). However, 80% of pipe network have exceeded the durable lifetime, therefore, renewal of drain pipes is also necessary. Also, in the two sewage treatment plants in Ulaanbaatar, industrial wastewater from leather factories etc. has flowed in without sufficient treatment. As the result, heavy metals such as chromium have accumulated in the sludge so that the sludge cannot be recycled.

Treated wastewater quality does not meet Mongolia's discharge standard in most areas. Compared to Ulaanbaatar, the sewerage penetration rate is only about 10% in all other Aimags.

(2) Overview of water supply

At present, out of 21 Aimags and 330 Soums in Mongolia, 70 Soums have secured a tap water source, and about 170 Soums are located in areas where hydrogeological conditions are favorable for securing water sources.

Mongolia's water resources are unevenly distributed. In mountainous regions, surface water resources are mostly sufficient. On the other hand, in the Gobi desert area, underground sources account for 80% of total water consumption. As of 2015, 30.5% of Mongolia's total population use central water supply networks, and 35.8% of the users rely on transport water supply services. Water supply facility called kiosk is used by 24.8% of the population, and spring and river water sources are used by 9.1% of that respectively.

The water supply penetration rate is about 77% in Ulaanbaatar. There is a large difference in maintenance of water supply and sewerage infrastructure in urban areas and the Gel district. The water supply per unit of the collective apartment exceeds 200 litter/person-day, whereas in the Gel district, it is 5 to 7 litter/person-day.

(3) Overview of current situation in Aimags

All Aimag centers are equipped with centralized wastewater treatment facilities, and a few households are connected to the facilities with pipes. In rural areas, however, most Soums, except for a few Soums, do not have such treatment facilities. Only a few houses in rural areas are equipped with septic tanks, and otherwise only pit latrines are used. Some public facilities such as schools, hospitals and others have a sewage purification tank respectively.

All Aimag centers have been operating centralized water supply systems with pipe networks. In rural areas including Ger districts, water kiosks and wells are commonly used for daily water demand.

Sciences, (2008).

(4) Overview of current situation in Ulaanbaatar

In Ulaanbaatar, population has increased rapidly in recent years, and improvement of living environment and maintenance of basic infrastructure are urgent issues. In particular, in the northern part of the urban area, the Ger area is expanding without planning due to the population inflow from rural areas, and the infrastructure development has not kept pace.

Not only domestic sewage but also wastewater from factories are connected to public sewers, and Ulaanbaatar Water Supply and Sewerage Company (USUG) and the Deputy Prime Minister's direct supervision body oversee whether these sources of wastewater is within the public sewer acceptance standard. However, instruction and punishment are not properly conducted. Therefore, the industrial wastewater exceeding the acceptance standards flows into the sewer, and as the result, the central sewage treatment plant does not meet the effluent water quality standards.

There are seven sewage treatment plants in Ulaanbaatar, and USUG manages six plants except for the Baganuri sewage treatment plant. The sewerage penetration rate in Ulaanbaatar is only 34.5%, and the maximum installed capacity of all the sewage treatment plants is 230,000 m^3/day, but the operation capacity is 177,500 m^3/day due to aging facilities, problems of operation capability, etc.

3.2 Issues for Water Resources

3.2.1 Water resources issues at national level

Issues for water resources at national level identified by the IWMP are summarized in Tables 3.2.1 through 3.2.5.

Table 3.2.1 Issues on Sub-Sector 1: Water for People

1.1: Safe drinking water and optimal wastewater treatment in urban areas
(a) Access to safe drinking water and sanitation is inadequate; (b) Growing demand requires additional water sources; (c) Water supply to Ger districts is inadequate; (d) Water quality standards are not met; (e) Water use in apartments is inefficient and extremely high; (f) Water supply infrastructure development does not keep pace with the urbanization; (g) Water sources need better protection; (h) Existing water supply systems are poorly maintained; (i) Sanitation infrastructure does not keep pace with the urbanization; (j) Improved sanitation facilities are lacking in Ger areas; and (k) Water supply and sanitation at army camps and border posts do not meet required standards.
1.2: Safe drinking water and optimal wastewater treatment in rural areas
(a) Water supply to rural herders is inadequate; (b) Protected water points are lacking for rural population; (c) Improvement of the water supply and sanitation infrastructure is required; (d) Wastewater treatment facilities are lacking in Soum centers; and (e) Improved sanitation facilities are lacking in Soum centers.
1.3: Water for tourism and sanatorium
(a) Reliable and high quality water supplies and wastewater treatments are needed for growing tourist sector; and

(b) Additional springs are needed for use in sanatoriums.

Source: Ministry of Environment and Green Development (former), (2013), "Integrated Water Management Plan, Mongolia"

Table 3.2.2 Issues on Sub-Sector 2: Water for Food

2.1: Water for livestock
(a) Operational water points are insufficient; (b) Grazing pressure is locally unacceptably high (c) Number of operating water points is declining; and (d) Livestock water supply systems are inadequate.
2.2: Water for irrigation
(a) Irrigation water demand will increase considerably; (b) Water use in crop irrigation is inefficient; and (c) Limited financing capabilities hamper development of irrigated agriculture.

Source: Ministry of Environment and Green Development (former), (2013), "Integrated Water Management Plan, Mongolia"

Table 3.2.3 Issues on Sub-Sector 3: Water for Industry, Mining and Energy

3.1: Water for industries
(a) Water demand by industries is expected to increase (b) Water use by industries is highly inefficient; and (c) Industrial wastewater increases beyond acceptable levels
3.2: Water for mines
(a) Water demand by mining activities is expected to increase; (b) Water use in mining operations is highly inefficient; (c) Wastewater is discharged without treatment; (d) Lack of water resources near mineral deposits constrains mining activities; and (e) Decision making on new mining operations is hampered by a lack of information on water resources.
3.3: Water for energy
(a) The energy production capacity needs to increase; (b) Hydropower development is restricted; and (c) Reservoirs change the regimes of the rivers and have a negative impact on ecology and water availability.

Source: Ministry of Environment and Green Development (former), (2013), "Integrated Water Management Plan, Mongolia"

Table 3.2.4 Issues on Sub-Sector 4: Water for the Environment

4.1: Conservation of water resources
(a) The hydrological regime of rivers is deteriorating; (b) The protection of watersheds and water bodies is insufficient; and (c) Large amounts of water leave the country unused; preservation of water in the catchments needs to improve.

4.2: Pollution of water resources
(a) Untreated water is released directly to rivers or infiltrates into the soil; (b) Hygienic protection zones around water bodies and water points are not protected; (c) Increase of irrigated agriculture, combined with the use of fertilizers and pesticides threatens water quality; (d) Discharge of untreated water from mining operations pollutes the water bodies; (e) Discharge of industrial effluents to the sewer system renders the wastewater treatment plants (WWTPs) inefficient; and (f) Regulations to make polluters pay are ineffective.
4.3: Sufficient and clean water for the environment
(a) Ecological conditions are deteriorating; (b) Deterioration of biodiversity and landscape, including its clean rivers threatens tourism sector; (c) Hydropower reservoirs have a negative impact on river ecology; (d) Knowledge is lacking on environmental flow; (e) Lowering groundwater tables is observed; (f) Pastureland is deteriorated; (g) Lake levels are dropping; and (h) Measures to protect lakes and wetlands are insufficient.
4.4: Restoration of water resources
(a) Mining activities adversely impact environment; and (b) Polluted river sediments require clean-up.
4.5: Hazards due to floods, droughts, Dzuds and other disasters
(a) Environment and the water resources are vulnerable to small changes in climate; (b) Flood protection systems are in poor condition; and (c) Flood prevention measures are not organized.

Source: Ministry of Environment and Green Development (former), (2013), "Integrated Water Management Plan, Mongolia"

Table 3.2.5 Issues on Sub-Sector 5: Enabling Setting/Water Governance

5.1: Legislation for water management
(a) Inconsistencies and ambiguity exist in water related laws; (b) Non-compliance with international treaties, conventions and agreements are pointed out; (c) Existing legislation is not sufficient; and (d) Law enforcement is weak.
5.2: Institutions for water management
At the national level: (a) Lack of effective coordination; (b) New National Water Committee's (NWC) authority to effectively coordinate uncertainties; (c) Disbanded Water Authority leaving a gap in the institutional landscape; (d) Overlapping in functions; (e) Shortages of adequately capable staff, budget and equipment; and

(f) Data and information dispersed and difficult to access. At the river basin level: (a) Unclear formal status of Water Basin Committees (WBC); (b) Establishment of Water Basin Authorities demoting the WBC to a mere consultative role; (c) Placing the WBA's and the WBC's under the RB Management Division contrary to the IWM principles; and (d) Lack of vision and planning for a controlled evolution of River Basin Organizations (RBO).
5.3: Financing water management
(a) Funding of the planned investments weighs heavily on the state's financial resources; (b) Cost recovery is developed insufficiently; (c) Existing legal provisions to channel revenue to the water sector are not used. (d) Mongolia is rapidly rising to the status of middle-income country, depriving it from accessing soft loans; and (e) Private sector (co-)financing cannot become source of financing soon.
5.4: Capacity building for water management
(a) Institutional and human resource capacity of organizations in the water sector is inadequate; (b) Water management curricula do not meet the needs of the sector; and (c) The pool of skilled labor and artisans is insufficient.
5.5: Monitoring and research for water management
(a) Quality and accessibility of data are insufficient; (b) Monitoring of water resources is underdeveloped; (c) Comprehensive monitoring system for groundwater is absent; (d) Sampling and analysis techniques for water quality are inadequate; (e) Water use data are not well monitored; (f) Data on return flows and re-use of water are insufficient; (g) Data on quality of water discharged to the sewer system or surface water are insufficient; (h) Surface water and groundwater requirements for ecological functions are unknown; (i) Data on flooding are very scarce; and (j) Research in water resources misses integration of disciplines.
5.6: Data and information management
(a) Existing databases are not linked; (b) Regulations for safeguarding the protection and quality of data are inadequate; and (c) Regular reporting of detailed results is lacking.
5.7: Public awareness of water management
(a) Importance of water management and the role of users are not well recognized; (b) Value of traditional methods to protect and take care of water resources are not appreciated; and (c) No incentives exist for users to participate.

Source: Ministry of Environment and Green Development (former), (2013), "Integrated Water Management Plan, Mongolia"

3.2.2 Issues for water resources in Ulaanbaatar

According to the report of 2030 Water Resources Group (WRG)[72], water demand of the capital city of Ulaanbaatar will not be met by 2021with the available water resources in the high and medium water demand scenarios. The water demand-supply gaps will widen by 2030 as described.

By 2030, a water demand supply gap was estimated in all scenarios. It has been estimated that 3% (4 million m^3/year) and 28% (34 million m^3/year) of total water demand will not be met with the given water supplies by 2030 in the low and medium water demand scenarios respectively. In the high-water demand scenario, 43% of the total water demand (92 million m^3/year) was estimated to not be met with given supplies by 2030. It is assumed that all surface water resources will be utilized and that the current groundwater yield will remain until 2030. If this is not the case, the water supply demand gap is expected to occur earlier and higher across all scenarios.

3.2.3 Issues for wastewater treatment plant

Table 3.2.6 shows the current situation of WWTPs in Mongolia as of September 2019. Some of WWTPs are old as the plants were constructed more than 30 years ago and treatment capacity is not sufficient with receiving water volume per capacity being more than 70%. These WWTPs need to be upgraded or improved.

Table 3.2.6 Situation of Wastewater Treatment Plants (WWTPs) in Mongolia as of September 2019

No	Aimag name	Soum name	No	Operating entity	Year of construction	Capacity (m^3/day)	Treatment technology	Receiving waste water (m^3/day)	Receive / Capacity (%)
1	Arkhangai	Erdenebulgan	1	"Ar us undarga" LLC	1987, 2006	3,000	Mechanical-biological	1,000	33%
2	Bayan-Ulgii	Ulgii	2	"Suat" LLC	1986, 2001, 2011	3,000	Mechanical	1,000	33%
3	Bayankhongor	Bayankhongor	3	"Chandmani Bayankhongor" Shareholding company	1995	4,000	Mechanical	900	23%
4	Bulgan	Bulgan	4	"Bulgan meej" LLC	1986	2,000	Mechanical	700	35%
		Teshig	5	"Teshig-Us" Locally owned self-financing enterprise	2014	50	Mechanical	20	40%
5	Gobi-Altai	Altai	6	"Undarga-Altai" Locally owned self-financing enterprise	1990, 2014	3,000	Mechanical	1,700	57%
6	Govisumber	Sumber	7	"Us-Du" Locally owned enterprise	2008	3,000	Mechanical	1,000	33%
		Bayantal	8	"Talyn ilch" Locally owned self-financing enterprise	2010	100	Mechanical	80	80%
7	Darkhan-Uul	Darkhan	9	"Darkhan us suvag" Shareholding company	1965	50,000	Mechanical-biological	7,000	14%
		Khongor	10	"Emt naran" Locally owned self-financing enterprise	1969	200	Mechanical	20	10%
		Sharyn gol	11	"Dulaan Sharyn gol" State owned	1978	3,000	Mechanical-biological	2,500	83%

[72] 2030 Water Resources Group, (2016), "Hydro-economic Analysis on Cost-Effective Solution to Close Ulaanbaatar's Future Water Gap, Mongolia, Ulaanbaatar,"

No	Aimag name	Soum name	No	Operating entity	Year of construction	Capacity (m^3/day)	Treatment technology	Receiving waste water (m^3/day)	Receive / Capacity (%)
				Shareholding company					
8	Dornod	Kherlen	12	"Dornod NAA" LLC	1969	10,000	Mechanical	2,500	25%
9	Dornogovi	Sainshand	13	"Chandmani Ilch" LLC	1987	2,700	Mechanical	1,000	37%
			14	"Chandmani Badral" LLC	1994	3,000	Mechanical-biological	900	30%
10	Dundgobi	Mandalgovi	15	"Dundgobi us Locally owned self-financing enterprise	2001	2,700	Mechanical	500	19%
11	Zavkhan	Uliastai	16	"Ami us trade" LLC	1973, 1985, 2001	1,100	Mechanical-biological	600	55%
		Tosontsengel	17	"Toson-Ochirt khairkhan" Locally owned self-financing enterprise	2015	250	Mechanical-biological	100	40%
12	Orkhon	Bayan-Undur	18	"Erdenet industry" LLC	1978	24,000	Mechanical-biological-underground-chemical	18,000	75%
			19	"Erdenet us dulaan tugeeh suljee" Locally owned enterprise	1978	400	Mechanical	80	20%
13	Selenge	Sukhbaatar	20	"Ursgal us" LLC	1989	7,000	Mechanical-biological	2,700	39%
		Mandal	21	"Tsant-Orkhon" LLC	1999	8,000	Mechanical-biological	3,000	38%
		Saikhan	22	"Gavshgai us" LLC	1985	3,000	Mechanical	2,800	93%
		Salkhit	23	"UBTZ Building maintenance service unit No.1"	1980	200	Mechanical	100	50%
		Orkhontuul	24		1980	100	Mechanical	50	50%
14	Sukhbaatar	Baruun-Urt	25	"Durvulj" LLC	1971	2,700	Mechanical-biological	800	30%
15	Tuv	Zuunmod	26	"Tuv chandmani DEHG" Locally owned enterprise	1988, 1994, 2011	2,700	Mechanical-biological	2,500	93%
			27	Airports Management Office	2018	800	Mechanical-biological	0	0%
16	Uvs	Ulaangom	28	"Chandmani Uvs" LLC	2001	3,800	Mechanical	1,200	32%
17	Uvurkhangai	Arvaikheer	29	"Ongi us suvag" Locally owned enterprise	1997	3,000	Mechanical-biological	900	30%
		Kharkhorin	30	"Kharkhorin us suvag" Locally owned self-financing enterprise	2012	250	Mechanical	100	40%
18	Umnugobi	Dalanzadgad	31	"Gunii us" LLC	1971	2,700	Mechanical-biological	1,000	37%
		Tsogttsetsii	32	"Ukhaa khudag us khangamj" LLC	2012	1,200	Mechanical-biological	300	25%
		Gurvantes	33	"Shugshaa uul" Locally owned self-financing enterprise	2016	300	Mechanical	100	33%
		Khanbogd	34	"Khandiesel" Locally owned self-financing	2016	50	Mechanical	30	60%

No	Aimag name	Soum name	No	Operating entity	Year of construction	Capacity (m^3/day)	Treatment technology	Receiving waste water (m^3/day)	Receive / Capacity (%)
				enterprise					
19	Khovd	Jargalant	35	"Shim-Us"	1987	2,700	Mechanical	1,000	37%
		Altai	36	Locally owned self-financing enterprise	2013	50	Mechanical	20	40%
		Myangad	37		2012	35	Mechanical	20	57%
		Zereg	38		2013	35	Mechanical	20	57%
20	Khentii	Undurkhaan	39	"Khentii us" LLC	1989, 2001	2,700	Mechanical	1,500	56%
		Bor-Undur	40	"Bor undur khot tokhijilt" Locally owned enterprise	1986	2,100	Mechanical	1,000	48%
21	Khuvsgul	Murun	41	"Khuvsgul us suvag" LLC	2001	1,000	Mechanical	900	90%
22	Ulaanbaatar	Songinokhairkhan district	42	Central WWTP	1963	1,700,000	Mechanical-biological	170,000	10%
			43	Bayangol WWTP	1979	1,000	Mechanical-biological	300	30%
		Khan-Uul district	44	Airport WWTP	1971, 2014	3,000	Mechanical-biological	3,000	100%
			45	Moringiin davaa WWTP	2018	20,000	Mechanical-biological	0	0%
			46	Bio WWTP	1990	1,000	Mechanical-biological	900	90%
			47	Pre-treatment plant for waste water	1972	13,000	Mechanical-chemical	13,000	100%
		Sukhbaatar district	48	Damba WWTP	2013	100	Mechanical-biological	80	80%
		Bagakhangai	49	Bagakhangai WWTP	1989	2,500	Mechanical-biological	250	10%
		Baganuur	50	"Baganuur-Us" Locally owned self-financing enterprise	1983	8,500	Mechanical-biological	3,000	35%
		Nalaikh	51	"Chandmani Nalaikh" Locally owned self-financing enterprise	2015	1,000	Mechanical-biological	500	50%

Source: Regulation Council of Urban Water Supply and Sewage, (2019)
Note: LLC stands for Limited Liability Company

Existing wastewater treatment plants in Aimags are summarized in Table 3.2.7.

Table 3.2.7 Number of Wastewater Treatment Plants (WWTPs) by Aimag in 2018

No.	Aimag name	Total number of WWTPs	Number of large scale WWTPs	Number of small scale WWTPs	Wastewater, million m^3/year
1	Arkhangai	28	1	27	0.86
2	Bayankhongor	2	1	1	0.73
3	Bayan-Ulgii	1	1	-	1.08
4	Bulgan	6	-	6	0.33
5	Darkhan-Uul	6	4	2	1.87
6	Dornod	11	4	7	2.15
7	Dornogovi	3	1	2	0.03
8	Dundgovi	3	-	3	0.09
9	Govi-Altai	1	1	-	0.45
10	Govisumber	1	-	1	0.09
11	Khentii	2	2	-	3.1
12	Khovd	2	1	1	4.31
13	Khuvsgul	3	1	2	0.01
14	Orkhon	3	2	1	7.73
15	Selenge	12	4	8	9.17
16	Sukhbaatar	2	-	2	0.28

17	Tuv	10	1	9	0
18	Umnugovi	33	2	31	0.28
19	Uvs	3	2	1	0.5
20	Uvurkhangai	7	2	5	0.56
21	Zavkhan	4	2	2	0.26
	TOTAL	**143**	**32**	**111**	**33.88**

Source: Ministry of Environment and Tourism, (2019), Environmental Information Centre's web site database (https://eic.mn)

3.3 Existing Institution and Organizations, Policy and Program

3.3.1 Institution and organizations

Central ministries involved in water resources development and management include the Ministry of Food, Agriculture and Light Industry (MOFALI) for irrigation and livestock water, Ministry of Energy (MoE) for hydropower development, Ministry of Construction and Urban Development (MCUD) for water supply and sewerage, Ministry of Environment and Tourism (MET) for water pollution, and Ministry of Health (MOH) for water quality standard for water supply. Local governments are responsible for monitoring of water resources and water pollution control measures. In Ulaanbaatar, Water Supply and Sewerage Authority of Ulaanbaatar (USUG) is responsible for construction, maintenance and management of water supply and sewer facilities in the City except for Baganuuru and Nalaikh districts.

Institutions and organizations involved particularly in the sewerage and water supply sector are summarized with their duties in Table 3.3.1.

Table 3.3.1 Responsibilities of Water Related Organizations

Organization	Responsibilities and current situation
MCUD	- Responsible for policy making of sewerage and water supply - Development of sewerage and water supply systems - Taking charge of water quality standards of water supply at national level - Management of water quality standards of sewage water
Ministry of Environment and Tourism (MET)	- Responsible for water resources and water pollution
MoH (Ministry of Health)	- Strengthening/enhancing water quality standards
Local government	- Management and monitoring of water resources and measures for water pollution - Taking charge of water quality standards of water supply at Aimag level
USUG	- Construction, maintenance and management of water supply and sewer facilities in Ulaanbaatar (except for Baganuuru and Nalaikh districts) - Taking charge of water quality standards of water supply at Capital City level - Management of sewer pipes in Ulaanbaatar
OSNAAUG (Housing and Public Utilities of Ulaanbaatar City)	- Management of sewerage facilities from sewer main pipes and manholes to apartments in Ulaanbaatar (except for Baganuuru and Nalaikh districts)

Source: JICA Project Team

3.3.2 Policy and programs

(1) Related law and plans

Mongolian law on utilization of urban settlements' water supply and sewerage

This law became effective in January 2012. The purpose of this law is to govern relationships related to possessing and utilizing engineer facilities designed for supplying urban settlement users with clean water meeting quality standard requirements, disposing, and treating wastewater from consumption.

Ulaanbaatar 2020 Master Plan and development approach for 2030

The treatment policy for sewage in the master plan is 1) expansion of treatment capacity by rehabilitation and expansion of central sewage treatment plant, construction of small to medium-sized satellite processing plants etc., 2) individual treatment of sewage from each household, 3) maintenance of factory wastewater treatment plants, and 4) management of system reform.

Action program of the Government of Mongolia for 2016-2020

The program describes to "Accelerate the step-by-step renovation work of the central wastewater treatment plant by foreign and domestic investments in line with the general development plan of Ulaanbaatar, other major cities and urban areas". In addition, enabling the utilization of recycled wastewater and groundwater in industrial uses with technology as necessary is required. In terms of environment and ecosystem, introduction of wastewater recycling technology is effective to protect water resources and implement integrated management to prevent their depletion.

Mongolia Sustainable Development Vision 2030 (SDV2030)

The concept of green development is emphasized in the SDV2030 with regard to the infrastructure sector as a whole. Especially, the Mongolian Government aims at meeting world-class environmental standards for urban development and settlements.

The objective is to increase drinking water supply that meets health standards, and improve the availability of sanitation and hygiene facilities, and following targets are set by phase:

- Phase I for 2016-20: Ensure that 80% of the population is supplied with safe drinking water, and 40% of the population uses improved sanitation and hygiene facilities.
- Phase II 2021-25: Ensure that 85% of the population is supplied with safe drinking water, and 50% of the population uses improved sanitation and hygiene facilities.
- Phase III 2026-30: Ensure that 90% of the population is supplied with safe drinking water, and 60% of the population uses improved sanitation and hygiene facilities.

(2) ADB support for wastewater treatment

As more municipalities and Aimags in Mongolia urbanize and develop, there is an increasing need to manage larger quantities of wastewater. Providing better urban infrastructure and services to Aimag centers will improve local environmental conditions and people's quality of life, as well as help attract more businesses and encourage economic activities. ADB have been supporting the improvement of wastewater treatment planning and construction.

The latest support from ADB will help replicate the current achievements of the project to five more Aimag centers—Baruun-Urt, Bulgan, Chinggis, Mandalgovi and Murun—that all need better wastewater management services. The newly proposed project will contribute to a more balanced national urban system and is fully aligned with ADB's Strategy 2030 by making cities more livable. In addition to the building of new wastewater treatment plants by ADB soft loans, model projects are being implemented in Uvurkhangai, Arkhangai and Bulgan Aimags to install standard pit latrines in some Ger areas and collect and treat accumulated sludge at the treatment plants.

The planned new wastewater treatment facilities with an individual operating capacity of 3,000m^3 will replace outdated and inefficient treatment systems not suitable for the extreme climate in Mongolia.

ADB will also invest in vacuum evacuation trucks to improve sanitation in the Ger district and prevent groundwater and surface water pollution. The project is expected to be completed by the end of 2021.

(3) Long term development policy 2050

The proportion of the population with access to safe drinking water is very different in the Aimags and the capital city. Despite the high percentage of safe water supply in Ulaanbaatar, most of the Aimags such as Bayan-Ulgii, Bayankhongor, Arkhangai, Khovd, Khuvsgul, Zavkhan and Uvs directly use surface water in their daily lives, which puts their drinking water hygiene and quality issues at risk.

In the LTDP2050, reducing wastewater by reusing and improving the efficiency of industrial wastewater through the mechanism of water pollution charges and permits have an important position. Also, promotion of wastewater treatment and reuse of treated wastewater should be enhanced.

Furthermore, in order to provide residents with quality drinking water that meets the standards, promoting water source surveys and mapping activities, expanding the resource database, and developing plans and management should be improved.

3.3.3 On-going initiatives and challenges

(1) Initiative of SDGs Goal 6: Clean water and sanitation

Ministries or authorities related to water and sanitation of the Mongolian Government have been working on Goal 6 of the SDGs. Out of all targets of the Goal 6, especially, MCUD has been responsible for target 6.1, 6.2 and 6.3 of Goal 6 which are the most important in the view of water supply and sanitary (Table 3.3.2).

Table 3.3.2 Water Related Initiatives to Achieve SDGs

Target of SDGs Goal 6	Action
6.1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all	Installation of purification devices for drinking water Connecting households to centralized networks and pipelines Connecting water kiosks to centralized networks Implementation of appropriate water-saving policies
6.2: By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation	Sanitary landfills in some Aimags will be established supported by ADB fund. Installation of impervious latrines will be implemented in stages.
6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	The new water treatment plants in Aimag centers will be constructed, and existing plants will be renewed by 2022. Sanitary facilities in all Aimag centers and larger settlements will be rehabilitated.

Source: JICA Project Team

(2) Initiative in water supply and sewerage

The expansion and upgrading of the engineering network in the capital city and Aimag centers have been implemented. Also, extension and renewal of the Ger district piping network will be started in Darkhan-Uul, Khovd, Orkhon, Govisumber, Bayan-Ulgii, Zavkhan, Khuvsgul, Khovd and Dornogovi Aimags.

In some Aimags, various types of projects such as renovation of laboratory equipment for monitoring and testing drinking water have been implemented in step-by-step. In parallel, projects of connecting households to centralized facilities and water kiosks to centralized supply networks are in progress. Drinking water laboratory equipment in Aimag centers have been renewed in phases with state budget investment.

The following efforts are currently undertaken in the sewage treatment sector:

- To construct a new sewage treatment plant in five Aimags of Bayan-Ulgii, Govisumber, Dornod, Zavkhan and Uvs,
- To construct a new sewage treatment plant (construction period: 2020~2024) in UB utilizing Chinese soft loan,
- To upgrade the existing sewage treatment plant in Erdenet,
- To renovate the equipment of clean and wastewater monitoring and analysis laboratories in each Aimag center,
- To renew the special purpose machinery and services in sewage treatment, and
- To implement projects and programs such as human resource capacity building and retraining.

Source: JICA Project Team

Photo: Upgraded Sewage Treatment Plant in Erdenet

(3) Challenge in water supply and sewerage

Especially, groundwater contamination has become more serious problems in recent years due to lack of sewage purification tank or septic tank in rural areas. These problems would have adverse impacts on natural environment and public health.

Different or insufficient accessibility to water and sewerage in rural areas or suburbs poses direct and serious risks to health and safety. In particular, the public utility sector faces the problem that infectious diseases may occur or be transmitted. That is because inadequate sanitation facilities can only meet the minimum requirements for schools and kindergartens. The amount of water supply in rural areas is insufficient, and therefore in some cases women or children have to take water from wells or streams by themselves.

Water purification plants, sewage treatment plants and network pipes built during the socialist era have become over 30 years of age in recent years. In order to prevent deterioration and malfunction of these facilities, appropriate facilities for longer lifespan with a concept of preventive maintenance should be planned and established in steps. One of the most important measures is to establish digitized database system with facility lodger consisting of information on installed date, materials, location, licence attribution and so forth. Also, it is necessary for the database to be managed with GIS. As a result, it will become possible to judge conditions of facilities in a technical manner.

3.4 Existing Measures for Water Resources

3.4.1 Measures for water resources at national level

Based on the issues on water resources at national level, the action plan of measures is proposed by the IWMP as summarized in Table 3.4.1.

Table 3.4.1 Action Plan for Water Resources Proposed by IWMP (2013)

No.	No.	Selected Project No.	Measure description	Activities	Selected Project Sheet	Responsible	Cooperate	Phase	Possible source	Rank	Investment, mln MNT: Phase 2014-2016	Investment, mln MNT: Phase 2017-2021	Investment, mln MNT: Total	Possible source, %: State budget	Possible source, %: Local budget	Possible source, %: Foreign	Possible source, %: Private	Source, %: Stateor local budget	Source, %: Owners
Objective 1. Safe drinking water supply																			
1	1.1		Establish and enforce sanitation and protection zones around water supply sources	Ulaanbaatar city, In 21 aimags and Kharkhorin, Bor Undur, Khotol, Zamiin Uud, Shariin gol, Zuunkharaa, Baganuur, Khanbogd, Tsogtsetsii construction of protection zones around existing and new water supply sources; construction of protection around water supply points (kiosks); enforcement of rules and guidelines on water supply sources protection and sanitation zones		MET, RBA, Capital and Local government	MCUD, MFALI, MH, GASI, NEMA	2014-2021	State budget Local budget	1	1,731	2,395	4,126	6	94	-	-	100	-
2	1.2	1	Local surveys and exploration studies to identify new or verify existing water resources	Comprehensive water resource surveys and studies in existing and new settlement areas; pre-feasibility study of Tuul Dam complex.		MET	NDA, MF, RBA	2014-2021	State budget Local budget Foreign Concession	2	76,461	89,375	165,836	-	100	-	-	-	100
				Comprehensive water resource surveys and studies in existing and new settlement areas in Gobi-Sumber, Dundgobi, Dornogobi, Bulgan, Bayan-Ulgii.					Local budget	2	825	800	1,625	100	-	-	-	-	-
				Feasibility and design study; construction of dam with hydropower plant and reservoir. Tuul Dam Complex	X				State budget Local budget Foreign Private	2	6,500	608,400	614,900	10	4	14	72	100	-
				Improvement of water supply system, including pump stations, reservoirs and pipeline from Taishir Dam					State budget	2	1,588	2,119	3,707	100	-	-	-	-	100
				Improvement of water supply system, including pump stations, reservoirs and pipelines in 6 urban areas					State budget Foreign	2	52,220	-	52,220	5	-	95	-	-	100
				Kharkhorin, Bor Undur, Zamiin Uud, Shariin Gol, Mandal. Zuunkharaa, Khanbogd and Kharkhorin, Saikhan, Khutul, Mandal, Zuunkharaa, Tsogt-Tsetsii					State budget	2	10,528	863	11,391	100	-	-	100	-	100
3	1.3	2	Renovation and expansion of water supply network and increase of number of connected water supply kiosks	Extension of water supply distribution network at Ulaanbaatar City. Constructed kiosks 400.	X	MCUD	NDA, MF, Capital and Local government, RBA	2014-2021	State budget Local budget Foreign Private	2	188,075	225,440	413,515	50	8	30	12	-	100
				Extension of water supply distribution networks of 21 aimag centers and Other big urban areas: Kharkhorin, Bor Undur, Zamiin Uud, Shariin Gol, Saikhan/Khutul, Mandal/Zuunkharaa, Khanbogd, Tsogttsetsii					State budget Local budget Foreign Private		281,304	201,665	482,969	40	10	40	10	-	100
4	1.4	3	Construction and renovation of waste water treatment plants	Renovation, improvement and extension of WWTP's at Ulaanbaatar City: 1. Central WWTP renovation, membrane reactor; 2. Central WWTP improvement of equipment and efficiency; 3. Nisekh/Yarmag new WWTP; 4. Emelt new WWTP; 5. Small treatment plants	X	MCUD	MET, NDA, MF, Capital and Local government, RBA	2014-2021	State budget Local budget Foreign Private	2	235,065	628,300	863,365	30	10	35	25	-	100
				Renovation and construction of WWTP's in 21 aimag centers and other big urban areas: Kharkhorin, Bor Undur, Saikhan. Khutul, Zamiin Uud, Shariin Gol, Mandal. Zuunkharaa, Khanbogd, Baganuur until 2015 and Kharkhorin, Mandal. Zuunkharaa, Tsogtsetsii until 2021					State budget Foreign		66,781	98,923	165,704	45	-	55	-	-	100
5	1.5	4	Renovation and expansion of sewerage network	Extension and renovation of sewerage system in parts of Ulaanbaatar City, aimag centers and other big urban areas: Kharkhorin, Bor Undur, Saikhan. Khutul, Zamiin Uud, Shariin Gol, Mandal. Zuunkharaa, Khanbogd, Tsogtsetsii, Baganuur	X	MCUD	NDA, MF, Capital and Local government, RBA	2014-2021	State budget Local budget Foreign Private	2	287,249	452,258	739,507	37	23	10	30	-	100
6	1.6		Reuse of domestic and treated waste water	Study and implementation of reuse of treated waste water for use by power plants; study and implement grey water systems in new apartments and public buildings		MET	MCUD, NDA, MF, RBA	2014-2021	State budget Foreign Private	4	12,500	17,662	30,162	-	26	1	73	-	100
7	1.7		Improve water supply and waste water treatment at army camps & border posts	Improved water supply and waste water treatment at 8 military units until 2015. Army camps: Ulaankhus of Bayan-Ulgii aimag, Bulgan of Khovd aimag, Bayanlig of Bayankhongor aimag, Songino of Zavkhan aimag, Zuungovi of Uvs aimag, Delgerkhaan of Khentii aimag, Bayanlig of Bayankhongor aimag, Sergelen of Tuv aimag, Altanbulag		MD, MET	NDA, MF	2014-2021	State budget	3	500	500	1,000	100	-	-	-	100	-
				Improved water supply and waste water treatment at 15 military units until 2015. (Zamiin-Ud, Altanbulag, Gahsuunsuxait, Shiveekhuren, Borshoo, Bichigt, Khangi, Burgastai, Bulgan, Khankh, Zelter, Khuvd, Ingensevstei, Uushig, Kharkhonit, Jaalshand, Khetsuu uul, Sainsuuj, Uzuur-Us, Khukh bulag, Tsagaan-Ovoo, Bayantukhum, Lamt, Kholboo zalaa, Buduun mod, Avdrant, Arbulag, Baga khuree, Urgustei, unit in 117, Khatan suudal)		MD	MF	2014-2021	State budget		1,455	2,000	3,455	100	-	-	-	100	-

No.	No.	Selected Project No.	Measure description	Activities	Selected Project Sheet	Responsible	Cooperate	Phase	Possible source	Rank	Investment, mln MNT Phase 2014-2016	Investment, mln MNT Phase 2017-2021	Investment, mln MNT Total	Possible source, % State budget	Possible source, % Local budget	Possible source, % Foreign	Possible source, % Private	Source, % Stateor local budget	Source, % Owners
8	1.8		Establish and enforce protection zones around water sources.	Protection of rural water sources mainly concerns fencing of water points and demarcation of a sanitation zone. Number of protected springs:560		MET, Capital and Local government	MH, MF, GASI, NEMA, RBA	2014-2021	Local budget	2	880	600	1,480		100	-	-	100	-
9	1.9		Local surveys and exploration studies to identify new or verify existing water resources at soum centers	Executed surveys: until 2015: 15 surveys at soum centers, 1352 surveys for boreholes; until 2021: 36 surveys at soum centers, 3380 surveys for boreholes		Capital and Local government, RBA	MET, NDA, MF	2014-2021	State budget	2	751	1,870	2,621	100	-	-	-	-	-
10	1.10		Construct water supplies in soum centers and in rural areas for herders and farmers	Constructed water supplies: until 2015: 15 small soum centers, until 2021: 36 soum centers.		MCUD, MFALI	NDA, MF, Capital & Local Goverment, RBA	2014-2021	State budget	1	9,747	29,412	39,159	100	-	-	-	-	100
11	1.11	5	Construct small waste water treatment plants in soum centers and organize reuse of treated waste water	Constructed waste water treatment plants: until 2015: 15, until 2021: 36 soum centers.	X	MCUD	NDA, Capital & Local Goverment, RBA	2014-2021	State budget Foreign	2	26,406	68,424	94,830	20	-	80	-	-	100
12	1.12		Construct small waste water treatment plants in soum centers and organize reuse of treated waste water	Analysis and selection of sustainable treatment facilities. Installation of new and replacement of existing equipment. Supervision and training of operators.		RBA	MCUD, MF	2014-2021	State budget		100	299	399	100	-	-	-	-	100
13	1.13		Improve and expand water supply infrastructure for tourism and sanatorium	This measure applies mainly to tourist facilities in rural areas. Costs included are not from state budget but from private companies. Measures are to be taken by private tourist companies. These include water supply of ger camps and hotels, water supply of tourist attractions, etc.		MECS	NDA, GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget Local budget Private	2	7,518	9,142	16,660	20	60	-	20	-	100
14	1.14		Improve water supply infrastructure and utilization of high-tech WWTP in tourist camps	Water supply and WWTP in tourist camps in Tuul and Terelj river basin, near Khovd and Buyant rivers as well as lakes of Khuvsgul, Ugii and Terkhiin Tsagaan, near Kherlen and Kharkhiraa rivers as well as lakes of Uvs, Khyargas and Khar-Us, near Ikh Tamir, Chuluut, Onon and Balj rivers as well as Gurvan lake.		MECS	NDA, GASI, NEMA, Capital and Local government, RBA	2014-2021	Private	3	18,800	20,000	38,800	-	-	-	100	-	100
15	1.15		Develop mineral springs for the purpose of spa resorts and sanatoriums	In total 12 springs are to be developed.		MH	NDA, GASI, NEMA, Capital and Local government	2014-2021	Private	2	1,262	1,890	3,152	-	-	-	100	-	100
Objective 2. Water supply for agricultural sector																			
16	2.1		Local surveys and exploration studies to identify water resources for new boreholes, ponds and reservoirs in rural areas	Surveys for ponds at 626 locations until 2015 and 829 locations until 2021		MET	MFALI, NDA, GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget	2	1,252	1,658	2,910	100	-	-	-	-	-
17	2.2	6	Construction of new and renovation of existing water sources (boreholes, ponds) based on grazing capacity and desertification condition	Number of boreholes constructed or rehabilitated: 2011-2015 2466 boreholes, 2016-2021 6050 boreholes. Number of ponds rehabilitated 5, constructed 54 (2011-2015). Number of ponds rehabilitated 7, constructed 125 (2016-2021).	X	MFALI	GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget	2	32,270	72,588	104,858	60	-	25	15	5	95
18	2.3	7	Improve the operation and maintenance of livestock water supply points	Support to herder groups: 300 before 2015, 900 in 2015-2021		MFALI	GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget Foreign Private	1	1,725	5,175	6,900	45	-	30	25	-	100
19	2.4		Support to improve water supply of intensive livestock breeding	Activities are concentrated around Ulaanbaatar, Darkhan and Erdenet		MFALI	Capital and Local government, RBA	2014-2021	State budget Private	2	1,750	2,100	3,850	-	50	-	50	-	100
20	2.5		Surveys and exploration studies to identify water resources for irrigation and haymaking areas	Surveys for new and for renovated irrigation systems		MET	MFALI, MF, Capital and Local government, RBA	2014-2021	State budget	2	315	552	867	100	-	-	-	-	-
21	2.6		Construction and renovation of dams and reservoirs for irrigation	Total capacity of newly constructed or renovated reservoirs should be sufficient to supply: 62,910 thousand m3/year for 22,000 ha until 2015 and 91,935 thousand m3/year for 32,000 ha until 2021.		MFALI	MET, MF, Capital and Local government, RBA	2014-2021	State budget Private	3	6,291	11,032	17,323	30	-	-	70	-	100
22	2.7		Construction and renovation of headworks, main conveyance channel and irrigation systems	Total area newly constructed: 2,900 ha until 2015, 10,600 ha until 2021. Total area renovated: 17,100 ha until 2015, 22,500 ha until 2021.		MFALI	MF, Capital and Local government, RBA	2014-2021	State budget Private	4	91,000	326,666	417,666	30	-	-	70	-	100
23	2.8	8	Improve irrigation management	Support of irrigation management groups: 50 until 2015 and 50 until 2021		MFALI	MF, Capital and Local government, RBA	2014-2021	Local budget Foreign	2	575	575	1,150	-	50	50		-	100

No.	No.	Selected Project No.	Measure description	Activities	Selected Project Sheet	Responsible	Cooperate	Phase	Possible source	Rank	Investment, mln MNT Phase 2014-2016	2017-2021	Total	Possible source, % State budget	Local budget	Foreign	Private	Source, % Stateor local budget	Owners
Objective 3. Water supply for manufacturing, mining and energy sectors																			
24	2.9		Improvement of agro technology of irrigated crops and conduct water saving technology	Improved use of fertilizers, of herbicides and pesticides, of sprinklers and other modern irrigation systems, of mechanical equipment for sowing, weeding and harvesting, of drought and cold resistant crops, of soil protection technologies, of irrigation water management to avoid salinization of soils by appropriate application of irrigation water		MFALI	Capital and Local government, RBA	2014-2021	Private	2	1,348	2,744	4,092	-	-	-	100	-	100
25	3.1		Surveys and exploration studies to investigate water supply sources for big industries	Survey for water supply sources at Sainshand, at Ulaanbaatar and at Choir and Nyalga in Gobisumber aimag.		MET	MF, Capital and Local government, RBA	2014-2021	State budget Private	2	9,350	8,320	17,670	50	-	-	50	-	-
26	3.2		Implementation of water supplies for new industrial parks	Construction of water supplies at Ulaanbaatar, Sainshand, Ulaanbaatar and Choir.		MFALI	MF, Capital and Local government, RBA	2014-2021	State budget Private	2	12,240	170,800	183,040	20	-	-	80	-	100
27	3.3		Implement water supplies to industries separate from drinking water supplies	Construction of separate drinking water pipes for industrial water supply, implementation of water reuse measures of waste water at the Ulaanbaatar and Aimag centers and big urban areas: Darkhan-uul, Erdenet, Khovd, Uliastai, Zuunmod, Choibalsan, Undurkhaan, Shariin-Gol, Ulaangom, Ulgii, Sukhbaatar, Sainshand		MCUD, MFALI	Capital and Local government, RBA	2015-2021	Private	3	2,250	1,950	4,200	-	-	-	100	-	100
28	3.4	9	Implement separate waste water treatment plants for industries	Primary treatment by industries and Industrial WWTP at Ulaanbaatar		MCUD, MFALI	MET, Capital and Local government, RBA	2014-2021	Foreign Private	3	42,120	68,120	110,240	-	-	90	10	-	100
				Installation of waste water treatment plants at industries in aimag centers and urban area and soum centers							6,114	120,400	126,514	-	-	80	20	-	100
29	3.5		Reuse of industrial water	Survey to investigate the feasibility of waste water reuse by industries		MFALI	MET, GASI, NEMA, Capital and Local government, RBA	2014-2021	Private	3	5,000	6,000	11,000	-	-	-	100	-	100
30	3.6		Surveys and exploration studies to investigate mining water supply sources	Assessment of available water resources at 8 mines until 2015 and at 11 mines. Mines: Asgat, Tsagaan Suvarga, Oyu Tolgoi, Tavan Tolgoi, Nariin Sukhait, Boroo, Shivee Ovoo, Olon Ovoot, Mardai, Dornod, Gurvanbulag, Burenkhaan, Shivee Ovoo, Dulaan-Uul, Kharaat		MET	MMHI, NDA, MF, RBA	2014-2021	Private	2	4,000	3,600	7,600	-	-	-	100	-	-
31	3.7	10	Implementation of water supplies for new mining areas	Construction of water supply at 7 mines Mines: Asgat, Tsagaan Suvarga, Oyu Tolgoi, Tavan Tolgoi, Nariin Sukhait, Boroo, Shivee Ovoo, Olon Ovoot, Mardai, Dornod, Gurvanbulag, Tumurtein, Burenkhaan, Choir, Nyalga, Tumurtein Ovoo, Tamsag / Matad, Tsav, Ulaan, Dulaan-Uul, Kharaat		MMHI	MF, Local Khural, RBA	2014-2021	Private	2	365,000	450,000	815,000	-	-	-	100	-	100
				Feasibility study (before 2015) and construction (after 2015) of water diversion project to transfer water from Orkhon river to the Gobi for water supply of mines and other water users. Costs cover construction works before 2021 only.	X				State budget Private	4	4,160	907,200	911,360	10	-	90	-	-	100
32	3.8		Reuse of water used by mines	Reduction in water use at mines to improve conservation of water resources Mines: Asgat, Tsagaan Suvarga, Oyu Tolgoi, Tavan Tolgoi, Nariin Sukhait, Boroo, Shivee Ovoo, Olon Ovoot, Mardai, Dornod, Gurvanbulag, Tumurtein, Burenkhaan, Choir, Nyalga, Tumurtein Ovoo, Tamsag / Matad, Tsav, Ulaan, Dulaan-Uul, Kharaat		MMHI, RBA	-	2014-2021	Private	2	146,526	223,568	370,094	-	-	-	100	-	100
33	3.9	11	Research and design of hydropower plants	Surveys of hydropower dams. Aimags Ulgii and Khovd and along the rivers Orkhon, Selenge and other big rivers		MMHI, GASI, NEMA	RBA	2014-2021	State budget Private	3	11,340	15,000	26,340	50	-	50	-	-	-
34	3.10	12	Construction of hydropower plants	Feasibility study and construction of hydropower dam on Selenge river. Preliminary estimate of investment costs.	X	MF	MET, NDA, MF, RBA	2014-2021	Private	3	4,160	300,000	304,160	-	-	100	-	-	100
35	3.11		Monitoring of water regime of hydropower plants	Hydrological information of operation of reservoirs and effect on river regime		RBA	MET, MF	2014-2021	State budget	3	150	300	450	100	-	-	-	-	100
36	3.12		Water supply to thermal power plants new and operating	Surveys of water sources for power plants, reduction of water losses and improvement of water reuse. Construction costs of new water supplies are assumed to be included in the costs of the power plant and are not included here.		MF	MF, Capital and Local government, RBA	2014-2021	State budget	2	1,185	2,480	3,665	100	-	-	-	-	100
37	3.13		Investigations into geothermal potential	Research into possibility of using geothermal energy		MF	Capital and Local government, RBA	2014-2021	State budget Foreign	2	500	-	500	50	-	50	-	-	-

No.	No.	Selected Project No.	Measure description	Activities	Selected Project Sheet	Responsible	Cooperate	Phase	Possible source	Rank	Investment, mln MNT: Phase 2014-2016	Investment, mln MNT: Phase 2017-2021	Investment, mln MNT: Total	Possible source, %: State budget	Possible source, %: Local budget	Possible source, %: Foreign	Possible source, %: Private	Source, %: Stateor local budget	Source, %: Owners
Objective 4. Keeping the balance of nature and conservation of water resources																			
38	4.1		Establish and enforce protection of runoff forming part of watershed areas	Protection of watershed areas that produce 70 percent of the surface water resources of Mongolia; restoration of forest and vegetation coverage. Watersheds of large and small river basins such as: Orkhon, Kherlen, Tuul, Kharaa, Onon, Khovd, Buyant, Zavkhan, Tsenkher, Ider, Chuluut, Tamir, Selenge, Delgermoron, Tui, Taats, Ongi, Shishkhid, Bulgan, Selbe, Eroo, Tes, Baidrag		MET, RBA	MF, GASI, NEMA, Capital and Local government	2014-2021	State budget	3	1,570	1,500	3,070	100				100	-
39	4.2		Establish and enforce protection zones around water bodies	Protection of water bodies by detailed zones around rivers and lakes. First priority with the lower parts of the main rivers or at rivers with intensive mining.		MET, RBA	MF, GASI, NEMA, Capital and Local government	2014-2021	State budget	2	300	600	900	100				100	-
40	4.3		Exploration to assess usable surface water and groundwater resource reserves taking into account recharge and future trends, and enforce water use within the limit which was set	Improved potential exploitable groundwater resources map of Mongolia; Improved assessment of the future available surface water resources by analysis of observed trends in surface water runoff		MET, RBA	MF, GASI, NEMA	2014-2021	State budget	3	500	1,000	1,500	100				-	-
41	4.4		Installation of water meters at water users	Reduction in water use in apartments and industries (in combination with outputs of measure 1.1.4). Already many meters installed in recent years.		MCUD, MFALI	MET, Capital and Local government, RBA	2014-2021	Private	2	6,436	8,003	14,439				100	-	100
42	4.5		Establish recreational area on river side in cities	Reduction of degradation of river banks near cities and reduction of pollution of water resources by river side recreation. Most works in Ulaanbaatar.		MCUD	Capital and Local government	2014-2021	State budget Local budget	4	5,000	10,000	15,000	80	20			-	100
43	4.6	13	Establish reservoirs to regulate river runoff and create water storage	Feasibility studies and design studies of dams and reservoirs. Construction of dams to be decided after completion of studies.		MET, MCUD	Capital and Local Khural, Capital and Local government	2014-2021	State budget Foreign	4	2,000	4,700	6,700	50		50		100	-
44	4.7		Protection of water resources from pollution	Make a registration and inventory of polluters		MET	MF, GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget Local budget	2	8,462	57,494	65,955	50	50			100	-
45	4.8		Implementation of polluter pay principle	Water users will reduce waste water discharge and will be more responsible to execute waste water treatment on site		MET	MF, GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget Local budget	2	200	400	600	50	50			100	-
46	4.9	14	Improve sanitation facilities and waste water disposal in ger areas	Better health conditions by improved latrines and water drainage systems in ger areas. Investments in eco- and bio-latrines outside Ulaanbaatar are expected to be smaller due to the limited financial capacity of inhabitants.	X	MET, MCUD	Capital and Local government	2014-2021	State budget Foreign Private	2	42,075	115,500	157,575	10		10	80	-	100
47	4.10	15	Research to determine environmental flow in rivers	Preservation of healthy ecological conditions in rivers. Main rivers such as: Selenge, Orkhon, Tuul, Kharaa, Eroo, Onon, Kherlen, Khovd, Buyant, Zavkhan, Tes, Tsenkher, Ider, Chuluut, Tamir, Delgermoron, Shishkhid,Tui, Taats, Ongi, Bulgan, Baidrag		MET	MF, Capital and Local government, RBA	2014-2021	State budget Foreign	2	450	900	1,350	50		50			
48	4.11		Improve implementation of Ramsar convention and increase number of lakes and wetlands registered in Ramsar Convention	Use of international reference for protection of lakes and wetlands. No investment costs required.		MET	MF, Capital and Local government, RBA	2014-2021	-	2			-					100	
49	4.12		Conservation of good and sustainable ecological conditions wetlands and lakes by preserving water to maintain biodiversity.	Improved environmental conditions in lakes and wetlands by taking measures to reduce losses of surface water and groundwater		MET	MF, Capital and Local government, RBA	2014-2021	State budget	2	100	200	300	100				100	
50	4.13		Improve irrigation technology of green areas in cities and enforce water supply norms	Reduction in water use for watering of green areas. Investment costs mainly in Ulaanbaatar.		MET	Capital and Local government, RBA	2014-2021	State budget	3	1,104	500	1,604	100					100

No.	No.	Selected Project No.	Measure description	Activities	Selected Project Sheet	Responsible	Cooperate	Phase	Possible source	Rank	Investment, mln MNT: Phase 2014-2016	Investment, mln MNT: Phase 2017-2021	Investment, mln MNT: Total	Possible source, %: State budget	Possible source, %: Local budget	Possible source, %: Foreign	Possible source, %: Private	Source, %: Stateor local budget	Source, %: Owners
51	4.14		Prevention of negative effects due to lower groundwater levels by human activities	Preservation of natural conditions in wet grassland areas and reduction of risk of drying op shallow groundwater wells. Activity includes hydrogeological mapping in approx. 10 river basins with costs budgeted as recurrent costs.		MET	MCUD, MFALI, MMHI, GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget	3	100	200	300	100				100	
52	4.15		Make inventory, clean and reconstruct damaged and polluted river valleys	Restoration of natural conditions in river valleys and protection of water resources		MET, RBA	MFALI, MMHI, MF, GASI, NEMA, Capital and Local government	2014-2021	State budget Private	2	20,300	40,600	60,900	5			95	100	
53	4.16	16	Create special protected areas to protect and restore rivers and lakes with changing ecological conditions	Protection of areas damaged by mining or other activities and restoration and reforestation activities. Forest and wetland areas in Tuul, Orkhon and other river basins.		MET, RBA	MFALI, MMHI, Capital and Local government	2014-2021	State budget Local budget Foreign	2	750	2,000	2,750	30	20	50		100	
54	4.17		Construction and maintenance of flood protection structures	Better protection against flooding by renovation and construction of flood protection dykes along Tuul, Selbe and Uliastai rivers		MCUD	MF, Capital and Local government	2014-2021	State budget	2	36,434	72,734	109,168	100				50	50
				Better protection against flooding by renovation and construction of flood protection structures							34,670	30,000	64,670	100				50	50
55	4.18		Construct drainage systems in urban areas	Improved drainage of rain water in areas not covered by drainage system and drainage of soil water in areas with high groundwater levels.		MRT	MF, Capital and Local government	2014-2021	State budget	2	13,650	27,300	40,950	100				50	50
56	4.19		Define ownership and improve maintenance and management of drainage systems in urban areas	Better maintenance and management of drainage systems in urban areas		MRT	Capital and Local Khural, LOCAL GOVERNMENT, RBA	2014-2021	-	2			-					100	
57	4.2		Establish and enforce water management methodology and rules for drought and desertification conditions	Activities to be carried out by river basin administrations in cooperation with MEGD, MFALI and local authorities.		NEMA, RBA	MET, MFALI, MF, Capital and Local government	2014-2021	-	2			-					100	
58	4.21		Installation of rain generators to implement cloud seeding	35 rain generators installed until 2015; continuation after 2015 depends on evaluation of effectiveness		MET	MF, Capital and Local government	2014-2021	State budget	2	700	300	1,000	100				100	
Objective 5. Implementation of an optimum water management and provision of a cross-sectoral coordination																			
59	5.1		Coordinate, make consistent and update water related laws and combine them in a "Package Law on Water"	Improved drainage of rain water in areas not covered by drainage system and drainage of soil water in areas with high groundwater levels. Better maintenance and management of drainage systems in urban areas Activities to be carried out by river basin administrations in cooperation with MEGD, MFALI and local authorities. 35 rain generators installed until 2015; continuation after 2015 depends on evaluation of effectiveness		MET	MF, MJ	2014-2021	-	2			-					100	-
60	5.2		Improve compliance with international treaties, conventions and trans-boundary agreements			MET	MF, Capital and Local government, RBA	2014-2021	-	2			-					100	-
61	5.3		Update and improve rules, procedures, norms, normatives and standards			MET	Capital and Local government, RBA	2014-2021	-	1			-					100	-
62	5.4		Improve enforcement capacity and capabilities			MET	GASI, Capital and Local government, RBA	2014-2021	-	2			-					100	-
63	5.5		Update status and mandate of responsible government authorities and basin organizations responsible for coordinating water issues	Approval of coordination between institutions involved in water management by reorganizing and strengthening the institutional structure and assigning clear responsibilities to the NWC and MEGD departments and river basin authorities.		MET	MF, MJ	2014-2021	-	2			-					100	
64	5.6		Improve the mechanisms for coordination and cooperation between sectors involved in water issues			MET	MET, MF	2014-2021	-	2			-					100	
65	5.7		Improve the operations and relations between authorities in charge of water issues at national and basin level			RBA	MET, MF, Capital and Local government	2014-2021	-	2			-					100	
66	5.8		Strengthen the role of scientific research, professional water related organizations, NGOs and civil society in water management	Strengthen institutions involved in water management by training staff, removing budget constraints and by providing means and equipment		MECS	MET, MF, RBA	2014-2021	-	2			-					100	

No.	No.	Selected Project No.	Measure description	Activities	Selected Project Sheet	Responsible	Cooperate	Phase	Possible source	Rank	Investment, mln MNT			Possible source, %				Source, %	
											Phase 2014-2016	Phase 2017-2021	Total	State budget	Local budget	Foreign	Private	Stateor local budget	Owners
67	5.9		Improve exchange, storage, quality control and access to water management data at national and basin levels	Enable exchange of water management data and information between organizations by providing funds for data collection, processing and storage and improve data quality.		RBA	MET, MF	2014-2021	-	2			-					100	
68	5.10		Develop a clear vision and prepare a work plan for the development of RBOs and their role in water management	Clarify role and status of WBCs. Support and strengthen WBAs by establishing technical offices for water management at the river basin level.		MET, RBA	MF, Capital and Local government	2014-2021	-	2			-					100	
69	5.11		Renew water pricing policy and improve cost recovery	Assess expenditures and determine required financial resources to cover the recurrent costs of water supply and waste water treatment.		MET, MCUD, MFALI	MF, RBA	2014-2021	State budget	2	30	50	80	100				100	
70	5.12		Develop additional and alternative financial sources to finance the planned investments in the water sector	Improve private financing through PPP-like concepts		MET, MCUD, MFALI	MF, RBA	2014-2021	State budget	2	30	50	80	100				100	
71	5.13		Improve efficiency of water sector to reduce recurrent costs	Improve coordination and cooperation between water sector organizations involved in planning, management and operation.		MET, MCUD, MFALI	MF, RBA	2014-2021	State budget	3	300	500	800	100				100	
72	5.14		Improve human resources capacity in water sector	Create employment conditions (in respect of salary, career options, etc.) at par with the private sector; make education centers more responsive to sector's needs; increase enrollment for vocational training among young people by promoting craftsmanship.		RBA	MET, MECS, MF	2014-2021	-	1			-					100	
73	5.15		Carry out study how to improve education and training of water professionals of all levels	Recommend measures to ensure an adequate supply of water managers, water engineers and specialists as well as technicians.		MET, RBA	MET, MECS, MF, RBA	2014-2021	State budget	2	2,000	-	2,000	100					
74	5.16		Implement recommendations of study to improve education and training of water professionals of all levels	Advise on required changes in the education system at university and vocational levels.		MET, RBA	MET, MECS, MF, RBA	2014-2021	State budget	3	-	10,000	10,000	100					
75	5.17		Improve and expand monitoring of quality and quantity of water resources	Modernize sampling equipment and analysis instruments to cover all important chemical parameters, including heavy metals and organic and inorganic substances.		MET	MF, , RBA	2014-2021	State budget	2	3,000	5,000	8,000	100				100	
76	5.18		Improve sampling equipment and laboratory facilities.	Analyse monitoring data to determine usefulness and representativeness.		MET, GASI	MF, RBA	2014-2021	State budget	2	3,000	5,000	8,000	100				100	
77	5.19		Rationalize monitoring programs and formalize	Support cooperation between organizations involved in monitoring of surface water, groundwater and water quality.		MET	MF, RBA	2014-2021	-	2			-					100	
78	5.20		Expand and integrate water sector research and studies	Establish a central database before 2015 for water sector data where all water related government organizations and research institutes place their data to be accessible for any interested party.		MET	MECS, MF, RBA	2014-2021	-	2			-					100	
79	5.21		Improve national databases, data quality control and data exchange	Establish river basin databases which are connected and deliver data to the central database		MET	Ministries of Government of Mongolia, GASI, NEMA, RBA	2014-2021	State budget	3	260	100	360	100				100	
80	5.22		Create water database systems at basin level	Prepare annual reports of monitoring results by central and river basin organizations.		MET, RBA	MF, Capital and Local Khural, LOCAL GOVERNMENT	2014-2021	State budget	3	10,000	30,000	40,000	100				100	
81	5.23		Institutionalize regular detailed publication of results	Á¿õ øàòíû ñàâ ãàçðûí áàéãóóëëàãóóä æèë á¿ð òàéëàí ãàðãàæ, àæëûí ¿ð ä ¿íã õÿâëýë ìýäýýëëèéí õýðýãñýë, öàõèì õóóäñààð òîãòìîë ìýäýýëýõ.		MET, RBA	MF	2014-2021	-	2			-					100	
82	5.24		Design, using specialized professionals, comprehensive information and awareness raising strategies for specific target groups	Engage a specialized and reputed firm having knowledge of mass psychology, communication and mass media to design a detailed awareness raising and public mobilization plan.		RBA	MF	2014-2021	State budget	3	2,000	-	2,000	100				-	-
83	5.25		Implement the recommended information and awareness raising strategies	Engage NGOs in the execution of awareness raising and public mobilization plans.		RBA	MF	2014-2021	-	2			-					100	-
84	5.26		Provide easy access for the public to all relevant information and data related to water resources and their use	Create internet access and publish annual reports		MET, MCUD, RBA	MFALI, MMHI, MF	2014-2021	-	2			-					100	-
85	5.27		Promote and reintroduce traditional protection methods	Aim to connect protection measures of water resources and water quality with traditional protection practices.		MET, RBA	MF, Capital and Local government	2014-2021	-	2			-					100	-
86	5.28		Enhance the role of NGOs as vehicles for public participation in water management at all levels	Involve NGOs in promotion and awareness raising activities		MET, RBA	MF, Capital and Local government	2014-2021	State budget	2	600	1,800	2,400	100				100	-

Source: Based on "Integrated Water Management Plan, Mongolia" 2013, Ministry of Environment and Green Development (former; now Ministry of Environment and Tourisms)

Source: Ministry of Environment and Green Development (predecessor of MET (2013), Integrated water Management Plan

3.4.2 Measures for water resources in Ulaanbaatar

Depending on the water demand scenarios analyzed by the IWMP, measures for water resources in Ulaanbaatar are summarized by 2030WRG as follows.

- *In the **low water demand scenario**, there are two options to close the gap of 4 million m^3/yr. The most cost-effective solution is to implement water efficiency measures in Combined Heat and Power Plant (CHP)-4 in Ulaanbaatar which would result in cost savings of 10.2 million USD/ year. However, as USUG (Ulaanbaatar Water Supply and Sewage Authority) is already engaged in the non-revenue water (NRW) reduction measures, which have the potential to close 95% of the low demand gap at 7.1 million USD/year this option may be preferred. The remaining 0.2 million m^3/year could be closed by exploring the additionally identified solutions which are assessed in a qualitative manner, or by installing water efficiency measures in CHP4 in addition.*
- *In the **medium water demand scenario**, there are also two options to close the gap of 34 million m^3/yr. Following the cost curve, the most cost-effective solution (US$/$m^3$) is the Tuul Water Complex. However, as the Tuul Water Complex cannot be constructed in segments, its construction would result in an excess of water available (57.3 million m^3/year) and would result in high total costs (US$46.4 million/year). Alternatively, the remaining measures analyzed in the cost curve could be chosen to close the gap at less than half the cost (US$21 million/year). These measures include the implementation of a combination of water efficiency measures at CHPs 2, 3 &4, reuse of treated Emeelt industrial wastewater, reuse of treated CWWTP (Central Waste Water Treatment Plant) water at CHPs 2, 3 &4, reuse treated wastewater from CWWTP at industrial clusters (Bayangol, Songinokhaikhan & Khan Uul) and USUG NRW leakage reduction measures (35.6 million m^3/year).*
- *In the **high-water demand scenario**, the only measures capable of closing the gap are the Tuul Water Complex in combination with water efficiency measures at CHP4 at US$36.2 million/year.*

Additional solutions include: grey water reuse in commercial and residential buildings, on-site industrial wastewater treatment and reuse, industrial water efficiency measures and conveyance of treated wastewater to upstream water source locations.

The following next steps are recommended by 2030WRG.

- *Currently, there is no regulatory provision to allow for reuse of treated wastewater, nor are there incentives for users to reuse treated wastewater. To enable treated wastewater reuse, a clear recycling and treated wastewater reuse policy, a legal and regulatory framework following a risk management approach, a sound and integrative strategy for reusing water and wastewater, good state of sewerage and wastewater treatment infrastructure as well as incentive and financing arrangements are required.*
- *Further assessments are required/ final outcomes of feasibility studies need to be awaited to gain a full picture of the potential of water efficiency measures at Combined Heat and Power Plants (CHPs), and Tuul Water Complex (dams), reusing treated wastewater for CHPs and industrial water usage, grey water reuse at commercial and residential buildings and retrofitting of appliances.*
- *Even after all identified potential uses for treated wastewater, 81 million m^3/year would remain unused. Subject to downstream water requirements, options of conveying this water upstream for storage and reuse could be further explored and integrated into the relevant strategy documents, such as the Tuul Integrated Water Management Plan.*

Table 3.4.2 shows a full list of related infrastructure with five water measures and two heat measures listed in the Implementation Plan of Ulaanbaatar Master Plan 2030.

Table 3.4.2 Measures List of the Implementation Plan of Ulaanbaatar Master Plan 2030

Project name	Implementing Agency	Investment cost (million MNT)	Source of financing	Category	Description	Status (as enquired from UB City Governor's office)
Engineering design of Expansion of CWWTP	USUG with the Ministry of Construction and Urban Development (MCUD), UB city mayor's office	580,000	National budget, Capital city budget, other	water supply and sewerage	Current capacity is of CWWTP is 170,000 m3/day. Following are planned: 1. Technology upgrade 2. Construction of additional 250,000 m3/day module 3. Sludge processing plant	Feasibility study is complete. Engineering design in progress.
Expansion of CWWTP			loan, other			Searching for financing sources.
Tuul Water Complex	USUG with MCUD, MET, UB governor's office	552,000	National budget, Capital city budget, other	water supply and sewerage	1. Fresh water reservoir: 405.4 mn m3 of volume 2. Hydro-power plant: 7.4 MW (total energy produced per year: 43.1 mn kWh)	Feasibility study is complete. Engineering design in progress.
Trenchless relining of aged pipelines	MCUD, UB city governor's office	15,200	Other, foreign loan	water supply and sewerage	43.7 km pipeline relining using Austrian technology. Goal is to improve water quality.	Contracts pending to be signed by the new Government. Work is expected to start in Sept. 2016.
Connecting freshwater reservoirs	MCUD, UB city governor's office	26,955	National budget	water supply and sewerage	1. Construction of 12 km pipeline that will connect West, 3-4 District, Tasgan, Northeast reservoirs. 2. Expansion of Northeast reservoir by additional 18,000 m^3.	Engineering design is completed. Searching for financing sources.
Exploration of water supply resources in Bagakhangai District	MET with UB city governor's office	650	Capital city budget	water supply and sewerage	Exploration of water supply source within 40 km radius from Bagakhangai district.	Project has not started yet, as ofJul 2016.
Central heating network upgrade	MoE with UB city Governor's office	36,016	National budget, Capital city budget, other	heat supply	Upgrade of main heating network lines, increase the diameters and construct new pump stations.	In progress.
Networks within apartment complexes	UB city Governor's office	15,045	Capital city budget	heat supply	Upgrade and replacement of network within apartment complexes.	In progress.

Source: 1) 2030 Water Resources Group, (2016), "Hydro-economic Analysis on Cost-Effective Solution to Close Ulaanbaatar's Future Water Gap, Mongolia, Ulaanbaatar,", 2) Capital City Master Planning Agency, (2014), Implementation Plan of Master Plan 2030

Proposed measures for water supply-demand issues in Ulaanbaatar by 2030WRG are summarized as follows:

- Water demand reduction,
- Combined heat and power plants (CHPs),
- Tuul water complex (dam #3),

- Reuse of treated wastewater from Central Wastewater Treatment Plants (CWWTP) for CHPs,
- Cluster-based industrial WWTPs and reuse of treated wastewater (Emeelt),
- Reuse of treated wastewater from CWWTP for industrial uses,
- Leak detection and non-revenue water reduction in central water supply network (USUG), and
- Water and energy leakage reduction in central heating supply system.

Capital expenditure (CAPEX) and operating expenditure (OPEX) estimates for the Tuul water complex as shown in Table 3.4.3 were taken from the Tuul Water Complex Feasibility Report[73] in relation to the dam site #3 and has been used in the analysis.

Table 3.4.3 CAPEX and OPEX Estimates for the Dam #3 Tuul Water Complex

CAPEX			OPEX	
Component	Total Cost (US$)	Lifetime (year)	Component	Annual Cost (US$)
Dam construction	168,459,841	100	Dam	585,360
Wastewater Treatment Plant (WWTP)	132,124,813	40	Wastewater Treatment Plant (WWTP)	10,019,700
Pipeline	53,404,000	40	Depreciation	6,313
Total	353,988,654		Total	10,605,060

Source: 1) 2030 Water Resources Group, (2016), "Hydro-economic Analysis on Cost-Effective Solution to Close Ulaanbaatar's Future Water Gap, Mongolia, Ulaanbaatar,"

The feasibility report inconsistently reported the value for surface water capacity. A figure of 250,000 m^3/day or 91.25 m^3/year has been used in the analysis. The feasibility report also provides estimates of energy consumption as shown in Table 3.4.4.

Table 3.4.4 Energy Consumption Estimates for the Dam #3 of Tuul Water Complex

Component	Energy (kWh/year)
Dam	318,000
WWTP and booster pumps	65,963,000
Total	66,281,000
Total (kWh/year/m3)	0.726

Source: 1) 2030 Water Resources Group, (2016), "Hydro-economic Analysis on Cost-Effective Solution to Close Ulaanbaatar's Future Water Gap, Mongolia, Ulaanbaatar,"

3.4.3 Measures for water supply by MCUD

On-going projects and planned projects for water supply by MCUD are summarized in Table 3.4.5 and Table 3.4.6.

Table 3.4.5 General Information of On-going Projects by MCUD (as of October 2019)

No.	Name of Project	Finance	Start / End Date	Amount of Funding	Financial Source		2018 Rating	Implementation (%)	Explanation / Achieved Results, Urgent Issues
					Grant Aid	Loans			
1	Development project of the township of Umnugobi and Dornogovi Aimags	ADB	2010-2019	15,000,000 USD	15,000,000 USD		It works	99	The benefits of the project are beneficial to 74,300 people from 6 Soums and 2025 to become engineering infrastructure to reach 125,000 people.
2	Development of Southeast	ADB	2016-2020	$ 19,430,000		$ 19,430,000	The results	81.6	The Uvurkhangai Aimag wastewater

[73] Yooshin Engineering Corp (2016) Feasibility Study and Basic Engineering Design Development of Tuul Water Complex Project 2nd Consultation Workshop.

	Gobi Urban Development and Border Towns						have been achieved		treatment plant was commissioned.
3	UII town of YII, XIY, housing and infrastructure project of MNB	Chinese soft loan	2010-11-20-2018-11-01	117.5 million / USD		100 million USD	The results have been achieved	86	The total number of apartments for 1872 was put into operation in the VII and XIV districts.
4	Erdenet City Wastewater Treatment Plant Extension Project	French	2013-06-28-2018-09-01	9,535,000.0 euros		9,535,000.0 euros	It works	93.3	The Orkhon Aimag government needs to identify the user.
5	Improvement of waste water management in Darkhan city MON 3244	ADB	2015-2020	$20.68 million		18.5 million / USD	The results have been achieved	64	The new CBB was built in Darkhan city, with the opportunity to expand the city.
6	National Action Plan for Greenhouse Emissions Reduction in Construction (NAMA)	The Global Environment Fund	July 2016 - December 2019	$ 1,269,863.0	$ 1,269,863.0		The results have been achieved	81	The development of the "Electronic System for the Construction of the Greenhouse System" was developed and introduced.
7	Draft II Capacity Building for Urban Sector Capacity Building	JICA	2015 - 2018	3,400,000 yen	3,400,000 yen		It works	100	A total of seven rules and regulations were followed by the Law on Rehabilitation of Cities and Settlements.

Source: MCUD, (2019)

Table 3.4.6 General Information of Planned Projects by MCUD (as of October 2019)

No.	Project Name	Finance	Project Cost	Description/Notes
1	Construction of the new Waste Water Treatment Plant in Ulaanbaatar City	Chinese soft loan	US$300 million	Capacity: 250,000 m3/day Introduce environmentally friendly, advanced technology and treat sewage sludge and produce electricity.
2	Construction of new Waste Water Treatment Plants and rehabilitation of the existing Waste Water Treatment Plants in Aimag centers	Poland's Government conditional loan	MNT50,697,150,000	Aimags: Bayan-Ulgii, Uvs, Zavkhan, Dornod, Gobisumber
3	Taishir-Altai project: to improve water supply in Altai City	Austria	EUR14 million	The Ministry of Construction and Urban Development of Mongolia and Austria's Tiroler Rohre GmbH will jointly implement the project with the funding of EUR14 million within the financial cooperation agreement established between the Governments of Mongolia and Austria. According to the project, the water will be supplied from the Taishir hydropower plant water reservoir through 52km water transmission pipeline, therefore there will be no adverse effect on the environment.

Source: MCUD, (2019)

3.4.4 Measures for irrigation and livestock water by MOFALI

Current measures for irrigation and livestock water by the Ministry of Food, Agriculture and Light Industry (MOFALI) are summarized below:

- Irrigation related measures: With the investment of MNT380 million from the state budget, MOFALI are organizing the selection of irrigation systems for vegetables and fodder crops in Bayan-Ulgii and Khuvsgul Aimags. In addition, the government of China has financed the supply of grain irrigation equipment with irrigation capacity of 1,100 ha. A study is undertaken on the use of irrigation systems in 10 Soums of Uvs, Khovd and Bayan-Ulgii Aimags to support the development of vegetable production, irrigation system and the creation of a reliable irrigation source.
- Pasture water supply: As of 2017, 43,800 wells have been provided for water supply for rural population and livestock breeding, of which 90.0% are in winter, spring and summer grazing areas. Of all the wells, 28.3% or 13,600 wells are engineered and 71.7% or 30,200 are dug wells/hand wells. More than 70% of the wells used for pasture are relatively low-pitched, where overgrazing of livestock is prevalent and desertification is proceeding. The availability of engineering wells is relatively limited, while it is possible to supply more than 60 million livestock by them. The state budget has not been allocated for water-based exploration in 2015-17, and a 200,000-point survey has covered 200 points in Govi-Altai and Sukhbaatar Aimags in 2017 with investment from the Local Development Fund and a well-functioning well.

3.4.5 Measures for hydropower by MoE

Currently operated hydropower plants (HPPs) and planned HPPs projects by the Ministry of Energy (MoE) are summarized in Table 3.4.7.

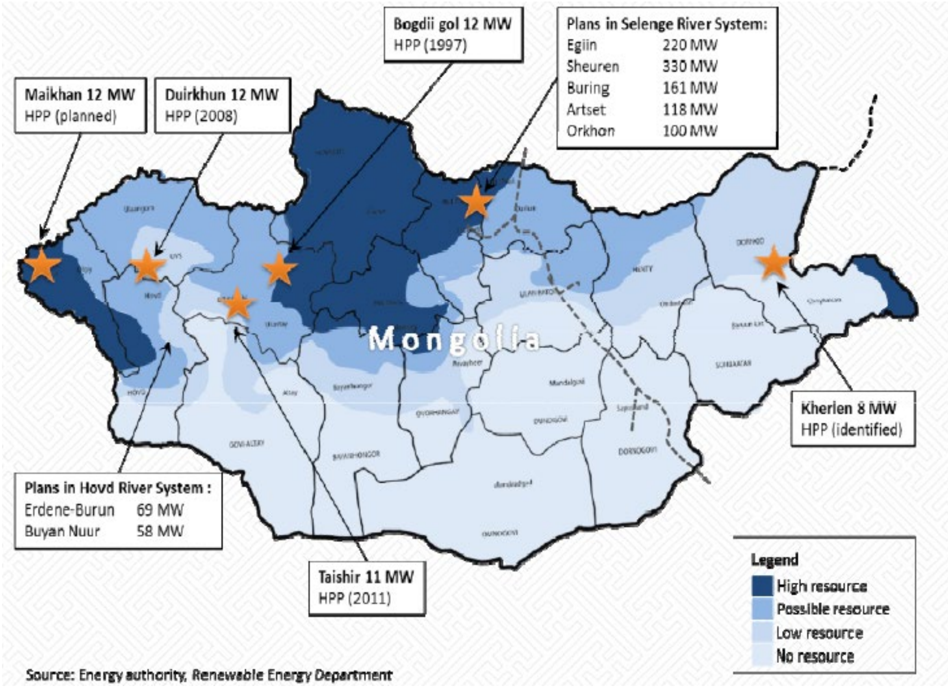
Table 3.4.7 Currently Operated Hydropower Plants (HPPs)

	1	2	3	4	5	6	7
	Taishir HPP	**Guulin HPP**	**Bogd River HPP**	**Galuutai HPP**	**Hungui HPP**	**Tosontsengel HPP**	**Durgun HPP**
Location	In Ulaanboom cliff in Taishir sum of Govi-Altai Aimag and Khyargas lake and Zavkhan river basin. /Gegeen nuur/	In Guulin town located in Delger sum of Govi-Altai Aimag	In Bogd gol bag[1] located in Aldarkhaan sum of Zavkhan Aimag	In the 2nd bag, Jargalant, located in Tsetsen-Uul sum of Zavkhan Aimag	In Zavkhanmandal sum of Zavkhan Aimag	In Tosontsengel sum of Zavkhan Aimag	In Chonoharaih cliff in Durgun sum of Khovd Aimag
Implementing organization	"Taishir Guulin Hydropower Plant" LLC	"Taishir Guulin Hydropower Plant" LLC	"Bogd Gol Hydropower Plant" LLC	"Bogd Gol Hydropower Plant" LLC	"Bogd Gol Hydropower Plant" LLC	"Tosontsengel Hydropower Plant" LLC	"Durgun Hydropower Plant" LLC
Expected outcome	Supply power to 32 sums of Govi-Altai and Zavkhan Aimags	Supply power to Delger Soum and Guulin town of Govi-Altai Aimag, and Shiluustei Soum of Zavkhan Aimag	Supply power to 5 Soums of Zavkhan Aimag	Supply power to Tsetsen-Uul Soum of Zavkhan Aimag	Supply power to Zavkhanmandal Soum of Zavkhan Aimag	Supply power to Tosontsengel Soum of Zavkhan Aimag	To co-operate next to/with the Erdeneburen HPP
Power generation capacity	11 MW	400 kW	2000 kW	150 kW	115 kW	375 kW	12 MW
Date of operation	October of 2008	1997	1997	2010	2010	2006	June of 2008

	1	2	3	4	5	6	7
	Taishir HPP	**Guulin HPP**	**Bogd River HPP**	**Galuutai HPP**	**Hungui HPP**	**Tosontsengel HPP**	**Durgun HPP**
Dam height	50 m		2.1 m	3 m	4 m	4 m	17.5 m /an earth dam/
Dam length	192 m			40 m	40 m	50 m	250 m
Dam type				Reinforced concrete, with spillway	Reinforced concrete, with spillway	Reinforced concrete, with spillway	
Penstock			Φ1200x2, length: 55 m	3.3 m	4 m	3.3 m	
Length of the channel		825 m	2500 m				
Irrigation channel		25 km					
Reservoir capacity	1130 million m^3	Water channel volume: 9 m^3	No place for storing water				170 million m^3
Reservoir Area				1.1 km^2	1.4 km^2	1.2 km^2	
Output	37 GWh/yr	555 thousand kWh/yr	4-5 GWh/yr	150-200 thousand kWh/yr	150-200 thousand kWh/yr	1.4 GWh/yr	38 GWh/yr
Energy used for power generation	0.5 GWh/yr	1500 kWh/yr	800 thousand kWh/yr	30-40 thousand kWh/yr	30-40 thousand kWh/yr	18 thousand kWh/yr	0.45 GWh/yr
Project cost	42.8 billion MNT	481 million MNT	5.5 billion MNT	752 million MNT	752 million MNT	900 million MNT	31.9 billion MNT
Funding	Kuwait Fund for Arab Economic Development, Abu Dhabi Fund for Development, Government of Mongolia	Chinese grant	German Technical Cooperation	Grant of the Government of Netherlands	German Technical Cooperation, Grant of the Government of Netherlands	Grant of the Federal Republic of Germany	China's Overseas Economic and Technological Cooperation, and the Government of Mongolia
Availability of irrigation field and water for irrigation	None	None	None	None	None	None	None
Water for domestic use	1752 m^3/yr (water use of the HPP)						1110 m^3/yr (water use of the HPP)

Source: Ministry of Energy, (2019)

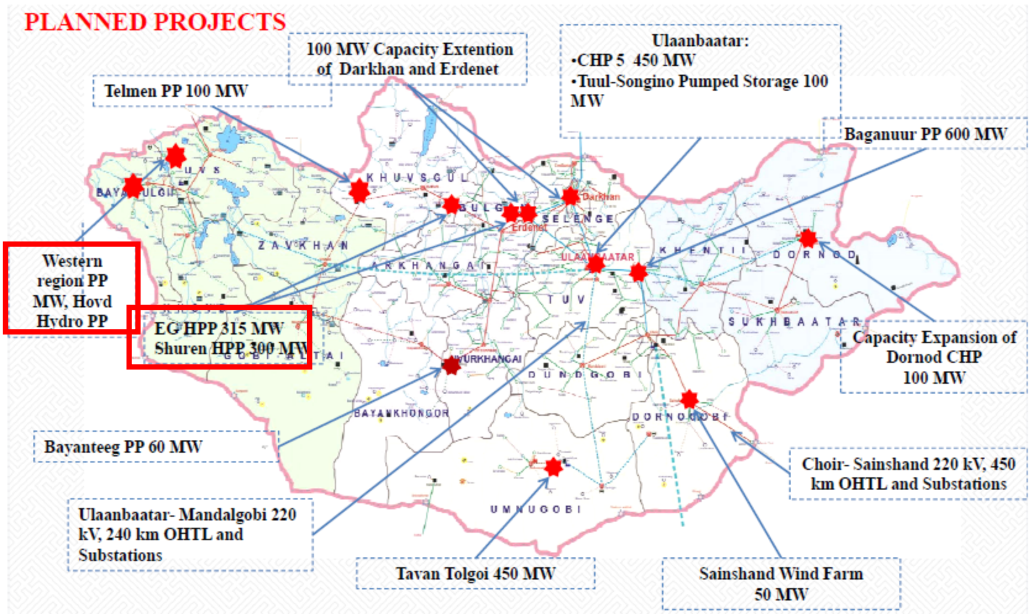
Location map of existing hydropower plants and proposed project sites are shown in Figure 3.4.1 and Figure 3.4.2.



Source: Energy Authority, Renewable Energy Department

Figure 3.4.1 Location Map of Hydropower Plants and Projects Sites

According to the "State Policy on Energy 2015-2030", in the 1st stage 2015-2023, hydropower will account for at least 10% of total installed capacity and it will increase backup capacity to 10% and create a basis for renewable energy sector to develop intensively and improve tariff system. In the 2nd stage 2024-30, secondary energy due to hydropower will be exported and contribute to the sustainable renewable energy sector. The backup capacity of power system will reach 20% and share of renewables will reach 30% during this stage.



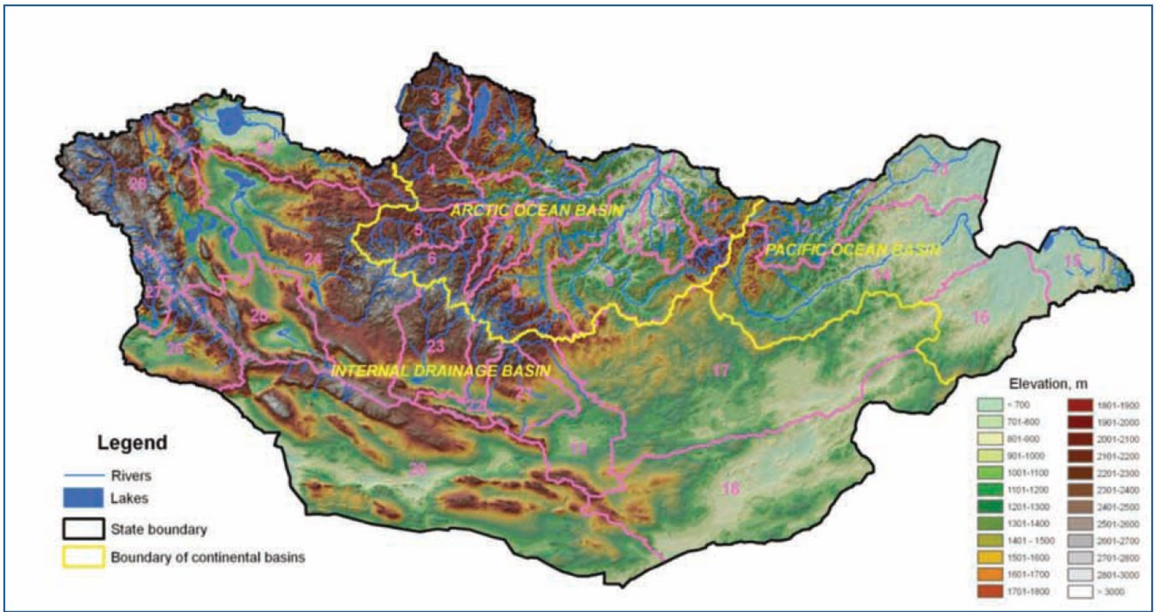
Source: Ministry of Energy, (2017)

Figure 3.4.2 Planned Power Sector Projects

3.5 Water Balance Analysis by River Basin

3.5.1 River basins

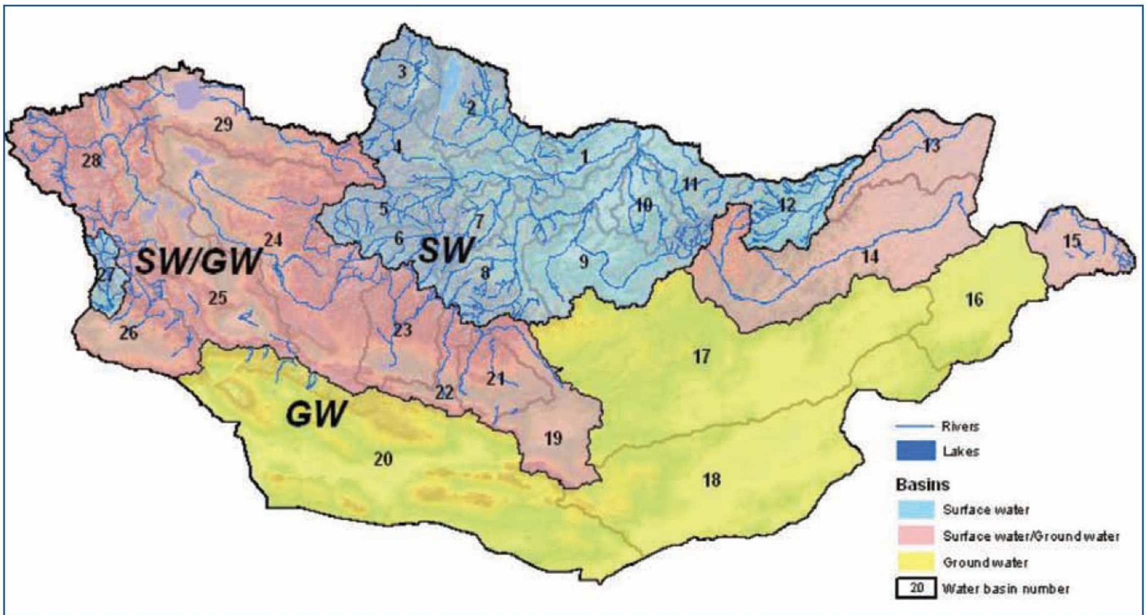
Mongolia is broadly divided into three basins: Arctic Ocean, Pacific Ocean and Central Asian internal drainage basins as shown in Figure 3.5.1.



Source: Ministry of Environment and Green Development (former), (2013), "Integrated Water Management Plan, Mongolia"

Figure 3.5.1 Continental Basins of Mongolia

The river basins of Mongolia are further sub-divided into 29 basins as shown in Figure 3.5.2.



Source: Ministry of Environment and Green Development (former), (2013), "Integrated Water Management Plan, Mongolia"

Figure 3.5.2 Classification of Water Basins

3.5.2 Water resources (the supply)

(1) IWMP estimates

According to the IWMP (2013)[74], endowments of surface water and groundwater resources were estimated by using hydrological model as shown in Table 3.5.1.

Table 3.5.1 Water Basins in Mongolia and Their Water Resources According to IWMP (2013)

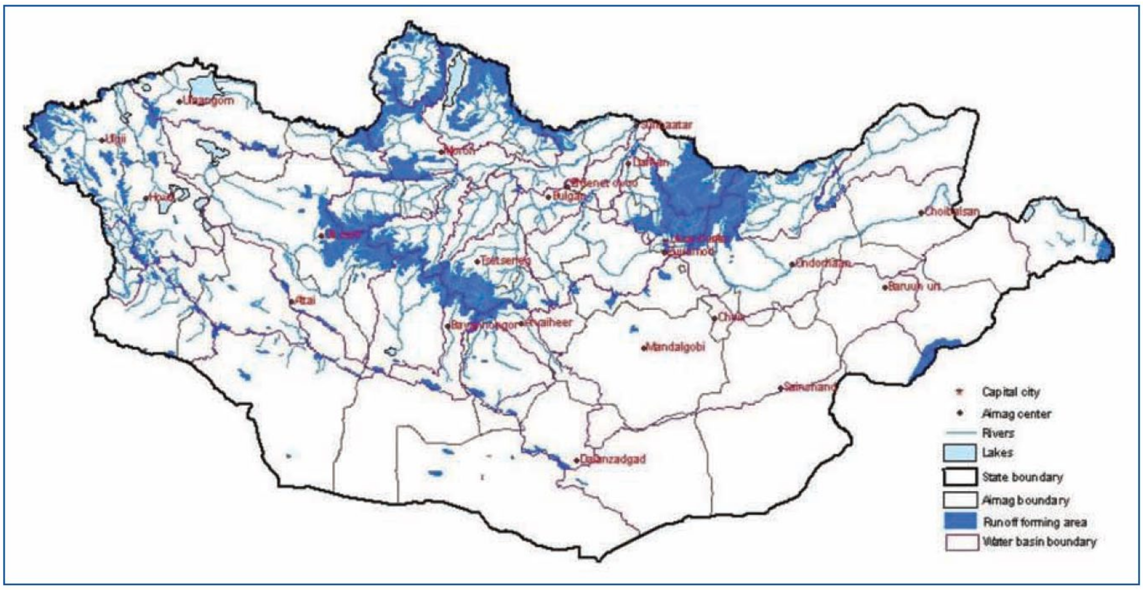
No.	Name	Area (km^2)	Basin	Type	Surface water resources (million m^3/year)			Groundwater resources (million m^3/year)	
					Total resources	Environ-mental	Possible use	Potential exploitable	Exploitable resources
1	Selenge	31,395	A	SW	2,133	1,856	277.3	697	90.3
2	Khuvsgul Lake - Eg	41,871	A	SW	2,971	2,570	401.1	432	0.2
3	Shishkhid	20,362	A	SW	519	481	39	206	0.2
4	Delgermurun	23,324	A	SW	1,080	999	81	229	2.7
5	Ider	23,061	A	SW	710	657	53.3	129	0.5
6	Chuluut	20,078	A	SW	185	171	13.9	86	0.1
7	Khanui	15,755	A	SW	231	217	13.9	96	0.2
8	Orkhon	53,455	A	SW	2,345	2,123	221.6	838.3	26.7
9	Tuul	50,074	A	SW	1,073	1,010	63.1	637.7	142.8
10	Kharaa	17,697	A	SW	432	406	25.9	182	52.6
11	Eroo	22,280	A	SW	1,121	925	196.2	239	0.6
12	Onon	28,241	P	SW	1,480	1,221	259	344	0.6
13	Ulz	37,961	P	SW	130	107	22.7	320	26.4
14	Kherlen	107,906	P	SW	567	507	59.5	721	43.9
15	Buir Lake - Khalkh	23,756	P	SW	1,023	920	102.3	198	1.1
16	Menengiin Tal	54,082	P	GW	0	0	0	168	0.1
17	Umard Goviin Guveet -Khalkhiin Dundad Tal	180,555	CA	GW	0	0	0	433	46.7
18	Galba – Uush - Doloodiin Govi	142,287	CA	GW	0	0	0	352	59
19	Ongi	39,724	CA	SW/GW	26	25	1	294	5.8
20	Altain Uvur Govi	221,156	CA	GW	0	0	0	337	65.5
21	Taats	25,425	CA	SW/GW	22	21	0.9	61	0.5
22	Orog Lake - Tui	15,735	CA	SW/GW	66	63	2.6	33	5.9
23	Buuntsagaan Lake – Baidrag	35,622	CA	SW/GW	303	280	22.7	174	2.9
24	Khyargas Lake – Zavkhan	122,315	CA	SW/GW	599	554	44.9	892	10
25	Khuisiin Govi - Tsetseg Lake	43,024	CA	SW/GW	0	0	0	493	8.1
26	Uench - Bodonch	34,491	CA	SW/GW	66	64	2.7	237	11.3
27	Bulgan	10,155	CA	SW	207	199	8.3	86	0
28	Khar Lake - Khovd	88,936	CA	SW/GW	2,317	2,201	115.8	684	12.7
29	Uvs Lake - Tes	54,223	CA	SW/GW	1,578	1,514	63.1	405	6.1
	Mongolia (Total)	1,584,946			21,184	19,092	2,092	10,004	623.4

Note:
Basin: A = Arctic Basin, P = Pacific Basin, CA = Central Asian Internal Drainage Basin
Type: SW = Surface water, GW = Groundwater
Surface water: Total resources based on surface water which is generated in an average year within the river basin only; inflow from other upstream river basins is not included.
Environmental flow: Davaa and Myagmarjav (1999) estimated the minimum flow requirement in Mongolian rivers. The environmental resources are based on their estimate.
Possible use: total resources – environmental resources
Groundwater: Potential resources based on aquifer properties and renewable resources.
Exploitable resources based on approved groundwater deposits.
Source: Ministry of Environment and Green Development (former), (2013), “Integrated Water Management Plan, Mongolia”

[74] Ministry of Environment and Green Development (Ministry of Environment and Tourism), (2013), “Integrated Water Resources Management Plan, Mongolia”

(2) Surface water

The surface water resources are unevenly distributed over the Country (Figure 3.5.3). There is more surface water potential in the northern and the central parts of the Country than in the rest of the Country.



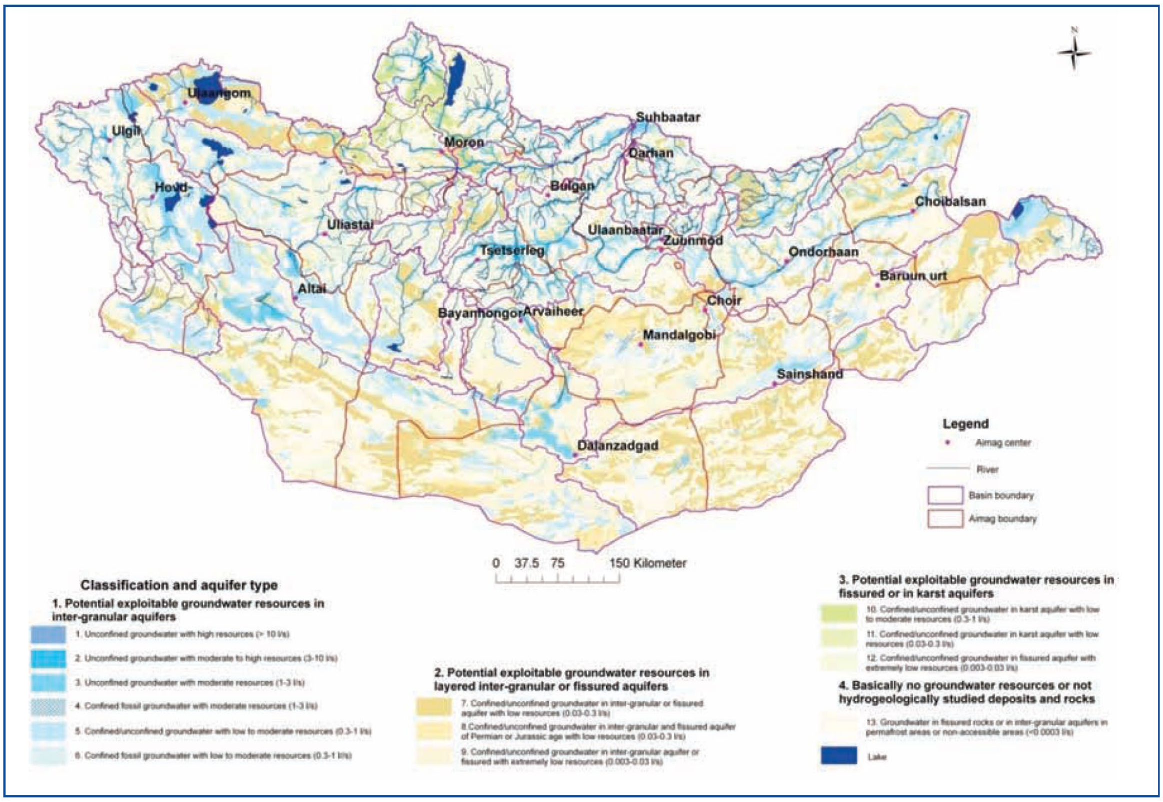
Source: Ministry of Environment and Green Development (former), (2013), "Integrated Water Management Plan, Mongolia"

Figure 3.5.3 Surface Water Runoff Forming Areas in Mongolia

The river water quality was affected by mining and other human influences (e.g. in the Tuul River basin at Zaamar) or discharge heavy metals through leakage from tailings (e.g. in the Kharaa River basin). The Selenge River is polluted by gold mining industries. The WWTPs of many Aimag and Soum centers are polluting the surface water due to poor operation of the facilities. In Ulaanbaatar, the CWWTP pollutes the Tuul River (IWRM, 2013).

(3) Groundwater

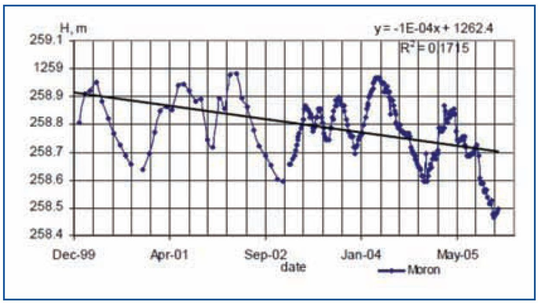
Groundwater is the main water source in Mongolia for drinking and industrial use (Figure 3.5.4). About 99% of the population uses groundwater for drinking purpose. Irrigation use mostly surface water but the use of groundwater is increasing. Most mines and industries extract groundwater. Industries in urban areas either use water from the central system or from own wells (IWRM, 2013).

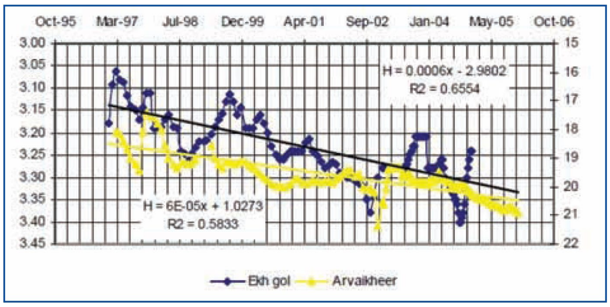


Source: Ministry of Environment and Green Development (former), (2013), "Integrated Water Management Plan, Mongolia"

Figure 3.5.4 Potential Exploitable Groundwater Resources Map of Mongolia

A decline of groundwater levels in wells observed by the Institute of Meteorology, Hydrology and Environment (IMHE) is reported. Groundwater levels in deep wells show a decline as exploitation of the groundwater proceeds. A decline of groundwater levels is reported in Ulaanbaatar (Figure 3.5.5).





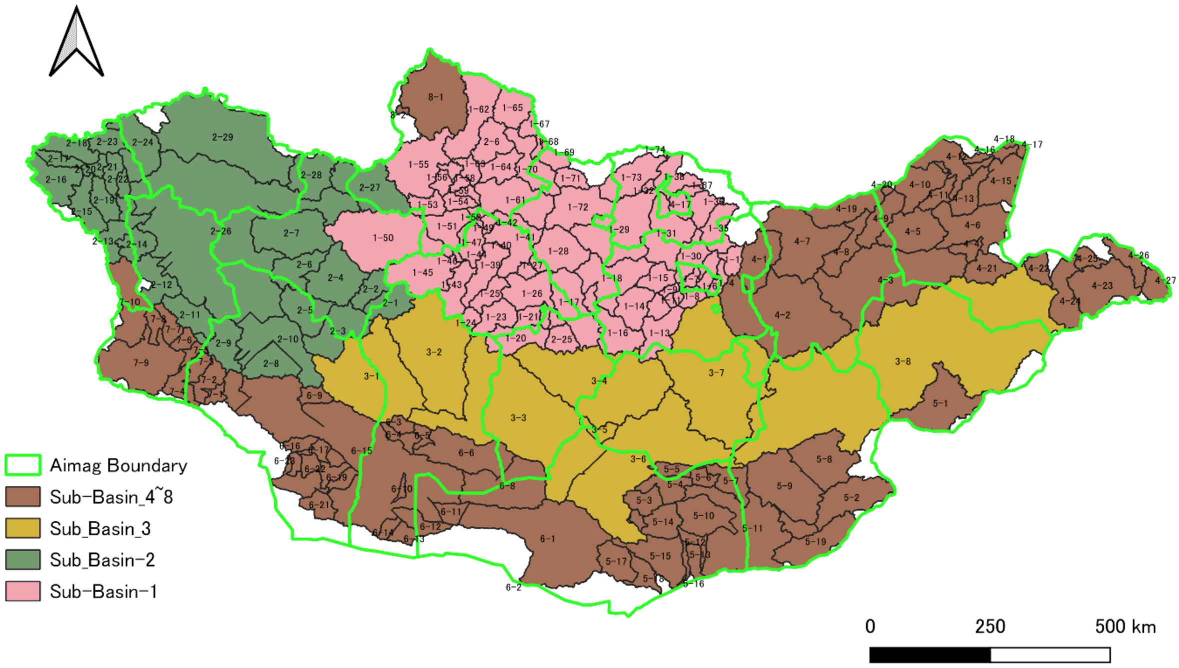
Source of data: IMHE, 1995-2005

Figure 3.5.5 Observed Groundwater Levels at Moron, Ekh Gol and Arvakheer

(4) Surface and groundwater potential estimated by JPT

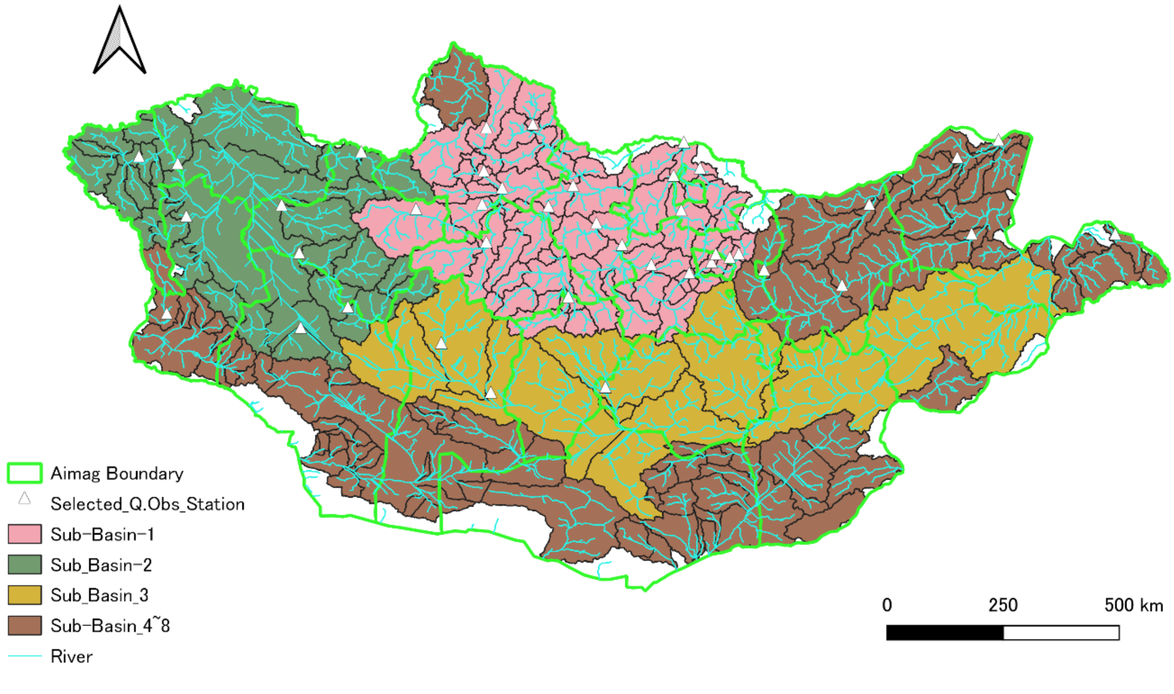
The JPT has estimated the surface and groundwater potentials by using the Tank Model that can consider snow fall and snow melting process and the groundwater model (Darcy's law model) for each sub-basin. The sub-basins within the entire Mongolia territory used for hydrological models are 192 in total as shown in Figure 3.5.6. The Tank Model for each sub-basin is calibrated by using observed discharge data at selected hydrological stations and observed precipitation and temperature data provided by NAMEM. The selected hydrological stations and meteorological stations are shown in Figure 3.5.7 and Figure 3.5.8, respectively. The groundwater model (Darcy's law model) is also calibrated by using groundwater level data by NAMEM as shown in Figure 3.5.9. The details of the Tank Model and

Darcy's law model are explained in Annex to Chapter 3.



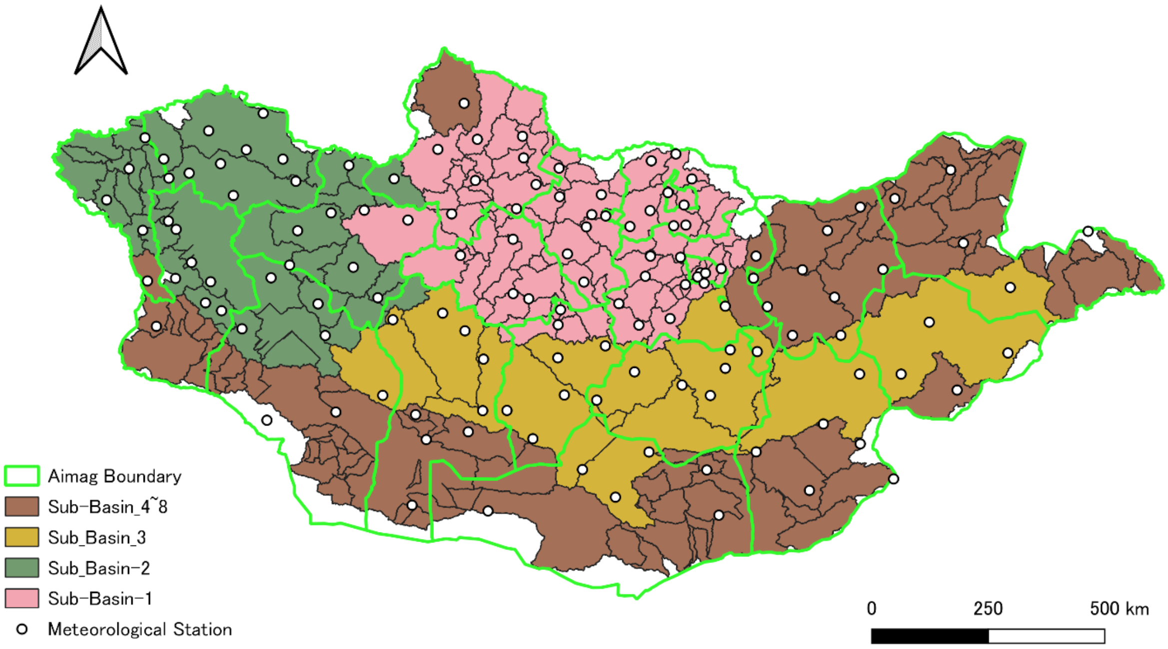
Source: JICA Project Team

Figure 3.5.6 Map of Sub-Basins for Hydrological Modelling by JPT



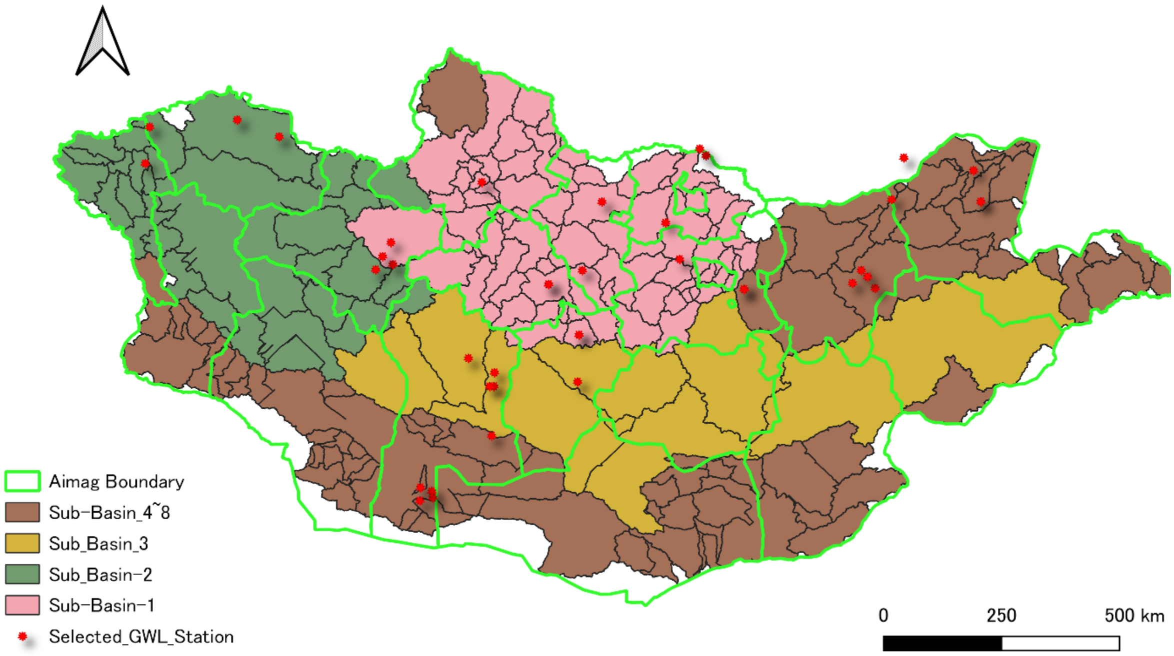
Source: prepared by JICA Project Team based on data of NAMEM

Figure 3.5.7 Location Map of Selected Hydrological Stations



Source: prepared by JICA Project Team based on data of NAMEM

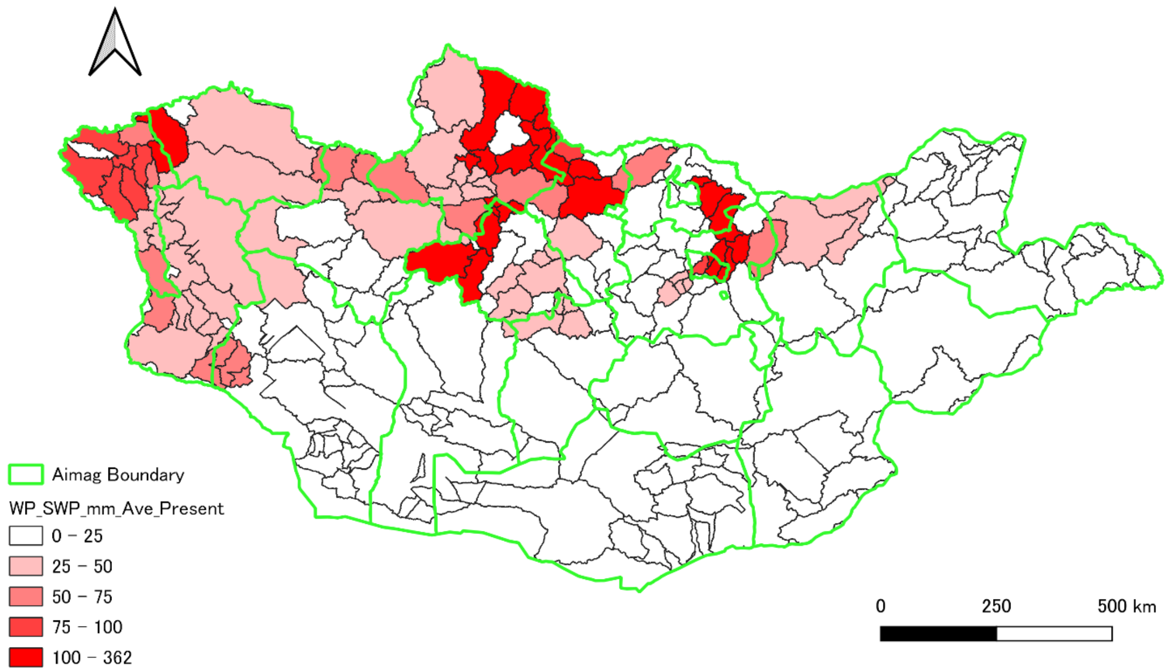
Figure 3.5.8 Location Map of Meteorological Stations in Mongolia



Source: prepared by JICA Project Team based on data of NAMEM

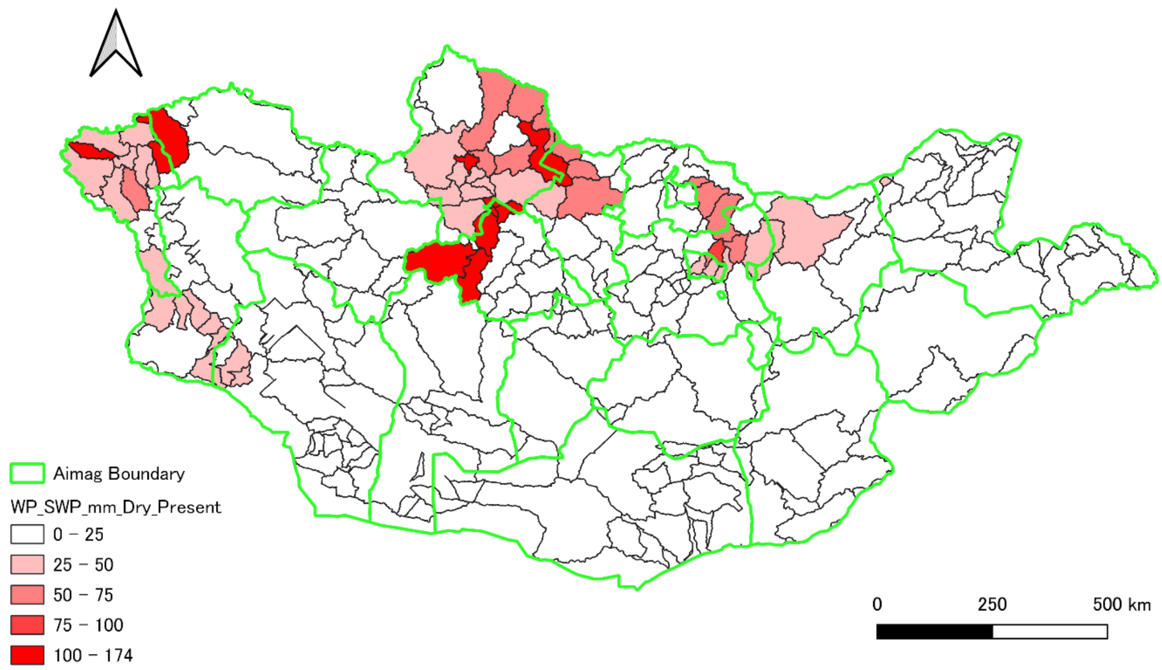
Figure 3.5.9 Location Map of Selected Groundwater Level Observation Stations

The estimated surface and groundwater potentials as the annual mean (average) and maximum and minimum for simulated period of 30 years (from 1989 to 2018) are shown in Table 3.5.3. The simulated sub-basin wise water potential maps of surface water and groundwater are shown in Figures 3.5.10 through 3.5.13. The southern part areas of the Mongolia such as the Gobi-area are shown as low water potential areas.



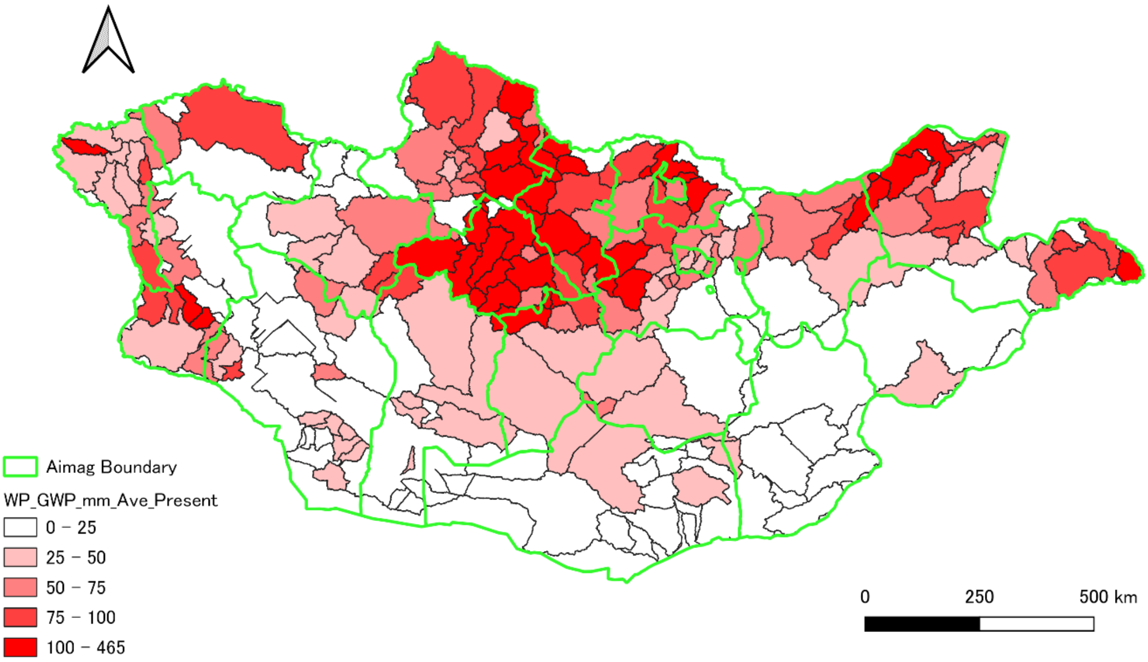
Source: JICA Project Team

Figure 3.5.10 Map of Annal Surface Water Potential by Sub-Basin (Average)



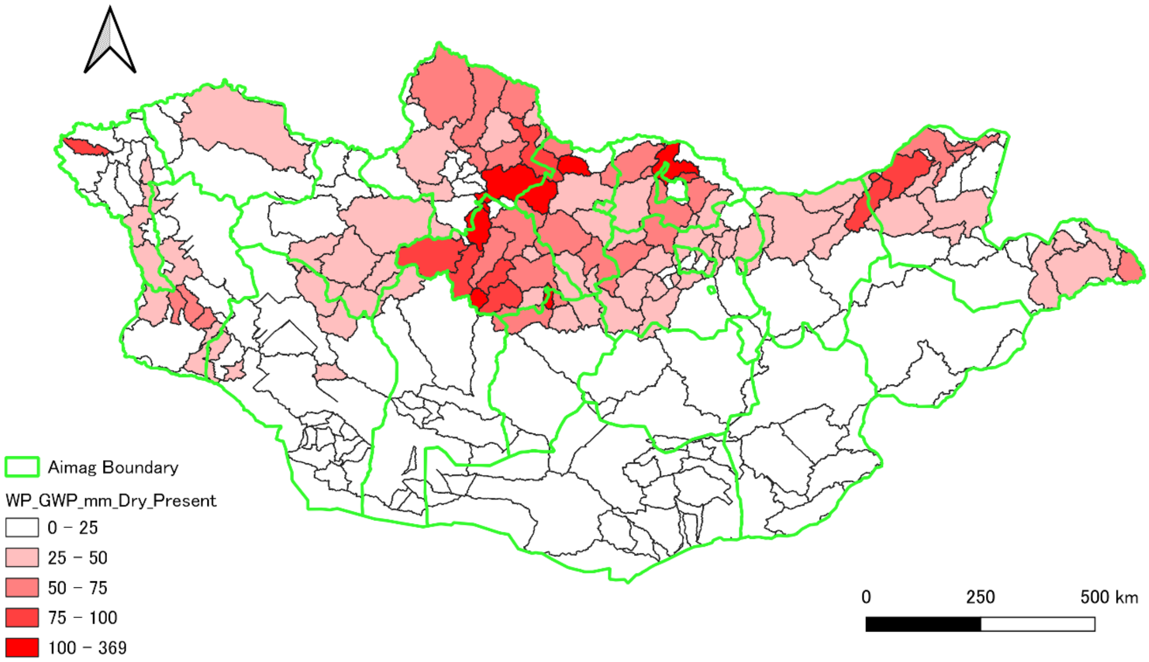
Source: JICA Project Team

Figure 3.5.11 Map of Annal Surface Water Potential by Sub-Basin (Dry Year)



Source: JICA Project Team

Figure 3.5.12 Map of Annal Groundwater Potential by Sub-Basin (Average)



Source: JICA Project Team

Figure 3.5.13 Map of Annal Groundwater Potential by Sub-Basin (Dry Year)

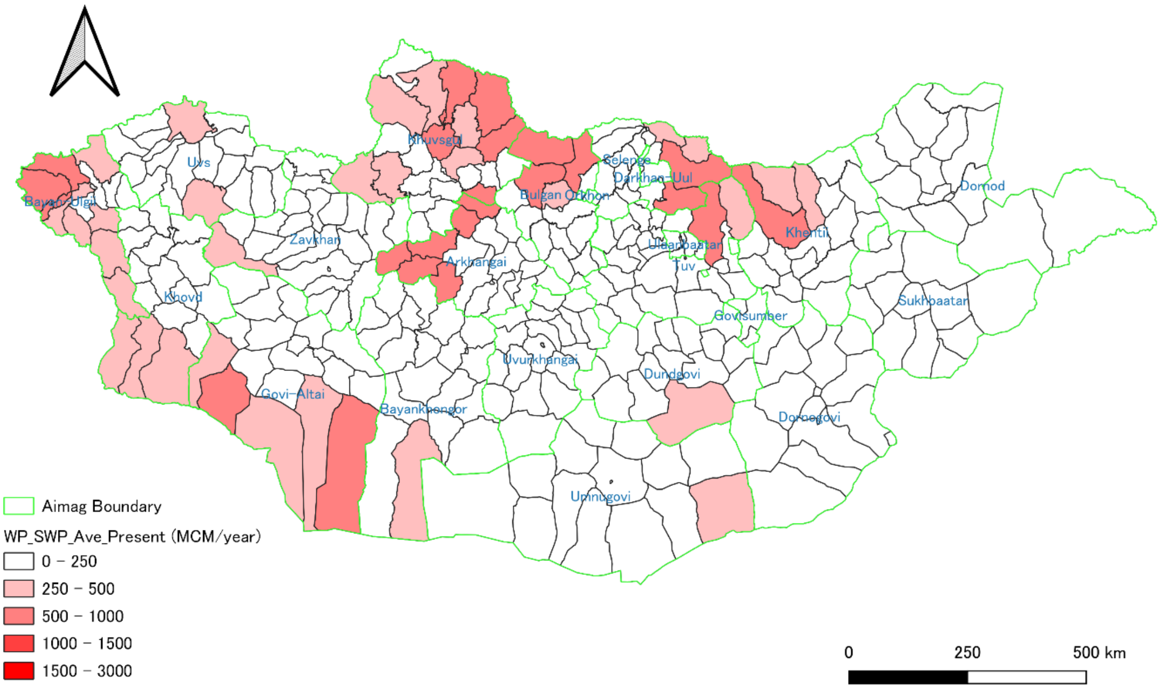
The Aimag-wise water potentials estimated by the JPT are shown in Table 3.5.2. Figures 3.5.14 through 3.5.17 show water potential maps of Soum level. The details of the Soum-level water potentials are shown in Table 3.5.4 (average) and Table 3.5.5 (dry year) and Figure 3.5.18 and Figure 3.5.19.

Table 3.5.2 Aimag-wise Surface and Groundwater Potentials Estimated by JPT

Unit: million m^3/year

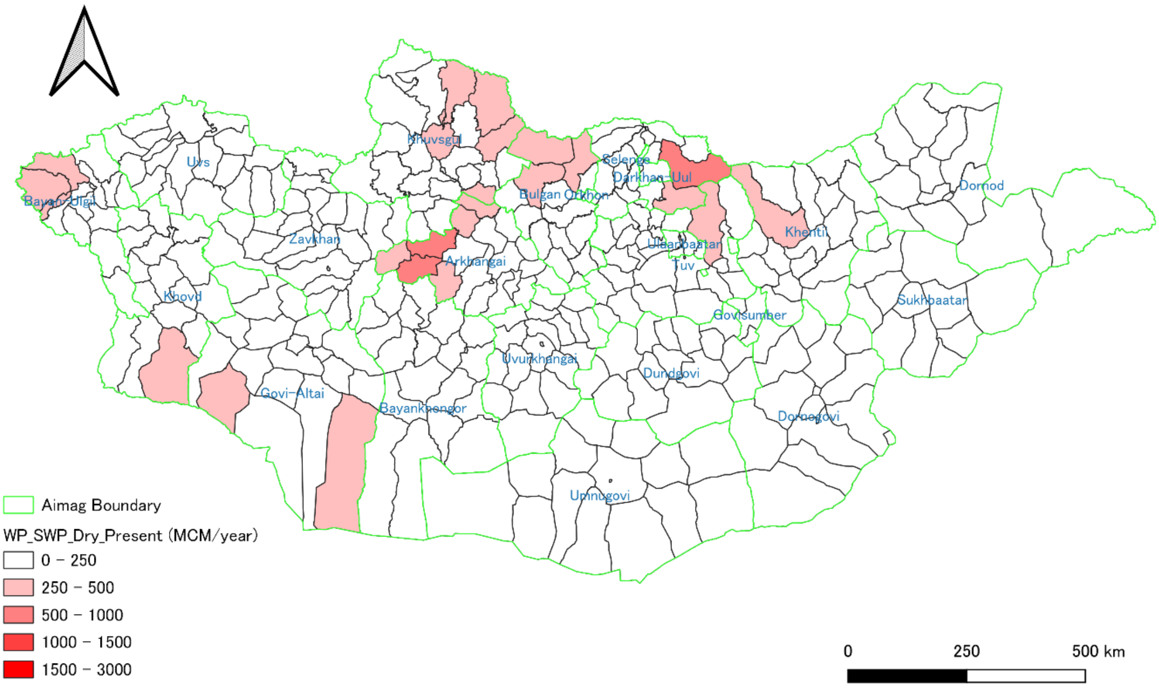
Aimag/City	Water Potential (Average)			Water Potential (Dry Year)		
	SW	GW	Total	SW	GW	Total
Mongolia	**44,209**	**80,487**	**124,697**	**22,081**	**42,740**	**64,820**
Western Region	*15,338*	*17,828*	*33,166*	*7,768*	*8,987*	*16,755*
Bayan-Ulgii	3,423	1,930	5,353	1,716	1,045	2,761
Gove-Altai	3,618	4,940	8,558	1,692	2,398	4,090
Zavkhan	2,198	3,838	6,036	1,124	2,078	3,202
Uvs	2,988	3,824	6,812	1,643	1,741	3,385
Khovd	3,110	3,297	6,407	1,593	1,724	3,317
Khangai Region	*17,498*	*29,615*	*47,114*	*9,735*	*16,709*	*26,445*
Arkhangai	4,714	7,046	11,760	2,951	4,071	7,022
Bayankhongor	1,728	3,366	5,094	793	1,612	2,405
Bulgan	2,977	6,151	9,127	1,817	3,515	5,332
Orkhon	13	61	74	6	33	40
Uvurkhangai	783	2,652	3,435	319	1,326	1,645
Khuvsgul	7,284	10,339	17,623	3,850	6,152	10,002
Central Region	*8,135*	*17,077*	*25,212*	*3,194*	*8,407*	*11,601*
Govisumber	59	105	164	23	51	73
Darkhan-Uul	32	534	566	18	344	362
Dornogovi	896	2,259	3,155	57	855	912
Dundgovi	830	2,069	2,899	249	955	1,204
Umnugovi	1,523	3,660	5,183	342	1,312	1,654
Selenge	2,775	4,150	6,925	1,595	2,746	4,341
Tuv	2,019	4,301	6,319	909	2,144	3,054
Eastern Region	*2,827*	*15,720*	*18,547*	*1,202*	*8,485*	*9,687*
Dornod	540	9,063	9,602	190	4,999	5,189
Sukhbaatar	533	2,482	3,015	79	1,199	1,278
Khentii	1,754	4,176	5,930	933	2,287	3,220
Ulaanbaatar	*412*	*246*	*659*	*182*	*151*	*332*

Source: JICA Project Team



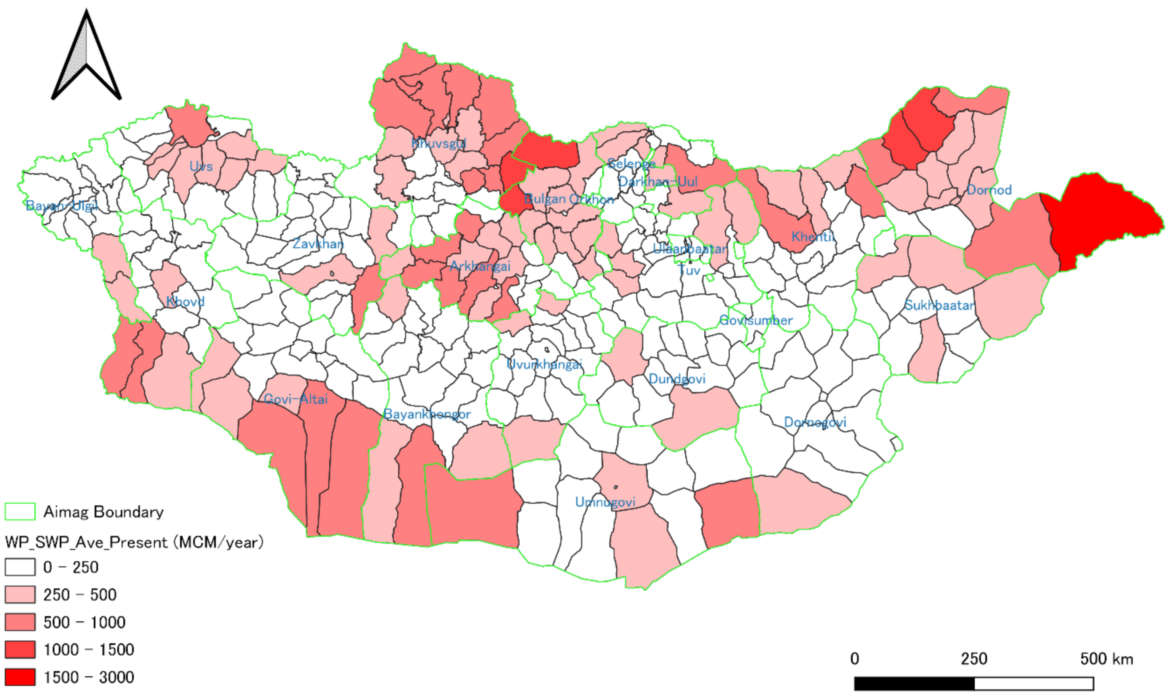
Source: JICA Project Team

Figure 3.5.14 Map of Estimated Annal Surface Water Potential by Soum (Average)



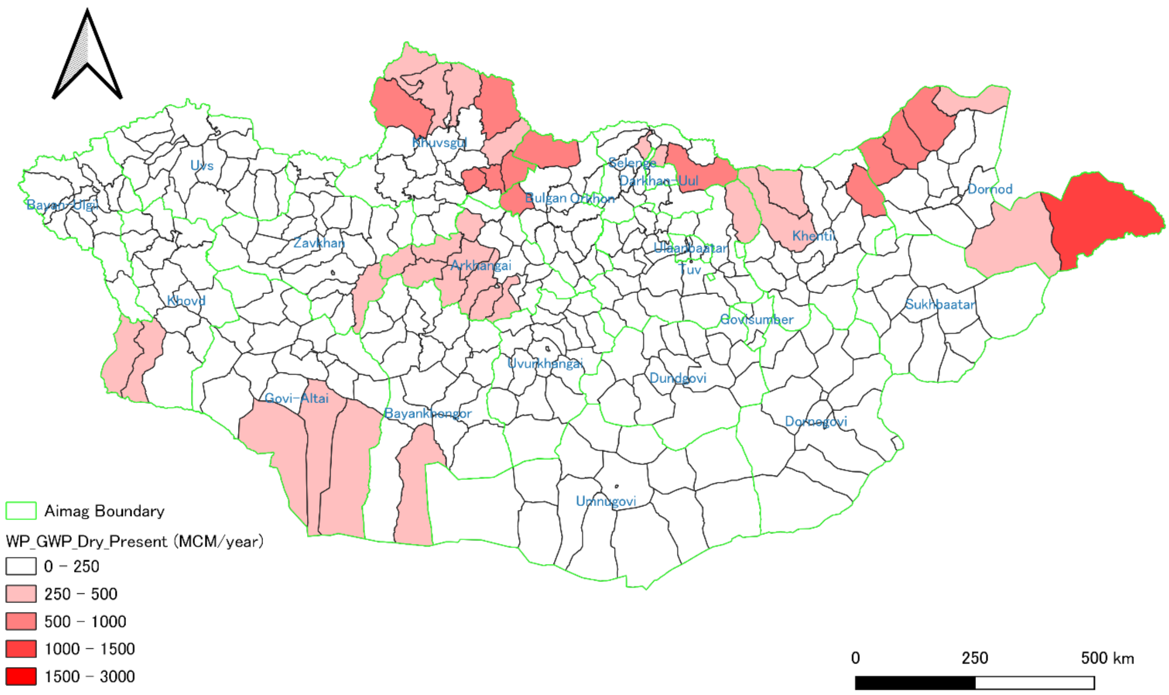
Source: JICA Project Team

Figure 3.5.15 Map of Estimated Annal Surface Water Potential by Soum (Dry Year)



Source: JICA Project Team

Figure 3.5.16 Map of Estimated Annal Groundwater Potential by Soum (Average)



Source: JICA Project Team

Figure 3.5.17 Map of Estimated Annal Groundwater Potential by Soum (Dry Year)

Table 3.5.3 Sub-Basin-wise Surface and Groundwater Potentials Estimated by JPT (1/2)

Block Name	Block No.	Polygon ID	Block Area	Catchment Area	SW Potential			GW Potential			SW Potential			GW Potential		
					Average	Max.	Min.	Average	Max.	Min.	Average	Max.	Min.	Average	Max.	Min.
			km^2	km^2	MCM/year	MCM/year	MCM/year	MCM/year	MCM/year	MCM/year	mm/year	mm/year	mm/year	mm/year	mm/year	mm/year
Block-1-1	C01	173	2,189	2,189	243.0	427.5	111.2	84.9	127.8	57.9	111.0	195.3	50.8	38.8	58.4	26.4
Block-1-2	C02	181	1,257	1,257	221.4	396.4	106.1	60.5	92.9	40.8	176.1	315.3	84.4	48.1	73.9	32.5
Block-1-3	C03	395	74	1,332	244.1	432.3	120.7	97.0	147.9	49.0	183.3	324.7	90.7	72.8	111.1	36.8
Block-1-5	C05	395	1,671	5,192	537.7	1,156.2	182.9	310.9	481.2	197.4	103.6	222.7	35.2	59.9	92.7	38.0
Block-1-4	C04	210	301	301	33.5	64.5	16.6	15.6	21.5	9.8	111.3	214.5	55.3	51.8	71.3	32.6
Block-1-6	C06	211	907	5,492	712.1	1,477.5	271.4	189.2	289.6	131.0	129.6	269.0	49.4	34.5	52.7	23.8
Block-1-7	C07	214	1,092	7,491	739.6	1,528.7	285.9	213.2	301.1	136.2	98.7	204.1	38.2	28.5	40.2	18.2
Block-1-8	C08	319	1,827	1,827	35.7	79.3	15.7	106.2	202.2	64.0	19.6	43.4	8.6	58.1	110.7	35.0
Block-1-9	C09	460	696	10,015	436.0	911.3	171.1	294.9	496.4	183.2	43.5	91.0	17.1	29.4	49.6	18.3
Block-1-10	C10	231	453	453	16.1	37.7	5.9	24.2	50.0	11.4	35.5	83.2	13.1	53.4	110.5	25.3
Block-1-11	C11	289	490	943	35.7	80.8	14.3	49.6	102.7	23.4	37.9	85.7	15.2	52.5	108.9	24.8
Block-1-12	C12	477	1,826	12,784	476.7	1,182.4	107.3	516.6	831.3	324.0	37.3	92.5	8.4	40.4	65.0	25.3
Block-1-13	C13	252	6,050	6,050	85.4	169.5	48.8	294.0	582.0	167.6	14.1	28.0	8.1	48.6	96.2	27.7
Block-1-14	C14	515	5,063	23,897	462.3	1,240.2	80.8	3,936.1	5,094.8	681.7	19.3	51.9	3.4	164.7	213.2	28.5
Block-1-15	C15	203	3,174	3,174	38.2	64.1	21.6	199.5	317.4	125.2	12.0	20.2	6.8	62.9	100.0	39.4
Block-1-16	C16	385	7,675	7,675	39.9	67.2	21.3	474.9	800.2	255.5	5.2	8.8	2.8	61.9	104.3	33.3
Block-1-17	C17	220	9,840	9,840	46.1	69.3	23.0	841.8	1,226.4	463.9	4.7	7.0	2.3	85.5	124.6	47.1
Block-1-18	C18	183	10,376	54,962	558.0	1,388.6	164.0	6,591.2	8,581.4	3,478.8	10.2	25.3	3.0	119.9	156.1	63.3
Block-1-19	C19	313	3,141	3,141	77.4	132.0	31.5	169.9	283.7	74.2	24.6	42.0	10.0	54.1	90.3	23.6
Block-1-20	C20	269	5,893	5,893	172.0	256.8	101.7	704.0	1,098.0	371.5	29.2	43.6	17.3	119.5	186.3	63.0
Block-1-21	C21	374	2,056	2,056	50.0	82.6	26.5	120.6	198.7	63.9	24.3	40.2	12.9	58.7	96.7	31.1
Block-1-22	C22	431	931	6,824	193.4	290.7	110.7	1,668.0	2,672.2	850.2	28.3	42.6	16.2	244.5	391.6	124.6
Block-1-23	C23	383	4,403	4,403	115.6	190.9	53.9	689.9	998.3	392.5	26.2	43.4	12.2	156.7	226.7	89.1
Block-1-24	C24	258	1,385	1,385	32.1	50.8	21.5	396.8	619.9	254.8	23.2	36.7	15.6	286.4	447.5	183.9
Block-1-25	C25	224	3,002	4,387	117.0	182.4	71.7	831.2	1,258.5	431.7	26.7	41.6	16.3	189.5	286.9	98.4
Block-1-26	C26	432	7,470	28,279	724.4	1,093.4	421.5	3,376.1	5,734.8	1,741.7	25.6	38.7	14.9	119.4	202.8	61.6
Block-1-27	C27	198	1,035	1,035	26.0	38.2	15.3	70.7	104.1	41.7	25.1	36.9	14.8	68.3	100.6	40.3
Block-1-28	C28	133	8,506	37,820	1,033.2	1,505.5	615.4	4,248.8	7,176.2	2,021.2	27.3	39.8	16.3	112.3	189.7	53.4
Block-1-29	C29	91	16,157	108,939	1,628.8	2,954.8	805.7	7,912.0	12,390.7	4,322.2	15.0	27.1	7.4	72.6	113.7	39.7
Block-1-30	C30	137	4,334	4,334	39.9	64.0	24.0	309.9	488.7	195.2	9.2	14.8	5.5	71.5	112.7	45.0
Block-1-31	C31	454	10,195	10,195	134.9	193.1	74.5	874.4	1,216.1	538.2	13.2	18.9	7.3	85.8	119.3	52.8
Block-1-32	C32	77	486	486	4.4	6.3	2.3	56.1	79.5	30.7	9.1	13.0	4.7	115.5	163.7	63.2
Block-1-33	C33	486	20	123,974	792.8	2,078.3	97.3	32,618.8	40,642.1	26,990.3	6.4	16.8	0.8	263.1	327.8	217.7
Block-1-34	C34	85	2,108	2,108	19.4	31.5	11.4	313.5	496.5	189.6	9.2	15.0	5.4	148.7	235.5	89.9
Block-1-35	C35	366	5,017	5,017	540.8	703.3	335.6	348.4	451.0	248.4	107.8	140.2	66.9	69.4	89.9	49.5
Block-1-36	C36	86	3,262	8,280	949.8	1,348.4	575.6	902.1	1,236.5	613.7	114.7	162.9	69.5	109.0	149.3	74.1
Block-1-37	C37	466	750	9,030	973.4	1,382.9	590.4	1,173.7	1,587.2	809.3	107.8	153.1	65.4	130.0	175.8	89.6
Block-1-38	C38	582	4,726	139,838	1,825.2	3,383.4	873.2	38,140.9	50,946.9	29,849.7	13.1	24.2	6.2	272.8	364.3	213.5
Block-1-39	C39	423	5,538	5,538	47.3	70.8	28.1	603.3	849.9	399.0	8.5	12.8	5.1	108.9	153.5	72.0
Block-1-40	C40	436	10	5,548	47.6	71.2	28.3	1,440.4	1,934.6	1,034.2	8.6	12.8	5.1	259.6	348.7	186.4
Block-1-41	C41	172	8,276	13,824	122.3	177.3	80.3	1,447.1	2,125.1	862.9	8.9	12.8	5.8	104.7	153.7	62.4
Block-1-42	C42	104	701	701	205.0	283.2	102.9	0.2	0.3	0.1	292.3	403.7	146.7	0.3	0.4	0.2
Block-1-43	C43	397	4,808	4,808	864.9	1,342.4	551.2	612.2	980.8	372.6	179.9	279.2	114.6	127.3	204.0	77.5
Block-1-44	C44	456	9	14,872	3,002.1	5,039.4	2,069.4	5,779.6	8,483.1	4,542.2	201.9	338.8	139.1	388.6	570.4	305.4
Block-1-45	C45	357	9,747	9,747	1,935.4	3,371.2	1,285.6	1,271.8	2,298.6	799.2	198.6	345.9	131.9	130.5	235.8	82.0
Block-1-46	C46	182	308	10,055	52.9	76.7	36.4	21.2	30.9	14.7	5.3	7.6	3.6	2.1	3.1	1.5
Block-1-47	C47	126	3,905	18,777	3,671.6	5,983.8	2,551.5	4,339.9	7,317.9	2,402.0	195.5	318.7	135.9	231.1	389.7	127.9
Block-1-48	C48	509	261	19,038	3,698.6	6,021.6	2,571.8	4,782.8	9,482.7	2,153.6	194.3	316.3	135.1	251.2	498.1	113.1
Block-1-49	C49	115	977	977	213.2	312.1	100.2	20.2	29.6	9.0	218.4	319.5	102.6	20.7	30.3	9.2
Block-1-50	C50	107	21,299	21,299	657.6	1,160.3	418.4	1,311.6	2,090.4	857.1	30.9	54.5	19.6	61.6	98.1	40.2
Block-1-51	C51	314	5,246	26,545	1,742.5	2,678.1	1,063.8	652.1	935.0	448.2	65.6	100.9	40.1	24.6	35.2	16.9
Block-1-52	C52	527	728	27,272	5,699.2	8,999.9	3,866.1	7,257.3	14,368.9	3,498.2	209.0	330.0	141.8	266.1	526.9	128.3
Block-1-53	C53	89	2,995	2,995	135.6	193.4	81.5	194.5	298.0	110.9	45.3	64.6	27.2	64.9	99.5	37.0
Block-1-54	C54	380	1,934	4,929	216.9	293.2	143.7	281.7	512.4	89.4	44.0	59.5	29.1	57.1	103.9	18.1
Block-1-55	C55	29	12,299	12,299	545.1	748.1	331.8	798.9	1,155.6	458.6	44.3	60.8	27.0	65.0	94.0	37.3
Block-1-56	C56	57	1,563	13,862	635.9	861.9	399.5	677.6	1,329.0	229.6	45.9	62.2	28.8	48.9	95.9	16.6
Block-1-57	C57	43	1,092	1,092	47.9	65.8	30.3	17.3	30.4	7.8	43.9	60.3	27.7	15.8	27.8	7.2
Block-1-58	C58	481	975	15,929	715.5	964.4	456.3	1,013.1	2,099.4	276.2	44.9	60.5	28.6	63.6	131.8	17.3
Block-1-59	C59	493	1,005	16,934	730.5	981.6	469.4	1,312.6	2,839.0	319.3	43.1	58.0	27.7	77.5	167.7	18.9
Block-1-60	C60	508	10	69,160	1,151.5	4,154.0	5.7	32,148.9	44,414.2	25,546.2	16.6	60.1	0.1	464.9	642.2	369.4
Block-1-61	C61	68	11,034	80,895	4,324.1	8,004.5	2,465.1	29,014.7	41,788.4	22,551.2	53.5	98.9	30.5	358.7	516.6	278.8
Block-1-62	C62	323	10,071	10,071	1,144.2	1,706.4	568.9	997.3	1,487.5	516.2	113.6	169.4	56.5	99.0	147.7	51.3
Block-1-63	C63	459	2,048	12,120	1,401.0	2,082.7	700.8	1,187.7	1,707.9	696.5	115.6	171.8	57.8	98.0	140.9	57.5
Block-1-64	C64	511	4,061	16,181	1,834.7	2,699.1	940.3	1,329.3	1,939.8	778.7	113.4	166.8	58.1	151.5	435.1	59.0
Block-1-65	C65	11	5,212	5,212	587.7	878.0	291.4	587.3	870.4	334.8	112.8	168.5	55.9	112.7	167.0	64.2
Block-1-66	C66	16	5,175	5,175	576.1	843.7	286.8	475.8	695.2	274.7	111.3	163.0	55.4	91.9	134.3	53.1
Block-1-67	C67	17	1,397	1,397	158.3	229.4	79.0	96.6	141.1	49.9	113.2	164.2	56.5	69.1	101.0	35.7
Block-1-68	C68	24	684	684	79.8	118.0	40.7	41.6	62.1	21.2	116.7	172.6	59.5	60.8	90.9	31.0
Block-1-69	C69	26	2,204	2,204	210.9	279.8	144.1	223.5	293.0	158.7	95.7	127.0	65.4	101.4	132.9	72.0
Block-1-70	C70	404	7,084	21,756	4,386.1	6,320.2	2,344.7	3,217.3	4,586.5	1,922.7	201.6	290.5	107.8	147.9	210.8	88.4
Block-1-71	C71	61	2,425	2,425	248.6	366.9	140.9	440.8	629.5	265.8	102.5	151.3	58.1	181.8	259.6	109.6
Block-1-72	C72	548	8,961	144,043	15,564.1	22,464.7	10,213.5	12,573.6	25,806.0	5,894.6	108.1	156.0	70.9	87.3	179.2	40.9
Block-1-73	C73	38	7,527	151,570	7,726.9	14,939.0	2,118.3	14,838.9	27,352.1	7,822.1	51.0	98.6	14.0	97.9	180.5	51.6
Block-1-74	C74	584	67	291,475	15,718.8	25,633.2	8,418.7	87,201.7	115,082.3	62,928.8	53.9	87.9	28.9	299.2	394.8	215.9
Block-2-1	C01	642	5,186	5,186	89.8	168.2	44.8	462.0	861.2	234.3	17.3	32.4	8.6	89.1	166.1	45.2
Block-2-2	C02	538	3,610	3,610	59.1	111.3	30.0	324.9	596.4	169.3	16.4	30.8	8.3	90.0	165.2	46.9
Block-2-3	C03	715	9,383	18,178	317.7	626.3	152.3	903.0	1,623.3	480.6	17.5	34.5	8.4	49.7	89.3	26.4
Block-2-5	C05	419	10,347	10,347	191.8	532.8	67.0	487.8	961.4	279.3	18.5	51.5	6.5	47.1	92.9	27.0
Block-2-4	C04	2704	6,954	25,132	474.2	1,210.1	187.9	1,322.7	2,322.4	720.1	18.9	48.1	7.5	52.6	92.4	28.7
Block-2-6	C06	483	5,972	41,452	795.6	2,072.1	317.0	1,920.2	3,507.8	1,073.6	19.2	50.0	7.6	46.3	84.6	25.9
Block-2-7	C07	285	13,052	13,052	123.4	270.8	56.6	571.0	1,195.8	273.0	9.5	20.7	4.3	43.7	91.6	20.9
Block-2-8	C08	850	5,868	5,868	101.9	176.4	42.7	82.1	141.4	34.3	17.4	30.1	7.3	14.0	24.1	5.8
Block-2-9	C09	769	6,422	6,422	99.8	181.3	35.0	158.9	275.2	59.9	15.5	28.2	5.4	24.7	42.9	9.3
Block-2-10	C10	2065	12,635	24,926	383.3	711.5	130.0	393.5	719.8	140.7	15.4	28.5	5.2	15.8	28.9	5.6
Block-2-11	C11	647	5,486	5,486	219.6	417.4	100.8	76.2	139.5	36.2	40.0	76.1	18.4	13.9	25.4	6.6
Block-2-12	C12	559	5,705	5,705	211.0	484.4	93.1	382.2	612.2	171.2	37.0	84.9	16.3	67.0	107.3	30.0
Block-2-13	C13	345	3,369	3,369	152.6	331.1	69.1	169.4	294.7	86.4	45.3	98.3	20.5	50.3	87.5	25.7
Block-2-14	C14	371	4,027	7,396	345.0	729.1	160.2	318.1	548.6	161.0	46.6	98.6	21.7	43.0	74.2	21.8
Block-2-15	C15	1489	4,970	4,970	443.2	841.3	211.0	187.2	317.4	105.0	89.2	169.3	42.4	37.7	63.9	21.1
Block-2-16	C16	167	6,857	6,857	620.5	1,180.1	301.7	241.5	416.3	134.4	90.5	172.1	44.0	35.2	60.7	19.6
Block-2-17	C17	1767	2,264	2,264	819.3	1,565.2	393.9	316.9	549.6	170.8	361.9	691.5	174.0	140.0	242.8	75.5
Block-2-18	C18	1643	4,301	4,301	414.6	758.6	214.6	149.0	261.6	79.7	96.4	176.4	49.9	34.6	60.8	18.5
Block-2-19	C19	272	3,637	3,637	351.7	645.8	182.1	119.7	211.0	63.9	96.7	177.6	50.1	32.9	58.0	17.6
Block-2-20	C20	2445	1,491	23,519	2,127.7	4,029.2	1,031.6	817.1	1,311.4	454.7	90.5	171.3	43.9	34.7	55.8	19.3
Block-2-21	C21	112	2,666	26,185	2,180.8	4,131.0	1,062.7	866.6	1,353.7	483.0	83.3	157.8	40.6	33.1	51.7	18.4
Block-2-22	C22	205	1,342	1,342	77.2	141.6	37.9	102.6	167.9	57.1	57.5	105.5	28.2	76.5	125.1	42.6

Source: JICA Project Team

Table 3.5.3 Sub-Basin-wise Surface and Groundwater Potentials Estimated by JPT (2/2)

Block Name	Block No.	Polygon ID	Block Area km^2	Catchment Area km^2	SW Potential Average MCM/year	SW Potential Max. MCM/year	SW Potential Min. MCM/year	GW Potential Average MCM/year	GW Potential Max. MCM/year	GW Potential Min. MCM/year	SW Potential Average mm/year	SW Potential Max. mm/year	SW Potential Min. mm/year	GW Potential Average mm/year	GW Potential Max. mm/year	GW Potential Min. mm/year
Block-2-23	C23	2095	3,036	3,036	191.2	323.5	98.4	98.6	164.9	51.0	63.0	106.6	32.4	32.5	54.3	16.8
Block-2-24	C24	43	9,302	12,338	2,568.8	4,734.0	1,333.1	858.6	1,288.6	188.1	208.2	383.7	108.0	69.6	104.4	15.2
Block-2-25	C25	313	2,534	2,534	102.3	218.6	45.5	131.0	206.0	66.6	40.4	86.3	18.0	51.7	81.3	26.3
Block-2-26	C26	218	84,453	224,868	8,207.1	15,077.6	4,369.6	5,066.2	9,363.1	2,881.0	36.5	67.1	19.4	22.5	41.6	12.8
Block-2-27	C27	2429	11,602	11,602	615.7	1,532.1	264.5	265.8	581.7	68.2	53.1	132.1	22.8	22.9	50.1	5.9
Block-2-28	C28	2654	7,258	18,859	979.9	2,357.1	468.8	384.7	792.9	66.0	52.0	125.0	24.9	20.4	42.0	3.5
Block-2-29	C29	56	31,297	275,025	10,851.5	20,222.4	6,026.4	21,585.2	31,530.1	9,504.4	39.5	73.5	21.9	78.5	114.6	34.6
Block-3-1	C01	1	29,345	29,345	573.8	1,049.6	237.4	594.9	1,074.1	250.4	19.6	35.8	8.1	20.3	36.6	8.5
Block-3-2	C02	4	28,421	57,766	845.7	1,563.6	370.1	1,666.8	2,969.1	777.3	14.6	27.1	6.4	28.9	51.4	13.5
Block-3-3	C03	5	54,561	112,327	1,526.5	3,058.1	594.1	2,899.0	5,096.8	1,474.4	13.6	27.2	5.3	25.8	45.4	13.1
Block-3-5	C05	2	35,761	35,761	221.9	535.3	54.2	1,277.7	2,331.5	585.0	6.2	15.0	1.5	35.7	65.2	16.4
Block-3-4	C04	3	2,111	37,872	247.2	582.2	66.2	2,033.3	3,708.1	933.4	6.5	15.4	1.7	53.7	97.9	24.6
Block-3-6	C06	6	43,886	194,085	3,183.6	6,936.3	833.5	5,620.0	9,803.6	2,553.8	16.4	35.7	4.3	29.0	50.5	13.2
Block-3-7	C07	0	45,710	45,710	484.7	1,062.2	187.4	869.0	1,592.7	417.0	10.6	23.2	4.1	19.0	34.8	9.1
Block-3-8	C08	7	129,898	369,693	2,599.4	6,695.9	209.1	9,151.5	16,700.1	4,782.5	7.0	18.1	0.6	24.8	45.2	12.9
Block-4-1	C01	2332	7,737	7,737	391.7	778.7	240.3	508.9	998.6	313.5	50.6	100.6	31.1	65.8	129.1	40.5
Block-4-2	C02	2727	32,696	40,433	281.4	668.9	126.9	496.2	1,933.8	199.6	7.0	16.5	3.1	12.3	47.8	4.9
Block-4-3	C03	2891	31,959	72,392	273.5	661.2	119.2	2,628.0	4,720.9	1,419.7	3.8	9.1	1.6	36.3	65.2	19.6
Block-4-5	C05	2894	1,892	74,284	191.5	574.8	42.6	5,689.4	9,389.5	3,475.5	2.6	7.7	0.6	76.6	126.4	46.8
Block-4-4	C04	2373	9,338	9,338	28.5	59.0	12.2	652.0	1,338.9	284.6	3.1	6.3	1.3	69.8	143.4	30.5
Block-4-6	C06	2928	10,801	94,424	219.3	613.9	68.4	8,301.5	13,541.0	4,366.1	2.3	6.5	0.7	87.9	143.4	46.2
Block-4-7	C07	2562	16,331	16,331	807.6	1,187.0	449.9	1,130.5	1,660.3	631.0	49.4	72.7	27.5	69.2	101.7	38.6
Block-4-8	C08	2632	4,835	21,166	921.9	1,346.5	514.7	1,605.9	2,343.0	969.7	43.6	63.6	24.3	75.9	110.7	45.8
Block-4-9	C09	2261	5,274	5,274	5.1	8.2	2.5	894.2	1,387.1	493.1	1.0	1.6	0.5	169.5	263.0	93.5
Block-4-10	C10	2585	6,772	12,046	10.7	18.9	5.0	1,949.5	3,467.8	1,086.8	0.9	1.6	0.4	161.8	287.9	90.2
Block-4-11	C11	257	2,420	2,420	1.0	2.2	0.4	178.8	367.5	90.8	0.4	0.9	0.2	73.9	151.9	37.5
Block-4-12	C12	2646	6,031	20,497	9.1	18.7	3.3	2,531.6	4,548.2	1,430.7	0.4	0.9	0.2	123.5	221.9	69.8
Block-4-13	C13	1755	4,269	4,269	1.7	3.5	0.7	209.3	422.2	95.2	0.4	0.8	0.2	49.0	98.9	22.3
Block-4-14	C14	2656	809	25,575	10.8	22.2	4.2	2,467.0	3,115.5	1,817.6	0.4	0.9	0.2	96.5	121.8	71.1
Block-4-15	C15	2370	7,175	7,175	3.0	6.6	1.3	287.0	594.9	135.9	0.4	0.9	0.2	40.0	82.9	18.9
Block-4-16	C16	2714	1,975	35,026	14.0	29.6	5.6	2,937.1	4,322.6	1,908.6	0.4	0.8	0.2	83.9	123.4	54.5
Block-4-17	C17	85	509	509	0.2	0.4	0.1	26.3	54.5	12.1	0.3	0.7	0.1	51.8	107.1	23.8
Block-4-18	C18	87	301	301	0.1	0.3	0.1	11.6	23.6	5.7	0.4	1.0	0.2	38.6	78.5	19.0
Block-4-19	C19	2689	6,670	27,836	1,219.7	1,824.3	683.1	1,951.9	2,936.3	1,126.0	43.8	65.5	24.5	70.1	105.5	40.4
Block-4-20	C20	2750	358	28,194	1,269.1	1,906.3	710.9	3,891.5	5,118.4	2,542.3	45.0	67.6	25.2	138.0	181.5	90.2
Block-4-21	C21	2035	4,675	4,675	15.8	36.4	7.0	183.1	421.5	81.5	3.4	7.8	1.5	39.2	90.2	17.4
Block-4-22	C22	1929	2,648	2,648	8.2	16.2	4.7	94.8	188.0	54.4	3.1	6.1	1.8	35.8	71.0	20.5
Block-4-23	C23	2471	11,102	11,102	80.5	163.6	47.1	931.4	1,893.6	544.9	7.2	14.7	4.2	83.9	170.6	49.1
Block-4-24	C24	2629	6,804	17,906	112.8	235.6	62.8	1,305.3	2,727.0	726.6	6.3	13.2	3.5	72.9	152.3	40.6
Block-4-25	C25	1851	1,969	19,875	151.0	290.1	72.8	1,747.2	3,357.1	842.6	7.6	14.6	3.7	87.9	168.9	42.4
Block-4-26	C26	2356	3,453	3,453	22.4	46.9	11.9	259.2	542.3	137.9	6.5	13.6	3.4	75.1	157.0	39.9
Block-4-27	C27	2124	2,888	2,888	29.5	61.8	15.8	341.5	715.7	182.5	10.2	21.4	5.5	118.3	247.8	63.2
Block-5-1	C01	2385	12,417	12,417	75.1	168.1	25.0	582.5	1,240.5	218.8	6.0	13.5	2.0	46.9	99.9	17.6
Block-5-2	C02	2420	9,649	9,649	80.5	151.8	10.9	174.8	328.0	24.9	8.3	15.7	1.1	18.1	34.0	2.6
Block-5-4	C04	1877	3,310	3,310	21.1	41.6	4.8	59.3	116.3	14.7	6.4	12.6	1.5	17.9	35.1	4.5
Block-5-5	C05	2302	4,197	7,507	48.3	95.2	11.5	129.6	252.0	34.6	6.4	12.7	1.5	17.3	33.6	4.6
Block-5-6	C06	1770	2,128	2,128	15.2	32.3	6.0	37.7	79.9	15.1	7.1	15.2	2.8	17.7	37.5	7.1
Block-5-7	C07	2355	1,729	11,365	77.8	140.5	24.5	197.1	338.9	70.7	6.8	12.4	2.2	17.3	29.8	6.2
Block-5-8	C08	2660	4,614	15,979	118.3	204.3	35.5	402.0	607.3	161.0	7.4	12.8	2.2	25.2	38.0	10.1
Block-5-9	C09	2243	10,968	10,968	105.6	177.7	1.6	161.7	230.3	25.8	9.6	16.2	0.1	14.7	21.0	2.3
Block-5-10	C10	2484	18,077	29,045	261.9	441.7	21.9	436.0	737.4	68.1	9.0	15.2	0.8	15.0	25.4	2.3
Block-5-11	C11	2303	2,355	2,355	45.0	87.4	11.0	99.8	190.9	25.7	19.1	37.1	4.7	42.4	81.1	10.9
Block-5-12	C12	2795	7,365	58,879	489.7	955.0	36.9	1,445.3	2,142.1	502.6	8.3	16.2	0.6	24.5	36.4	8.5
Block-5-13	C13	1632	22,470	22,470	10.0	20.0	2.1	21.0	41.3	4.7	0.4	0.9	0.1	0.9	1.8	0.2
Block-5-14	C14	1412	891	61,489	631.3	1,179.1	62.8	820.0	1,148.5	260.5	10.3	19.2	1.0	13.3	18.7	4.2
Block-5-15	C15	1927	4,536	4,536	31.1	58.7	8.1	91.1	168.7	25.1	6.9	12.9	1.8	20.1	37.2	5.5
Block-5-16	C16	2451	8,101	12,636	82.4	156.5	21.8	202.2	380.3	57.3	6.5	12.4	1.7	16.0	30.1	4.5
Block-5-17	C17	2452	887	13,523	86.9	165.1	23.0	432.0	918.4	137.1	6.4	12.2	1.7	31.9	67.9	10.1
Block-5-18	C18	2205	4,803	4,803	26.6	60.4	1.4	89.8	168.6	23.9	5.5	12.6	0.3	18.7	35.1	5.0
Block-5-19	C19	2242	2,848	7,651	37.3	87.7	0.9	135.5	244.7	43.5	4.9	11.5	0.1	17.7	32.0	5.7
Block-5-21	C21	2353	8,504	8,504	57.2	109.6	6.7	178.5	328.8	24.1	6.7	12.9	0.8	21.0	38.7	2.8
Block-6-1	C01	1402	333	333	2.1	5.5	0.1	6.1	11.7	2.2	6.2	16.4	0.4	18.3	35.1	6.5
Block-6-2	C02	2687	4	338	2.1	5.5	0.1	6.2	11.9	2.2	6.2	16.4	0.4	18.3	35.1	6.5
Block-6-3	C03	1127	1,446	1,446	16.2	32.5	6.7	49.6	98.1	22.7	11.2	22.5	4.6	34.3	67.9	15.7
Block-6-4	C04	1849	2,064	2,064	23.1	46.4	9.5	70.7	140.0	32.4	11.2	22.5	4.6	34.3	67.9	15.7
Block-6-5	C05	2056	1,287	4,797	14.4	28.9	6.0	44.1	87.4	20.2	3.0	6.0	1.2	9.2	18.2	4.2
Block-6-6	C06	2597	11,866	16,663	218.3	430.5	94.3	463.3	895.3	213.1	13.1	25.8	5.7	27.8	53.7	12.8
Block-6-7	C07	2686	14,263	30,926	311.7	573.4	155.9	671.0	1,126.9	325.8	10.1	18.5	5.0	21.7	36.4	10.5
Block-6-8	C08	2686	14,263	14,263	60.0	93.5	32.2	136.0	229.7	66.1	4.2	6.6	2.3	9.5	16.1	4.6
Block-6-9	C09	1868	2,065	2,065	44.8	76.4	22.9	106.2	177.7	57.0	21.7	37.0	11.1	51.4	86.1	27.6
Block-6-10	C10	1283	591	591	11.2	19.5	6.1	22.0	39.0	11.2	19.0	33.0	10.3	37.2	65.9	19.0
Block-6-11	C11	1315	2,259	2,259	23.1	48.5	7.3	32.0	66.4	10.5	10.2	21.5	3.3	14.2	29.4	4.6
Block-6-12	C12	2178	3,403	3,403	34.8	73.1	11.1	48.2	100.1	15.8	10.2	21.5	3.3	14.2	29.4	4.6
Block-6-13	C13	1573	1,832	1,832	18.7	39.4	6.0	26.0	53.9	8.5	10.2	21.5	3.3	14.2	29.4	4.6
Block-6-14	C14	1570	1,258	1,258	12.9	27.0	4.1	17.8	37.0	5.8	10.2	21.5	3.3	14.2	29.4	4.6
Block-6-15	C15	2892	65,263	135,026	1,238.7	2,152.9	673.6	2,429.0	4,303.3	1,240.6	9.2	15.9	5.0	18.0	31.9	9.2
Block-6-16	C16	1900	1,678	1,678	35.8	63.8	17.0	57.2	102.6	26.8	21.3	38.0	10.1	34.1	61.2	15.9
Block-6-17	C17	2009	1,550	3,228	68.8	122.7	32.7	110.1	197.4	51.5	21.3	38.0	10.1	34.1	61.2	15.9
Block-6-18	C18	1470	1,004	4,232	90.2	160.8	42.8	144.3	258.8	67.5	21.3	38.0	10.1	34.1	61.2	15.9
Block-6-19	C19	2331	1,931	6,163	131.3	234.2	62.4	210.1	376.9	98.2	21.3	38.0	10.1	34.1	61.2	15.9
Block-6-20	C20	1247	1,593	7,756	165.3	294.7	78.5	264.4	474.3	123.6	21.3	38.0	10.1	34.1	61.2	15.9
Block-6-21	C21	1824	2,909	2,909	55.6	102.0	27.3	83.2	152.3	41.1	19.1	35.1	9.4	28.6	52.3	14.1
Block-6-22	C22	1210	1,502	1,502	25.4	48.5	11.1	32.6	62.1	14.3	16.9	32.3	7.4	21.7	41.4	9.5
Block-6-23	C23	1220	999	999	16.9	32.3	7.4	21.7	41.3	9.5	16.9	32.3	7.4	21.7	41.4	9.5
Block-7-1	C01	1563	1,318	1,318	78.1	151.7	34.3	119.5	204.1	39.0	59.3	115.1	26.0	90.6	154.9	29.6
Block-7-2	C02	2064	3,378	4,696	254.7	500.3	118.3	230.6	377.2	103.7	54.2	106.5	25.2	49.1	80.3	22.1
Block-7-3	C03	2155	2,082	2,082	110.1	201.6	50.2	122.8	216.4	59.5	52.8	96.8	24.1	59.0	103.9	28.6
Block-7-4	C04	2223	3,172	5,254	365.1	704.4	167.7	287.4	514.1	160.2	69.5	134.1	31.9	54.7	97.8	30.5
Block-7-5	C05	857	1,291	1,291	62.6	104.8	33.7	72.7	120.1	39.7	48.5	81.2	26.1	56.4	93.1	30.8
Block-7-6	C06	793	1,567	1,567	76.3	135.1	41.8	235.1	395.1	93.6	48.7	86.2	26.7	150.1	252.2	59.7
Block-7-7	C07	1981	2,499	2,499	120.4	201.4	72.5	250.2	426.8	150.9	48.2	80.6	29.0	100.1	170.8	60.4
Block-7-8	C08	719	1,831	1,831	90.4	154.5	55.3	149.4	254.8	93.0	49.4	84.4	30.2	81.6	139.2	50.8
Block-7-9	C09	2634	15,241	27,682	1,012.9	1,816.1	554.8	1,051.4	1,870.5	511.2	36.6	65.6	20.0	38.0	67.6	18.5
Block-7-10	C10	2469	9,434	9,434	514.2	842.5	280.9	743.0	1,325.5	409.1	54.5	89.3	29.8	78.8	140.5	43.4
Block-8-1	C01	2531	2,531	17,791	715.6	973.7	403.5	1,715.2	2,369.6	937.9	40.2	54.7	22.7	96.4	133.2	52.7
Block-8-2	C02	27	27	370	11.9	16.9	6.2	34.9	49.6	18.5	32.0	45.5	16.9	94.3	133.8	50.0

Source: JICA Project Team

Table 3.5.4 Soum-level Surface and Groundwater Potentials Estimated by JPT (Average)

ID	Aimag	Soum Name	Water Potential (Average)		
			SW	GW	Total
1101	Ulaanbaatar	Baganuur	31.63	41.09	72.72
1104	Ulaanbaatar	Bagaxangai	1.66	2.97	4.63
1107	Ulaanbaatar	Bayangol	2.36	0.68	3.04
1110	Ulaanbaatar	Bayanzu'rx	159.54	42.39	201.94
1113	Ulaanbaatar	Nalaix	126.42	50.23	176.64
1116	Ulaanbaatar	Songinoxairxan	11.08	86.09	97.16
1119	Ulaanbaatar	Su'xbaatar	21.05	6.07	27.11
1121	Ulaanbaatar	Xan-Uul	49.64	14.31	63.94
1125	Ulaanbaatar	Chingeltei	8.89	2.56	11.45
2104	Dornod	Bayandun	5.61	1,019.99	1,025.60
2107	Dornod	Bayantumen	29.32	339.35	368.67
2107	Dornod	Bayantumen	29.32	339.35	368.67
2110	Dornod	Bayan-Uul	5.47	953.93	959.40
2113	Dornod	Bulgan	49.75	175.14	224.89
2116	Dornod	Gurvanzagal	2.08	258.01	260.09
2119	Dornod	Dashbalbar	3.90	1,084.29	1,088.19
2122	Dornod	Matad	160.47	564.98	725.45
2125	Dornod	Selgeren	9.67	365.95	375.62
2128	Dornod	Khalkhgol	202.96	2,349.08	2,552.04
2131	Dornod	Khulunbuir	14.35	137.85	152.20
2134	Dornod	Tsagaan-Ovoo	19.77	452.18	471.96
2137	Dornod	Choibalsan	4.19	404.51	408.70
2140	Dornod	Chuluunkhoroot	2.70	617.94	620.64
2201	Sukhbaatar	Baruun-Urt	90.04	317.01	407.05
2204	Sukhbaatar	Asgat	50.71	178.55	229.26
2207	Sukhbaatar	Bayandelger	53.21	187.33	240.54
2210	Sukhbaatar	Dariganga	29.09	225.62	254.71
2213	Sukhbaatar	Munkhkhaan	27.98	268.88	296.86
2216	Sukhbaatar	Naran	20.38	158.07	178.46
2219	Sukhbaatar	Ongon	41.90	324.92	366.82
2225	Sukhbaatar	Tuvshinshiree	30.91	108.83	139.74
2228	Sukhbaatar	Tumentsogt	8.06	77.46	85.52
2231	Sukhbaatar	Uubayan	34.80	122.53	157.34
2234	Sukhbaatar	Khalzan	26.73	94.12	120.85
2237	Sukhbaatar	Erdenetsagaan	119.01	418.98	537.99
2301	Khenti	Kherlen	14.24	136.84	151.08
2304	Khenti	Batnorov	18.75	180.19	198.94
2307	Khenti	Batshireet	346.58	485.17	831.74
2310	Khenti	Bayan-Adarga	131.46	228.98	360.45
2313	Khenti	Bayanmunkh	17.78	31.36	49.15
2316	Khenti	Bayan-Ovoo	12.74	122.40	135.13
2319	Khenti	Bayankhutag	22.81	219.15	241.96
2322	Khenti	Binder	268.08	375.28	643.35
2325	Khenti	Galshir	46.83	164.88	211.71
2328	Khenti	Dadal	215.11	344.25	559.36
2331	Khenti	Darkhan	31.37	55.33	86.70
2334	Khenti	Dergelkhaan	26.75	47.17	73.92
2337	Khenti	Jagaltkhaan	19.85	35.00	54.85
2340	Khenti	Murun	15.40	27.16	42.57
2343	Khenti	Norovlin	5.33	928.66	933.99
2346	Khenti	Umnudelger	539.11	754.70	1,293.81
2349	Khenti	Tsenkhermandal	22.15	39.06	61.21
4101	Tuv	Zuunmod	0.38	1.12	1.50
4103	Tuv	Altanbulag	211.40	229.05	440.45
4107	Tuv	Argalant	13.57	70.78	84.35
4110	Tuv	Arkhust	5.73	10.11	15.85
4113	Tuv	Batsumber	22.28	173.20	195.48
4116	Tuv	Bayan	20.65	36.41	57.06
4119	Tuv	Bayandelger	14.82	26.14	40.96
4122	Tuv	Bayanjargalan	19.95	35.19	55.14
4125	Tuv	Bayan-Unjuul	67.76	233.23	301.00
4128	Tuv	Bayankhangai	12.05	62.85	74.89
4131	Tuv	Bayantsagaan	62.39	111.86	174.26
4134	Tuv	Bayantsogt	18.27	95.32	113.59
4137	Tuv	Bayanchandmani	7.52	48.72	56.24
4140	Tuv	Bornuur	15.22	98.62	113.84
4143	Tuv	Buren	19.54	232.60	252.14
4146	Tuv	Delgerkhaan	11.26	134.01	145.27
4149	Tuv	Jargalant	24.49	158.72	183.21
4152	Tuv	Zaamar	28.64	338.30	366.94
4155	Tuv	Lun	49.03	417.41	466.43
4158	Tuv	Mungunmorit	339.69	441.33	781.02
4161	Tuv	Undurshireet	50.71	431.76	482.47
4164	Tuv	Sumber	4.61	29.88	34.50
4167	Tuv	Sergelen	40.28	72.22	112.51
4170	Tuv	Ugtaaltsaidam	15.72	185.73	201.45
4173	Tuv	Tseel	24.41	118.57	142.98
4176	Tuv	Erdene	902.41	315.49	1,217.90
4179	Tuv	Erdensant	16.12	191.90	208.02
4201	Goveisumber	Sumber	39.70	71.18	110.87
4204	Goveisumber	Bayantal	9.50	17.03	26.52
4207	Goveisumber	Shivee gobi	9.55	17.13	26.68
4301	Selenge	Sukhbaatar	0.67	13.94	14.61
4304	Selenge	Altanbulag	261.82	168.67	430.50
4307	Selenge	Baruunburen	42.27	205.34	247.61
4310	Selenge	Bayangol	26.74	173.26	200.00
4313	Selenge	Yeruu	954.91	906.94	1,861.85
4316	Selenge	Javkhlant	15.45	322.79	338.23
4319	Selenge	Zuunburen	15.52	324.30	339.82
4322	Selenge	Mandal	515.75	332.26	848.01
4325	Selenge	Orkhon	19.45	94.46	113.90
4328	Selenge	Orkhontuul	44.17	214.56	258.73
4331	Selenge	Saikhan	19.47	94.55	114.02
4334	Selenge	Sant	20.26	98.39	118.65
4337	Selenge	Tushig	245.23	259.80	505.03
4340	Selenge	Khuder	288.43	185.82	474.24
4343	Selenge	Khushaat	102.45	196.75	299.20
4346	Selenge	Tsagaannuur	193.46	371.53	564.99
4349	Selenge	Shaamar	8.67	181.24	189.91
4352	Selenge	Shaamar	0.76	4.92	5.67
4401	Dornogovi	Sainshand	19.66	30.10	49.76
4404	Dornogovi	Airag	52.50	184.85	237.35
4407	Dornogovi	Altanshiree	50.34	177.23	227.56
4410	Dornogovi	Dalanjargalan	28.31	99.66	127.96
4413	Dornogovi	Delgerekh	33.82	119.09	152.91
4416	Dornogovi	Zamin-Uud	4.03	8.75	12.77
4419	Dornogovi	Ikhkhet	29.33	103.27	132.61
4422	Dornogovi	Mandakh	114.35	190.38	304.73
4425	Dornogovi	Urgun	59.11	208.10	267.20
4428	Dornogovi	Saikhandulaan	67.07	236.14	303.21
4431	Dornogovi	Ulaanbadrakh	112.14	171.74	283.88
4434	Dornogovi	Khatanbulag	155.27	458.33	613.60
4437	Dornogovi	Khuvsgul	75.76	126.13	201.89

ID	Aimag	Soum Name	Water Potential (Average)		
			SW	GW	Total
4440	Dornogovi	Erdene	92.17	141.17	233.35
4443	Dornogovi	Sainshand	2.62	4.01	6.63
4501	Darkhan-Uul	Darkhan	1.35	8.76	10.11
4504	Darkhan-Uul	Orkohn	5.77	120.61	126.38
4507	Darkhan-Uul	Khongor	24.20	390.01	414.21
4510	Darkhan-Uul	Sharingol	0.88	14.26	15.14
4601	Umnugovi	Dalanzadgad	0.38	0.67	1.05
4604	Umnugovi	Bayandalai	65.75	194.94	260.69
4607	Umnugovi	Bayan-Ovoo	72.78	178.53	251.30
4610	Umnugovi	Bulgan	101.30	192.38	293.68
4613	Umnugovi	Gurvantes	172.48	511.36	683.83
4616	Umnugovi	Mandal-Ovoo	88.24	167.57	255.81
4619	Umnugovi	Munlai	84.86	215.15	300.01
4622	Umnugovi	Noyon	65.18	193.24	258.42
4625	Umnugovi	Nomgon	102.15	344.71	446.86
4628	Umnugovi	Sevrei	82.46	177.50	259.96
4631	Umnugovi	Khanbogd	285.82	633.84	919.66
4634	Umnugovi	Khankhongor	169.47	299.17	468.64
4637	Umnugovi	Khurmen	77.95	231.11	309.06
4640	Umnugovi	Tsogt-Ovoo	107.51	189.79	297.31
4643	Umnugovi	Tsogttsetsii	46.44	130.40	176.84
4801	Dundgovi	Saintsagaan	54.97	97.04	152.01
4804	Dundgovi	Adaatsag	20.60	118.60	139.20
4807	Dundgovi	Bayanjargalan	33.74	60.48	94.22
4810	Dundgovi	Govi-Ugtaal	28.66	51.39	80.06
4813	Dundgovi	Gurvansaihan	57.87	103.75	161.62
4816	Dundgovi	Delgerkhangai	38.52	221.81	260.33
4819	Dundgovi	Delgertsogt	26.50	47.52	74.02
4822	Dundgovi	Deren	38.34	68.74	107.09
4825	Dundgovi	Luus	19.57	112.71	132.29
4828	Dundgovi	Ulziit	253.19	446.95	700.14
4831	Dundgovi	Undurshil	51.46	92.25	143.71
4834	Dundgovi	Saikhan-Ovoo	25.10	144.56	169.66
4837	Dundgovi	Khuld	99.46	175.58	275.04
4840	Dundgovi	Tsagaandelger	36.68	65.76	102.43
4843	Dundgovi	Erdendalai	45.40	261.42	306.82
6101	Orkhon	Bayan-Undur	4.08	19.84	23.93
6104	Orkhon	Jargalant	8.48	41.18	49.66
6201	Uvurkhangai	Arvaikheer	0.30	1.75	2.06
6204	Uvurkhangai	Baruunbayan-Ulaan	53.65	101.88	155.53
6207	Uvurkhangai	Bat-Ulzii	74.79	306.19	380.98
6210	Uvurkhangai	Bayangol	21.76	125.30	147.06
6213	Uvurkhangai	Bayan-Undur	20.18	116.20	136.38
6216	Uvurkhangai	Bogd	136.42	259.08	395.50
6219	Uvurkhangai	Burd	12.09	220.45	232.54
6222	Uvurkhangai	Guchin-Us	64.84	123.13	187.96
6225	Uvurkhangai	Yesunzuil	10.44	190.43	200.87
6228	Uvurkhangai	Zuunbayan-Ulaan	15.57	89.64	105.21
6231	Uvurkhangai	Nariinteel	36.61	69.52	106.13
6234	Uvurkhangai	Ulziit	48.68	106.84	155.52
6237	Uvurkhangai	Sant	16.29	93.79	110.07
6240	Uvurkhangai	Taragt	21.81	125.58	147.38
6243	Uvurkhangai	Tugrug	74.02	140.57	214.59
6246	Uvurkhangai	Uyanga	18.91	108.87	127.78
6249	Uvurkhangai	Khairkhandulaan	56.12	106.58	162.70
6252	Uvurkhangai	Kharkhorin	58.94	274.69	333.63
6255	Uvurkhangai	Khujirt	41.82	91.78	133.60
6301	Bulgan	Bulgan	1.38	6.68	8.05
6304	Bulgan	Bayan-Agt	165.06	1,107.52	1,272.57
6307	Bulgan	Bayannuur	10.30	121.67	131.97
6310	Bulgan	Bugat	345.19	278.86	624.05
6313	Bulgan	Buregkhangai	35.37	417.88	453.25
6316	Bulgan	Gurvanbulag	12.61	229.96	242.57
6319	Bulgan	Dhashinchilen	23.51	277.68	301.18
6322	Bulgan	Mogod	77.25	317.67	394.92
6325	Bulgan	Orkhon	60.03	291.58	351.61
6328	Bulgan	Rashaant	5.09	60.53	65.61
6331	Bulgan	Saikhan	73.91	303.96	377.87
6334	Bulgan	Selenge	525.62	424.63	950.24
6337	Bulgan	Teshig	793.99	1,407.46	2,201.45
6340	Bulgan	Khangal	173.88	140.47	314.35
6343	Bulgan	Khishing-Undur	66.61	273.92	340.52
6346	Bulgan	Khutag-Unduur	606.85	490.25	1,097.10
6401	Bayankhongor	Bayankhongor	0.88	1.67	2.55
6404	Bayankhongor	Baatsagaan	145.09	150.43	295.52
6407	Bayankhongor	Bayanbulag	61.61	63.87	125.48
6410	Bayankhongor	Bayangobi	61.24	129.95	191.19
6413	Bayankhongor	Bayanlig	156.42	331.90	488.32
6416	Bayankhongor	Bayan-Ovoo	47.01	92.64	139.65
6419	Bayankhongor	Bayan-Undur	155.84	305.58	461.41
6422	Bayankhongor	Bayantsagaan	62.14	190.33	252.47
6425	Bayankhongor	Bogd	53.82	102.21	156.04
6428	Bayankhongor	Bumbugur	44.47	87.64	132.11
6431	Bayankhongor	Buutsagaan	105.20	109.07	214.27
6434	Bayankhongor	Galuut	73.57	145.00	218.57
6437	Bayankhongor	Gurvanbulag	76.50	393.65	470.15
6440	Bayankhongor	Jargalant	61.51	121.23	182.74
6443	Bayankhongor	Jinst	75.57	148.95	224.52
6446	Bayankhongor	Zag	37.32	73.55	110.87
6449	Bayankhongor	Ulziit	53.62	101.83	155.45
6452	Bayankhongor	Khureemaral	84.90	88.02	172.92
6455	Bayankhongor	Shinejinst	311.88	611.56	923.45
6458	Bayankhongor	Erdenetsogt	59.20	116.67	175.87
6501	Arkhangai	Erdenbulgan	1.62	9.68	11.30
6504	Arkhangai	Battsengel	89.91	419.04	508.95
6507	Arkhangai	Bulgan	84.58	504.85	589.42
6510	Arkhangai	Jargalant	555.06	656.07	1,211.13
6513	Arkhangai	Ikh Tamir	130.51	927.45	1,057.96
6516	Arkhangai	Ugiinuur	43.45	202.53	245.98
6519	Arkhangai	Ulziit	46.82	192.53	239.35
6522	Arkhangai	Unduur-Ulaan	37.17	474.09	511.26
6525	Arkhangai	Tariat	806.92	530.26	1,337.18
6528	Arkhangai	Tuvshruulekh	30.63	142.75	173.38
6531	Arkhangai	Khairkhan	23.10	273.21	296.31
6534	Arkhangai	Khangai	771.94	507.27	1,279.21
6537	Arkhangai	Khashaat	12.16	221.83	233.99
6540	Arkhangai	Khotont	56.95	137.38	194.32
6543	Arkhangai	Tsakhir	653.85	429.67	1,083.52
6546	Arkhangai	Tsenkher	83.08	495.90	578.98
6549	Arkhangai	Tsetserleg	549.65	52.03	601.67
6552	Arkhangai	Chuluut	707.58	500.90	1,208.48
6555	Arkhangai	Erdebmandal	28.92	368.87	397.79
6701	Khusvgul	Murun	4.60	6.51	11.11

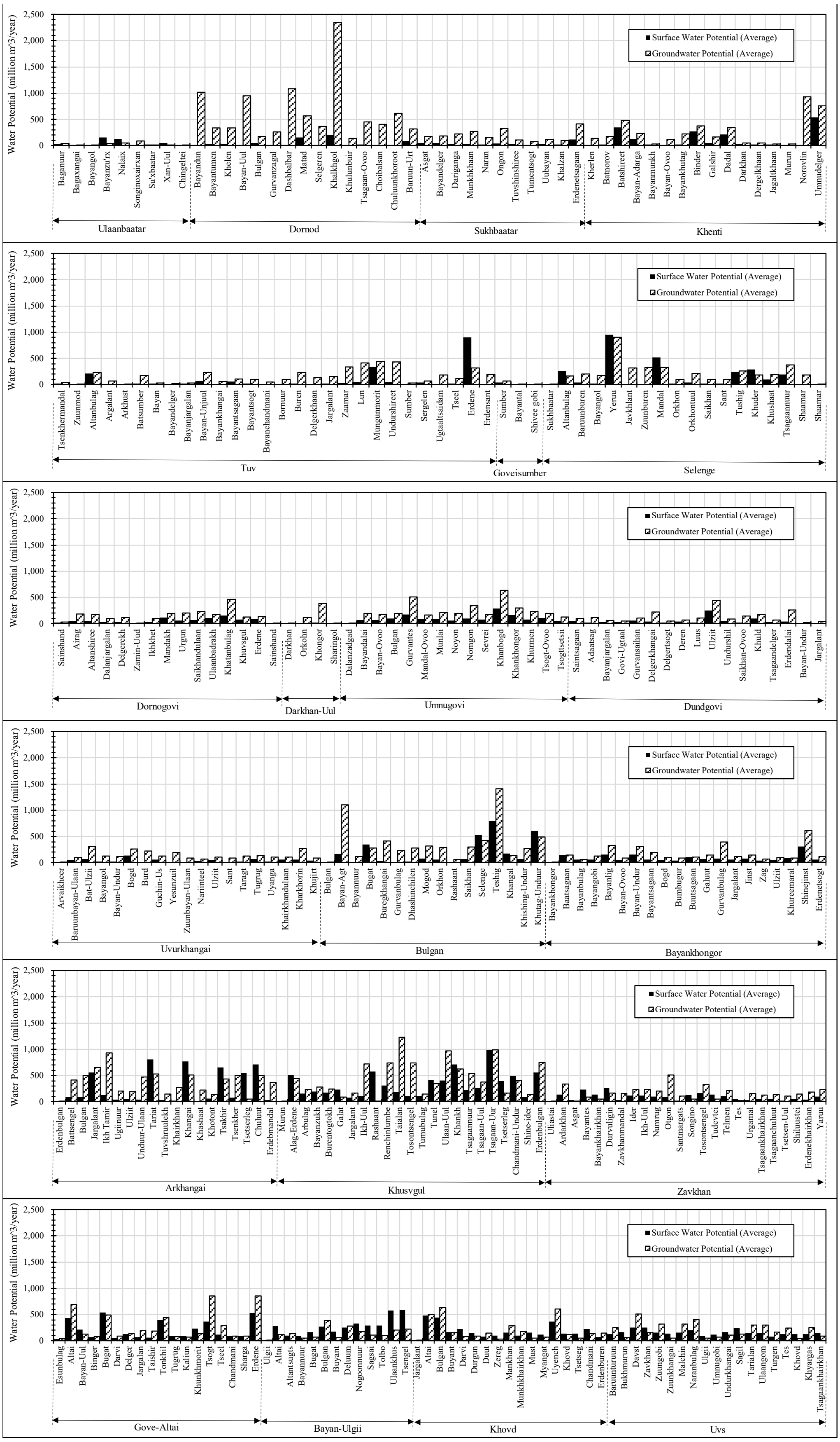
ID	Aimag	Soum Name	Water Potential (Average)		
			SW	GW	Total
6704	Khusvgul	Alag-Erdene	510.90	445.28	956.18
6707	Khusvgul	Arbulag	157.43	230.74	388.17
6710	Khusvgul	Bayanzukh	191.54	280.73	472.26
6713	Khusvgul	Burentogtokh	172.26	247.02	419.28
6716	Khusvgul	Galat	228.39	85.48	313.87
6719	Khusvgul	Jargalant	81.65	162.87	244.52
6722	Khusvgul	Ikh-Uul	107.27	719.76	827.03
6725	Khusvgul	Rashaant	574.11	0.64	574.74
6728	Khusvgul	Renchinlumbe	308.52	739.52	1,048.04
6731	Khusvgul	Taialan	183.21	1,229.33	1,412.54
6734	Khusvgul	Tosontsengel	110.15	739.09	849.23
6737	Khusvgul	Tumubulag	110.74	143.79	254.53
6740	Khusvgul	Tunel	411.38	348.76	760.14
6743	Khusvgul	Ulaan-Uul	404.86	970.44	1,375.29
6746	Khusvgul	Khankh	712.80	621.25	1,334.05
6749	Khusvgul	Tsagaannuur	225.94	541.57	767.51
6752	Khusvgul	Tsagaan-Uul	256.90	376.52	633.42
6755	Khusvgul	Tsagaan-Uur	991.65	990.92	1,982.57
6758	Khusvgul	Tsetserleg	392.99	169.62	562.62
6761	Khusvgul	Chandmani-Undur	494.93	408.73	903.66
6764	Khusvgul	Shine-ider	93.46	134.03	227.49
6767	Khusvgul	Erdenbulgan	558.57	746.55	1,305.12
8101	Zavkhan	Uliastai	0.80	2.04	2.84
8104	Zavkhan	Ardarkhan	132.64	337.34	469.97
8107	Zavkhan	Asgat	30.09	12.99	43.07
8110	Zavkhan	Bayantes	228.58	89.73	318.32
8113	Zavkhan	Bayankhairkhan	134.84	52.93	187.77
8116	Zavkhan	Durvuligin	264.66	163.37	428.04
8119	Zavkhan	Zavkhanmandal	34.03	157.50	191.54
8122	Zavkhan	Ider	114.44	228.26	342.69
8125	Zavkhan	Ikh-Uul	116.92	233.22	350.14
8128	Zavkhan	Numrug	101.00	201.45	302.45
8131	Zavkhan	Otgon	92.62	509.27	601.89
8134	Zavkhan	Santmargats	22.69	105.00	127.69
8137	Zavkhan	Songino	126.29	49.58	175.86
8140	Zavkhan	Tosontsengel	163.43	325.99	489.42
8143	Zavkhan	Tudevtei	138.75	54.47	193.21
8146	Zavkhan	Telmen	106.76	212.94	319.69
8149	Zavkhan	Tes	47.91	18.81	66.72
8152	Zavkhan	Urgamal	33.10	153.21	186.31
8155	Zavkhan	Tsagaankhairkhan	48.61	123.63	172.24
8158	Zavkhan	Tsagaanchuluut	48.91	136.43	185.34
8161	Zavkhan	Tsetsen-Uul	23.09	106.85	129.93
8164	Zavkhan	Shiluustei	53.17	151.12	204.28
8167	Zavkhan	Erdenekhairkhan	39.44	182.54	221.97
8170	Zavkhan	Yaruu	95.10	229.53	324.63
8201	Gove-Altai	Esunbulag	35.85	36.80	72.65
8204	Gove-Altai	Altai	429.62	687.28	1,116.91
8207	Gove-Altai	Bayan-Uul	213.19	131.60	344.80
8210	Gove-Altai	Binger	74.93	77.69	152.62
8213	Gove-Altai	Bugat	539.49	488.51	1,028.00
8216	Gove-Altai	Darvi	54.20	86.31	140.51
8219	Gove-Altai	Delger	129.66	134.43	264.10
8222	Gove-Altai	Jargalan	69.44	193.71	263.14
8225	Gove-Altai	Taishir	65.40	185.88	251.27
8228	Gove-Altai	Tonkhil	399.32	445.60	844.92
8231	Gove-Altai	Tugrug	93.82	75.55	169.37
8234	Gove-Altai	Kaliun	89.78	72.29	162.07
8237	Gove-Altai	Khunkhmorit	229.47	141.65	371.12
8240	Gove-Altai	Tsogt	362.17	859.08	1,221.25
8243	Gove-Altai	Tseel	121.47	288.12	409.59
8246	Gove-Altai	Chandmani	90.03	93.34	183.37
8249	Gove-Altai	Sharga	87.88	90.21	178.09
8252	Gove-Altai	Erdene	532.61	852.03	1,384.64
8301	Bayan-Ulgii	Ulgii	8.29	3.29	11.59
8304	Bayan-Ulgii	Altai	282.95	119.48	402.43
8307	Bayan-Ulgii	Altantsugts	103.56	137.69	241.25
8310	Bayan-Ulgii	Bayannuur	85.12	52.55	137.67
8313	Bayan-Ulgii	Bugat	169.77	67.46	237.23
8316	Bayan-Ulgii	Bulgan	269.09	388.88	657.97
8319	Bayan-Ulgii	Buyant	177.29	60.31	237.60
8322	Bayan-Ulgii	Deluum	254.92	282.87	537.78
8325	Bayan-Ulgii	Nogoonnuur	332.49	171.38	503.87
8328	Bayan-Ulgii	Sagsai	289.42	112.62	402.05
8331	Bayan-Ulgii	Tolbo	287.43	97.78	385.22
8334	Bayan-Ulgii	Ulaankhus	578.83	207.98	786.81
8340	Bayan-Ulgii	Tsengel	584.24	227.35	811.60
8401	Khovd	Jargalant	3.33	3.07	6.39
8404	Khovd	Altai	480.50	498.72	979.21
8407	Khovd	Bulgan	441.76	638.41	1,080.17
8410	Khovd	Buyant	169.89	156.65	326.54
8413	Khovd	Darvi	222.77	77.29	300.06
8416	Khovd	Durgun	149.74	92.43	242.17
8419	Khovd	Duut	79.17	143.41	222.58
8422	Khovd	Zereg	100.74	34.95	135.69
8425	Khovd	Mankhan	160.22	290.24	450.46
8428	Khovd	Munkhkhairkhan	94.79	171.72	266.51
8431	Khovd	Must	159.40	55.30	214.71
8434	Khovd	Myangat	120.33	74.28	194.61
8437	Khovd	Uyench	365.41	603.66	969.07
8440	Khovd	Khovd	132.66	122.33	254.99
8443	Khovd	Tsetseg	139.69	48.46	188.15
8446	Khovd	Chandmani	221.47	136.71	358.19
8449	Khovd	Erdenburen	68.02	149.29	217.31
8504	Uvs	Baruunturuun	127.01	252.64	379.66
8507	Uvs	Bukhmurun	167.43	60.37	227.80
8510	Uvs	Davst	256.50	510.22	766.73
8513	Uvs	Zavkhan	252.13	155.64	407.76
8516	Uvs	Zuungobi	158.07	314.43	472.50
8519	Uvs	Zuunkhangai	138.15	54.23	192.38
8522	Uvs	Malchin	157.97	314.23	472.20
8525	Uvs	Naranbulag	204.25	406.29	610.54
8528	Uvs	Ulgii	86.97	53.68	140.65
8531	Uvs	Umnugobi	114.93	70.94	185.87
8534	Uvs	Undurkhangai	169.17	104.43	273.59
8537	Uvs	Sagil	245.85	126.72	372.57
8540	Uvs	Tarialan	150.24	298.84	449.08
8540	Uvs	Tarialan	150.24	298.84	449.08
8543	Uvs	Turgen	82.99	165.07	248.06
8546	Uvs	Tes	123.84	246.33	370.16
8549	Uvs	Khovd	126.26	45.53	171.79
8552	Uvs	Khyargas	127.39	253.40	380.78
8555	Uvs	Tsagaankhairkhan	148.68	91.78	240.47

Source: JICA Project Team

Table 3.5.5 Soum-level Surface and Groundwater Potentials Estimated by JPT (Dry Year)

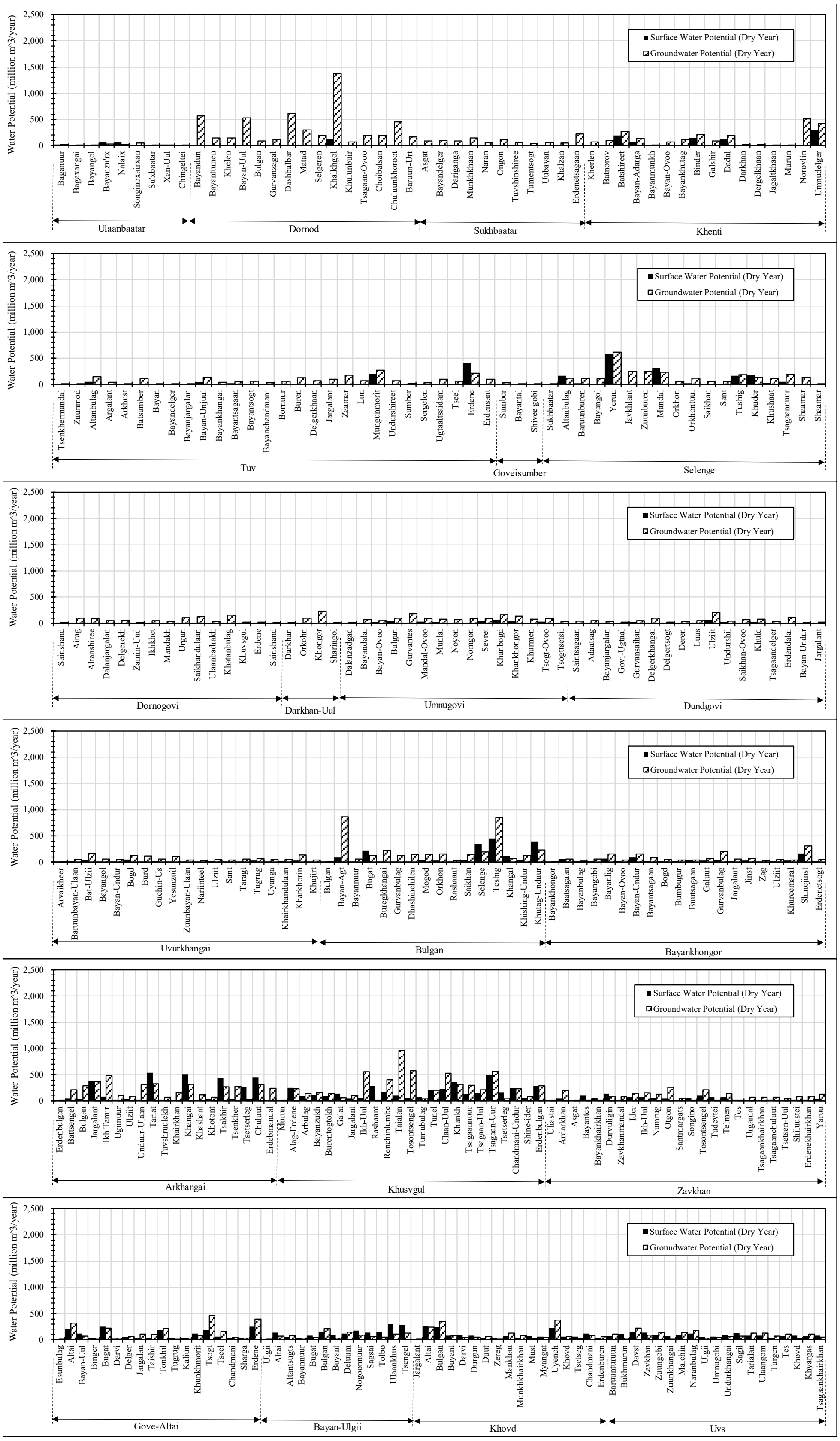
ID	Aimag	Soum Name	Water Potential (Dry Year)			ID	Aimag	Soum Name	Water Potential (Dry Year)			ID	Aimag	Soum Name	Water Potential (Dry Year)		
			SW	GW	Total				SW	GW	Total				SW	GW	Total
1101	Ulaanbaatar	Baganuur	19.40	25.31	44.71	4440	Dornogovi	Erdene	1.37	22.50	23.87	6704	Khusvgul	Alag-Erdene	254.02	230.51	484.53
1104	Ulaanbaatar	Bagaxangai	0.64	1.43	2.07	4443	Dornogovi	Sainshand	0.04	0.64	0.68	6707	Khusvgul	Arbulag	95.85	132.46	228.30
1107	Ulaanbaatar	Bayangol	0.91	0.43	1.35	4501	Darkhan-Uul	Darkhan	0.75	5.39	6.14	6710	Khusvgul	Bayanzukh	116.61	161.15	277.76
1110	Ulaanbaatar	Bayanzu'rx	60.82	29.34	90.16	4504	Darkhan-Uul	Orkohn	2.76	94.39	97.15	6713	Khusvgul	Burentogtokh	103.50	140.78	244.28
1113	Ulaanbaatar	Nalaix	62.52	25.37	87.89	4507	Darkhan-Uul	Khongor	14.18	235.87	250.05	6716	Khusvgul	Galat	139.43	58.75	198.18
1116	Ulaanbaatar	Songinoxairxan	6.66	54.23	60.89	4510	Darkhan-Uul	Sharingol	0.52	8.62	9.14	6719	Khusvgul	Jargalant	51.95	106.43	158.38
1119	Ulaanbaatar	Su'xbaatar	8.14	3.87	12.01	4601	Umnugovi	Dalanzadgad	0.10	0.31	0.40	6722	Khusvgul	Ikh-Uul	61.15	559.42	620.57
1121	Ulaanbaatar	Xan-Uul	19.19	9.14	28.33	4604	Umnugovi	Bayandalai	3.91	69.79	73.70	6725	Khusvgul	Rashaant	288.08	0.33	288.41
1125	Ulaanbaatar	Chingeltei	3.44	1.64	5.07	4607	Umnugovi	Bayan-Ovoo	19.28	50.57	69.86	6728	Khusvgul	Renchinlumbe	173.98	404.41	578.39
2104	Dornod	Bayandun	2.62	568.61	571.23	4610	Umnugovi	Bulgan	39.43	97.84	137.27	6731	Khusvgul	Taialan	104.44	955.47	1,059.92
2107	Dornod	Bayantumen	13.05	151.06	164.12	4613	Umnugovi	Gurvantes	10.25	183.07	193.33	6734	Khusvgul	Tosontsengel	62.79	574.44	637.24
2107	Dornod	Bayantumen	13.05	151.06	164.12	4616	Umnugovi	Mandal-Ovoo	34.34	85.23	119.57	6737	Khusvgul	Tumubulag	73.33	45.63	118.96
2110	Dornod	Bayan-Uul	2.64	526.08	528.72	4619	Umnugovi	Munlai	26.72	77.13	103.85	6740	Khusvgul	Tunel	205.79	204.52	410.31
2113	Dornod	Bulgan	4.00	91.53	95.53	4622	Umnugovi	Noyon	3.87	69.18	73.06	6743	Khusvgul	Ulaan-Uul	228.30	530.69	758.99
2116	Dornod	Gurvanzagal	0.88	117.32	118.20	4625	Umnugovi	Nomgon	5.33	91.88	97.21	6746	Khusvgul	Khankh	354.40	321.60	676.00
2119	Dornod	Dashbalbar	1.42	612.79	614.21	4628	Umnugovi	Sevrei	41.24	86.19	127.43	6749	Khusvgul	Tsagaannuur	127.41	296.16	423.57
2122	Dornod	Matad	12.91	295.25	308.16	4631	Umnugovi	Khanbogd	69.88	163.42	233.30	6752	Khusvgul	Tsagaan-Uul	156.40	216.15	372.55
2125	Dornod	Selgeren	3.01	192.47	195.48	4634	Umnugovi	Khankhongor	44.37	135.95	180.32	6755	Khusvgul	Tsagaan-Uur	491.68	564.91	1,056.60
2128	Dornod	Khalkhgol	118.74	1,374.32	1,493.06	4637	Umnugovi	Khurmen	4.63	82.74	87.37	6758	Khusvgul	Tsetserleg	168.85	43.51	212.36
2131	Dornod	Khulunbuir	6.25	74.47	80.72	4640	Umnugovi	Tsogt-Ovoo	28.15	86.24	114.39	6761	Khusvgul	Chandmani-Undur	246.36	236.00	482.36
2134	Dornod	Tsagaan-Ovoo	8.46	197.42	205.88	4643	Umnugovi	Tsogttsetsii	10.66	32.41	43.08	6764	Khusvgul	Shine-ider	56.16	76.38	132.54
2137	Dornod	Choibalsan	1.77	191.56	193.33	4801	Dundgovi	Saintsagaan	14.39	44.10	58.49	6767	Khusvgul	Erdenbulgan	286.28	290.58	576.86
2140	Dornod	Chuluunkhoroot	1.06	455.26	456.33	4804	Dundgovi	Adaatsag	5.03	54.30	59.33	8101	Zavkhan	Uliastai	0.28	1.17	1.45
2201	Sukhbaatar	Baruun-Urt	7.24	165.66	172.91	4807	Dundgovi	Bayanjargalan	13.04	29.02	42.06	8104	Zavkhan	Ardarkhan	46.32	193.12	239.44
2204	Sukhbaatar	Asgat	4.08	93.31	97.39	4810	Dundgovi	Govi-Ugtaal	11.08	24.66	35.74	8107	Zavkhan	Asgat	12.93	3.33	16.26
2207	Sukhbaatar	Bayandelger	4.28	97.90	102.18	4813	Dundgovi	Gurvansaihan	22.37	49.79	72.16	8110	Zavkhan	Bayantes	109.35	15.39	124.74
2210	Sukhbaatar	Dariganga	9.68	84.74	94.42	4816	Dundgovi	Delgerkhangai	9.41	101.55	110.96	8113	Zavkhan	Bayankhairkhan	64.50	9.08	73.58
2213	Sukhbaatar	Munkhkhaan	12.20	145.25	157.45	4819	Dundgovi	Delgertsogt	10.24	22.80	33.05	8116	Zavkhan	Durvuligin	140.91	92.91	233.82
2216	Sukhbaatar	Naran	6.78	59.37	66.15	4822	Dundgovi	Deren	14.82	32.99	47.81	8119	Zavkhan	Zavkhanmandal	15.61	75.31	90.92
2219	Sukhbaatar	Ongon	13.94	122.04	135.98	4825	Dundgovi	Luus	4.78	51.60	56.39	8122	Zavkhan	Ider	72.81	149.16	221.97
2225	Sukhbaatar	Tuvshinshiree	2.49	56.87	59.36	4828	Dundgovi	Ulziit	66.29	203.10	269.39	8125	Zavkhan	Ikh-Uul	74.39	152.40	226.79
2228	Sukhbaatar	Tumentsogt	3.51	41.84	45.36	4831	Dundgovi	Undurshil	19.89	44.27	64.16	8128	Zavkhan	Numrug	64.26	131.64	195.90
2231	Sukhbaatar	Uubayan	2.80	64.03	66.83	4834	Dundgovi	Saikhan-Ovoo	6.13	66.18	72.32	8131	Zavkhan	Otgon	47.00	265.39	312.39
2234	Sukhbaatar	Khalzan	2.15	49.19	51.34	4837	Dundgovi	Khuld	26.04	79.79	105.83	8134	Zavkhan	Santmargats	10.41	50.21	60.61
2237	Sukhbaatar	Erdenetsagaan	9.57	218.95	228.53	4840	Dundgovi	Tsagaandelger	14.18	31.55	45.73	8137	Zavkhan	Songino	60.41	8.50	68.92
2301	Khenti	Kherlen	6.21	73.92	80.13	4843	Dundgovi	Erdendalai	11.09	119.69	130.78	8140	Zavkhan	Tosontsengel	103.99	213.02	317.00
2304	Khenti	Batnorov	8.18	97.34	105.52	6101	Orkhon	Bayan-Undur	2.02	10.84	12.86	8143	Zavkhan	Tudevtei	66.37	9.34	75.72
2307	Khenti	Batshireet	193.08	270.80	463.88	6104	Orkhon	Jargalant	4.19	22.50	26.69	8146	Zavkhan	Telmen	67.92	139.15	207.07
2310	Khenti	Bayan-Adarga	73.40	138.28	211.67	6201	Uvurkhangai	Arvaikheer	0.07	0.80	0.88	8149	Zavkhan	Tes	22.92	3.23	26.15
2313	Khenti	Bayanmunkh	8.02	12.61	20.64	6204	Uvurkhangai	Baruunbayan-Ulaan	20.88	51.81	72.69	8152	Zavkhan	Urgamal	15.18	73.25	88.44
2316	Khenti	Bayan-Ovoo	5.55	66.12	71.67	6207	Uvurkhangai	Bat-Ulzii	44.22	161.55	205.77	8155	Zavkhan	Tsagaankhairkhan	16.98	70.78	87.75
2319	Khenti	Bayankhutag	9.94	118.39	128.33	6210	Uvurkhangai	Bayangol	5.32	57.37	62.68	8158	Zavkhan	Tsagaanchuluut	19.38	74.28	93.66
2322	Khenti	Binder	149.35	209.47	358.81	6213	Uvurkhangai	Bayan-Undur	4.93	53.20	58.13	8161	Zavkhan	Tsetsen-Uul	10.59	51.09	61.68
2325	Khenti	Galshir	3.77	86.16	89.93	6216	Uvurkhangai	Bogd	53.09	131.76	184.86	8164	Zavkhan	Shiluustei	25.49	80.43	105.92
2328	Khenti	Dadal	120.48	198.58	319.06	6219	Uvurkhangai	Burd	6.01	121.50	127.51	8167	Zavkhan	Erdenekhairkhan	18.09	87.28	105.37
2331	Khenti	Darkhan	14.15	22.25	36.40	6222	Uvurkhangai	Guchin-Us	25.23	62.62	87.86	8170	Zavkhan	Yaruu	37.89	128.34	166.23
2334	Khenti	Dergelkhaan	12.07	18.97	31.04	6225	Uvurkhangai	Yesunzuil	5.19	104.95	110.14	8201	Gove-Altai	Esunbulag	12.16	13.16	25.31
2337	Khenti	Jagaltkhaan	8.95	14.08	23.03	6228	Uvurkhangai	Zuunbayan-Ulaan	3.80	41.04	44.84	8204	Gove-Altai	Altai	204.07	321.35	525.42
2340	Khenti	Murun	6.95	10.92	17.87	6231	Uvurkhangai	Nariinteel	14.25	35.36	49.61	8207	Gove-Altai	Bayan-Uul	113.51	74.84	188.35
2343	Khenti	Norovlin	2.57	512.14	514.71	6234	Uvurkhangai	Ulziit	19.82	46.64	66.47	8210	Gove-Altai	Binger	31.01	32.70	63.70
2346	Khenti	Umnudelger	300.34	421.25	721.59	6237	Uvurkhangai	Sant	3.98	42.94	46.92	8213	Gove-Altai	Bugat	250.53	219.59	470.12
2349	Khenti	Tsenkhermandal	9.99	15.71	25.70	6240	Uvurkhangai	Taragt	5.33	57.49	62.82	8216	Gove-Altai	Darvi	19.01	32.55	51.56
4101	Tuv	Zuunmod	0.17	0.68	0.84	6243	Uvurkhangai	Tugrug	28.81	71.49	100.30	8219	Gove-Altai	Delger	53.66	56.58	110.24
4103	Tuv	Altanbulag	47.57	143.65	191.22	6246	Uvurkhangai	Uyanga	4.62	49.85	54.47	8222	Gove-Altai	Jargalan	27.52	105.46	132.97
4107	Tuv	Argalant	7.68	44.41	52.09	6249	Uvurkhangai	Khairkhandulaan	21.84	54.21	76.05	8225	Gove-Altai	Taishir	31.35	98.93	130.28
4110	Tuv	Arkhust	2.59	4.07	6.65	6252	Uvurkhangai	Kharkhorin	34.30	141.71	176.00	8228	Gove-Altai	Tonkhil	182.05	215.86	397.91
4113	Tuv	Batsumber	13.40	109.09	122.49	6255	Uvurkhangai	Khujirt	17.03	40.07	57.10	8231	Gove-Altai	Tugrug	39.29	31.56	70.85
4116	Tuv	Bayan	9.32	14.64	23.96	6301	Bulgan	Bulgan	0.68	3.65	4.33	8234	Gove-Altai	Kaliun	37.59	30.20	67.79
4119	Tuv	Bayandelger	6.69	10.51	17.20	6304	Bulgan	Bayan-Agt	94.09	860.80	954.90	8237	Gove-Altai	Khunkhmorit	122.18	80.55	202.73
4122	Tuv	Bayanjargalan	9.00	14.15	23.15	6307	Bulgan	Bayannuur	3.03	64.22	67.25	8240	Gove-Altai	Tsogt	185.50	460.53	646.03
4125	Tuv	Bayan-Unjuul	38.69	132.93	171.62	6310	Bulgan	Bugat	226.52	130.73	357.25	8243	Gove-Altai	Tseel	62.22	154.46	216.67
4128	Tuv	Bayankhangai	6.82	39.43	46.25	6313	Bulgan	Buregkhangai	10.40	220.55	230.95	8246	Gove-Altai	Chandmani	37.26	39.29	76.54
4131	Tuv	Bayantsagaan	24.12	53.68	77.80	6316	Bulgan	Gurvanbulag	6.27	126.74	133.01	8249	Gove-Altai	Sharga	29.80	32.25	62.05
4134	Tuv	Bayantsogt	10.34	59.81	70.15	6319	Bulgan	Dhashinchilen	6.91	146.56	153.47	8252	Gove-Altai	Erdene	252.99	398.38	651.37
4137	Tuv	Bayanchandmani	4.15	29.99	34.14	6322	Bulgan	Mogod	46.01	151.12	197.13	8301	Bayan-Ulgii	Ulgii	4.04	1.84	5.88
4140	Tuv	Bornuur	8.40	60.70	69.10	6325	Bulgan	Orkhon	29.69	159.29	188.98	8304	Bayan-Ulgii	Altai	134.68	67.03	201.71
4143	Tuv	Buren	10.44	125.11	135.56	6328	Bulgan	Rashaant	2.72	32.56	35.27	8307	Bayan-Ulgii	Altantsugts	50.81	76.65	127.46
4146	Tuv	Delgerkhaan	6.02	72.08	78.10	6331	Bulgan	Saikhan	44.02	144.60	188.62	8310	Bayan-Ulgii	Bayannuur	45.32	29.88	75.20
4149	Tuv	Jargalant	13.51	97.69	111.21	6334	Bulgan	Selenge	344.92	199.07	543.99	8313	Bayan-Ulgii	Bugat	82.73	37.60	120.33
4152	Tuv	Zaamar	8.42	178.55	186.97	6337	Bulgan	Teshig	449.80	848.80	1,298.60	8316	Bayan-Ulgii	Bulgan	147.02	214.09	361.11
4155	Tuv	Lun	8.57	72.29	80.86	6340	Bulgan	Khangal	114.10	65.85	179.96	8319	Bayan-Ulgii	Buyant	91.78	32.23	124.01
4158	Tuv	Mungunmorit	208.38	271.86	480.24	6343	Bulgan	Khishing-Undur	39.67	130.30	169.98	8322	Bayan-Ulgii	Deluum	115.39	144.36	259.75
4161	Tuv	Undurshireet	8.86	74.78	83.64	6346	Bulgan	Khutag-Unduur	398.22	229.83	628.06	8325	Bayan-Ulgii	Nogoonnuur	171.06	88.71	259.77
4164	Tuv	Sumber	2.54	18.39	20.94	6401	Bayankhongor	Bayankhongor	0.34	0.85	1.19	8328	Bayan-Ulgii	Sagsai	140.73	62.70	203.42
4167	Tuv	Sergelen	15.57	34.66	50.23	6404	Bayankhongor	Baatsagaan	60.04	63.31	123.35	8331	Bayan-Ulgii	Tolbo	148.79	52.26	201.05
4170	Tuv	Ugtaaltsaidam	4.62	98.03	102.65	6407	Bayankhongor	Bayanbulag	25.49	26.88	52.38	8334	Bayan-Ulgii	Ulaankhus	299.55	111.32	410.87
4173	Tuv	Tseel	12.07	64.77	76.85	6410	Bayankhongor	Bayangobi	26.45	59.77	86.22	8340	Bayan-Ulgii	Tsengel	284.08	126.56	410.64
4176	Tuv	Erdene	412.94	215.00	627.95	6413	Bayankhongor	Bayanlig	67.55	152.66	220.21	8401	Khovd	Jargalant	1.54	1.55	3.10
4179	Tuv	Erdensant	8.62	103.22	111.83	6416	Bayankhongor	Bayan-Ovoo	20.57	43.20	63.77	8404	Khovd	Altai	263.19	242.50	505.69
4201	Goveisumber	Sumber	15.34	34.15	49.50	6419	Bayankhongor	Bayan-Undur	84.74	156.07	240.80	8407	Khovd	Bulgan	241.35	351.47	592.82
4204	Goveisumber	Bayantal	3.67	8.17	11.84	6422	Bayankhongor	Bayantsagaan	25.68	87.08	112.76	8410	Khovd	Buyant	78.89	79.27	158.16
4207	Goveisumber	Shivee gobi	3.69	8.22	11.91	6425	Bayankhongor	Bogd	20.95	51.99	72.93	8413	Khovd	Darvi	102.25	36.75	139.01
4301	Selenge	Sukhbaatar	0.32	10.91	11.23	6428	Bayankhongor	Bumbugur	19.46	40.87	60.33	8416	Khovd	Durgun	79.72	52.56	132.29
4304	Selenge	Altanbulag	162.49	120.27	282.76	6431	Bayankhongor	Buutsagaan	43.53	45.91	89.44	8419	Khovd	Duut	34.92	64.26	99.18
4307	Selenge	Baruunburen	20.91	112.17	133.08	6434	Bayankhongor	Galuut	32.20	67.61	99.81	8422	Khovd	Zereg	46.24	16.62	62.86
4310	Selenge	Bayangol	14.75	106.65	121.40	6437	Bayankhongor	Gurvanbulag	38.15	199.63	237.78	8425	Khovd	Mankhan	70.67	130.05	200.72
4313	Selenge	Yeruu	578.67	616.94	1,195.61	6440	Bayankhongor	Jargalant	26.92	56.53	83.45	8428	Khovd	Munkhkhairkhan	41.81	76.94	118.75
4316	Selenge	Javkhlant	7.39	252.62	260.01	6443	Bayankhongor	Jinst	33.07	69.45	102.53	8431	Khovd	Must	73.17	26.30	99.47
4319	Selenge	Zuunburen	7.42	253.80	261.23	6446	Bayankhongor	Zag	16.33	34.30	50.63	8434	Khovd	Myangat	64.07	42.24	106.31
4322	Selenge	Mandal	320.07	236.91	556.99	6449	Bayankhongor	Ulziit	20.87	51.79	72.66	8437	Khovd	Uyench	223.52	376.01	599.54
4325	Selenge	Orkhon	9.62	51.60	61.22	6452	Bayankhongor	Khureemaral	35.13	37.05	72.18	8440	Khovd	Khovd	61.61	61.90	123.51
4328	Selenge	Orkhontuul	21.85	117.21	139.06	6455	Bayankhongor	Shinejinst	169.59	312.34	481.93	8443	Khovd	Tsetseg	64.12	23.05	87.17
4331	Selenge	Saikhan	9.63	51.65	61.28	6458	Bayankhongor	Erdenetsogt	25.91	54.40	80.31	8446	Khovd	Chandmani	117.92	77.75	195.66
4334	Selenge	Sant	10.02	53.75	63.77	6501	Arkhangai	Erdenbulgan	0.76	5.51	6.26	8449	Khovd	Erdenburen	27.70	65.17	92.87
4337	Selenge	Tushig	167.58	184.53	352.11	6504	Arkhangai	Battsengel	52.32	216.17	268.49	8504	Uvs	Baruunturuun	70.54	111.24	181.78
4340	Selenge	Khuder	179.00	132.49	311.49	6507	Arkhangai	Bulgan	39.41	287.21	326.62	8507	Uvs	Bukhmurun	105.76	27.37	133.13
4343	Selenge	Khushaat	28.09	103.71	131.80	6510	Arkhangai	Jargalant	385.72	363.13	748.84	8510	Uvs	Davst	142.45	224.66	367.11
4346	Selenge	Tsagaannuur	53.04	195.85	248.88	6513	Arkhangai	Ikh Tamir	80.03	481.75	561.78	8513	Uvs	Zavkhan	134.24	88.51	222.74
4349	Selenge	Shaamar	4.15	141.84	145.99	6516	Arkhangai	Ugiinuur	25.29	104.48	129.76	8516	Uvs	Zuungobi	87.79	138.45	226.23
4352	Selenge	Shaamar	0.42	3.03	3.44	6519	Arkhangai	Ulziit	27.89	91.59	119.48	8519	Uvs	Zuunkhangai	66.09	9.30	75.39
4401	Dornogovi	Sainshand	0.29	4.80	5.09	6522	Arkhangai	Unduur-Ulaan	22.11	313.54	335.65	8522	Uvs	Malchin	87.73	138.36	226.09
4404	Dornogovi	Airag	4.22	96.60	100.82	6525	Arkhangai	Tariat	535.98	333.21	869.19	8525	Uvs	Naranbulag	113.43	178.90	292.33
4407	Dornogovi	Altanshiree	4.05	92.62	96.66	6528	Arkhangai	Tuvshruulekh	17.82	73.64	91.47	8528	Uvs	Ulgii	46.30	30.53	76.83
4410	Dornogovi	Dalanjargalan	2.28	52.08	54.36	6531	Arkhangai	Khairkhan	15.16	162.92	178.07	8531	Uvs	Umnugobi	61.19	40.34	101.53
4413	Dornogovi	Delgerekh	2.72	62.23	64.95	6534	Arkhangai	Khangai	512.74	318.76	831.51	8534	Uvs	Undurkhangai	90.07	59.38	149.45
4416	Dornogovi	Zamin-Uud	0.55	1.24	1.79	6537	Arkhangai	Khashaat	6.05	122.26	128.31	8537	Uvs	Sagil	126.48	65.59	192.08
4419	Dornogovi	Ikhkhet	2.36	53.97	56.33	6540	Arkhangai	Khotont	30.13	72.81	102.94	8540	Uvs	Tarialan	83.43	131.59	215.02
4422	Dornogovi	Mandakh	9.56	29.75	39.31	6543	Arkhangai	Tsakhir	434.31	270.00	704.31	8540	Uvs	Tarialan	83.43	131.59	215.02
4425	Dornogovi	Urgun	4.75	108.75	113.50	6546	Arkhangai	Tsenkher	38.71	282.12	320.83	8543	Uvs	Turgen	46.09	72.68	118.77
4428	Dornogovi	Saikhandulaan	5.39	123.40	128.80	6549	Arkhangai	Tsetserleg	258.21	23.20	281.41	8546	Uvs	Tes	68.77	108.46	177.23
4431	Dornogovi	Ulaanbadrakh	1.67	27.37	29.04	6552	Arkhangai	Chuluut	450.96	304.87	755.82	8549	Uvs	Khovd	79.75	20.64	100.39
4434	Dornogovi	Khatanbulag	11.69	159.36	171.06	6555	Arkhangai	Erdebmandal	17.20	243.95	261.15	8552	Uvs	Khyargas	70.75	111.57	182.32
4437	Dornogovi	Khuvsgul	6.33	19.71	26.04	6701	Khusvgul	Murun	2.93	1.78	4.71	8555	Uvs	Tsagaankhairkhan	79.16	52.19	131.36

Source: JICA Project Team



Source: JICA Project Team

Figure 3.5.18 Comparison of Estimated Annal Groundwater Potential by Soum (Average)



Source: JICA Project Team

Figure 3.5.19 Comparison of Estimated Annal Groundwater Potential by Soum (Dry Year)

3.5.3 Water demand

In the IWMP (2013) report, water demand in 2010, 2015 and 2021 was estimated based on the socio-economic development analysis by sector as shown in Table 3.5.6.

Table 3.5.6 Overview of Water Use (2008, 2010) and Projected Water Demand (2015, 2021) for Low, Medium and High Scenarios by IWMP

Sector	Sub-sector	Total water demand (million m^3/year)							
		2008	2010	2015			2021		
				Low	Medium	High	Low	Medium	High
Domestic	Urban	46.9	51.9	66.4	70.9	78.6	67.2	72.9	81.8
	Rural	2.6	3.2	4.1	4	4	5.9	6	6
Agriculture	Livestock	94.7	76.9	90.2	94.9	109.4	103.1	108.6	117.3
	Irrigation	83.5	98.7	125	169.8	203.2	165.5	260.8	360
Industries	Mining	49.4	41.5	52.5	81.1	103.5	61.8	111.1	187.8
	Heavy industries	1.3	1.3	1.6	1.8	2.3	2	2.7	4.7
	Manufacturing	2.2	3.6	4.4	5.1	6.6	5.6	7.6	13.5
Construction		1	1.2	1.6	2	2.4	2.1	3.2	4.5
Energy	Power plants	35.2	33.4	37.8	44.7	54.3	43.9	63.5	97.3
Municipal	Commercial services	3.7	3.9	4.8	5.6	7.7	6.3	8.7	17.2
	Public services	5.3	5.5	5.8	5.9	6.7	6	6.5	8.5
	Green areas	0.3	2.5	2.6	2.6	2.7	2.7	2.9	3
Tourism		0.6	0.8	1.2	1.4	1.6	2.7	3.4	4
Roads, transport		2.3	2.7	3.2	3.6	4.1	4.1	4.5	5
Total		329	327.1	401.2	493.4	587.1	478.9	662.4	910.6

Source: Ministry of Environment and Green Development (former), (2013), "Integrated Water Management Plan, Mongolia"

The biggest water use currently is the agricultural sector, and in the future, mining will be a major water user. MET is updating the water demand in Mongolia up to 2030. The JPT will make own estimates of water demand up to 2040 in the next stage. Water demand by river basin was estimated by IWMP as summarized in Table 3.5.7.

Table 3.5.7 Water Demand by Water Basin in Year 2021 by IWMP

No.	Name of basin	2021, low scenario (million a^3/year)							2021, medium scenario (million m^3/year)							2021, high scenario (million m^3/year)						
		Drinking and domestic water for population	Utility service & tourism & green area	Industry, energy, construction, road and transport	Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Grand total	Drinking and domestic water for population	Utility service & tourism & green area	Industry, energy, construction, road and transport	Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Grand total	Drinking and domestic water for population	Utility service & tourism & green area	Industry, energy, construction, road and transport	Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Grand total
1	Selenge	0.23	0.18	0.18	0.03	4.35	23	27.97	0.23	0.23	0.2	0.08	4.57	36.23	41.53	0.24	0.27	0.22	0.25	4.57	50.01	55.56
2	Khuvsgul Lake - Eg	0.15	0.36	0.18	0.08	3.18	0.3	4.25	0.15	0.45	0.2	0.17	3.35	0.47	4.79	0.15	0.54	0.22	0.55	2.94	0.65	5.05
3	Shishkhid	0.05	0.07	0.18	0	1.24	0	1.54	0.05	0.09	0.2	0	1.3	0	1.65	0.05	0.11	0.22	0	1.13	0	1.51
4	Delgermurun	0.74	0.28	0.17	0	3.43	0	4.62	0.79	0.32	0.21	0	3.61	0	4.94	0.86	0.42	0.3	0	3.84	0	5.42
5	Ider	0.18	0	0.18	0	2.61	0.93	3.91	0.18	0	0.2	0	2.75	1.47	4.6	0.18	0	0.22	0	2.86	2.03	5.29
6	Chuluut	0.12	0.07	0.09	0	3.62	0	3.9	0.12	0.09	0.1	0	3.81	0	4.12	0.12	0.11	0.11	0	3.34	0	3.68
7	Khanui	0.11	0	0.09	0	3.79	0	3.99	0.12	0	0.1	0	3.99	0	4.2	0.12	0	0.11	0	4.02	0	4.25
8	Orkhon	7	0.87	3.72	16.37	11.99	20.56	60.51	7.53	1.04	5.56	18.36	12.62	32.39	77.51	8.31	1.51	8.5	27.14	12.55	44.72	102.71
9	Tuul	47.97	11.82	35.58	3.3	9.8	5.93	114.4	52.08	14.31	50.94	7	10.32	9.34	143.99	58.48	23.45	79.6	15.5	10.87	12.9	200.8
10	Kharaa	4.58	0.48	6.7	2.62	4.67	18.41	37.45	4.95	0.57	9.5	5.43	4.91	29	54.35	5.54	0.76	14.69	11.58	4.6	40.03	77.2
11	Eroo	0.06	0	0.18	0.98	0.92	3.31	5.45	0.06	0	0.2	2.11	0.97	5.22	8.56	0.06	0	0.22	6.65	0.92	7.2	15.06
12	Onon	0.08	0.18	0.18	0.06	2.12	0	2.62	0.08	0.23	0.2	0.13	2.23	0	2.86	0.08	0.27	0.22	0.41	2.07	0	3.05
13	Ulz	0.09	0	0.18	7.22	2.18	0	9.67	0.09	0	0.2	14.63	2.29	0	17.21	0.09	0	0.22	23.03	2.23	0	25.57
14	Kherlen	2.31	0.45	4.46	5.57	7.3	9.1	29.19	2.47	0.53	6.39	11.64	7.68	14.33	43.05	2.73	0.69	9.74	27.74	8.52	19.78	69.21
15	Buir Lake - Khalkh	0.02	0.03	0.18	0	0.41	0.93	1.57	0.02	0.03	0.2	0	0.43	1.47	2.15	0.02	0.04	0.22	0	0.37	2.03	2.68
16	Menengiin Tal	0.07	0.03	0.18	0.71	1.12	0	2.1	0.07	0.03	0.2	1.42	1.18	0	2.9	0.07	0.04	0.22	1.78	1.35	0	3.45
17	Umard Goviin Guveet - Kh. D. T.	2.88	0.53	1.38	1.95	6.41	1.22	14.36	3.08	0.62	1.87	3.98	6.74	1.92	18.22	3.35	0.86	3.02	7.08	9.17	2.65	26.13
18	Galba – Uush - Doloodiin Govi	0.47	0.21	0.18	18.43	3.92	0.42	23.63	0.49	0.26	0.2	36.86	4.12	0.67	42.59	0.5	0.31	0.22	45.46	4.88	0.92	52.29
19	Ongi	1.01	0.33	1.31	0.99	2.04	1.46	7.13	1.08	0.38	1.86	2.07	2.14	2.3	9.83	1.17	0.5	2.82	4.92	2.34	3.17	14.93
20	Altain Uvur Govi	0.22	0.1	0.18	1.7	3.3	4.85	10.34	0.22	0.12	0.2	3.4	3.47	7.64	15.05	0.22	0.14	0.22	4.18	4.42	10.55	19.73
21	Taats	0.12	0.1	0.09	0	1.72	0.43	2.46	0.12	0.12	0.1	0	1.81	0.68	2.83	0.12	0.14	0.11	0	2.15	0.94	3.46
22	Orog Lake - Tui	0.67	0.24	0.25	0	1.85	3.7	6.71	0.72	0.28	0.33	0	1.94	5.83	9.11	0.79	0.38	0.47	0	2.06	8.06	11.75
23	Buuntsagaan Lake – Baidrag	0.13	0.1	0.09	1.44	2.32	2.69	6.77	0.13	0.12	0.1	3.13	2.44	4.24	10.16	0.13	0.14	0.11	10.17	2.76	5.85	19.17
24	Khyargas Lake – Zavkhan	1.02	0.32	0.65	0.07	5.51	18.43	26	1.07	0.36	0.87	0.16	5.8	29.02	37.29	1.17	0.48	1.28	0.51	6.96	40.07	50.47
25	Khuisiin Govi - Tsetseg Lake	0.12	0.1	0.18	0	2.02	9.89	12.31	0.12	0.12	0.2	0	2.13	15.58	18.15	0.12	0.14	0.22	0	2.5	21.51	24.49
26	Uench - Bodonch	0.07	0.03	0	0	0.9	0.7	1.7	0.07	0.03	0	0	0.94	1.1	2.15	0.07	0.04	0	0	1.06	1.52	2.7
27	Bulgan	0.07	0.03	0.18	0	0.48	2.66	3.43	0.07	0.03	0.2	0	0.51	4.2	5.01	0.08	0.04	0.22	0	0.53	5.79	6.66
28	Khar Lake - Khovd	1.76	0.55	0.34	0.25	5.91	17.09	25.9	1.86	0.65	0.43	0.5	6.23	26.92	36.57	2.01	0.88	0.58	0.62	7.51	37.16	48.75
29	Uvs Lake - Tes	0.82	0.34	0.35	0.04	4.03	19.53	25.11	0.87	0.4	0.44	0.08	4.24	30.77	36.81	0.94	0.51	0.62	0.27	4.76	42.48	49.58
	Total	73.12	17.76	57.62	61.81	103.13	165.55	478.98	78.91	21.4	81.41	111.13	108.56	260.77	662.19	87.78	32.76	124.91	187.83	117.29	360.03	910.61

Source: Ministry of Environment and Green Development (former), (2013), "Integrated Water Management Plan, Mongolia"

3.5.4 Water balance by river basin

Estimated water balance in 2021 by river basin reported in the IWMP is shown in Table 3.5.8. In almost all river basins, further development of water resources is needed to meet the future demand during average years (50%) and during dry years (10%). Especially groundwater resources need to be investigated further to meet the increasing demand for groundwater. The potential groundwater availability is large and sufficient amount of groundwater resources are expected to be available. However, locally it may be difficult to find the required volumes, e.g. in Ulaanbaatar or near large mines in the south. In such situations, the solution may be to reduce the water demand by promoting more efficient use of water or to increase the water availability by storing water in reservoirs or by transferring water from other basins with abundant water resources (IWMP, 2013). The water balance study up to the year 2040 was newly conducted by the JPT.

Table 3.5.8 Water Balance by Water Basin in 2021 by IWMP

No	Name	Year 2021 Demand (medium scenario, million m^3/year)			Groundwater Availability (million m^3/year)		Surface water Availability (million m^3/year)		2021 Total Demand as % of Total Resources
		SW	GW	Total	Potential	Exploitable	50%	10%	
A	B	C	D	E	F	G	H	I	J=E/(G+I)
1	Selenge*	20.8	36.7	57.5	697	90.3	277.3	165.2	22.5
2	KhuvsgulLake-Eg	2.8	2	4.8	432	0.2	401.1	276.2	1.7
3	Shishkhid	1	0.6	1.6	206	0.2	39	29.6	5.5
4	Delgermurun	2	2.9	4.9	229	2.7	81	47.6	9.8
5	Ider	3.3	1.3	4.6	129	0.5	53.3	29.7	15.2
6	Chuluut	2.4	1.7	4.1	86	0.1	13.9	6.2	65.5
7	Khanui	2.5	1.7	4.2	96	0.2	13.9	11.8	35
8	Orkhon*	40.3	21.2	61.5	838.3	26.7	221.6	99.7	48.7
9	Tuul	10.5	133.5	144	637.7	142.8	63.1	30.5	83.1
10	Kharaa	17.4	37	54.5	182	52.6	25.9	12.8	83.1
11	Eroo	5.3	3.2	8.6	239	0.6	196.2	112.1	7.6
12	Onon	1.3	1.5	2.9	344	0.6	259	230.8	1.2
13	Ulz	1.3	16	17.2	320	26.4	22.7	3.8	57
14	Kherlen	16.9	26.1	43	721	43.9	59.5	28.4	59.5
15	BuirLake-Khalkh	0.9	1.2	2.2	198	1.1	102.3	54.9	3.8
16	MenengiinTal	0	2.9	2.9	168	0.1	0	0	2895.7
17	UmardGoviinGuveet-KhalkhiinDundadTal	0	18.2	18.2	433	46.7	0	0	39
18	Galba-Uush-DoloodiinGovi	0	42.6	42.6	352	59	0	0	72.2
19	Ongi	3.7	6.1	9.8	294	5.8	1	0.3	161.1
20	AltainUvurGovi	0	15.1	15.1	337	65.5	0	0	23
21	Taats	1.3	1.5	2.8	61	0.5	0.9	0.3	353.5
22	OrogLake-Tui	6.5	2.6	9.1	33	5.9	2.6	0.9	134
23	BuuntsagaanLake–Baidrag	8.2	1.9	10.2	174	2.9	22.7	12.9	64.3
24	KhyargasLake–Zavkhan	31.1	6.2	37.3	892	10	44.9	22.8	113.7
25	KhuisiinGovi-TsetsegLake**	15.6	2.5	18.1	493	8.1	0	0	224
26	Uench-Bodonch	1.3	0.8	2.2	237	11.3	2.7	1.1	17.4
27	Bulgan	4.6	0.4	5	86	0	8.3	5.7	87.9
28	KharLake-Khovd	30.2	6.4	36.6	684	12.7	115.8	80.8	39.1
29	UvsLake-Tes	33	3.8	36.8	405	6.1	63.1	29.8	102.5
	Mongolia Total	264.5	397.7	662.2	10,004.00	623.4	2,091.70	1,294.10	

Note:
Groundwater availability: Potential resources based on aquifer properties and renewable resources;
Exploitable resources based on approved groundwater deposits.
Surface water availability: Available resources after subtracting environmental flow: 50% means available in an average year, 10% means available in a dry year with probability of once in 10 years; the surface water resources include the surface water which is generated within the river basin only; inflow from

other upstream river basins is not included.
2021 total demand as % of total resources: total resources based on sum of exploitable groundwater resources and 10% surface water resources
Remarks:
* Demand of Erdenet mine is located in Orkhon river basin but is supplied by transfer from groundwater resources in Selenge river basin and therefore is added to total water demand of the Selenge Basin: 15.118 million m^3/year in 2010, 15.5 million m^3/year in 2015 and 16 million m^3/year in 2021.
** Khuisiin Govi - Tsetseg Lake basin has demand from surface water for irrigation but surface water resource was not estimated
Source: Ministry of Environment and Green Development (former), (2013), "Integrated Water Management Plan, Mongolia"

3.5.5 Existing water balance by Aimag

Table 3.5.9 shows water resources availability and water usage at the Aimag level in 2018 estimated by MET.

Table 3.5.9 Waterer Resources and Water Usage by the Aimag Level in 2018

Unit: million m^3/year

No.	Aimag Name	Surface Water Resources	Ground Water Resources	Total Water Resources	Used Surface water	Used Ground water	Total Water Use	Gap
		a	b	c=a+b	d	e	f=d+e	g=c-f
1	Arkhangai	2,830	1,060	3,890	6.72	4.82	11.54	3,878.46
2	Bayankhongor	450	100	550	13.10	4.58	17.68	532.32
3	Bayan-Ulgii	2,390	1,050	3,440	6.31	3.22	9.53	3,430.47
4	Bulgan	1,750	500	2,250	16.24	10.27	26.51	2,223.49
5	Darkhan-Uul	44	10	54	6.65	5.78	12.43	41.57
6	Dornod	1,510	300	1,810	3.77	26.99	30.76	1,779.24
7	Dornogovi	50	10	60	-	11.55	11.55	48.45
8	Dundgovi	120	80	200	-	5.05	5.05	194.95
9	Govi-Altai	58	100	158	1.85	2.45	4.30	153.70
10	Govisumber	10	1	11	-	9.26	9.26	1.74
11	Khentii	6,690	2,700	9,390	4.59	9.00	13.59	9,376.41
12	Khovd	1,100	250	1,350	16.13	4.73	20.86	1,329.14
13	Khuvsgul	6,590	2,490	9,080	6.81	1.14	7.95	9,072.05
14	Orkhon	5	1	6	2.29	27.12	29.41	-23.41
15	Selenge	3,200	970	4,170	52.84	6.86	59.70	4,110.30
16	Sukhbaatar	140	30	170	-	2.80	2.80	167.20
17	Tuv	1,910	590	2,500	14.70	23.98	38.68	2,461.32
18	Ulaanbaatar	** 29.88*	** 103.62*	** 133.5*	0.02	72.65	72.67	*60.83*
19	Umnugovi	-	0	0	0.13	20.02	20.15	-19.86
20	Uvs	1,200	230	1,430	33.90	3.40	37.30	1,392.70
21	Uvurkhangai	560	100	660	6.64	10.11	16.75	643.25
22	Zavkhan	3,160	1,140	4,300	0.58	0.85	1.43	4,298.57
	TOTAL	33,767	11,712	45,479	193.27	266.63	459.90	45,092.06

Source: Ministry of Environment and Tourism, (2019), Environmental Information Centre's web site database (https://eic.mn), *: 2030 WRG (2016)

Since the IWMP conducts water balance analysis by river basin up to the year 2021, the water balance by Aimag or Soum up to the year 2040 is not estimated. For this reason, the water balance analysis by river sub-basin and administrative level will be carried out in the Project.

3.5.6 Water balance in Ulaanbaatar

(1) Ongoing initiatives and programs

Key documents with measures to address water challenges faced by Ulaanbaatar city, and approved by the Government of Mongolia include the following:

- Tuul Integrated Water Management Plan,
- National Water Program (and Khatan Tuul National Program), and

- Ulaanbaatar 2020 Master Plan and Development Approaches for 2030/ Implementation Plan 2030[75].

(2) Estimated water demand in Ulaanbaatar

Future water demand in Ulaanbaatar is estimated by using following assumptions as summarized in Table 3.5.10.

The future domestic water demand is calculated based on predictions of population and type of connections and using water consumption norms. The population of Ulaanbaatar is expected to rise from 1.125 million in 2010 to 1.485 million in 2021 according to the medium scenario. The water consumption per person is assumed to drop to 160 l/person/day in 2021 for private connections and rise to 20-30 l/person/day in 2021 for public connections (kiosks). The future water also incorporates the One Hundred Thousand Household Apartments program with required approximately 50,000 m^3 water per day. (2030 WRG)

Table 3.5.10 Assumptions about Various Socio-Economic Variables used for Projecting Water Demand in Ulaanbaatar (2010-2021)

	Low scenario	Medium scenario	High scenario
Drinking water use			
Population growth	2010-2015: 1.17%	2010-2015: 1.38%	2010-2015: 1.51%
	2015-2021: 1.03%	2015-2021: 1.20%	2015-2021: 1.28%
% urban population in 2021	69.40%	70.70%	71.90%
Private connections and connected kiosks	2015: 45.9%	2015: 48.3%	2015: 53.5%
	2021: 53.6%	2021: 56.4%	2021: 62.2%
Water consumption norm	Similar as medium scenario	For apartment dwellers: 200 l/day/person in 2015 and 160 l/day/person in 2021; For users of kiosks and protected sources: 10-25 l/day/person in 2015 and 15-30 l/day/person in 2021	Similar as medium scenario
Municipal water use			
Utilities growth rate	0.70%	1.40%	4%
Services growth rate	4.50%	7.60%	14.50%
Industrial water use			
Manufacturing growth rate	4%	6.90%	12.60%
Heavy industries growth rate	4%	6.90%	12.60%
Construction growth rate	4%	6.90%	10%
Energy growth rate	2.50%	6%	10.20%
Existing mines/New mines	3% growth 50% lower than Ministry of Mineral Resources and Energy （MMRE） estimates	10.5% growth According MMRE estimates	23% growth 20% higher than MMRE estimates
Livestock water use			
Livestock numbers	5% lower than medium	Projection according	Projection according

[75] Capital city governor's office and approved by Government of Mongolia (2016), Ulaanbaatar 2020 Master Plan and Development Approaches for 2030 - Implementation Plan /Project 2016.03/

	scenario	MOFALI (35.6 million in 2021)	Davaadorj G. (2010)-52.6million in 2021
Consumption norm	Unchanged	Unchanged	Unchanged
Irrigation water use			
Irrigated area *	According trend 1998-2010, 63,000 ha in 2021: 2010-2015: 4.8% 2015-2021: 4.8%	Projection according MOFALI, 92,000 ha in 2021: 2010-2015: 9.8% 2015-2021: 7.4%	Projection according Davaadorj G. (2010) , 137,000 ha in 2021: 2010-2015: 15.5 % 2015-2021: 10%
Crop water requirement	Unchanged	Unchanged	Unchanged
Tourism water use			
Water demand growth	20% lower than medium scenario	2010-2015: 14.9% 2015-2021: 16.5%	20% higher than medium scenario
Green areas water use			
Water use	20% lower than medium scenario	2010-2015: 8% 2015-2021: 12%	20% higher than medium scenario

Source: Ministry of Environment, Green Development and Tourism (MEGDT), (2013), Integrated Water Management Plan of Mongolia

Estimates of water demand 2010-30 in Ulaanbaatar for low, medium and high-water demand scenarios by 2030WRG are shown in Table 3.5.11.

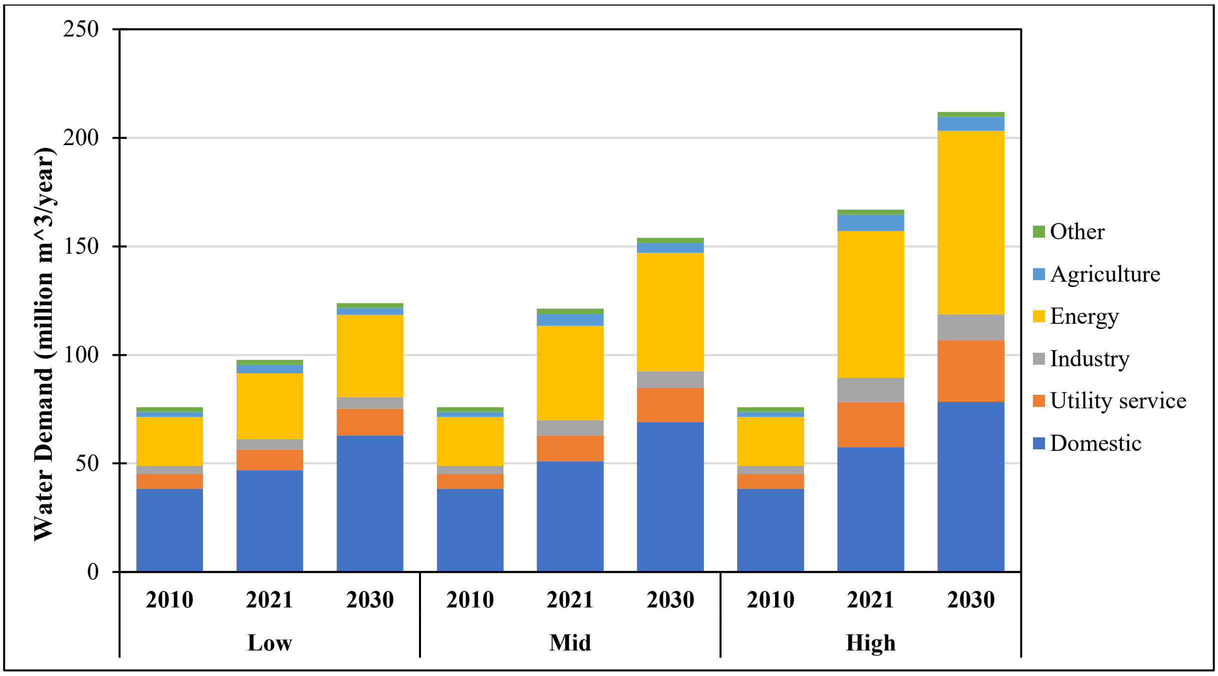
Table 3.5.11 Water Demand Estimates 2010-2030 for Low, Medium and High-Water Demand Scenarios by 2030WRG

(Unit: million m^3/year)

million m^3/year	Low			Mid			High		
Sector	2010	2021	2030	2010	2021	2030	2010	2021	2030
Domestic demand (urban)	***38.4***	***47.04***	***62.9***	***38.4***	***51.08***	***68.97***	***38.4***	***57.4***	***78.37***
Utility service (hospital, school, office and public service)	***6.83***	***9.33***	***12.37***	***6.83***	***11.81***	***15.85***	***6.83***	***20.91***	***28.3***
Industry subtotal	***3.68***	***4.95***	***5.34***	***3.68***	***7.09***	***7.72***	***3.68***	***11.08***	***12.07***
Light industry	2.99	4.02	4.34	2.99	5.75	6.27	2.99	8.99	9.8
Heavy industry	0.3	0.4	0.44	0.3	0.58	0.63	0.3	0.9	0.98
Construction and its material industry	0.39	0.53	0.57	0.39	0.76	0.83	0.39	1.18	1.29
Non-food industry subtotal	***2.63***	***3.59***	***3.62***	***2.63***	***5.41***	***5.59***	***2.63***	***8.76***	***9.13***
Energy	***22.5***	***30.25***	***37.98***	***22.5***	***43.31***	***54.4***	***22.5***	***67.68***	***84.49***
Agriculture sub-total	***2.32***	***3.95***	***2.99***	***2.32***	***5.72***	***4.71***	***2.32***	***7.56***	***6.5***
Livestock (pastoral and farming)	0.54	0.96		0.54	1.01		0.54	1.07	
Irrigated area	1.78	2.99	2.99	1.78	4.71	4.71	1.78	6.5	6.5
Other sub-total	***2.2***	***2.25***	***2.25***	***2.2***	***2.25***	***2.25***	***2.2***	***2.25***	***2.25***
Tourism	0.04	0.09	0.09	0.04	0.09	0.09	0.04	0.09	0.09
Green area	2.15	2.16	2.16	2.15	2.16	2.16	2.15	2.16	2.16
Total	**75.93**	**97.77**	**123.84**	**75.93**	**121.27**	**153.9**	**75.93**	**166.9**	**211.99**

Source: 2030 Water Resources Group, (2016), "Hydro-economic Analysis on Cost-Effective Solution to Close Ulaanbaatar's Future Water Gap, Mongolia, Ulaanbaatar,"

Figure 3.5.20 shows domestic water demand and energy water demand accounts for a large proportion.



Source: 2030 Water Resources Group, (2016), "Hydro-economic Analysis on Cost-Effective Solution to Close Ulaanbaatar's Future Water Gap, Mongolia, Ulaanbaatar,"

Figure 3.5.20 Water Demand Estimates 2010-2030 for Low, Medium and High-Water Demand Scenarios by 2030WRG

(3) Future water supply-demand gap in Ulaanbaatar

Estimated water supply-demand gap in Ulaanbaatar by 2030WRG is shown in Table 3.5.12.

Table 3.5.12 Water Supply-Demand Gap in Ulaanbaatar

Unit: million m³/year

		Year	2010	2015	2021	2025	2030
Surface water	Surface water resource (*)	P=50%	536.82	536.82	536.82	536.82	536.82
		P=90%	298.33	298.33	298.33	298.33	298.33
	Ecological resource (*)	P=50%	506.94	506.94	506.94	506.94	506.94
		P=90%	282.11	282.11	282.11	282.11	282.11
	Possible use of resource(*)	P=50%	29.88	29.88	29.88	29.88	29.88
		P=90%	16.22	16.22	16.22	16.22	16.22
Groundwater	Possible resource for use (*)		121.60	121.60	121.60	121.60	121.60
	Resource for use (*)		138.30	138.30	138.30	138.30	138.30
	Groundwater reserves (Resolution 2015/4) (#)		103.62	103.62	103.62	103.62	103.62
Water Availability	**Total water availability (incl. SW)**		**119.85**	**119.85**	**119.85**	**119.85**	**119.85**
Demand Scenario	High demand (~)		75.93	117.86	166.90	185.99	211.99
	Medium demand (~)		75.93	101.15	121.27	135.12	153.90
	Low demand (~)		75.93	90.86	97.77	108.48	123.84
Gap based on total water availability	Gap -high demand scenario		43.92	1.99	-47.05	-66.14	-92.14
	Gap -medium demand scenario		43.92	18.70	-1.42	-15.27	-34.05
	Gap -low demand scenario		43.92	28.99	22.08	11.37	-3.99
Gap based on	Gap -high demand scenario		27.69	-14.24	-63.28	-82.37	-108.37

groundwater only	Gap -medium demand scenario	27.69	2.47	-17.65	-31.50	-50.28
	Gap -low demand scenario	27.69	12.76	5.85	-4.86	-20.22

Source: 2030 Water Resources Group, (2016), "Hydro-economic Analysis on Cost-Effective Solution to Close Ulaanbaatar's Future Water Gap, Mongolia, Ulaanbaatar,"
(*) MEDGT (2012) Integrated water management assessment report: Underlying dataset (Conducted as part of the Strengthening Integrated Water Resource Management in Mongolia project)
(#) Water Reserve Committee Resolution No. 2015/4, approved by Munkh-Erdem, Head of Water reserve committee, MEGDT, date: 7 September 2015
(~) For water demand data between 2010 and 2021: MEGDT (2012) Integrated water management assessment report: Underlying dataset
For water demand data between 2021 and 2030, water demand growth estimates (per sector) were taken from JICA (2013) Strategic Planning of Water Supply and Sewerage Service in Ulaanbaatar and used to forecast future water demand based on MEGDT (2012) data.

As shown in Table 3.3.8, in the year 2030, estimated water demand of all scenarios does not meet water availability. Measures for increased water demand will be required.

3.5.7 Results of water balance analysis by Aimag and Soum for the NCDP

(1) Water demand estimation

The JPT has estimated the water demand in 2018, 2030 and 2040 by using the assumptions summarized in Table 3.5.13.

Table 3.5.13 Assumptions for Projecting Water Demand in 2018, 2030 and 2040

Year	2018	2030	2040
Drinking water use			
Population growth	Statistical data of 2018	Aimag:0.8%~3.4%/year [*1]	Aimag:0.8%~3.0%/year [*1]
		Average: 1.8%/year [*1]	Average: 1.6%/year [*1]
% urban population	67.40%	75.10% [*2]	81.00% [*2]
Water consumption norm	For apartment dwellers: 200 l/day/person in Ulaanbaatar, and 80 l/day/person in other urban area;	For apartment dwellers: 160 l/day/person in Ulaanbaatar [*3], and 150 l/day/person [*4] in other urban area;	Same as 2030
	For users of kiosks and protected sources: 20 l/day/person	For users of kiosks and protected sources: 30 l/day/person [*3]	
Municipal water use			
Utilities growth rate	-	1.40% [*3]	1.40% [*3]
Services growth rate	-	1.40% [*3]	1.40% [*3]
Industrial water use			
Manufacturing growth rate	-	4.80% [*5]	6.00% [*5]
Heavy industries growth rate	-	4.80% [*5]	6.00% [*5]
Construction growth rate	-	4.80% [*5]	6.00% [*5]
Energy growth rate	-	6.90% [*3]	6.90% [*3]
Existing mines & new mines	-	10.5% growth According MMRE estimates [*3]	Same as 2030

Livestock water use			
Livestock numbers	Statistical data of 2018	According trend of statistical data from 2000-2018 *6	According trend of statistical data from 2000-2018 *6
Consumption norm	8.80 l/head/day *7	8.80 l/head/day *7	8.80 l/head/day *7
Irrigation water use			
Irrigated area *	Statistical data of 2018	Projection according MOFALI	Projection according MOFALI
Crop water requirement	by CropWat[76]	Unchanged	Unchanged
Tourism water use			
Water demand growth	-	1.40% *8	9.38% *9
Green areas water use			
Water use growth	-	1.40% *8	9.38% *9

Note) *1: Based on socio-economic frame growth forecast by JICA Project Team.
Note) *2: Urban population refers to people living in urban areas as defined by NSO. The number of urban populations was forecasted from trends in the Urban population from 2005 to 2018, according to NSO, "Mongolian Statistical Yearbook 2018".
Note) *3: Based on Ministry of Environment, Green Development and Tourism (MEGDT), (2013), Integrated Water Management Plan of Mongolia.
Note) *4: Assumed based on Note) *3.
Note) *5: Based on "Production of major industrial commodities by Aimag" by NSO, Water Consumption Table by Ulaanbaatar City 2015 (Land organized construction and integrated water policy regulation), Integrated Water Management National Assessment Report Volume II Ulaanbaatar 2012, and Ulaanbaatar Hydro-economic Analysis on Cost-Effective Solutions to Close Ulaanbaatar's Future Water Gap, August 2016.
Note) *6: Forecast from trends from 2000 to 2018, according to NSO, "Mongolian Statistical Yearbook 2018".
Note) *7: Average of water consumption norm of "Use of the Water Basin Management Plan", MEGDT, (2015).
Note) *8: Assumed as "utility growth rate" based on Ministry of Environment, Green Development and Tourism (MEGDT), (2013), Integrated Water Management Plan of Mongolia.
Note) *9: Average of utility, service, tourism and green area water use growth rate" based on Ministry of Environment, Green Development and Tourism (MEGDT), (2013), Integrated Water Management Plan of Mongolia.
Source: JICA Project Team (2019)

Estimated water demand in 2018, 2020 and 2040 by Aimag are shown in Tables 3.5.14 through 3.5.23.

[76] CropWat is computer program for the calculation of crop water requirements and irrigation requirements based on soil, climate and crop data developed by FAO

Table 3.5.14 Domestic Water Demand in Mongolia in 2018, 2030 and 2040

Assumed Unit Water Consumption at UB (l/day/person)=											200			160			160		
Assumed Unit Water Consumption (l/day/person)=											80	20		150	30		150	30	
Region/Aimag	**Growth Rate (%/year)**		**Population (x1000)**									**Domestic Water Demand (million m^3/year)**							
	2018-30	**2030-40**	**2018**			**2030**			**2040**			**2018**			**2030**			**2040**	
	Estimated	**Estimated**	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**
Mongolia	**1.8**	**1.6**	**2,147.6**	**1,038.7**	**3,186.3**	**2,980.3**	**987.3**	**3,967.6**	**3,758.0**	**879.6**	**4,637.6**	**62.7**	**7.6**	**70.3**	**163.2**	**10.8**	**174.0**	**205.8**	**9.6**	**215.4**
Western Region	*2.2*	*1.9*	*135.2*	*272.0*	*407.2*	*194.6*	*331.5*	*526.1*	*255.4*	*380.9*	*636.3*	*3.9*	*2.0*	*5.9*	*10.7*	*3.6*	*14.3*	*14.0*	*4.2*	*18.2*
Bayan-Ulgii	2.7	2.4	38.6	65.2	103.8	62.2	81.4	143.6	88.9	93.8	182.7	1.1	0.5	1.6	3.4	0.9	4.3	4.9	1.0	5.9
Gove-Altai	1.5	1.1	19.3	39.0	58.3	23.2	46.6	69.8	26.3	51.6	77.9	0.6	0.3	0.8	1.3	0.5	1.8	1.4	0.6	2.0
Zavkhan	1.4	1.2	16.7	56.4	73.1	21.7	64.4	86.1	26.6	70.8	97.4	0.5	0.4	0.9	1.2	0.7	1.9	1.5	0.8	2.2
Uvs	1.6	1.5	30.3	53.3	83.6	45.8	55.8	101.6	60.9	57.4	118.3	0.9	0.4	1.3	2.5	0.6	3.1	3.3	0.6	4.0
Khovd	2.9	2.5	30.3	58.1	88.4	41.7	83.3	125.0	52.5	107.5	160.0	0.9	0.4	1.3	2.3	0.9	3.2	2.9	1.2	4.1
Khangai Region	*2.0*	*1.6*	*242.0*	*358.4*	*600.4*	*348.3*	*417.1*	*765.4*	*444.9*	*448.7*	*893.6*	*7.1*	*2.6*	*9.7*	*19.1*	*4.6*	*23.6*	*24.4*	*4.9*	*29.3*
Arkhangai	1.9	1.5	21.2	74.8	96.0	31.1	89.1	120.2	39.6	100.0	139.6	0.6	0.5	1.2	1.7	1.0	2.7	2.2	1.1	3.3
Bayankhongor	2.4	1.9	30.6	57.8	88.4	49.0	68.4	117.4	66.3	75.1	141.4	0.9	0.4	1.3	2.7	0.7	3.4	3.6	0.8	4.5
Bulgan	1.5	1.0	15.7	46.1	61.8	15.3	58.5	73.8	15.3	66.3	81.6	0.5	0.3	0.8	0.8	0.6	1.5	0.8	0.7	1.6
Orkhon	1.7	1.3	99.5	3.7	103.2	127.5	-0.5	127.0	149.9	-5.2	144.7	2.9	0.0	2.9	7.0	0.0	7.0	8.2	-0.1	8.2
Uvurkhangai	2.1	1.6	32.3	84.3	116.6	48.7	101.7	150.4	65.7	111.0	176.7	0.9	0.6	1.6	2.7	1.1	3.8	3.6	1.2	4.8
Khusvgul	2.3	1.7	42.7	91.7	134.4	57.6	119.0	176.6	69.3	140.3	209.6	1.2	0.7	1.9	3.2	1.3	4.5	3.8	1.5	5.3
Central Region	*1.4*	*1.3*	*232.7*	*278.7*	*511.4*	*309.1*	*295.5*	*604.6*	*373.9*	*312.9*	*686.8*	*6.8*	*2.0*	*8.8*	*16.9*	*3.2*	*20.2*	*20.5*	*3.4*	*23.9*
Goveisumber	3.4	3.0	10.4	7.1	17.5	12.0	14.2	26.2	14.1	21.1	35.2	0.3	0.1	0.4	0.7	0.2	0.8	0.8	0.2	1.0
Darkhan-Uul	1.6	1.2	84.7	19.5	104.2	102.6	23.2	125.8	115.8	26.6	142.4	2.5	0.1	2.6	5.6	0.3	5.9	6.3	0.3	6.6
Dornogovi	1.3	1.6	44.2	25.4	69.6	58.2	23.5	81.7	74.0	21.5	95.5	1.3	0.2	1.5	3.2	0.3	3.4	4.0	0.2	4.3
Dundgovi	1.8	1.2	12.4	34.4	46.8	14.4	43.9	58.3	15.3	50.6	65.9	0.4	0.3	0.6	0.8	0.5	1.3	0.8	0.6	1.4
Umnugovi	1.5	1.8	26.0	43.1	69.1	37.7	44.8	82.5	50.6	47.7	98.3	0.8	0.3	1.1	2.1	0.5	2.6	2.8	0.5	3.3
Selenge	1.1	0.8	37.9	71.3	109.2	64.0	61.0	125.0	79.8	56.1	135.9	1.1	0.5	1.6	3.5	0.7	4.2	4.4	0.6	5.0
Tuv	0.8	0.8	17.3	77.7	95.0	17.4	87.7	105.1	17.5	96.1	113.6	0.5	0.6	1.1	1.0	1.0	1.9	1.0	1.1	2.0
Eastern Region	*1.7*	*1.6*	*92.6*	*130.0*	*222.6*	*115.5*	*156.2*	*271.7*	*137.5*	*180.7*	*318.2*	*2.7*	*0.9*	*3.7*	*6.3*	*1.7*	*8.0*	*7.5*	*2.0*	*9.5*
Dornod	1.4	1.3	46.7	35.6	82.3	57.6	39.2	96.8	68.4	42.0	110.4	1.4	0.3	1.6	3.2	0.4	3.6	3.7	0.5	4.2
Sukhbaatar	2.1	1.9	18.3	44.3	62.6	31.1	49.4	80.5	44.6	52.8	97.4	0.5	0.3	0.9	1.7	0.5	2.2	2.4	0.6	3.0
Khenti	1.6	1.6	27.6	50.1	77.7	26.2	68.2	94.4	23.9	86.5	110.4	0.8	0.4	1.2	1.4	0.7	2.2	1.3	0.9	2.3
Ulaanbaatar	*1.8*	*1.6*	*1,444.7*	*0.0*	*1,444.7*	*1,798.9*	*0.0*	*1,798.9*	*2,102.7*	*0.0*	*2,102.7*	*105.5*	*0.0*	*105.5*	*105.1*	*0.0*	*105.1*	*122.8*	*0.0*	*122.8*

Source: JICA Project Team

Table 3.5.15 Proportion of Urban and Rural Population in Resident Population of Mongolia, by Region, Aimag and the Capital

Unit: %

Aimags and the capital	2006		2016		2017		2018		*2030*		*2040*	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Total	60.9	39.1	67.8	32.2	67.2	32.8	67.4	32.6	75.1	24.9	81.0	19.0
Western region	29.2	70.8	32.7	67.3	32.8	67.2	33.2	66.8	37.0	63.0	40.1	59.9
Bayan-Ulgii	30.4	69.6	35.8	64.2	36.1	63.9	37.2	62.8	43.3	56.7	48.6	51.4
Govi-Altai	31.9	68.1	31.9	68.1	32.5	67.5	33.1	66.9	33.2	66.8	33.8	66.2
Zavkhan	20.3	79.7	22.2	77.8	22.6	77.4	22.8	77.2	25.3	74.7	27.3	72.7
Uvs	28.6	71.4	37.7	62.3	36.4	63.6	36.2	63.8	45.0	55.0	51.5	48.5
Khovd	34.6	65.4	33.7	66.3	34.1	65.9	34.3	65.7	33.4	66.6	32.8	67.2
Khangai region	35.2	64.8	40.1	59.9	39.5	60.5	40.3	59.7	45.5	54.5	49.8	50.2
Arkhangai	19.8	80.2	23	77	22.8	77.2	22.1	77.9	25.9	74.1	28.4	71.6
Bayankhongor	29.5	70.5	35.5	64.5	35.5	64.5	34.6	65.4	41.8	58.2	46.9	53.1
Bulgan	25.4	74.6	24.3	75.7	19.8	80.2	25.4	74.6	20.7	79.3	18.8	81.2
Orkhon	92.6	7.4	96.2	3.8	96.2	3.8	96.4	3.6	100.4	-0.4	103.6	-3.6
Uvurkhangai	21.2	78.8	24.9	75.1	25.4	74.6	27.7	72.3	32.3	67.7	37.2	62.8
Khuvsgul	31.6	68.4	32.1	67.9	32.2	67.8	31.8	68.2	32.6	67.4	33.0	67.0
Central region	43.1	53.9	49.9	50.1	45.5	54.5	45.5	54.5	51.1	48.9	54.4	45.6
Govisumber	61.3	38.7	59.9	40.1	40.9	59.1	59.7	40.3	45.9	54.1	40.0	60.0
Darkhan-Uul	82.1	17.9	82.4	17.6	82.3	17.7	81.3	18.7	81.6	18.4	81.3	18.7
Dornogovi	57.2	42.8	62.4	37.6	63.1	36.9	63.5	36.5	71.2	28.8	77.5	22.5
Dundgovi	28	72	26.1	73.9	26.6	73.4	26.6	73.4	24.6	75.4	23.2	76.8
Umnugovi	30.3	69.7	39.1	60.9	38.2	61.8	37.6	62.4	45.7	54.3	51.5	48.5
Selenge	33.2	66.8	54.2	45.8	37.2	62.8	34.7	65.3	51.2	48.8	58.7	41.3
Tuv	19.2	80.8	18.3	81.7	17.9	82.1	18.2	81.8	16.6	83.4	15.4	84.6
Eastern region	41.1	29.7	41.1	58.9	41.9	58.1	41.6	58.4	42.5	57.5	43.2	56.8
Dornod	53.7	46.3	56	44	56.4	43.6	56.8	43.2	59.5	40.5	61.9	38.1
Sukhbaatar	22	78	29	71	30.2	69.8	29.2	70.8	38.7	61.3	45.8	54.2
Khentii	43	57	35.2	64.8	36.1	63.9	35.5	64.5	27.7	72.3	21.7	78.3
Ulaanbaatar	100	-	100	-	100	-	100	0	100.0	0.0	100.0	0.0

Source: NSO, (2018), "Mongolian Statistical Yearbook"

Table 3.5.16 Industry Water Demand in 2018, 2030 and 2040

Unit: million m^3/year

Aimag	Industry Water Demand (million m^3/year)					
	2018	*(%)*	2030	*(%)*	2040	*(%)*
Mongolia	**12.386**	***100.0***	**19.493**	***100.0***	**28.680**	***100.0***
Western Region	0.272	*2.2*	0.642	*3.3*	0.997	*3.5*
Bayan-Ulgii	0.014	*0.1*	0.091	*0.5*	0.141	*0.5*
Gove-Altai	0.067	*0.5*	0.143	*0.7*	0.223	*0.8*
Zavkhan	0.071	*0.6*	0.152	*0.8*	0.236	*0.8*
Uvs	0.077	*0.6*	0.165	*0.8*	0.256	*0.9*
Khovd	0.043	*0.3*	0.091	*0.5*	0.141	*0.5*
Khangai Region	0.607	*4.9*	1.292	*6.6*	2.008	*7.0*
Arkhangai	0.002	*0.0*	0.004	*0.0*	0.007	*0.0*
Bayankhongor	0.002	*0.0*	0.004	*0.0*	0.007	*0.0*
Bulgan	0.013	*0.1*	0.028	*0.1*	0.043	*0.1*
Orkhon	0.349	*2.8*	0.742	*3.8*	1.152	*4.0*
Uvurkhangai	0.160	*1.3*	0.341	*1.7*	0.530	*1.8*
Khuvsgul	0.081	*0.7*	0.173	*0.9*	0.269	*0.9*
Central Region	2.956	*23.9*	6.294	*32.3*	9.775	*34.1*
Govisumber	0.000	*0.0*	0.001	*0.0*	0.002	*0.0*
Darkhan-Uul	0.355	*2.9*	0.757	*3.9*	1.175	*4.1*
Dornogovi	1.534	*12.4*	3.265	*16.7*	5.071	*17.7*
Dundgovi	0.002	*0.0*	0.004	*0.0*	0.006	*0.0*
Umnugovi	0.001	*0.0*	0.002	*0.0*	0.003	*0.0*

Selenge	1.033	*8.3*	2.198	*11.3*	3.414	*11.9*
Tuv	0.031	*0.3*	0.067	*0.3*	0.104	*0.4*
Eastern Region	0.033	*0.3*	0.070	*0.4*	0.109	*0.4*
Dornod	0.024	*0.2*	0.051	*0.3*	0.080	*0.3*
Sukhbaatar	0.007	*0.1*	0.014	*0.1*	0.022	*0.1*
Khentii	0.002	*0.0*	0.005	*0.0*	0.007	*0.0*
Ulaanbaatar	8.518	*68.8*	11.195	*57.4*	15.791	*55.1*
Total	**12.386**		**19.493**		**28.680**	

Sources: JICA Project Team based on "Production of major industrial commodities by aimag" by NSO, Water Consumption Table by Ulaanbaatar City 2015 (Land organized construction and integrated water policy regulation), Integrated Water Management National Assessment Report Volume II Ulaanbaatar 2012, and Ulaanbaatar Hydro-economic Analysis on Cost-Effective Solutions to Close Ulaanbaatar's Future Water Gap, August 2016.

Table 3.5.17 Other Industry, Utility, Tourism and Green Area, Energy and Mining Water Demand

Unit: million m^3/year

Aimag	2018			2030			2040		
	Utility service & tourism & green area	Other Industry, energy, construction, road and transport	Mining (mine and processing)	Utility service & tourism & green area	Other Industry, energy, construction, road and transport	Mining (mine and processing)	Utility service & tourism & green area	Other Industry, energy, construction, road and transport	Mining (mine and processing)
Mongolia	17.80	48.26	61.81	21.04	96.35	146.18	56.18	130.70	211.08
Western Region	1.37	1.65	0.36	1.62	3.02	0.85	4.32	4.01	1.23
Bayan-Ulgii	0.58	0.51	0.25	0.69	0.90	0.59	1.83	1.20	0.85
Gove-Altai	0.10	0.11	0.00	0.12	0.20	0.00	0.32	0.24	0.00
Zavkhan	0.32	0.76	0.07	0.38	1.42	0.17	1.01	1.91	0.24
Uvs	0.34	0.27	0.04	0.40	0.50	0.09	1.07	0.65	0.14
Khovd	0.03	0.00	0.00	0.04	0.00	0.00	0.09	0.00	0.00
Khangai Region	2.27	4.85	17.92	2.68	9.18	42.38	7.16	12.48	61.20
Arkhangai	0.94	3.90	16.37	1.11	7.39	38.72	2.97	10.08	55.90
Bayankhongor	0.34	0.34	1.44	0.40	0.64	3.41	1.07	0.87	4.92
Bulgan	0.18	0.17	0.03	0.21	0.31	0.07	0.57	0.42	0.10
Orkhon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uvurkhangai	0.10	0.00	0.00	0.12	0.00	0.00	0.32	0.00	0.00
Khuvsgul	0.71	0.45	0.08	0.84	0.83	0.19	2.24	1.10	0.27
Central Region	1.65	9.54	26.67	1.95	18.08	63.07	5.21	24.64	91.08
Govisumber	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Darkhan-Uul	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dornogovi	0.21	0.00	18.43	0.25	0.00	43.59	0.66	0.00	62.94
Dundgovi	0.53	1.38	1.95	0.63	2.61	4.61	1.67	3.56	6.66
Umnugovi	0.43	1.49	2.69	0.51	2.82	6.36	1.36	3.85	9.19
Selenge	0.00	0.00	0.98	0.00	0.00	2.32	0.00	0.00	3.35
Tuv	0.48	6.67	2.62	0.57	12.64	6.20	1.52	17.23	8.95
Eastern Region	0.69	5.15	13.56	0.82	9.77	32.07	2.18	13.31	46.31
Dornod	0.06	0.52	7.93	0.07	0.97	18.75	0.19	1.32	27.08
Sukhbaatar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Khentii	0.63	4.64	5.63	0.74	8.80	13.31	1.99	12.00	19.23
Ulaanbaatar	11.82	27.06	3.30	13.97	56.30	7.80	37.31	76.25	11.27

Source: JICA Project Team

Table 3.5.18 Irrigation Water Requirement by Aimag in 2018, 2030 and 2040

Aimag	Irrigation Water Requirement (million m^3/year)		
	2018	2030	2040
Mongolia	370.55	614.33	845.52
Western Region	20.99	34.48	47.70
Bayan-Ulgii	2.31	3.98	5.31
Gove-Altai	1.51	2.40	3.43
Zavkhan	1.82	2.98	4.21
Uvs	12.60	19.48	26.66

Khovd	2.75	5.64	8.09
Khangai Region	52.49	84.49	115.61
Arkhangai	5.39	8.89	12.11
Bayankhongor	0.57	1.09	1.53
Bulgan	25.09	39.74	54.12
Orkhon	2.33	3.73	5.08
Uvurkhangai	7.60	12.80	17.93
Khuvsgul	11.52	18.24	24.85
Central Region	242.16	401.72	550.74
Govisumber	0.05	0.11	0.15
Darkhan-Uul	14.92	27.84	38.38
Dornogovi	0.18	0.43	0.62
Dundgovi	0.08	0.21	0.35
Umnugovi	0.46	1.07	1.59
Selenge	143.58	237.45	325.60
Tuv	82.89	134.62	184.05
Eastern Region	54.10	91.74	128.64
Dornod	25.58	44.25	62.75
Sukhbaatar	7.11	11.77	16.41
Khentii	21.41	35.73	49.48
Ulaanbaatar	0.81	1.90	2.83

Source: JICA Project Team

Table 3.5.19 Livestock Water Demand by Aimag in 2018, 2030 and 2040

				8.8	little/day/head	
Aimags and the Capital	**Nos. Livestock (x 1000 heads)**			**W. Demand (million m^3/year)**		
	2018	***2030***	***2040***	***2018***	***2030***	***2040***
TOTAL Mongolia	***66,460***	***96,084***	***120,985***	***213.5***	***308.6***	***388.6***
Western region	*15,557*	*22,180*	*27,269*	*50.0*	*71.2*	*87.6*
Bayan-Ulgii	2,167	2,922	3,508	7.0	9.4	11.3
Govi-Altai	3,513	5,263	6,589	11.3	16.9	21.2
Zavkhan	3,555	5,062	6,247	11.4	16.3	20.1
Uvs	3,175	4,247	5,155	10.2	13.6	16.6
Khovd	3,146	4,685	5,769	10.1	15.0	18.5
Khangai region	*24,323*	*36,274*	*46,126*	*78.1*	*116.5*	*148.2*
Arkhangai	5,482	8,012	10,207	17.6	25.7	32.8
Bayankhongor	4,250	6,620	8,481	13.6	21.3	27.2
Bulgan	3,306	5,011	6,335	10.6	16.1	20.3
Orkhon	114	99	80	0.4	0.3	0.3
Uvurkhangai	5,461	8,384	10,697	17.5	26.9	34.4
Khuvsgul	5,710	8,149	10,325	18.3	26.2	33.2
Central region	*15,429*	*22,168*	*27,988*	*49.6*	*71.2*	*89.9*
Govisumber	428	692	905	1.4	2.2	2.9
Darkhan-Uul	306	431	531	1.0	1.4	1.7
Dornogovi	2,148	2,831	3,536	6.9	9.1	11.4
Dundgovi	3,826	5,230	6,569	12.3	16.8	21.1
Umnugovi	2,598	3,629	4,544	8.3	11.7	14.6
Selenge	1,540	2,294	2,897	4.9	7.4	9.3
Tuv	4,582	7,060	9,006	14.7	22.7	28.9
Eastern region	*10,740*	*14,876*	*18,892*	*34.5*	*47.8*	*60.7*
Dornod	2,378	3,100	3,914	7.6	10.0	12.6

Sukhbaatar	3,717	5,035	6,320	11.9	16.2	20.3
Khentii	4,645	6,741	8,658	14.9	21.7	27.8
Ulaanbaatar	*412*	*585*	*711*	*1.3*	*1.9*	*2.3*

Source: JICA Project Team

Table 3.5.20 Estimated Total Water Demand by Aimag in 2018

Aimag	Water Demand in 2018 (million m^3/year)							
	Drinking and domestic water for population	Utility service & tourism & green area	Industry	Other Industry, energy, construction, road and transport	Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Grand total
Mongolia	70.30	17.80	12.39	48.26	61.81	213.50	370.55	794.6
Western Region	5.90	1.37	0.27	1.65	0.36	50.00	20.99	80.5
Bayan-Ulgii	1.60	0.58	0.01	0.51	0.25	7.00	2.31	12.3
Gove-Altai	0.80	0.10	0.07	0.11	0.00	11.30	1.51	13.9
Zavkhan	0.90	0.32	0.07	0.76	0.07	11.40	1.82	15.3
Uvs	1.30	0.34	0.08	0.27	0.04	10.20	12.60	24.8
Khovd	1.30	0.03	0.04	0.00	0.00	10.10	2.75	14.2
Khangai Region	9.70	2.27	0.61	4.85	17.92	78.10	52.49	165.9
Arkhangai	1.20	0.94	0.00	3.90	16.37	17.60	5.39	45.4
Bayankhongor	1.30	0.34	0.00	0.34	1.44	13.60	0.57	17.6
Bulgan	0.80	0.18	0.01	0.17	0.03	10.60	25.09	36.9
Orkhon	2.90	0.00	0.35	0.00	0.00	0.40	2.33	6.0
Uvurkhangai	1.60	0.10	0.16	0.00	0.00	17.50	7.60	27.0
Khuvsgul	1.90	0.71	0.08	0.45	0.08	18.30	11.52	33.0
Central Region	8.80	1.65	2.96	9.54	26.67	49.60	242.16	341.4
Govisumber	0.40	0.00	0.00	0.00	0.00	1.40	0.05	1.9
Darkhan-Uul	2.60	0.00	0.36	0.00	0.00	1.00	14.92	18.9
Dornogovi	1.50	0.21	1.53	0.00	18.43	6.90	0.18	28.8
Dundgovi	0.60	0.53	0.00	1.38	1.95	12.30	0.08	16.8
Umnugovi	1.10	0.43	0.00	1.49	2.69	8.30	0.46	14.5
Selenge	1.60	0.00	1.03	0.00	0.98	4.90	143.58	152.1
Tuv	1.10	0.48	0.03	6.67	2.62	14.70	82.89	108.5
Eastern Region	3.70	0.69	0.03	5.15	13.56	34.50	54.10	111.7
Dornod	1.60	0.06	0.02	0.52	7.93	7.60	25.58	43.3
Sukhbaatar	0.90	0.00	0.01	0.00	0.00	11.90	7.11	19.9
Khentii	1.20	0.63	0.00	4.64	5.63	14.90	21.41	48.4
Ulaanbaatar	105.50	11.82	8.52	27.06	3.30	1.30	0.81	158.3

Source: JICA Project Team

Table 3.5.21 Estimated Total Water Demand by Aimag in 2030

Aimag	Water Demand in 2030 (million m^3/year)							
	Drinking and domestic water for population	Utility service & tourism & green area	Industry	Other Industry, energy, construction, road and transport	Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Grand total
Mongolia	174.00	21.04	19.49	96.35	146.18	308.60	614.33	1,380.0
Western Region	14.30	1.62	0.64	3.02	0.85	71.20	34.48	126.1
Bayan-Ulgii	4.30	0.69	0.09	0.90	0.59	9.40	3.98	19.9
Gove-Altai	1.80	0.12	0.14	0.20	0.00	16.90	2.40	21.6
Zavkhan	1.90	0.38	0.15	1.42	0.17	16.30	2.98	23.3
Uvs	3.10	0.40	0.17	0.50	0.09	13.60	19.48	37.3
Khovd	3.20	0.04	0.09	0.00	0.00	15.00	5.64	24.0
Khangai Region	23.60	2.68	1.29	9.18	42.38	116.50	84.49	280.1
Arkhangai	2.70	1.11	0.00	7.39	38.72	25.70	8.89	84.5
Bayankhongor	3.40	0.40	0.00	0.64	3.41	21.30	1.09	30.2
Bulgan	1.50	0.21	0.03	0.31	0.07	16.10	39.74	58.0
Orkhon	7.00	0.00	0.74	0.00	0.00	0.30	3.73	11.8
Uvurkhangai	3.80	0.12	0.34	0.00	0.00	26.90	12.80	44.0
Khuvsgul	4.50	0.84	0.17	0.83	0.19	26.20	18.24	51.0
Central Region	20.20	1.95	6.29	18.08	63.07	71.20	401.72	582.5
Govisumber	0.80	0.00	0.00	0.00	0.00	2.20	0.11	3.1
Darkhan-Uul	5.90	0.00	0.76	0.00	0.00	1.40	27.84	35.9
Dornogovi	3.40	0.25	3.27	0.00	43.59	9.10	0.43	60.0
Dundgovi	1.30	0.63	0.00	2.61	4.61	16.80	0.21	26.2
Umnugovi	2.60	0.51	0.00	2.82	6.36	11.70	1.07	25.1
Selenge	4.20	0.00	2.20	0.00	2.32	7.40	237.45	253.6
Tuv	1.90	0.57	0.07	12.64	6.20	22.70	134.62	178.7
Eastern Region	8.00	0.82	0.07	9.77	32.07	47.80	91.74	190.3
Dornod	3.60	0.07	0.05	0.97	18.75	10.00	44.25	77.7
Sukhbaatar	2.20	0.00	0.01	0.00	0.00	16.20	11.77	30.2
Khentii	2.20	0.74	0.01	8.80	13.31	21.70	35.73	82.5
Ulaanbaatar	105.10	13.97	11.20	56.30	7.80	1.90	1.90	198.2

Source: JICA Project Team

Table 3.5.22 Estimated Total Water Demand by Aimag in 2040

Aimag	Water Demand in 2040 (million m³/year)							
	Drinking and domestic water for population	Utility service & tourism & green area	Industry	Other industry, energy, construction, road and transport	Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Grand total
Mongolia	201.80	56.18	28.68	130.70	211.08	388.70	845.52	1,862.7
Western Region	18.20	4.32	1.00	4.01	1.23	87.60	47.70	164.1
Bayan-Ulgii	5.90	1.83	0.14	1.20	0.85	11.30	5.31	26.5
Gove-Altai	2.00	0.32	0.22	0.24	0.00	21.20	3.43	27.4
Zavkhan	2.20	1.01	0.24	1.91	0.24	20.10	4.21	29.9
Uvs	4.00	1.07	0.26	0.65	0.14	16.60	26.66	49.4
Khovd	4.10	0.09	0.14	0.00	0.00	18.50	8.09	30.9
Khangai Region	27.70	7.16	2.01	12.48	61.20	148.20	115.61	374.4
Arkhangai	3.30	2.97	0.01	10.08	55.90	32.80	12.11	117.2
Bayankhongor	4.50	1.07	0.01	0.87	4.92	27.20	1.53	40.1
Bulgan	1.60	0.57	0.04	0.42	0.10	20.30	54.12	77.2
Orkhon	8.20	0.00	1.15	0.00	0.00	0.30	5.08	14.7
Uvurkhangai	4.80	0.32	0.53	0.00	0.00	34.40	17.93	58.0
Khuvsgul	5.30	2.24	0.27	1.10	0.27	33.20	24.85	67.2
Central Region	23.60	5.21	9.78	24.64	91.08	89.90	550.74	794.9
Govisumber	1.00	0.00	0.00	0.00	0.00	2.90	0.15	4.1
Darkhan-Uul	6.60	0.00	1.18	0.00	0.00	1.70	38.38	47.9
Dornogovi	4.30	0.66	5.07	0.00	62.94	11.40	0.62	85.0
Dundgovi	1.40	1.67	0.01	3.56	6.66	21.10	0.35	34.8
Umnugovi	3.30	1.36	0.00	3.85	9.19	14.60	1.59	33.9
Selenge	5.00	0.00	3.41	0.00	3.35	9.30	325.60	346.7
Tuv	2.00	1.52	0.10	17.23	8.95	28.90	184.05	242.7
Eastern Region	9.50	2.18	0.11	13.31	46.31	60.70	128.64	260.8
Dornod	4.20	0.19	0.08	1.32	27.08	12.60	62.75	108.2
Sukhbaatar	3.00	0.00	0.02	0.00	0.00	20.30	16.41	39.7
Khentii	2.30	1.99	0.01	12.00	19.23	27.80	49.48	112.8
Ulaanbaatar	122.80	37.31	15.79	76.25	11.27	2.30	2.83	268.5

Source: JICA Project Team

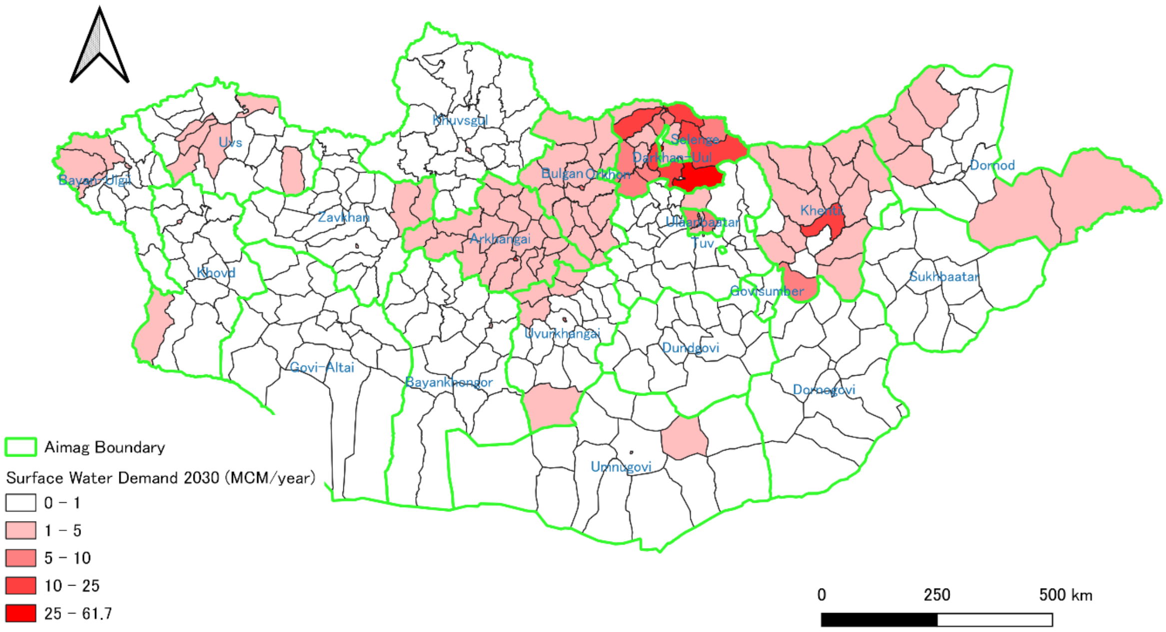
Table 3.5.23 Ratio of Surface Water and Groundwater by Sector

Aimag	Ratio of Surface Water and Groundwater													
	Drinking and domestic water for population		Utility service & tourism & green area		Industry		Other Industry, energy, construction, road and transport		Mining (mine and processing)		Livestock (pastoral and farming)		Irrigated area	
	SF	GW	SF	GW	SF	GW	SF	GW	SF	GW	SF	GW	SF	GW
Mongolia														
Western Region														
Bayan-Ulgii	50%	50%	50%	50%	50%	50%	0%	100%	50%	50%	60%	40%	100%	0%
Gove-Altai	33%	67%	0%	100%	0%	100%	0%	100%	100%	0%	0%	100%	100%	0%
Zavkhan	39%	61%	50%	50%	50%	50%	50%	50%	100%	0%	60%	40%	100%	0%
Uvs	10%	90%	35%	65%	35%	65%	0%	100%	0%	100%	50%	50%	100%	0%
Khovd	35%	65%	0%	100%	0%	100%	0%	100%	50%	50%	20%	80%	100%	0%
Khangai Region														
Arkhangai	42%	58%	50%	50%	50%	50%	50%	50%	100%	0%	60%	40%	50%	50%
Bayankhongor	7%	93%	0%	100%	0%	100%	0%	100%	50%	50%	35%	65%	100%	0%
Bulgan	25%	75%	50%	50%	50%	50%	50%	50%	100%	0%	45%	55%	50%	50%
Orkhon	3%	97%	0%	100%	0%	100%	0%	100%	5%	95%	50%	50%	100%	0%
Uvurkhangai	42%	58%	0%	100%	0%	100%	0%	100%	50%	50%	35%	65%	80%	20%
Khuvsgul	37%	63%	50%	50%	50%	50%	50%	50%	100%	0%	40%	60%	0%	100%

Central Region														
Govisumber	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%
Darkhan-Uul	25%	75%	50%	50%	50%	50%	50%	50%	0%	100%	55%	45%	100%	0%
Dornogovi	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%
Dundgovi	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%
Umnugovi	5%	95%	0%	100%	0%	100%	0%	100%	50%	50%	35%	65%	80%	20%
Selenge	25%	75%	50%	50%	50%	50%	50%	50%	0%	100%	55%	45%	100%	0%
Tuv	0%	100%	0%	100%	0%	100%	50%	50%	0%	100%	33%	67%	0%	100%
Eastern Region														
Dornod	30%	70%	50%	50%	50%	50%	50%	50%	0%	100%	50%	50%	50%	50%
Sukhbaatar	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%
Khentii	40%	60%	50%	50%	50%	50%	50%	50%	0%	100%	55%	45%	50%	50%
Ulaanbaatar	0%	100%	0%	100%	0%	100%	50%	50%	0%	100%	33%	67%	0%	100%

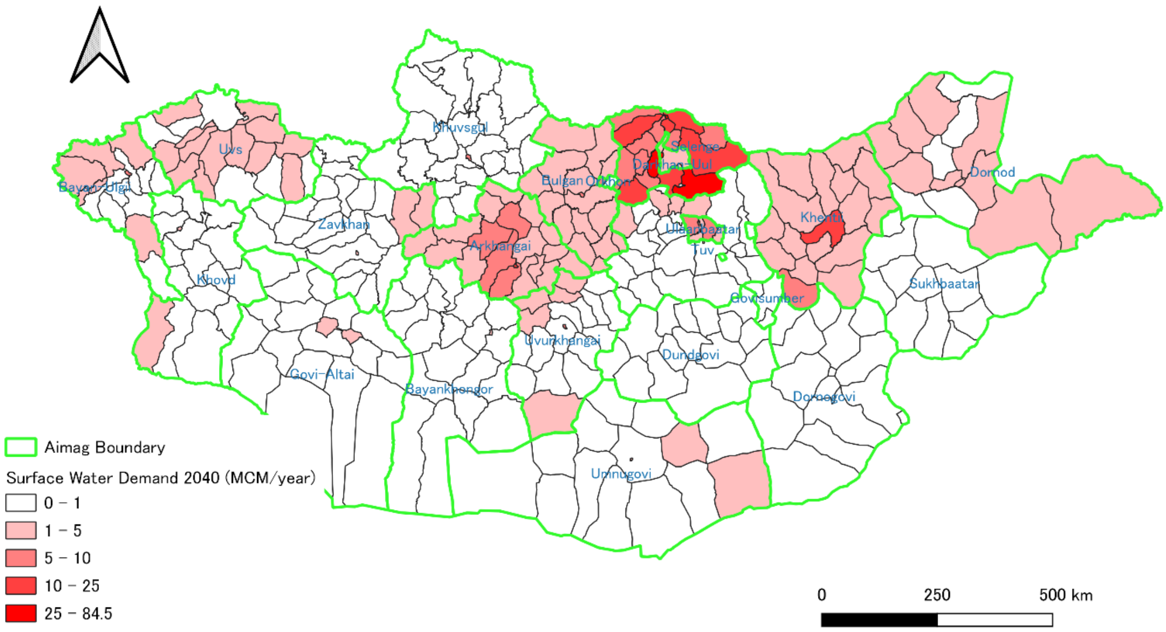
Source: MEGD, (2013), IWMP

The water demand for each Soum was calculated by using the water demand of each Aimag and the total population (2015) of Aimags and the population ratio of each Soum. The area and population in 2015 of each Soum are shown in Table 3.3.24 and estimated water demand of each Soum is shown Table 3.5.25 for 2030 and Table 3.5.26 for 2040. The maps of surface water demand by Soum is shown in Figure 3.5.21 for 2030 and Figure 3.5.22 for 2040, and groundwater demand by Soum is shown in Figure 3.5.23 for 2030 and Figure 3.5.24 for 2040. Details of estimated water demand by Soum are shown in Figure 3.5.25 and Figure 3.5.26. Groundwater demand is high in Ulaanbaatar, and surface water demand is high in Selenge Aimag.



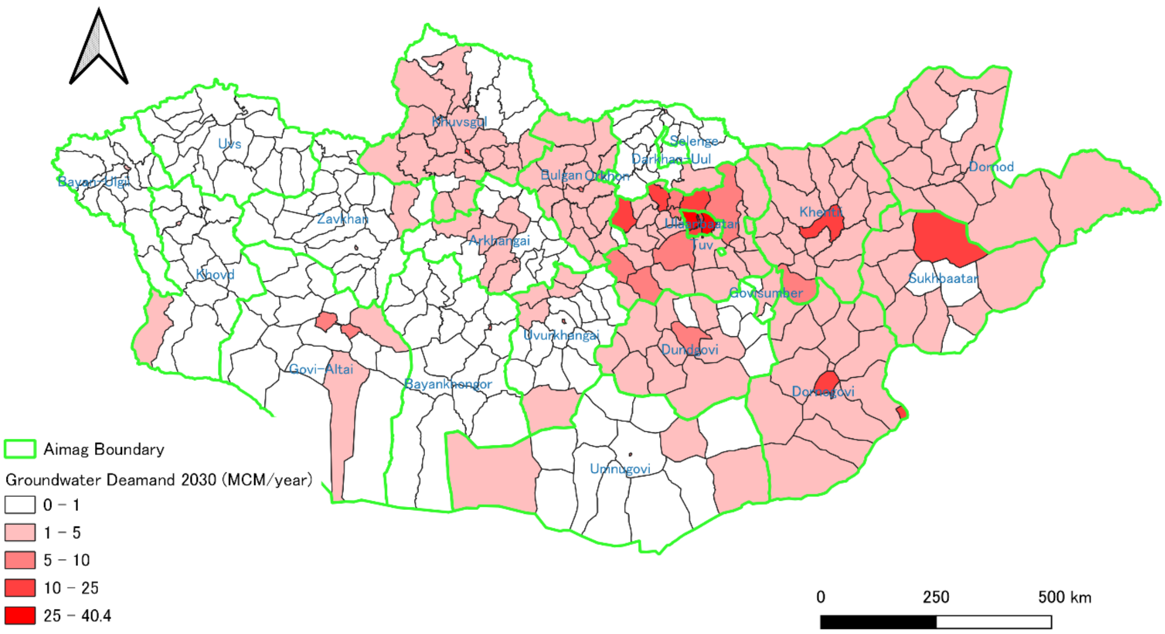
Source: JICA Project Team

Figure 3.5.21 Map of Estimated Surface Water Demand by Soum in 2030



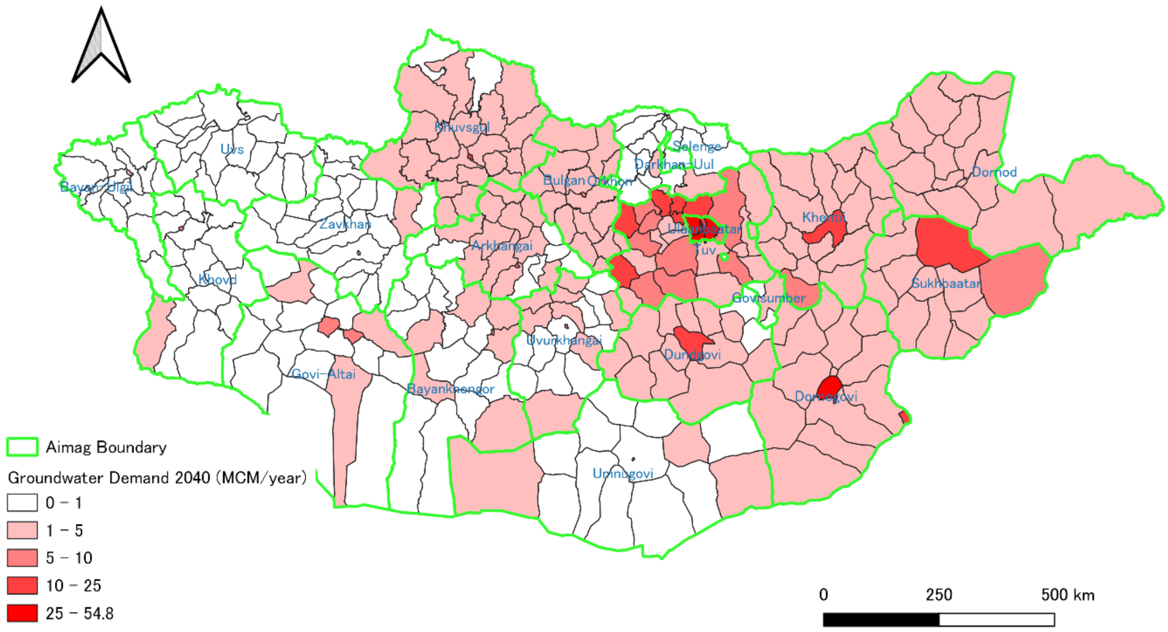
Source: JICA Project Team

Figure 3.5.22 Map of Estimated Surface Water Demand by Soum in 2040



Source: JICA Project Team

Figure 3.5.23 Map of Estimated Groundwater Demand by Soum in 2030



Source: JICA Project Team

Figure 3.5.24 Map of Estimated Groundwater Demand by Soum in 2040

Table 3.5.24 Area and Population in 2015 by Soum

ID	Aimag	Soum Name	Area km^2	Population 2015	Population % in Aimag	ID	Aimag	Soum Name	Area km^2	Population 2015	Population % in Aimag	ID	Aimag	Soum Name	Area km^2	Population 2015	Population % in Aimag
1101	Ulaanbaatar	Baganuur	624.7	28,419	2.11%	4440	Dornogovi	Erdene	9,576.6	2,340	3.71%	6704	Khusvgul	Alag-Erdene	4,496.9	6,219	4.88%
1104	Ulaanbaatar	Bagaxangai	156.4	4,131	0.31%	4443	Dornogovi	Sainshand	272.2	2,725	4.32%	6707	Khusvgul	Arbulag	3,552.4	3,942	3.09%
1107	Ulaanbaatar	Bayangol	23.9	205,663	15.29%	4501	Darkhan-Uul	Darkhan	102.1	80,652	82.56%	6710	Khusvgul	Bayanzukh	4,321.9	3,963	3.11%
1110	Ulaanbaatar	Bayanzu'rx	1,230.6	320,852	23.85%	4504	Darkhan-Uul	Orkohn	442.2	3,076	3.15%	6713	Khusvgul	Burentogtokh	3,803.5	4,252	3.34%
1113	Ulaanbaatar	Nalaix	689.7	35,813	2.66%	4507	Darkhan-Uul	Khongor	2,622.3	5,970	6.11%	6716	Khusvgul	Galat	3,479.2	5,242	4.11%
1116	Ulaanbaatar	Songinoxairxan	1,203.8	307,224	22.83%	4510	Darkhan-Uul	Sharingol	95.9	7,993	8.18%	6719	Khusvgul	Jargalant	2,644.7	5,189	4.07%
1119	Ulaanbaatar	Su'xbaatar	213.2	137,633	10.23%	4601	Umnugovi	Dalanzadgad	23.2	22,873	37.27%	6722	Khusvgul	Ikh-Uul	2,006.8	4,001	3.14%
1121	Ulaanbaatar	Xan-Uul	502.8	154,819	11.51%	4604	Umnugovi	Bayandalai	10,657.5	2,053	3.35%	6725	Khusvgul	Rashaant	1,964.2	3,642	2.86%
1125	Ulaanbaatar	Chingeltei	90.0	150,946	11.22%	4607	Umnugovi	Bayan-Ovoo	11,158.5	1,686	2.75%	6728	Khusvgul	Renchinlumbe	7,670.7	4,839	3.80%
2104	Dornod	Bayandun	6,302.2	2,962	3.88%	4610	Umnugovi	Bulgan	7,454.1	2,049	3.34%	6731	Khusvgul	Taialan	3,427.5	5,749	4.51%
2107	Dornod	Bayantumen	8,665.3	42,877	56.13%	4613	Umnugovi	Gurvantes	27,956.2	4,569	7.45%	6734	Khusvgul	Tosontsengel	2,060.6	4,156	3.26%
2107	Dornod	Bayantumen	8,665.3	42,877	56.13%	4616	Umnugovi	Mandal-Ovoo	6,493.0	1,607	2.62%	6737	Khusvgul	Tumubulag	2,516.2	4,209	3.30%
2110	Dornod	Bayan-Uul	5,626.5	4,464	5.84%	4619	Umnugovi	Munlai	12,403.9	2,440	3.98%	6740	Khusvgul	Tunel	3,558.9	4,056	3.18%
2113	Dornod	Bulgan	7,075.2	1,680	2.20%	4622	Umnugovi	Noyon	10,564.8	1,259	2.05%	6743	Khusvgul	Ulaan-Uul	10,065.9	4,224	3.31%
2116	Dornod	Gurvanzagal	5,262.2	1,337	1.75%	4625	Umnugovi	Nomgon	18,447.3	2,534	4.13%	6746	Khusvgul	Khankh	6,274.0	2,446	1.92%
2119	Dornod	Dashbalbar	8,778.9	3,216	4.21%	4628	Umnugovi	Sevrei	8,181.3	2,020	3.29%	6749	Khusvgul	Tsagaannuur	5,617.5	1,830	1.44%
2122	Dornod	Matad	22,823.3	3,463	4.53%	4631	Umnugovi	Khanbogd	14,962.8	5,563	9.07%	6752	Khusvgul	Tsagaan-Uul	5,796.7	5,430	4.26%
2125	Dornod	Selgeren	4,162.4	1,904	2.49%	4634	Umnugovi	Khankhongor	10,331.7	2,025	3.30%	6755	Khusvgul	Tsagaan-Uur	8,794.0	2,566	2.01%
2128	Dornod	Khalkhgol	27,998.5	2,980	3.90%	4637	Umnugovi	Khurmen	12,634.9	1,568	2.56%	6758	Khusvgul	Tsetserleg	7,404.6	4,513	3.54%
2131	Dornod	Khulunbuir	3,797.3	1,722	2.25%	4640	Umnugovi	Tsogt-Ovoo	6,554.5	1,662	2.71%	6761	Khusvgul	Chandmani-Undur	4,445.7	3,039	2.38%
2134	Dornod	Tsagaan-Ovoo	6,476.7	3,425	4.48%	4643	Umnugovi	Tsogttsetsii	7,281.3	7,459	12.15%	6764	Khusvgul	Shine-ider	2,063.7	3,198	2.51%
2137	Dornod	Choibalsan	10,112.0	2,527	3.31%	4801	Dundgovi	Saintsagaan	3,351.3	14,294	32.36%	6767	Khusvgul	Erdenbulgan	4,926.4	2,797	2.20%
2140	Dornod	Chuluunkhoroot	6,406.0	1,668	2.18%	4804	Dundgovi	Adaatsag	3,319.5	2,801	6.34%	8101	Zavkhan	Uliastai	43.3	15,938	22.89%
2201	Sukhbaatar	Baruun-Urt	12,806.1	19,665	33.45%	4807	Dundgovi	Bayanjargalan	3,181.4	1,189	2.69%	8104	Zavkhan	Ardarkhan	7,155.0	2,714	3.90%
2204	Sukhbaatar	Asgat	7,212.9	1,712	2.91%	4810	Dundgovi	Govi-Ugtaal	2,703.2	1,574	3.56%	8107	Zavkhan	Asgat	566.9	938	1.35%
2207	Sukhbaatar	Bayandelger	7,567.7	4,801	8.17%	4813	Dundgovi	Gurvansaihan	5,457.3	2,073	4.69%	8110	Zavkhan	Bayantes	4,399.2	2,544	3.65%
2210	Sukhbaatar	Dariganga	4,809.7	2,994	5.09%	4816	Dundgovi	Delgerkhangai	6,208.0	2,158	4.88%	8113	Zavkhan	Bayankhairkhan	2,595.0	1,720	2.47%
2213	Sukhbaatar	Munkhkhaan	7,406.7	4,517	7.68%	4819	Dundgovi	Delgertsogt	2,499.4	1,547	3.50%	8116	Zavkhan	Durvuligin	7,251.6	2,051	2.95%
2216	Sukhbaatar	Naran	3,369.8	1,552	2.64%	4822	Dundgovi	Deren	3,615.9	2,026	4.59%	8119	Zavkhan	Zavkhanmandal	3,600.5	1,050	1.51%
2219	Sukhbaatar	Ongon	6,926.6	3,786	6.44%	4825	Dundgovi	Luus	3,154.6	1,791	4.05%	8122	Zavkhan	Ider	3,706.5	2,449	3.52%
2225	Sukhbaatar	Tuvshinshiree	4,396.3	3,251	5.53%	4828	Dundgovi	Ulziit	15,435.4	2,319	5.25%	8125	Zavkhan	Ikh-Uul	3,787.0	6,068	8.71%
2228	Sukhbaatar	Tumentsogt	2,133.7	2,398	4.08%	4831	Dundgovi	Undurshil	4,852.5	1,410	3.19%	8128	Zavkhan	Numrug	3,271.3	1,753	2.52%
2231	Sukhbaatar	Uubayan	4,949.9	2,854	4.85%	4834	Dundgovi	Saikhan-Ovoo	4,045.9	2,136	4.83%	8131	Zavkhan	Otgon	5,660.0	2,630	3.78%
2234	Sukhbaatar	Khalzan	3,802.1	1,598	2.72%	4837	Dundgovi	Khuld	6,063.6	2,295	5.19%	8134	Zavkhan	Santmargats	2,400.4	1,536	2.21%
2237	Sukhbaatar	Erdenetsagaan	16,925.5	9,664	16.44%	4840	Dundgovi	Tsagaandelger	3,458.7	975	2.21%	8137	Zavkhan	Songino	2,430.5	1,498	2.15%
2301	Khenti	Kherlen	3,769.4	21,520	29.75%	4843	Dundgovi	Erdendalai	7,316.8	5,590	12.65%	8140	Zavkhan	Tosontsengel	5,293.5	8,885	12.76%
2304	Khenti	Batnorov	4,963.7	5,413	7.48%	6101	Orkhon	Bayan-Undur	273.2	94,976	96.18%	8143	Zavkhan	Tudevtei	2,670.2	1,856	2.67%
2307	Khenti	Batshireet	7,008.7	2,248	3.11%	6104	Orkhon	Jargalant	567.1	3,774	3.82%	8146	Zavkhan	Telmen	3,457.8	2,675	3.84%
2310	Khenti	Bayan-Adarga	3,018.1	2,418	3.34%	6201	Uvurkhangai	Arvaikheer	49.1	30,335	27.11%	8149	Zavkhan	Tes	922.1	2,803	4.02%
2313	Khenti	Bayanmunkh	2,555.4	1,627	2.25%	6204	Uvurkhangai	Baruunbayan-Ulaan	3,947.5	2,701	2.41%	8152	Zavkhan	Urgamal	3,502.3	1,210	1.74%
2316	Khenti	Bayan-Ovoo	3,371.6	1,657	2.29%	6207	Uvurkhangai	Bat-Ulzii	2,562.9	7,271	6.50%	8155	Zavkhan	Tsagaankhairkhan	2,622.2	1,232	1.77%
2319	Khenti	Bayankhutag	6,036.8	2,158	2.98%	6210	Uvurkhangai	Bayangol	3,506.9	3,819	3.41%	8158	Zavkhan	Tsagaanchuluut	2,592.3	1,247	1.79%
2322	Khenti	Binder	5,421.2	3,976	5.50%	6213	Uvurkhangai	Bayan-Undur	3,252.2	3,786	3.38%	8161	Zavkhan	Tsetsen-Uul	2,442.4	1,680	2.41%
2325	Khenti	Galshir	6,660.4	2,112	2.92%	6216	Uvurkhangai	Bogd	10,038.4	5,439	4.86%	8164	Zavkhan	Shiluustei	3,042.0	1,736	2.49%
2328	Khenti	Dadal	4,909.4	2,821	3.90%	6219	Uvurkhangai	Burd	2,577.0	2,841	2.54%	8167	Zavkhan	Erdenekhairkhan	4,172.7	1,521	2.18%
2331	Khenti	Darkhan	4,507.9	10,415	14.40%	6222	Uvurkhangai	Guchin-Us	4,770.9	2,142	1.91%	8170	Zavkhan	Yaruu	4,955.1	1,907	2.74%
2334	Khenti	Dergelkhaan	3,843.5	2,339	3.23%	6225	Uvurkhangai	Yesunzuil	2,226.0	3,000	2.68%	8201	Gove-Altai	Esunbulag	2,331.1	17,802	31.78%
2337	Khenti	Jagaltkhaan	2,852.0	2,092	2.89%	6228	Uvurkhangai	Zuunbayan-Ulaan	2,508.8	3,901	3.49%	8204	Gove-Altai	Altai	20,160.2	2,102	3.75%
2340	Khenti	Murun	2,213.2	1,833	2.53%	6231	Uvurkhangai	Nariinteel	2,693.8	3,595	3.21%	8207	Gove-Altai	Bayan-Uul	5,841.4	2,984	5.33%
2343	Khenti	Norovlin	5,477.4	2,341	3.24%	6234	Uvurkhangai	Ulziit	1,975.1	2,351	2.10%	8210	Gove-Altai	Binger	3,832.2	2,113	3.77%
2346	Khenti	Umnudelger	10,902.4	5,521	7.63%	6237	Uvurkhangai	Sant	2,624.9	3,497	3.12%	8213	Gove-Altai	Bugat	9,947.4	2,186	3.90%
2349	Khenti	Tsenkhermandal	3,182.6	1,848	2.55%	6240	Uvurkhangai	Taragt	3,514.6	3,213	2.87%	8216	Gove-Altai	Darvi	3,488.5	1,819	3.25%
4101	Tuv	Zuunmod	19.3	15,942	17.76%	6243	Uvurkhangai	Tugrug	5,446.8	2,655	2.37%	8219	Gove-Altai	Delger	6,631.4	3,023	5.40%
4103	Tuv	Altanbulag	5,668.9	3,040	3.39%	6246	Uvurkhangai	Uyanga	3,047.1	9,389	8.39%	8222	Gove-Altai	Jargalan	3,680.5	1,752	3.13%
4107	Tuv	Argalant	1,126.0	1,694	1.89%	6249	Uvurkhangai	Khairkhandulaan	4,129.7	3,351	2.99%	8225	Gove-Altai	Taishir	3,741.7	1,470	2.62%
4110	Tuv	Arkhust	823.9	1,251	1.39%	6252	Uvurkhangai	Kharkhorin	2,300.9	12,045	10.76%	8228	Gove-Altai	Tonkhil	7,556.0	2,142	3.82%
4113	Tuv	Batsumber	2,421.9	6,792	7.57%	6255	Uvurkhangai	Khujirt	1,696.6	6,576	5.88%	8231	Gove-Altai	Tugrug	5,402.9	2,014	3.60%
4116	Tuv	Bayan	2,966.8	2,139	2.38%	6301	Bulgan	Bulgan	92.0	12,086	20.26%	8234	Gove-Altai	Kaliun	5,169.8	2,367	4.23%
4119	Tuv	Bayandelger	2,129.6	1,394	1.55%	6304	Bulgan	Bayan-Agt	3,087.9	3,035	5.09%	8237	Gove-Altai	Khunkhmorit	6,287.3	2,332	4.16%
4122	Tuv	Bayanjargalan	2,867.1	1,570	1.75%	6307	Bulgan	Bayannuur	1,014.6	1,860	3.12%	8240	Gove-Altai	Tsogt	16,699.2	3,513	6.27%
4125	Tuv	Bayan-Unjuul	4,799.4	2,093	2.33%	6310	Bulgan	Bugat	3,194.6	2,175	3.65%	8243	Gove-Altai	Tseel	5,600.7	2,101	3.75%
4128	Tuv	Bayankhangai	999.8	1,475	1.64%	6313	Bulgan	Buregkhangai	3,484.5	2,716	4.55%	8246	Gove-Altai	Chandmani	4,604.4	2,176	3.88%
4131	Tuv	Bayantsagaan	5,883.9	1,808	2.01%	6316	Bulgan	Gurvanbulag	2,688.1	3,129	5.25%	8249	Gove-Altai	Sharga	5,714.4	1,971	3.52%
4134	Tuv	Bayantsogt	1,516.5	1,785	1.99%	6319	Bulgan	Dhashinchilen	2,315.5	2,790	4.68%	8252	Gove-Altai	Erdene	24,992.7	2,151	3.84%
4137	Tuv	Bayanchandmani	568.0	4,032	4.49%	6322	Bulgan	Mogod	2,827.7	2,671	4.48%	8301	Bayan-Ulgii	Ulgii	99.6	33,420	34.18%
4140	Tuv	Bornuur	1,149.8	4,983	5.55%	6325	Bulgan	Orkhon	4,014.8	3,471	5.82%	8304	Bayan-Ulgii	Altai	3,173.1	4,143	4.24%
4143	Tuv	Buren	3,758.7	2,989	3.33%	6328	Bulgan	Rashaant	978.1	3,126	5.24%	8307	Bayan-Ulgii	Altantsugts	1,800.9	2,787	2.85%
4146	Tuv	Delgerkhaan	2,165.4	1,645	1.83%	6331	Bulgan	Saikhan	2,705.6	3,561	5.97%	8310	Bayan-Ulgii	Bayannuur	2,332.3	4,825	4.93%
4149	Tuv	Jargalant	1,850.5	6,379	7.11%	6334	Bulgan	Selenge	4,864.5	3,195	5.36%	8313	Bayan-Ulgii	Bugat	2,038.4	3,626	3.71%
4152	Tuv	Zaamar	2,821.0	5,453	6.07%	6337	Bulgan	Teshig	7,743.6	3,483	5.84%	8316	Bayan-Ulgii	Bulgan	4,937.5	5,095	5.21%
4155	Tuv	Lun	2,534.2	2,550	2.84%	6340	Bulgan	Khangal	1,609.2	4,510	7.56%	8319	Bayan-Ulgii	Buyant	1,833.0	2,698	2.76%
4158	Tuv	Mungunmorit	6,709.3	1,982	2.21%	6343	Bulgan	Khishing-Undur	2,438.2	3,125	5.24%	8322	Bayan-Ulgii	Deluum	5,626.9	7,118	7.28%
4161	Tuv	Undurshireet	2,621.3	1,903	2.12%	6346	Bulgan	Khutag-Unduur	5,616.3	4,719	7.91%	8325	Bayan-Ulgii	Nogoonnuur	5,278.3	7,750	7.93%
4164	Tuv	Sumber	348.4	1,769	1.97%	6401	Bayankhongor	Bayankhongor	64.7	29,611	35.42%	8328	Bayan-Ulgii	Sagsai	3,198.3	5,046	5.16%
4167	Tuv	Sergelen	3,798.9	1,952	2.17%	6404	Bayankhongor	Baatsagaan	7,420.5	3,111	3.72%	8331	Bayan-Ulgii	Tolbo	2,971.8	4,037	4.13%
4170	Tuv	Ugtaaltsaidam	1,548.7	2,627	2.93%	6407	Bayankhongor	Bayanbulag	3,150.8	1,662	1.99%	8334	Bayan-Ulgii	Ulaankhus	6,004.7	8,299	8.49%
4173	Tuv	Tseel	1,632.6	2,478	2.76%	6410	Bayankhongor	Bayangobi	4,673.6	2,777	3.32%	8340	Bayan-Ulgii	Tsengel	6,456.2	8,943	9.15%
4176	Tuv	Erdene	8,130.0	3,756	4.18%	6413	Bayankhongor	Bayanlig	11,937.0	3,652	4.37%	8401	Khovd	Jargalant	71.3	27,880	33.54%
4179	Tuv	Erdensant	3,100.9	4,284	4.77%	6416	Bayankhongor	Bayan-Ovoo	3,210.7	2,546	3.05%	8404	Khovd	Altai	13,131.0	3,086	3.71%
4201	Goveisumber	Sumber	3,743.8	11,881	72.85%	6419	Bayankhongor	Bayan-Undur	16,986.7	2,541	3.04%	8407	Khovd	Bulgan	8,105.7	9,381	11.29%
4204	Goveisumber	Bayantal	895.5	1,168	7.16%	6422	Bayankhongor	Bayantsagaan	5,552.4	3,369	4.03%	8410	Khovd	Buyant	3,642.4	3,392	4.08%
4207	Goveisumber	Shivee gobi	901.0	3,259	19.98%	6425	Bayankhongor	Bogd	3,960.5	3,028	3.62%	8413	Khovd	Darvi	5,565.4	2,817	3.39%
4301	Selenge	Sukhbaatar	51.1	22,238	21.23%	6428	Bayankhongor	Bumbugur	3,037.3	3,063	3.66%	8416	Khovd	Durgun	4,102.7	2,893	3.48%
4304	Selenge	Altanbulag	2,428.9	4,729	4.52%	6431	Bayankhongor	Buutsagaan	5,380.3	3,523	4.21%	8419	Khovd	Duut	2,140.8	1,947	2.34%
4307	Selenge	Baruunburen	2,827.3	3,111	2.97%	6434	Bayankhongor	Galuut	5,025.2	3,802	4.55%	8422	Khovd	Zereg	2,516.8	3,143	3.78%
4310	Selenge	Bayangol	2,020.1	5,403	5.16%	6437	Bayankhongor	Gurvanbulag	4,417.9	2,144	2.56%	8425	Khovd	Mankhan	4,332.6	4,067	4.89%
4313	Selenge	Yeruu	8,324.0	6,393	6.10%	6440	Bayankhongor	Jargalant	4,201.3	2,826	3.38%	8428	Khovd	Munkhkhairkhan	2,563.3	2,184	2.63%
4316	Selenge	Javkhlant	1,183.4	1,974	1.88%	6443	Bayankhongor	Jinst	5,161.9	2,122	2.54%	8431	Khovd	Must	3,982.3	3,075	3.70%
4319	Selenge	Zuunburen	1,189.0	2,704	2.58%	6446	Bayankhongor	Zag	2,549.0	2,014	2.41%	8434	Khovd	Myangat	3,297.0	3,581	4.31%
4322	Selenge	Mandal	4,784.6	26,526	25.33%	6449	Bayankhongor	Ulziit	3,945.5	3,661	4.38%	8437	Khovd	Uyench	7,399.0	4,083	4.91%
4325	Selenge	Orkhon	1,300.6	2,306	2.20%	6452	Bayankhongor	Khureemaral	4,342.0	1,705	2.04%	8440	Khovd	Khovd	2,844.3	3,477	4.18%
4328	Selenge	Orkhontuul	2,954.3	3,621	3.46%	6455	Bayankhongor	Shinejinst	16,431.7	2,317	2.77%	8443	Khovd	Tsetseg	3,489.8	2,922	3.52%
4331	Selenge	Saikhan	1,301.9	9,130	8.72%	6458	Bayankhongor	Erdenetsogt	4,043.4	4,129	4.94%	8446	Khovd	Chandmani	6,068.2	2,860	3.44%
4334	Selenge	Sant	1,354.8	1,961	1.87%	6501	Arkhangai	Erdenbulgan	61.8	21,211	23.12%	8449	Khovd	Erdenburen	2,759.7	2,339	2.81%
4337	Selenge	Tushig	2,562.7	1,694	1.62%	6504	Arkhangai	Battsengel	3,510.0	3,600	3.92%	8504	Uvs	Baruunturuun	3,219.0	2,648	3.29%
4340	Selenge	Khuder	2,675.7	2,384	2.28%	6507	Arkhangai	Bulgan	3,222.1	2,465	2.69%	8507	Uvs	Bukhmurun	3,814.1	2,165	2.69%
4343	Selenge	Khushaat	2,009.7	1,831	1.75%	6510	Arkhangai	Jargalant	2,838.6	4,335	4.72%	8510	Uvs	Davst	6,500.9	1,572	1.96%
4346	Selenge	Tsagaannuur	3,794.9	4,687	4.48%	6513	Arkhangai	Ikh Tamir	4,895.0	5,325	5.80%	8513	Uvs	Zavkhan	6,908.1	1,803	2.24%
4349	Selenge	Shaamar	664.5	3,959	3.78%	6516	Arkhangai	Ugiinuur	1,696.4	3,011	3.28%	8516	Uvs	Zuungobi	4,006.2	2,705	3.36%
4352	Selenge	Shaamar	57.3	74	0.07%	6519	Arkhangai	Ulziit	1,713.8	3,301	3.60%	8519	Uvs	Zuunkhangai	2,658.8	2,240	2.79%
4401	Dornogovi	Sainshand	2,042.2	20,466	32.42%	6522	Arkhangai	Unduur-Ulaan	4,351.8	5,652	6.16%	8522	Uvs	Malchin	4,003.7	2,486	3.09%
4404	Dornogovi	Airag	7,467.2	3,612	5.72%	6525	Arkhangai	Tariat	4,063.6	4,660	5.08%	8525	Uvs	Naranbulag	5,176.6	4,043	5.03%
4407	Dornogovi	Altanshiree	7,159.3	1,262	2.00%	6528	Arkhangai	Tuvshruulekh	1,195.8	2,975	3.24%	8528	Uvs	Ulgii	2,382.8	2,347	2.92%
4410	Dornogovi	Dalanjargalan	4,025.8	2,680	4.25%	6531	Arkhangai	Khairkhan	2,610.0	3,701	4.03%	8531	Uvs	Umnugobi	3,148.9	4,450	5.54%
4413	Dornogovi	Delgerekh	4,810.7	1,851	2.93%	6534	Arkhangai	Khangai	3,887.5	3,113	3.39%	8534	Uvs	Undurkhangai	4,635.1	3,177	3.95%
4416	Dornogovi	Zamin-Uud	482.7	15,702	24.87%	6537	Arkhangai	Khashaat	2,593.1	3,171	3.46%	8537	Uvs	Sagil	3,902.8	2,343	2.91%
4419	Dornogovi	Ikhkhet	4,171.9	2,039	3.23%	6540	Arkhangai	Khotont	2,340.8	4,221	4.60%	8540	Uvs	Tarialan	3,807.7	30,349	37.75%
4422	Dornogovi	Mandakh	12,681.1	1,566	2.48%	6543	Arkhangai	Tsakhir	3,292.8	2,328	2.54%	8540	Uvs	Tarialan	3,807.7	30,349	37.75%
4425	Dornogovi	Urgun	8,406.4	1,889	2.99%	6546	Arkhangai	Tsenkher	3,165.0	5,605	6.11%	8543	Uvs	Turgen	2,103.2	2,129	2.65%
4428	Dornogovi	Saikhandulaan	9,539.2	1,292	2.05%	6549	Arkhangai	Tsetserleg	2,517.3	3,712	4.05%	8546	Uvs	Tes	3,138.5	5,218	6.49%
4431	Dornogovi	Ulaanbadrakh	11,650.4	1,431	2.27%	6552	Arkhangai	Chuluut	3,933.9	3,923	4.28%	8549	Uvs	Khovd	2,876.2	2,391	2.97%
4434	Dornogovi	Khatanbulag	18,670.9	2,752	4.36%	6555	Arkhangai	Erdebmandal	3,386.0	5,451	5.94%	8552	Uvs	Khyargas	3,228.6	2,474	3.08%
4437	Dornogovi	Khuvsgul	8,401.6	1,518	2.40%	6701	Khusvgul	Murun	102.4	37,921	29.76%	8555	Uvs	Tsagaankhairkhan	4,073.8	2,003	2.49%

Source: ALAMGAC

Table 3.5.25 Estimated Water Demand by Soum in 2030

Unit: million m^3/year

ID	Aimag	Soum Name	Water Demand 2030			ID	Aimag	Soum Name	Water Demand 2030			ID	Aimag	Soum Name	Water Demand 2030		
			SW	GW	Total				SW	GW	Total				SW	GW	Total
1101	Ulaanbaatar	Baganuur	0.61	3.58	4.19	4440	Dornogovi	Erdene	0.00	2.23	2.23	6704	Khusvgul	Alag-Erdene	0.65	1.84	2.49
1104	Ulaanbaatar	Bagaxangai	0.09	0.52	0.61	4443	Dornogovi	Sainshand	0.00	2.59	2.59	6707	Khusvgul	Arbulag	0.41	1.17	1.58
1107	Ulaanbaatar	Bayangol	4.40	25.89	30.29	4501	Darkhan-Uul	Darkhan	25.15	4.49	29.63	6710	Khusvgul	Bayanzukh	0.41	1.17	1.59
1110	Ulaanbaatar	Bayanzu'rx	6.86	40.39	47.26	4504	Darkhan-Uul	Orkohn	0.96	0.17	1.13	6713	Khusvgul	Burentogtokh	0.44	1.26	1.70
1113	Ulaanbaatar	Nalaix	0.77	4.51	5.27	4507	Darkhan-Uul	Khongor	1.86	0.33	2.19	6716	Khusvgul	Galat	0.55	1.55	2.10
1116	Ulaanbaatar	Songinoxairxan	6.57	38.68	45.25	4510	Darkhan-Uul	Sharingol	2.49	0.44	2.94	6719	Khusvgul	Jargalant	0.54	1.54	2.08
1119	Ulaanbaatar	Su'xbaatar	2.94	17.33	20.27	4601	Umnugovi	Dalanzadgad	3.08	6.26	9.34	6722	Khusvgul	Ikh-Uul	0.42	1.18	1.60
1121	Ulaanbaatar	Xan-Uul	3.31	19.49	22.80	4604	Umnugovi	Bayandalai	0.28	0.56	0.84	6725	Khusvgul	Rashaant	0.38	1.08	1.46
1125	Ulaanbaatar	Chingeltei	3.23	19.00	22.23	4607	Umnugovi	Bayan-Ovoo	0.23	0.46	0.69	6728	Khusvgul	Renchinlumbe	0.50	1.43	1.94
2104	Dornod	Bayandun	1.11	1.90	3.01	4610	Umnugovi	Bulgan	0.28	0.56	0.84	6731	Khusvgul	Taialan	0.60	1.70	2.30
2107	Dornod	Bayantumen	16.14	27.47	43.61	4613	Umnugovi	Gurvantes	0.62	1.25	1.87	6734	Khusvgul	Tosontsengel	0.43	1.23	1.66
2107	Dornod	Bayantumen	16.14	27.47	43.61	4616	Umnugovi	Mandal-Ovoo	0.22	0.44	0.66	6737	Khusvgul	Tumubulag	0.44	1.25	1.68
2110	Dornod	Bayan-Uul	1.68	2.86	4.54	4619	Umnugovi	Munlai	0.33	0.67	1.00	6740	Khusvgul	Tunel	0.42	1.20	1.62
2113	Dornod	Bulgan	0.63	1.08	1.71	4622	Umnugovi	Noyon	0.17	0.34	0.51	6743	Khusvgul	Ulaan-Uul	0.44	1.25	1.69
2116	Dornod	Gurvanzagal	0.50	0.86	1.36	4625	Umnugovi	Nomgon	0.34	0.69	1.03	6746	Khusvgul	Khankh	0.25	0.72	0.98
2119	Dornod	Dashbalbar	1.21	2.06	3.27	4628	Umnugovi	Sevrei	0.27	0.55	0.83	6749	Khusvgul	Tsagaannuur	0.19	0.54	0.73
2122	Dornod	Matad	1.30	2.22	3.52	4631	Umnugovi	Khanbogd	0.75	1.52	2.27	6752	Khusvgul	Tsagaan-Uul	0.56	1.61	2.17
2125	Dornod	Selgeren	0.72	1.22	1.94	4634	Umnugovi	Khankhongor	0.27	0.55	0.83	6755	Khusvgul	Tsagaan-Uur	0.27	0.76	1.03
2128	Dornod	Khalkhgol	1.12	1.91	3.03	4637	Umnugovi	Khurmen	0.21	0.43	0.64	6758	Khusvgul	Tsetserleg	0.47	1.34	1.81
2131	Dornod	Khulunbuir	0.65	1.10	1.75	4640	Umnugovi	Tsogt-Ovoo	0.22	0.46	0.68	6761	Khusvgul	Chandmani-Undur	0.32	0.90	1.22
2134	Dornod	Tsagaan-Ovoo	1.29	2.19	3.48	4643	Umnugovi	Tsogttsetsii	1.00	2.04	3.05	6764	Khusvgul	Shine-ider	0.33	0.95	1.28
2137	Dornod	Choibalsan	0.95	1.62	2.57	4801	Dundgovi	Saintsagaan	0.00	8.47	8.47	6767	Khusvgul	Erdenbulgan	0.29	0.83	1.12
2140	Dornod	Chuluunkhoroot	0.63	1.07	1.70	4804	Dundgovi	Adaatsag	0.00	1.66	1.66	8101	Zavkhan	Uliastai	3.35	1.98	5.33
2201	Sukhbaatar	Baruun-Urt	0.00	10.10	10.10	4807	Dundgovi	Bayanjargalan	0.00	0.70	0.70	8104	Zavkhan	Ardarkhan	0.57	0.34	0.91
2204	Sukhbaatar	Asgat	0.00	0.88	0.88	4810	Dundgovi	Govi-Ugtaal	0.00	0.93	0.93	8107	Zavkhan	Asgat	0.20	0.12	0.31
2207	Sukhbaatar	Bayandelger	0.00	2.46	2.46	4813	Dundgovi	Gurvansaihan	0.00	1.23	1.23	8110	Zavkhan	Bayantes	0.53	0.32	0.85
2210	Sukhbaatar	Dariganga	0.00	1.54	1.54	4816	Dundgovi	Delgerkhangai	0.00	1.28	1.28	8113	Zavkhan	Bayankhairkhan	0.36	0.21	0.58
2213	Sukhbaatar	Munkhkhaan	0.00	2.32	2.32	4819	Dundgovi	Delgertsogt	0.00	0.92	0.92	8116	Zavkhan	Durvuligin	0.43	0.25	0.69
2216	Sukhbaatar	Naran	0.00	0.80	0.80	4822	Dundgovi	Deren	0.00	1.20	1.20	8119	Zavkhan	Zavkhanmandal	0.22	0.13	0.35
2219	Sukhbaatar	Ongon	0.00	1.94	1.94	4825	Dundgovi	Luus	0.00	1.06	1.06	8122	Zavkhan	Ider	0.51	0.30	0.82
2225	Sukhbaatar	Tuvshinshiree	0.00	1.67	1.67	4828	Dundgovi	Ulziit	0.00	1.37	1.37	8125	Zavkhan	Ikh-Uul	1.28	0.75	2.03
2228	Sukhbaatar	Tumentsogt	0.00	1.23	1.23	4831	Dundgovi	Undurshil	0.00	0.84	0.84	8128	Zavkhan	Numrug	0.37	0.22	0.59
2231	Sukhbaatar	Uubayan	0.00	1.47	1.47	4834	Dundgovi	Saikhan-Ovoo	0.00	1.26	1.26	8131	Zavkhan	Otgon	0.55	0.33	0.88
2234	Sukhbaatar	Khalzan	0.00	0.82	0.82	4837	Dundgovi	Khuld	0.00	1.36	1.36	8134	Zavkhan	Santmargats	0.32	0.19	0.51
2237	Sukhbaatar	Erdenetsagaan	0.00	4.96	4.96	4840	Dundgovi	Tsagaandelger	0.00	0.58	0.58	8137	Zavkhan	Songino	0.31	0.19	0.50
2301	Khenti	Kherlen	10.55	13.99	24.54	4843	Dundgovi	Erdendalai	0.00	3.31	3.31	8140	Zavkhan	Tosontsengel	1.87	1.10	2.97
2304	Khenti	Batnorov	2.65	3.52	6.17	6101	Orkhon	Bayan-Undur	3.94	7.39	11.32	8143	Zavkhan	Tudevtei	0.39	0.23	0.62
2307	Khenti	Batshireet	1.10	1.46	2.56	6104	Orkhon	Jargalant	0.16	0.29	0.45	8146	Zavkhan	Telmen	0.56	0.33	0.89
2310	Khenti	Bayan-Adarga	1.18	1.57	2.76	6201	Uvurkhangai	Arvaikheer	5.76	6.16	11.92	8149	Zavkhan	Tes	0.59	0.35	0.94
2313	Khenti	Bayanmunkh	0.80	1.06	1.86	6204	Uvurkhangai	Baruunbayan-Ulaan	0.51	0.55	1.06	8152	Zavkhan	Urgamal	0.25	0.15	0.40
2316	Khenti	Bayan-Ovoo	0.81	1.08	1.89	6207	Uvurkhangai	Bat-Ulzii	1.38	1.48	2.86	8155	Zavkhan	Tsagaankhairkhan	0.26	0.15	0.41
2319	Khenti	Bayankhutag	1.06	1.40	2.46	6210	Uvurkhangai	Bayangol	0.73	0.77	1.50	8158	Zavkhan	Tsagaanchuluut	0.26	0.15	0.42
2322	Khenti	Binder	1.95	2.59	4.53	6213	Uvurkhangai	Bayan-Undur	0.72	0.77	1.49	8161	Zavkhan	Tsetsen-Uul	0.35	0.21	0.56
2325	Khenti	Galshir	1.04	1.37	2.41	6216	Uvurkhangai	Bogd	1.03	1.10	2.14	8164	Zavkhan	Shiluustei	0.37	0.22	0.58
2328	Khenti	Dadal	1.38	1.83	3.22	6219	Uvurkhangai	Burd	0.54	0.58	1.12	8167	Zavkhan	Erdenekhairkhan	0.32	0.19	0.51
2331	Khenti	Darkhan	5.10	6.77	11.88	6222	Uvurkhangai	Guchin-Us	0.41	0.43	0.84	8170	Zavkhan	Yaruu	0.40	0.24	0.64
2334	Khenti	Dergelkhaan	1.15	1.52	2.67	6225	Uvurkhangai	Yesunzuil	0.57	0.61	1.18	8201	Gove-Altai	Esunbulag	0.95	5.90	6.85
2337	Khenti	Jagaltkhaan	1.03	1.36	2.39	6228	Uvurkhangai	Zuunbayan-Ulaan	0.74	0.79	1.53	8204	Gove-Altai	Altai	0.11	0.70	0.81
2340	Khenti	Murun	0.90	1.19	2.09	6231	Uvurkhangai	Nariinteel	0.68	0.73	1.41	8207	Gove-Altai	Bayan-Uul	0.16	0.99	1.15
2343	Khenti	Norovlin	1.15	1.52	2.67	6234	Uvurkhangai	Ulziit	0.45	0.48	0.92	8210	Gove-Altai	Binger	0.11	0.70	0.81
2346	Khenti	Umnudelger	2.71	3.59	6.30	6237	Uvurkhangai	Sant	0.66	0.71	1.37	8213	Gove-Altai	Bugat	0.12	0.72	0.84
2349	Khenti	Tsenkhermandal	0.91	1.20	2.11	6240	Uvurkhangai	Taragt	0.61	0.65	1.26	8216	Gove-Altai	Darvi	0.10	0.60	0.70
4101	Tuv	Zuunmod	2.45	29.28	31.74	6243	Uvurkhangai	Tugrug	0.50	0.54	1.04	8219	Gove-Altai	Delger	0.16	1.00	1.16
4103	Tuv	Altanbulag	0.47	5.58	6.05	6246	Uvurkhangai	Uyanga	1.78	1.91	3.69	8222	Gove-Altai	Jargalan	0.09	0.58	0.67
4107	Tuv	Argalant	0.26	3.11	3.37	6249	Uvurkhangai	Khairkhandulaan	0.64	0.68	1.32	8225	Gove-Altai	Taishir	0.08	0.49	0.57
4110	Tuv	Arkhust	0.19	2.30	2.49	6252	Uvurkhangai	Kharkhorin	2.29	2.44	4.73	8228	Gove-Altai	Tonkhil	0.11	0.71	0.82
4113	Tuv	Batsumber	1.05	12.48	13.52	6255	Uvurkhangai	Khujirt	1.25	1.33	2.58	8231	Gove-Altai	Tugrug	0.11	0.67	0.77
4116	Tuv	Bayan	0.33	3.93	4.26	6301	Bulgan	Bulgan	5.64	6.10	11.74	8234	Gove-Altai	Kaliun	0.13	0.78	0.91
4119	Tuv	Bayandelger	0.21	2.56	2.78	6304	Bulgan	Bayan-Agt	1.42	1.53	2.95	8237	Gove-Altai	Khunkhmorit	0.12	0.77	0.90
4122	Tuv	Bayanjargalan	0.24	2.88	3.13	6307	Bulgan	Bayannuur	0.87	0.94	1.81	8240	Gove-Altai	Tsogt	0.19	1.16	1.35
4125	Tuv	Bayan-Unjuul	0.32	3.84	4.17	6310	Bulgan	Bugat	1.01	1.10	2.11	8243	Gove-Altai	Tseel	0.11	0.70	0.81
4128	Tuv	Bayankhangai	0.23	2.71	2.94	6313	Bulgan	Buregkhangai	1.27	1.37	2.64	8246	Gove-Altai	Chandmani	0.12	0.72	0.84
4131	Tuv	Bayantsagaan	0.28	3.32	3.60	6316	Bulgan	Gurvanbulag	1.46	1.58	3.04	8249	Gove-Altai	Sharga	0.11	0.65	0.76
4134	Tuv	Bayantsogt	0.27	3.28	3.55	6319	Bulgan	Dhashinchilen	1.30	1.41	2.71	8252	Gove-Altai	Erdene	0.11	0.71	0.83
4137	Tuv	Bayanchandmani	0.62	7.41	8.03	6322	Bulgan	Mogod	1.25	1.35	2.60	8301	Bayan-Ulgii	Ulgii	4.26	2.56	6.82
4140	Tuv	Bornuur	0.77	9.15	9.92	6325	Bulgan	Orkhon	1.62	1.75	3.37	8304	Bayan-Ulgii	Altai	0.53	0.32	0.85
4143	Tuv	Buren	0.46	5.49	5.95	6328	Bulgan	Rashaant	1.46	1.58	3.04	8307	Bayan-Ulgii	Altantsugts	0.36	0.21	0.57
4146	Tuv	Delgerkhaan	0.25	3.02	3.27	6331	Bulgan	Saikhan	1.66	1.80	3.46	8310	Bayan-Ulgii	Bayannuur	0.61	0.37	0.98
4149	Tuv	Jargalant	0.98	11.72	12.70	6334	Bulgan	Selenge	1.49	1.61	3.10	8313	Bayan-Ulgii	Bugat	0.46	0.28	0.74
4152	Tuv	Zaamar	0.84	10.02	10.86	6337	Bulgan	Teshig	1.63	1.76	3.38	8316	Bayan-Ulgii	Bulgan	0.65	0.39	1.04
4155	Tuv	Lun	0.39	4.68	5.08	6340	Bulgan	Khangal	2.10	2.28	4.38	8319	Bayan-Ulgii	Buyant	0.34	0.21	0.55
4158	Tuv	Mungunmorit	0.30	3.64	3.95	6343	Bulgan	Khishing-Undur	1.46	1.58	3.04	8322	Bayan-Ulgii	Deluum	0.91	0.55	1.45
4161	Tuv	Undurshireet	0.29	3.50	3.79	6346	Bulgan	Khutag-Unduur	2.20	2.38	4.59	8325	Bayan-Ulgii	Nogoonnuur	0.99	0.59	1.58
4164	Tuv	Sumber	0.27	3.25	3.52	6401	Bayankhongor	Bayankhongor	3.71	7.00	10.71	8328	Bayan-Ulgii	Sagsai	0.64	0.39	1.03
4167	Tuv	Sergelen	0.30	3.59	3.89	6404	Bayankhongor	Baatsagaan	0.39	0.74	1.13	8331	Bayan-Ulgii	Tolbo	0.51	0.31	0.82
4170	Tuv	Ugtaaltsaidam	0.40	4.83	5.23	6407	Bayankhongor	Bayanbulag	0.21	0.39	0.60	8334	Bayan-Ulgii	Ulaankhus	1.06	0.64	1.69
4173	Tuv	Tseel	0.38	4.55	4.93	6410	Bayankhongor	Bayangobi	0.35	0.66	1.00	8340	Bayan-Ulgii	Tsengel	1.14	0.68	1.82
4176	Tuv	Erdene	0.58	6.90	7.48	6413	Bayankhongor	Bayanlig	0.46	0.86	1.32	8401	Khovd	Jargalant	3.27	4.76	8.04
4179	Tuv	Erdensant	0.66	7.87	8.53	6416	Bayankhongor	Bayan-Ovoo	0.32	0.60	0.92	8404	Khovd	Altai	0.36	0.53	0.89
4201	Goveisumber	Sumber	0.00	2.27	2.27	6419	Bayankhongor	Bayan-Undur	0.32	0.60	0.92	8407	Khovd	Bulgan	1.10	1.60	2.70
4204	Goveisumber	Bayantal	0.00	0.22	0.22	6422	Bayankhongor	Bayantsagaan	0.42	0.80	1.22	8410	Khovd	Buyant	0.40	0.58	0.98
4207	Goveisumber	Shivee gobi	0.00	0.62	0.62	6425	Bayankhongor	Bogd	0.38	0.72	1.10	8413	Khovd	Darvi	0.33	0.48	0.81
4301	Selenge	Sukhbaatar	51.74	2.10	53.84	6428	Bayankhongor	Bumbugur	0.38	0.72	1.11	8416	Khovd	Durgun	0.34	0.49	0.83
4304	Selenge	Altanbulag	11.00	0.45	11.45	6431	Bayankhongor	Buutsagaan	0.44	0.83	1.27	8419	Khovd	Duut	0.23	0.33	0.56
4307	Selenge	Baruunburen	7.24	0.29	7.53	6434	Bayankhongor	Galuut	0.48	0.90	1.38	8422	Khovd	Zereg	0.37	0.54	0.91
4310	Selenge	Bayangol	12.57	0.51	13.08	6437	Bayankhongor	Gurvanbulag	0.27	0.51	0.78	8425	Khovd	Mankhan	0.48	0.70	1.17
4313	Selenge	Yeruu	14.87	0.60	15.48	6440	Bayankhongor	Jargalant	0.35	0.67	1.02	8428	Khovd	Munkhkhairkhan	0.26	0.37	0.63
4316	Selenge	Javkhlant	4.59	0.19	4.78	6443	Bayankhongor	Jinst	0.27	0.50	0.77	8431	Khovd	Must	0.36	0.53	0.89
4319	Selenge	Zuunburen	6.29	0.26	6.55	6446	Bayankhongor	Zag	0.25	0.48	0.73	8434	Khovd	Myangat	0.42	0.61	1.03
4322	Selenge	Mandal	61.72	2.51	64.23	6449	Bayankhongor	Ulziit	0.46	0.87	1.32	8437	Khovd	Uyench	0.48	0.70	1.18
4325	Selenge	Orkhon	5.37	0.22	5.58	6452	Bayankhongor	Khureemaral	0.21	0.40	0.62	8440	Khovd	Khovd	0.41	0.59	1.00
4328	Selenge	Orkhontuul	8.43	0.34	8.77	6455	Bayankhongor	Shinejinst	0.29	0.55	0.84	8443	Khovd	Tsetseg	0.34	0.50	0.84
4331	Selenge	Saikhan	21.24	0.86	22.11	6458	Bayankhongor	Erdenetsogt	0.52	0.98	1.49	8446	Khovd	Chandmani	0.34	0.49	0.82
4334	Selenge	Sant	4.56	0.19	4.75	6501	Arkhangai	Erdenbulgan	14.79	4.75	19.54	8449	Khovd	Erdenburen	0.27	0.40	0.67
4337	Selenge	Tushig	3.94	0.16	4.10	6504	Arkhangai	Battsengel	2.51	0.81	3.32	8504	Uvs	Baruunturuun	0.88	0.35	1.23
4340	Selenge	Khuder	5.55	0.23	5.77	6507	Arkhangai	Bulgan	1.72	0.55	2.27	8507	Uvs	Bukhmurun	0.72	0.28	1.01
4343	Selenge	Khushaat	4.26	0.17	4.43	6510	Arkhangai	Jargalant	3.02	0.97	3.99	8510	Uvs	Davst	0.52	0.21	0.73
4346	Selenge	Tsagaannuur	10.91	0.44	11.35	6513	Arkhangai	Ikh Tamir	3.71	1.19	4.90	8513	Uvs	Zavkhan	0.60	0.24	0.84
4349	Selenge	Shaamar	9.21	0.37	9.59	6516	Arkhangai	Ugiinuur	2.10	0.67	2.77	8516	Uvs	Zuungobi	0.90	0.36	1.26
4352	Selenge	Shaamar	0.17	0.01	0.18	6519	Arkhangai	Ulziit	2.30	0.74	3.04	8519	Uvs	Zuunkhangai	0.75	0.29	1.04
4401	Dornogovi	Sainshand	0.00	19.46	19.46	6522	Arkhangai	Unduur-Ulaan	3.94	1.27	5.21	8522	Uvs	Malchin	0.83	0.33	1.15
4404	Dornogovi	Airag	0.00	3.43	3.43	6525	Arkhangai	Tariat	3.25	1.04	4.29	8525	Uvs	Naranbulag	1.35	0.53	1.88
4407	Dornogovi	Altanshiree	0.00	1.20	1.20	6528	Arkhangai	Tuvshruulekh	2.07	0.67	2.74	8528	Uvs	Ulgii	0.78	0.31	1.09
4410	Dornogovi	Dalanjargalan	0.00	2.55	2.55	6531	Arkhangai	Khairkhan	2.58	0.83	3.41	8531	Uvs	Umnugobi	1.48	0.58	2.07
4413	Dornogovi	Delgerekh	0.00	1.76	1.76	6534	Arkhangai	Khangai	2.17	0.70	2.87	8534	Uvs	Undurkhangai	1.06	0.42	1.48
4416	Dornogovi	Zamin-Uud	0.00	14.93	14.93	6537	Arkhangai	Khashaat	2.21	0.71	2.92	8537	Uvs	Sagil	0.78	0.31	1.09
4419	Dornogovi	Ikhkhet	0.00	1.94	1.94	6540	Arkhangai	Khotont	2.94	0.95	3.89	8540	Uvs	Tarialan	10.11	3.98	14.10
4422	Dornogovi	Mandakh	0.00	1.49	1.49	6543	Arkhangai	Tsakhir	1.62	0.52	2.14	8540	Uvs	Tarialan	10.11	3.98	14.10
4425	Dornogovi	Urgun	0.00	1.80	1.80	6546	Arkhangai	Tsenkher	3.91	1.25	5.16	8543	Uvs	Turgen	0.71	0.28	0.99
4428	Dornogovi	Saikhandulaan	0.00	1.23	1.23	6549	Arkhangai	Tsetserleg	2.59	0.83	3.42	8546	Uvs	Tes	1.74	0.68	2.42
4431	Dornogovi	Ulaanbadrakh	0.00	1.36	1.36	6552	Arkhangai	Chuluut	2.73	0.88	3.61	8549	Uvs	Khovd	0.80	0.31	1.11
4434	Dornogovi	Khatanbulag	0.00	2.62	2.62	6555	Arkhangai	Erdebmandal	3.80	1.22	5.02	8552	Uvs	Khyargas	0.82	0.32	1.15
4437	Dornogovi	Khuvsgul	0.00	1.44	1.44	6701	Khusvgul	Murun	3.95	11.23	15.17	8555	Uvs	Tsagaankhairkhan	0.67	0.26	0.93

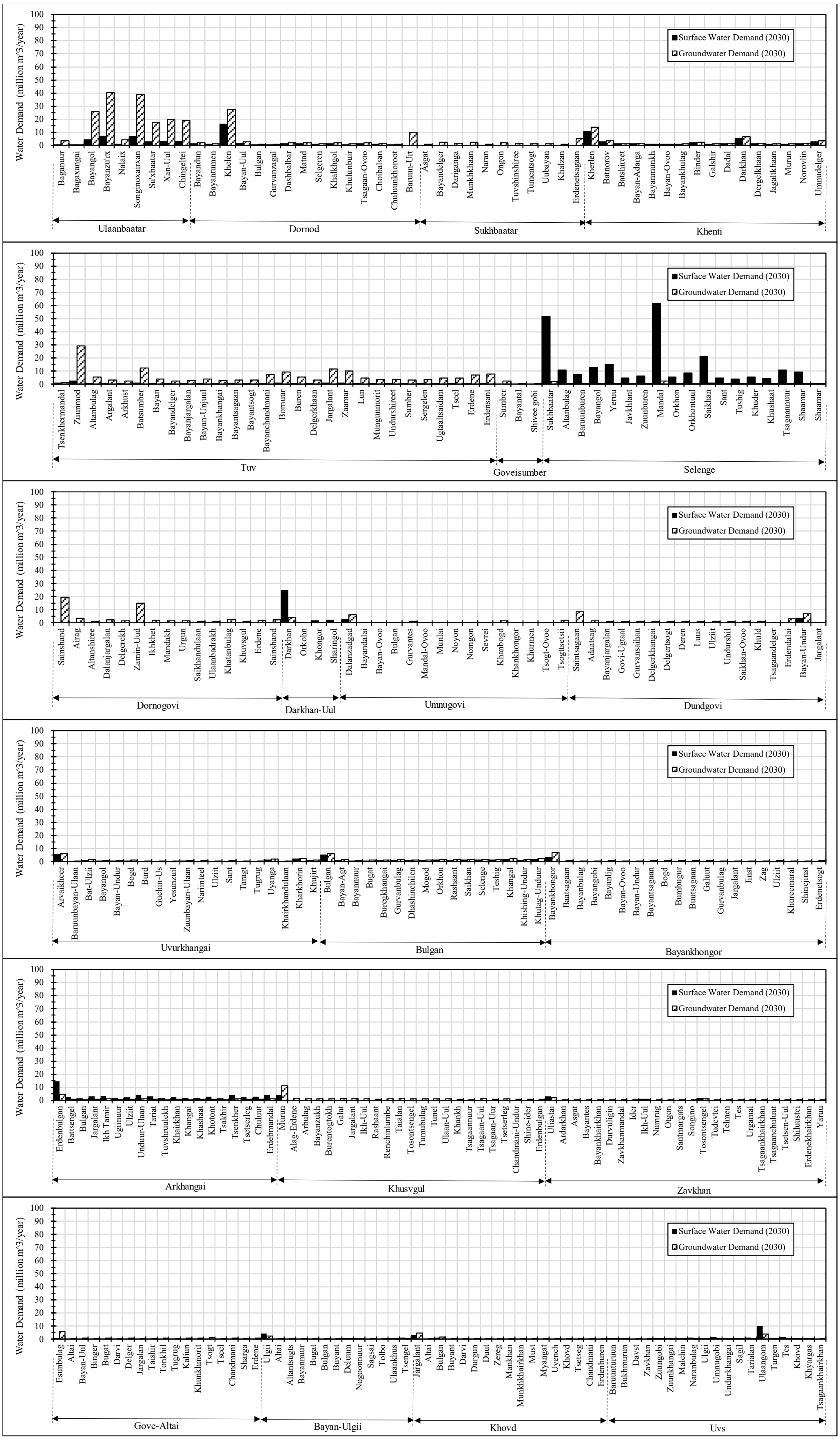
Source: JICA Project Team

Table 3.5.26 Estimated Water Demand by Soum in 2040

Unit: million m^3/year

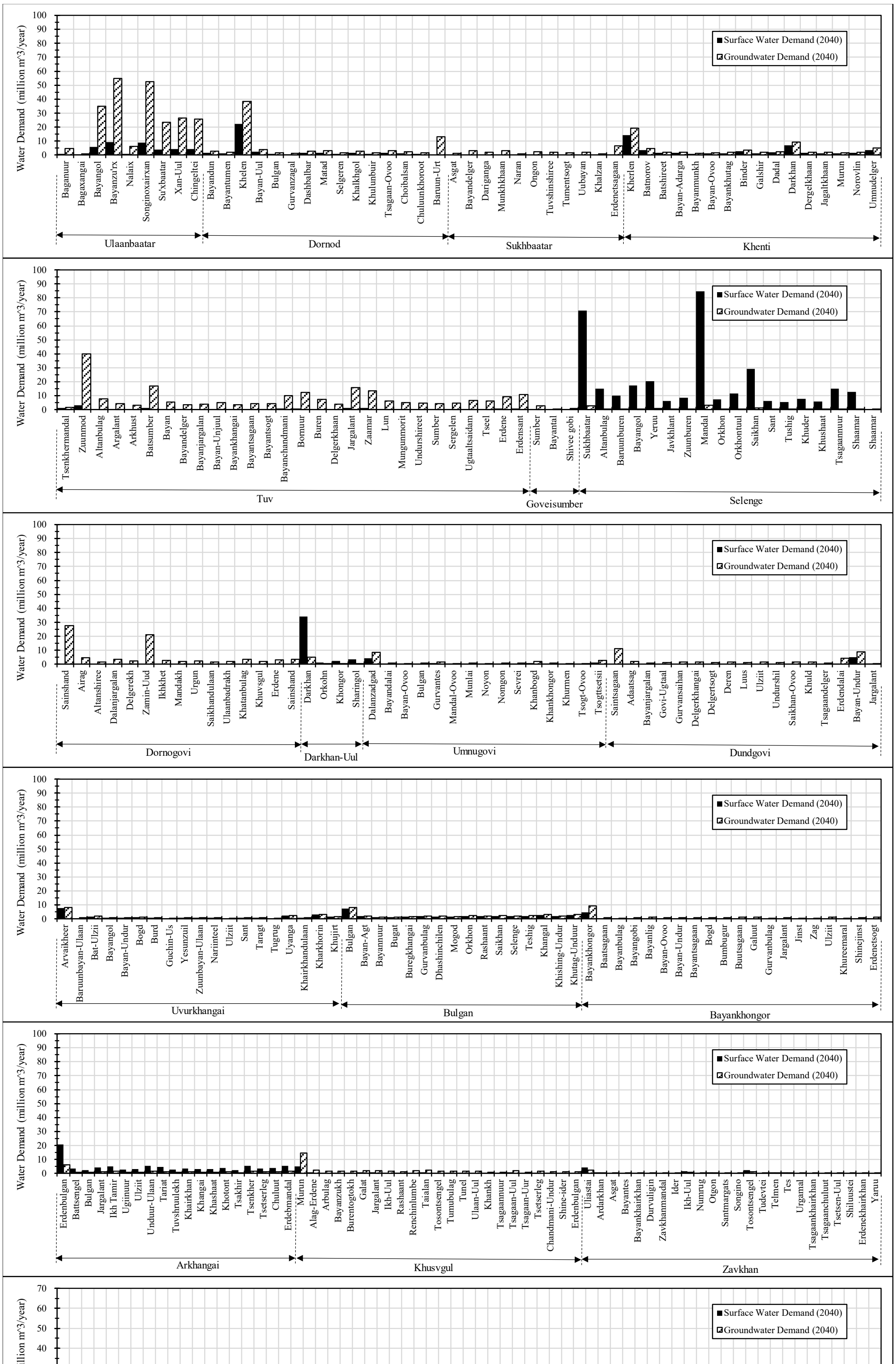
ID	Aimag	Soum Name	Water Demand 2040			ID	Aimag	Soum Name	Water Demand 2040			ID	Aimag	Soum Name	Water Demand 2040		
			SW	GW	Total				SW	GW	Total				SW	GW	Total
1101	Ulaanbaatar	Baganuur	0.82	4.85	5.67	4440	Dornogovi	Erdene	0.00	3.15	3.15	6704	Khusvgul	Alag-Erdene	0.85	2.44	3.28
1104	Ulaanbaatar	Bagaxangai	0.12	0.71	0.82	4443	Dornogovi	Sainshand	0.00	3.67	3.67	6707	Khusvgul	Arbulag	0.54	1.54	2.08
1107	Ulaanbaatar	Bayangol	5.94	35.10	41.05	4501	Darkhan-Uul	Darkhan	34.31	5.20	39.51	6710	Khusvgul	Bayanzukh	0.54	1.55	2.09
1110	Ulaanbaatar	Bayanzu'rx	9.27	54.77	64.04	4504	Darkhan-Uul	Orkohn	1.31	0.20	1.51	6713	Khusvgul	Burentogtokh	0.58	1.67	2.24
1113	Ulaanbaatar	Nalaix	1.04	6.11	7.15	4507	Darkhan-Uul	Khongor	2.54	0.39	2.92	6716	Khusvgul	Galat	0.71	2.05	2.77
1116	Ulaanbaatar	Songinoxairxan	8.88	52.44	61.32	4510	Darkhan-Uul	Sharingol	3.40	0.52	3.92	6719	Khusvgul	Jargalant	0.71	2.03	2.74
1119	Ulaanbaatar	Su'xbaatar	3.98	23.49	27.47	4601	Umnugovi	Dalanzadgad	4.15	8.48	12.63	6722	Khusvgul	Ikh-Uul	0.54	1.57	2.11
1121	Ulaanbaatar	Xan-Uul	4.47	26.43	30.90	4604	Umnugovi	Bayandalai	0.37	0.76	1.13	6725	Khusvgul	Rashaant	0.50	1.43	1.92
1125	Ulaanbaatar	Chingeltei	4.36	25.76	30.13	4607	Umnugovi	Bayan-Ovoo	0.31	0.62	0.93	6728	Khusvgul	Renchinlumbe	0.66	1.90	2.55
2104	Dornod	Bayandun	1.54	2.66	4.20	4610	Umnugovi	Bulgan	0.37	0.76	1.13	6731	Khusvgul	Taialan	0.78	2.25	3.03
2107	Dornod	Bayantumen	22.30	38.44	60.74	4613	Umnugovi	Gurvantes	0.83	1.69	2.52	6734	Khusvgul	Tosontsengel	0.56	1.63	2.19
2107	Dornod	Bayantumen	22.30	38.44	60.74	4616	Umnugovi	Mandal-Ovoo	0.29	0.60	0.89	6737	Khusvgul	Tumubulag	0.57	1.65	2.22
2110	Dornod	Bayan-Uul	2.32	4.00	6.32	4619	Umnugovi	Munlai	0.44	0.90	1.35	6740	Khusvgul	Tunel	0.55	1.59	2.14
2113	Dornod	Bulgan	0.87	1.51	2.38	4622	Umnugovi	Noyon	0.23	0.47	0.70	6743	Khusvgul	Ulaan-Uul	0.57	1.65	2.23
2116	Dornod	Gurvanzagal	0.70	1.20	1.89	4625	Umnugovi	Nomgon	0.46	0.94	1.40	6746	Khusvgul	Khankh	0.33	0.96	1.29
2119	Dornod	Dashbalbar	1.67	2.88	4.56	4628	Umnugovi	Sevrei	0.37	0.75	1.12	6749	Khusvgul	Tsagaannuur	0.25	0.72	0.97
2122	Dornod	Matad	1.80	3.10	4.91	4631	Umnugovi	Khanbogd	1.01	2.06	3.07	6752	Khusvgul	Tsagaan-Uul	0.74	2.13	2.87
2125	Dornod	Selgeren	0.99	1.71	2.70	4634	Umnugovi	Khankhongor	0.37	0.75	1.12	6755	Khusvgul	Tsagaan-Uur	0.35	1.01	1.35
2128	Dornod	Khalkhgol	1.55	2.67	4.22	4637	Umnugovi	Khurmen	0.28	0.58	0.87	6758	Khusvgul	Tsetserleg	0.61	1.77	2.38
2131	Dornod	Khulunbuir	0.90	1.54	2.44	4640	Umnugovi	Tsogt-Ovoo	0.30	0.62	0.92	6761	Khusvgul	Chandmani-Undur	0.41	1.19	1.60
2134	Dornod	Tsagaan-Ovoo	1.78	3.07	4.85	4643	Umnugovi	Tsogttsetsii	1.35	2.76	4.12	6764	Khusvgul	Shine-ider	0.43	1.25	1.69
2137	Dornod	Choibalsan	1.31	2.27	3.58	4801	Dundgovi	Saintsagaan	0.00	11.25	11.25	6767	Khusvgul	Erdenbulgan	0.38	1.10	1.48
2140	Dornod	Chuluunkhoroot	0.87	1.50	2.36	4804	Dundgovi	Adaatsag	0.00	2.20	2.20	8101	Zavkhan	Uliastai	4.34	2.51	6.84
2201	Sukhbaatar	Baruun-Urt	0.00	13.29	13.29	4807	Dundgovi	Bayanjargalan	0.00	0.94	0.94	8104	Zavkhan	Ardarkhan	0.74	0.43	1.17
2204	Sukhbaatar	Asgat	0.00	1.16	1.16	4810	Dundgovi	Govi-Ugtaal	0.00	1.24	1.24	8107	Zavkhan	Asgat	0.26	0.15	0.40
2207	Sukhbaatar	Bayandelger	0.00	3.24	3.24	4813	Dundgovi	Gurvansaihan	0.00	1.63	1.63	8110	Zavkhan	Bayantes	0.69	0.40	1.09
2210	Sukhbaatar	Dariganga	0.00	2.02	2.02	4816	Dundgovi	Delgerkhangai	0.00	1.70	1.70	8113	Zavkhan	Bayankhairkhan	0.47	0.27	0.74
2213	Sukhbaatar	Munkhkhaan	0.00	3.05	3.05	4819	Dundgovi	Delgertsogt	0.00	1.22	1.22	8116	Zavkhan	Durvuligin	0.56	0.32	0.88
2216	Sukhbaatar	Naran	0.00	1.05	1.05	4822	Dundgovi	Deren	0.00	1.59	1.59	8119	Zavkhan	Zavkhanmandal	0.29	0.17	0.45
2219	Sukhbaatar	Ongon	0.00	2.56	2.56	4825	Dundgovi	Luus	0.00	1.41	1.41	8122	Zavkhan	Ider	0.67	0.39	1.05
2225	Sukhbaatar	Tuvshinshiree	0.00	2.20	2.20	4828	Dundgovi	Ulziit	0.00	1.82	1.82	8125	Zavkhan	Ikh-Uul	1.65	0.96	2.61
2228	Sukhbaatar	Tumentsogt	0.00	1.62	1.62	4831	Dundgovi	Undurshil	0.00	1.11	1.11	8128	Zavkhan	Numrug	0.48	0.28	0.75
2231	Sukhbaatar	Uubayan	0.00	1.93	1.93	4834	Dundgovi	Saikhan-Ovoo	0.00	1.68	1.68	8131	Zavkhan	Otgon	0.72	0.41	1.13
2234	Sukhbaatar	Khalzan	0.00	1.08	1.08	4837	Dundgovi	Khuld	0.00	1.81	1.81	8134	Zavkhan	Santmargats	0.42	0.24	0.66
2237	Sukhbaatar	Erdenetsagaan	0.00	6.53	6.53	4840	Dundgovi	Tsagaandelger	0.00	0.77	0.77	8137	Zavkhan	Songino	0.41	0.24	0.64
2301	Khenti	Kherlen	14.26	19.29	33.56	4843	Dundgovi	Erdendalai	0.00	4.40	4.40	8140	Zavkhan	Tosontsengel	2.42	1.40	3.82
2304	Khenti	Batnorov	3.59	4.85	8.44	6101	Orkhon	Bayan-Undur	5.26	8.90	14.17	8143	Zavkhan	Tudevtei	0.50	0.29	0.80
2307	Khenti	Batshireet	1.49	2.02	3.51	6104	Orkhon	Jargalant	0.21	0.35	0.56	8146	Zavkhan	Telmen	0.73	0.42	1.15
2310	Khenti	Bayan-Adarga	1.60	2.17	3.77	6201	Uvurkhangai	Arvaikheer	7.70	8.02	15.72	8149	Zavkhan	Tes	0.76	0.44	1.20
2313	Khenti	Bayanmunkh	1.08	1.46	2.54	6204	Uvurkhangai	Baruunbayan-Ulaan	0.69	0.71	1.40	8152	Zavkhan	Urgamal	0.33	0.19	0.52
2316	Khenti	Bayan-Ovoo	1.10	1.49	2.58	6207	Uvurkhangai	Bat-Ulzii	1.85	1.92	3.77	8155	Zavkhan	Tsagaankhairkhan	0.34	0.19	0.53
2319	Khenti	Bayankhutag	1.43	1.93	3.37	6210	Uvurkhangai	Bayangol	0.97	1.01	1.98	8158	Zavkhan	Tsagaanchuluut	0.34	0.20	0.54
2322	Khenti	Binder	2.64	3.56	6.20	6213	Uvurkhangai	Bayan-Undur	0.96	1.00	1.96	8161	Zavkhan	Tsetsen-Uul	0.46	0.26	0.72
2325	Khenti	Galshir	1.40	1.89	3.29	6216	Uvurkhangai	Bogd	1.38	1.44	2.82	8164	Zavkhan	Shiluustei	0.47	0.27	0.75
2328	Khenti	Dadal	1.87	2.53	4.40	6219	Uvurkhangai	Burd	0.72	0.75	1.47	8167	Zavkhan	Erdenekhairkhan	0.41	0.24	0.65
2331	Khenti	Darkhan	6.90	9.34	16.24	6222	Uvurkhangai	Guchin-Us	0.54	0.57	1.11	8170	Zavkhan	Yaruu	0.52	0.30	0.82
2334	Khenti	Dergelkhaan	1.55	2.10	3.65	6225	Uvurkhangai	Yesunzuil	0.76	0.79	1.55	8201	Gove-Altai	Esunbulag	1.30	7.41	8.71
2337	Khenti	Jagaltkhaan	1.39	1.88	3.26	6228	Uvurkhangai	Zuunbayan-Ulaan	0.99	1.03	2.02	8204	Gove-Altai	Altai	0.15	0.88	1.03
2340	Khenti	Murun	1.21	1.64	2.86	6231	Uvurkhangai	Nariinteel	0.91	0.95	1.86	8207	Gove-Altai	Bayan-Uul	0.22	1.24	1.46
2343	Khenti	Norovlin	1.55	2.10	3.65	6234	Uvurkhangai	Ulziit	0.60	0.62	1.22	8210	Gove-Altai	Binger	0.15	0.88	1.03
2346	Khenti	Umnudelger	3.66	4.95	8.61	6237	Uvurkhangai	Sant	0.89	0.92	1.81	8213	Gove-Altai	Bugat	0.16	0.91	1.07
2349	Khenti	Tsenkhermandal	1.22	1.66	2.88	6240	Uvurkhangai	Taragt	0.82	0.85	1.66	8216	Gove-Altai	Darvi	0.13	0.76	0.89
4101	Tuv	Zuunmod	3.22	39.89	43.11	6243	Uvurkhangai	Tugrug	0.67	0.70	1.38	8219	Gove-Altai	Delger	0.22	1.26	1.48
4103	Tuv	Altanbulag	0.61	7.61	8.22	6246	Uvurkhangai	Uyanga	2.38	2.48	4.86	8222	Gove-Altai	Jargalan	0.13	0.73	0.86
4107	Tuv	Argalant	0.34	4.24	4.58	6249	Uvurkhangai	Khairkhandulaan	0.85	0.89	1.74	8225	Gove-Altai	Taishir	0.11	0.61	0.72
4110	Tuv	Arkhust	0.25	3.13	3.38	6252	Uvurkhangai	Kharkhorin	3.06	3.18	6.24	8228	Gove-Altai	Tonkhil	0.16	0.89	1.05
4113	Tuv	Batsumber	1.37	16.99	18.37	6255	Uvurkhangai	Khujirt	1.67	1.74	3.41	8231	Gove-Altai	Tugrug	0.15	0.84	0.99
4116	Tuv	Bayan	0.43	5.35	5.78	6301	Bulgan	Bulgan	7.54	8.09	15.63	8234	Gove-Altai	Kaliun	0.17	0.99	1.16
4119	Tuv	Bayandelger	0.28	3.49	3.77	6304	Bulgan	Bayan-Agt	1.89	2.03	3.93	8237	Gove-Altai	Khunkhmorit	0.17	0.97	1.14
4122	Tuv	Bayanjargalan	0.32	3.93	4.25	6307	Bulgan	Bayannuur	1.16	1.25	2.41	8240	Gove-Altai	Tsogt	0.26	1.46	1.72
4125	Tuv	Bayan-Unjuul	0.42	5.24	5.66	6310	Bulgan	Bugat	1.36	1.46	2.81	8243	Gove-Altai	Tseel	0.15	0.87	1.03
4128	Tuv	Bayankhangai	0.30	3.69	3.99	6313	Bulgan	Buregkhangai	1.69	1.82	3.51	8246	Gove-Altai	Chandmani	0.16	0.91	1.06
4131	Tuv	Bayantsagaan	0.37	4.52	4.89	6316	Bulgan	Gurvanbulag	1.95	2.10	4.05	8249	Gove-Altai	Sharga	0.14	0.82	0.96
4134	Tuv	Bayantsogt	0.36	4.47	4.83	6319	Bulgan	Dhashinchilen	1.74	1.87	3.61	8252	Gove-Altai	Erdene	0.16	0.90	1.05
4137	Tuv	Bayanchandmani	0.82	10.09	10.90	6322	Bulgan	Mogod	1.67	1.79	3.45	8301	Bayan-Ulgii	Ulgii	5.62	3.45	9.07
4140	Tuv	Bornuur	1.01	12.47	13.48	6325	Bulgan	Orkhon	2.17	2.32	4.49	8304	Bayan-Ulgii	Altai	0.70	0.43	1.12
4143	Tuv	Buren	0.60	7.48	8.08	6328	Bulgan	Rashaant	1.95	2.09	4.04	8307	Bayan-Ulgii	Altantsugts	0.47	0.29	0.76
4146	Tuv	Delgerkhaan	0.33	4.12	4.45	6331	Bulgan	Saikhan	2.22	2.38	4.61	8310	Bayan-Ulgii	Bayannuur	0.81	0.50	1.31
4149	Tuv	Jargalant	1.29	15.96	17.25	6334	Bulgan	Selenge	1.99	2.14	4.13	8313	Bayan-Ulgii	Bugat	0.61	0.37	0.98
4152	Tuv	Zaamar	1.10	13.64	14.75	6337	Bulgan	Teshig	2.17	2.33	4.50	8316	Bayan-Ulgii	Bulgan	0.86	0.53	1.38
4155	Tuv	Lun	0.52	6.38	6.90	6340	Bulgan	Khangal	2.81	3.02	5.83	8319	Bayan-Ulgii	Buyant	0.45	0.28	0.73
4158	Tuv	Mungunmorit	0.40	4.96	5.36	6343	Bulgan	Khishing-Undur	1.95	2.09	4.04	8322	Bayan-Ulgii	Deluum	1.20	0.73	1.93
4161	Tuv	Undurshireet	0.38	4.76	5.15	6346	Bulgan	Khutag-Unduur	2.94	3.16	6.10	8325	Bayan-Ulgii	Nogoonnuur	1.30	0.80	2.10
4164	Tuv	Sumber	0.36	4.43	4.78	6401	Bayankhongor	Bayankhongor	4.90	9.31	14.20	8328	Bayan-Ulgii	Sagsai	0.85	0.52	1.37
4167	Tuv	Sergelen	0.39	4.88	5.28	6404	Bayankhongor	Baatsagaan	0.51	0.98	1.49	8331	Bayan-Ulgii	Tolbo	0.68	0.42	1.10
4170	Tuv	Ugtaaltsaidam	0.53	6.57	7.10	6407	Bayankhongor	Bayanbulag	0.27	0.52	0.80	8334	Bayan-Ulgii	Ulaankhus	1.40	0.86	2.25
4173	Tuv	Tseel	0.50	6.20	6.70	6410	Bayankhongor	Bayangobi	0.46	0.87	1.33	8340	Bayan-Ulgii	Tsengel	1.50	0.92	2.43
4176	Tuv	Erdene	0.76	9.40	10.16	6413	Bayankhongor	Bayanlig	0.60	1.15	1.75	8401	Khovd	Jargalant	4.43	5.94	10.37
4179	Tuv	Erdensant	0.87	10.72	11.58	6416	Bayankhongor	Bayan-Ovoo	0.42	0.80	1.22	8404	Khovd	Altai	0.49	0.66	1.15
4201	Goveisumber	Sumber	0.00	2.95	2.95	6419	Bayankhongor	Bayan-Undur	0.42	0.80	1.22	8407	Khovd	Bulgan	1.49	2.00	3.49
4204	Goveisumber	Bayantal	0.00	0.29	0.29	6422	Bayankhongor	Bayantsagaan	0.56	1.06	1.62	8410	Khovd	Buyant	0.54	0.72	1.26
4207	Goveisumber	Shivee gobi	0.00	0.81	0.81	6425	Bayankhongor	Bogd	0.50	0.95	1.45	8413	Khovd	Darvi	0.45	0.60	1.05
4301	Selenge	Sukhbaatar	70.85	2.76	73.61	6428	Bayankhongor	Bumbugur	0.51	0.96	1.47	8416	Khovd	Durgun	0.46	0.62	1.08
4304	Selenge	Altanbulag	15.07	0.59	15.65	6431	Bayankhongor	Buutsagaan	0.58	1.11	1.69	8419	Khovd	Duut	0.31	0.41	0.72
4307	Selenge	Baruunburen	9.91	0.39	10.30	6434	Bayankhongor	Galuut	0.63	1.19	1.82	8422	Khovd	Zereg	0.50	0.67	1.17
4310	Selenge	Bayangol	17.21	0.67	17.89	6437	Bayankhongor	Gurvanbulag	0.35	0.67	1.03	8425	Khovd	Mankhan	0.65	0.87	1.51
4313	Selenge	Yeruu	20.37	0.79	21.16	6440	Bayankhongor	Jargalant	0.47	0.89	1.36	8428	Khovd	Munkhkhairkhan	0.35	0.47	0.81
4316	Selenge	Javkhlant	6.29	0.24	6.53	6443	Bayankhongor	Jinst	0.35	0.67	1.02	8431	Khovd	Must	0.49	0.65	1.14
4319	Selenge	Zuunburen	8.62	0.34	8.95	6446	Bayankhongor	Zag	0.33	0.63	0.97	8434	Khovd	Myangat	0.57	0.76	1.33
4322	Selenge	Mandal	84.52	3.29	87.81	6449	Bayankhongor	Ulziit	0.61	1.15	1.76	8437	Khovd	Uyench	0.65	0.87	1.52
4325	Selenge	Orkhon	7.35	0.29	7.63	6452	Bayankhongor	Khureemaral	0.28	0.54	0.82	8440	Khovd	Khovd	0.55	0.74	1.29
4328	Selenge	Orkhontuul	11.54	0.45	11.99	6455	Bayankhongor	Shinejinst	0.38	0.73	1.11	8443	Khovd	Tsetseg	0.46	0.62	1.09
4331	Selenge	Saikhan	29.09	1.13	30.22	6458	Bayankhongor	Erdenetsogt	0.68	1.30	1.98	8446	Khovd	Chandmani	0.45	0.61	1.06
4334	Selenge	Sant	6.25	0.24	6.49	6501	Arkhangai	Erdenbulgan	20.70	6.38	27.08	8449	Khovd	Erdenburen	0.37	0.50	0.87
4337	Selenge	Tushig	5.40	0.21	5.61	6504	Arkhangai	Battsengel	3.51	1.08	4.60	8504	Uvs	Baruunturuun	1.18	0.45	1.63
4340	Selenge	Khuder	7.60	0.30	7.89	6507	Arkhangai	Bulgan	2.41	0.74	3.15	8507	Uvs	Bukhmurun	0.96	0.36	1.33
4343	Selenge	Khushaat	5.83	0.23	6.06	6510	Arkhangai	Jargalant	4.23	1.30	5.54	8510	Uvs	Davst	0.70	0.26	0.97
4346	Selenge	Tsagaannuur	14.93	0.58	15.51	6513	Arkhangai	Ikh Tamir	5.20	1.60	6.80	8513	Uvs	Zavkhan	0.80	0.30	1.11
4349	Selenge	Shaamar	12.61	0.49	13.11	6516	Arkhangai	Ugiinuur	2.94	0.91	3.84	8516	Uvs	Zuungobi	1.21	0.46	1.66
4352	Selenge	Shaamar	0.24	0.01	0.24	6519	Arkhangai	Ulziit	3.22	0.99	4.21	8519	Uvs	Zuunkhangai	1.00	0.38	1.38
4401	Dornogovi	Sainshand	0.00	27.56	27.56	6522	Arkhangai	Unduur-Ulaan	5.52	1.70	7.22	8522	Uvs	Malchin	1.11	0.42	1.53
4404	Dornogovi	Airag	0.00	4.86	4.86	6525	Arkhangai	Tariat	4.55	1.40	5.95	8525	Uvs	Naranbulag	1.80	0.68	2.48
4407	Dornogovi	Altanshiree	0.00	1.70	1.70	6528	Arkhangai	Tuvshruulekh	2.90	0.90	3.80	8528	Uvs	Ulgii	1.05	0.40	1.44
4410	Dornogovi	Dalanjargalan	0.00	3.61	3.61	6531	Arkhangai	Khairkhan	3.61	1.11	4.73	8531	Uvs	Umnugobi	1.98	0.75	2.73
4413	Dornogovi	Delgerekh	0.00	2.49	2.49	6534	Arkhangai	Khangai	3.04	0.94	3.97	8534	Uvs	Undurkhangai	1.42	0.54	1.95
4416	Dornogovi	Zamin-Uud	0.00	21.14	21.14	6537	Arkhangai	Khashaat	3.09	0.95	4.05	8537	Uvs	Sagil	1.04	0.39	1.44
4419	Dornogovi	Ikhkhet	0.00	2.75	2.75	6540	Arkhangai	Khotont	4.12	1.27	5.39	8540	Uvs	Tarialan	13.52	5.12	18.64
4422	Dornogovi	Mandakh	0.00	2.11	2.11	6543	Arkhangai	Tsakhir	2.27	0.70	2.97	8540	Uvs	Tarialan	13.52	5.12	18.64
4425	Dornogovi	Urgun	0.00	2.54	2.54	6546	Arkhangai	Tsenkher	5.47	1.69	7.16	8543	Uvs	Turgen	0.95	0.36	1.31
4428	Dornogovi	Saikhandulaan	0.00	1.74	1.74	6549	Arkhangai	Tsetserleg	3.62	1.12	4.74	8546	Uvs	Tes	2.32	0.88	3.20
4431	Dornogovi	Ulaanbadrakh	0.00	1.93	1.93	6552	Arkhangai	Chuluut	3.83	1.18	5.01	8549	Uvs	Khovd	1.07	0.40	1.47
4434	Dornogovi	Khatanbulag	0.00	3.71	3.71	6555	Arkhangai	Erdebmandal	5.32	1.64	6.96	8552	Uvs	Khyargas	1.10	0.42	1.52
4437	Dornogovi	Khuvsgul	0.00	2.04	2.04	6701	Khusvgul	Murun	5.15	14.85	20.01	8555	Uvs	Tsagaankhairkhan	0.89	0.34	1.23

Source: JICA Project Team



Source: JICA Project Team

Figure 3.5.25 Estimated Water Demand by Soum in 2030



Source: JICA Project Team

Figure 3.5.26 Estimated Water Demand by Soum in 2040

(2) Water supply-demand gap estimates

Water supply-demand gaps and water balance in 2018, 2030 and 2040 by using water availability (water potential) estimated by the Ministry of Environment and Tourism are summarized in Table 3.5.27. Some Aimags will face water shortages in the future. The largest gaps are projected for Dornogovi, followed by Umnugovi, Darkhan-Uul and Orkhon in 2040. The gaps will exist already in 2030 in these Aimags.

Table 3.5.27 Water Supply and Demand Balance Using MET's Water Potential Estimation

Unit: million m^3/year

Aimag Name	Water Availability *			Water Demand in 2018			Gap in 2018			Water Demand in 2030			Gap in 2030			Water Demand in 2040			Gap in 2040		
	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total
	a	b	c=a+b	d	e	f=d+e	g=c-d	h=c-e	i=c-f	d	e	f=d+e	m=c-j	n=c-k	o=c-l	p	q	r=p+q	s=c-p	t=c-q	u=c-r
Mongolia	**33,783.0**	**11,816.3**	**45,599.3**	**352.7**	**505.0**	**857.7**	**33,430.3**	**11,311.3**	**44,741.6**	**596.7**	**779.9**	**1,376.6**	**33,186.3**	**11,036.4**	**44,222.7**	**811.4**	**1,051.4**	**1,862.8**	**32,971.6**	**10,764.9**	**43,736.5**
Western Region	*7,908.0*	*2,770.0*	*10,678.0*	*42.4*	*38.2*	*80.5*	*7,865.6*	*2,731.8*	*10,597.5*	*66.6*	*59.5*	*126.1*	*7,841.4*	*2,710.5*	*10,551.9*	*88.5*	*75.6*	*164.2*	*7,819.5*	*2,694.4*	*10,513.8*
Bayan-Ulgii	2,390.0	1,050.0	3,440.0	7.7	4.5	12.3	2,382.3	1,045.5	3,427.7	12.5	7.5	19.9	2,377.5	1,042.5	3,420.1	16.5	10.1	26.5	2,373.5	1,039.9	3,413.5
Gove-Altai	58.0	100.0	158.0	1.8	12.1	13.9	56.2	87.9	144.1	3.0	18.6	21.6	55.0	81.4	136.4	4.1	23.3	27.4	53.9	76.7	130.6
Zavkhan	3,160.0	1,140.0	4,300.0	9.7	5.7	15.3	3,150.3	1,134.3	4,284.7	14.6	8.7	23.3	3,145.4	1,131.3	4,276.7	18.9	11.0	29.9	3,141.1	1,129.0	4,270.1
Uvs	1,200.0	230.0	1,430.0	18.0	6.9	24.8	1,182.0	223.1	1,405.2	26.8	10.6	37.3	1,173.2	219.4	1,392.7	35.8	13.5	49.4	1,164.2	216.5	1,380.6
Khovd	1,100.0	250.0	1,350.0	5.2	9.0	14.2	1,094.8	241.0	1,335.8	9.8	14.2	24.0	1,090.2	235.8	1,326.0	13.2	17.7	30.9	1,086.8	232.3	1,319.1
Khangai Region	*12,185.0*	*4,251.0*	*16,436.0*	*80.6*	*85.2*	*165.8*	*12,104.4*	*4,165.8*	*16,270.2*	*140.9*	*138.5*	*279.4*	*12,044.1*	*4,112.5*	*16,156.6*	*191.8*	*182.6*	*374.4*	*11,993.2*	*4,068.4*	*16,061.6*
Arkhangai	2,830.0	1,060.0	3,890.0	32.6	12.9	45.4	2,797.4	1,047.1	3,844.6	64.0	20.5	84.5	2,766.0	1,039.5	3,805.5	89.6	27.6	117.2	2,740.4	1,032.4	3,772.8
Bayankhongor	450.0	100.0	550.0	6.1	11.4	17.6	443.9	88.6	532.4	10.5	19.8	30.2	439.5	80.2	519.8	13.8	26.3	40.1	436.2	73.7	509.9
Bulgan	1,750.0	500.0	2,250.0	17.7	19.2	36.9	1,732.3	480.8	2,213.1	27.8	30.1	58.0	1,722.2	469.9	2,192.0	37.2	39.9	77.2	1,712.8	460.1	2,172.8
Orkhon	5.0	1.0	6.0	2.6	3.4	6.0	2.4	-2.4	0.0	4.1	7.7	11.8	0.9	-6.7	-5.8	5.5	9.3	14.7	-0.5	-8.3	-8.7
Uvurkhangai	560.0	100.0	660.0	12.9	14.1	27.0	547.1	85.9	633.0	21.3	22.7	44.0	538.7	77.3	616.0	28.4	29.6	58.0	531.6	70.4	602.0
Khusvgul	6,590.0	2,490.0	9,080.0	8.7	24.3	33.0	6,581.3	2,465.7	9,047.0	13.3	37.7	51.0	6,576.7	2,452.3	9,029.0	17.3	49.9	67.2	6,572.7	2,440.1	9,012.8
Central Region	*5,334.0*	*1,661.3*	*6,995.3*	*176.4*	*165.0*	*341.4*	*5,157.6*	*1,496.3*	*6,653.9*	*296.2*	*286.3*	*582.5*	*5,037.8*	*1,375.0*	*6,412.8*	*404.5*	*390.4*	*794.9*	*4,929.5*	*1,270.9*	*6,200.3*
Goveisumber	10.0	1.0	11.0	0.0	1.9	1.9	10.0	-0.9	9.1	0.0	3.1	3.1	10.0	-2.1	7.9	0.0	4.1	4.1	10.0	-3.1	6.9
Darkhan-Uul	44.0	10.0	54.0	16.3	2.6	18.9	27.7	7.4	35.1	30.5	5.4	35.9	13.5	4.6	18.1	41.6	6.3	47.9	2.4	3.7	6.1
Dornogovi	50.0	10.0	60.0	0.0	28.8	28.8	50.0	-18.8	31.2	0.0	60.0	60.0	50.0	-50.0	-0.0	0.0	85.0	85.0	50.0	-75.0	-25.0
Dundgovi	120.0	80.0	200.0	0.0	16.8	16.8	120.0	63.2	183.2	0.0	26.2	26.2	120.0	53.8	173.8	0.0	34.8	34.8	120.0	45.2	165.2
Umnugovi		0.3	0.3	4.7	9.8	14.5	-4.7	-9.5	-14.2	8.3	16.8	25.1	-8.3	-16.5	-24.8	11.1	22.7	33.9	-11.1	-22.5	-33.6
Selenge	3,200.0	970.0	4,170.0	147.2	4.9	152.1	3,052.8	965.1	4,017.9	243.7	9.9	253.6	2,956.3	960.1	3,916.4	333.7	13.0	346.7	2,866.3	957.0	3,823.3
Tuv	1,910.0	590.0	2,500.0	8.2	100.3	108.5	1,901.8	489.7	2,391.5	13.8	164.9	178.7	1,896.2	425.1	2,321.3	18.2	224.6	242.7	1,891.8	365.4	2,257.3
Eastern Region	*8,340.0*	*3,030.0*	*11,370.0*	*39.4*	*72.3*	*111.6*	*8,300.6*	*2,957.7*	*11,258.4*	*64.2*	*126.2*	*190.4*	*8,275.8*	*2,903.8*	*11,179.6*	*87.7*	*173.1*	*260.8*	*8,252.3*	*2,856.9*	*11,109.2*
Dornod	1,510.0	300.0	1,810.0	17.4	25.9	43.3	1,492.6	274.1	1,766.7	28.8	48.9	77.7	1,481.2	251.1	1,732.3	39.7	68.5	108.2	1,470.3	231.5	1,701.8
Sukhbaatar	140.0	30.0	170.0	0.0	19.9	19.9	140.0	10.1	150.1	0.0	30.2	30.2	140.0	-0.2	139.8	0.0	39.7	39.7	140.0	-9.7	130.3
Khenti	6,690.0	2,700.0	9,390.0	22.0	26.4	48.4	6,668.0	2,673.6	9,341.6	35.5	47.0	82.5	6,654.5	2,653.0	9,307.5	47.9	64.9	112.8	6,642.1	2,635.1	9,277.2
*Ulaanbaatar ***	16.0	104.0	120.0	14.0	144.3	158.3	2.0	-40.3	-38.3	28.8	169.4	198.2	-12.8	-65.4	-78.2	38.9	229.7	268.5	-22.9	-125.7	-148.5

Source: JICA Project Team, (2019)
* : Water Availability: MET, (2019), https;//eic.mn. **: Water Availability of Ulaanbaatar from 2030 WRG, (20116)

Aimag-wise water supply-demand gaps and water balance in 2018, 2030 and 2040 by using water availability (water potential) estimated by the JPT for average year and dry year are summarized in Table 3.5.28 and Table 3.5.29. This Aimag-wise water balance analysis does not show serious water gaps except Ulaanbaatar in dry year. The estimated water availabilities (water potentials) of the JPT estimation are larger than the MET estimation values. However, from the viewpoint of the Soum-wise water balance, many Soums will face serious water shortages in the future as shown in Figures 3.5.27 through 3.5.30. Details of Soum-wise water balance are shown in Tables 3.5.30 through 3.5.31. The largest gaps are projected for Sukhbaatar Soum in Selenge Aimag, followed by Zuunmod in Tuv Aimag, Bayangol in Ulaanbaatar, Darkhan in Darkhan-Uul, Bayanzu'rx in Ulaanbaatar Chingeltei in Ulaanbaatar, Sainshand in Dornogovi, Erdenbulgan in Arkhangai and Zamin-Uud in Dornogovi in 2040. The gaps will exist already in 2030 in these Soums. The details of water deficit by Soum are shown in Figure 3.5.31 and Figure 3.5.32.

Table 3.5.28 Water Supply and Demand Balance by Aimag Using JPT's Water Potential Estimation (Average Year)

Unit: million m^3/year

Aimag Name	Water Availability (Average)			Water Demand in 2018			Gap in 2018			Water Demand in 2030			Gap in 2030			Water Demand in 2040			Gap in 2040		
	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total
	a	b	c=a+b	d	e	f=d+e	g=c-d	h=c-e	i=c-f	d	e	f=d+e	m=c-j	n=c-k	o=c-l	p	q	r=p+q	s=c-p	t=c-q	u=c-r
Mongolia	**44,209.5**	**80,487.4**	**124,696.9**	**352.7**	**505.0**	**857.7**	**43,856.8**	**79,982.3**	**123,839.1**	**596.7**	**779.9**	**1,376.6**	**43,612.8**	**79,707.5**	**123,320.3**	**811.4**	**1,051.4**	**1,862.8**	**43,398.1**	**79,436.0**	**122,834.1**
Western Region	*15,337.5*	*17,828.5*	*33,166.0*	*42.4*	*38.2*	*80.5*	*15,295.2*	*17,790.3*	*33,085.5*	*66.6*	*59.5*	*126.1*	*15,270.9*	*17,769.0*	*33,039.9*	*88.5*	*75.6*	*164.2*	*15,249.0*	*17,752.8*	*33,001.9*
Bayan-Ulgii	3,423.4	1,929.7	5,353.1	7.7	4.5	12.3	3,415.7	1,925.1	5,340.8	12.5	7.5	19.9	3,410.9	1,922.2	5,333.1	16.5	10.1	26.5	3,406.9	1,919.6	5,326.5
Gove-Altai	3,618.3	4,940.1	8,558.4	1.8	12.1	13.9	3,616.6	4,928.0	8,544.5	3.0	18.6	21.6	3,615.3	4,921.5	8,536.9	4.1	23.3	27.4	3,614.2	4,916.8	8,531.0
Zavkhan	2,197.9	3,838.2	6,036.0	9.7	5.7	15.3	2,188.2	3,832.5	6,020.7	14.6	8.7	23.3	2,183.2	3,829.5	6,012.7	18.9	11.0	29.9	2,178.9	3,827.2	6,006.1
Uvs	2,988.1	3,823.6	6,811.7	18.0	6.9	24.8	2,970.1	3,816.8	6,786.8	26.8	10.6	37.3	2,961.3	3,813.1	6,774.3	35.8	13.5	49.4	2,952.2	3,810.1	6,762.3
Khovd	3,109.9	3,296.9	6,406.8	5.2	9.0	14.2	3,104.7	3,287.9	6,392.6	9.8	14.2	24.0	3,100.1	3,282.7	6,382.8	13.2	17.7	30.9	3,096.7	3,279.2	6,375.9
Khangai Region	*17,498.3*	*29,615.2*	*47,113.5*	*80.6*	*85.2*	*165.8*	*17,417.7*	*29,530.0*	*46,947.7*	*140.9*	*138.5*	*279.4*	*17,357.4*	*29,476.7*	*46,834.1*	*191.8*	*182.6*	*374.4*	*17,306.5*	*29,432.6*	*46,739.2*
Arkhangai	4,713.9	7,046.3	11,760.2	32.6	12.9	45.4	4,681.3	7,033.5	11,714.8	64.0	20.5	84.5	4,649.9	7,025.8	11,675.7	89.6	27.6	117.2	4,624.3	7,018.7	11,643.0
Bayankhongor	1,727.8	3,365.8	5,093.5	6.1	11.4	17.6	1,721.6	3,354.3	5,076.0	10.5	19.8	30.2	1,717.3	3,346.0	5,063.3	13.8	26.3	40.1	1,714.0	3,339.5	5,053.4
Bulgan	2,976.6	6,150.7	9,127.3	17.7	19.2	36.9	2,958.9	6,131.6	9,090.5	27.8	30.1	58.0	2,948.8	6,120.6	9,069.4	37.2	39.9	77.2	2,939.4	6,110.8	9,050.2
Orkhon	12.6	61.0	73.6	2.6	3.4	6.0	9.9	57.7	67.6	4.1	7.7	11.8	8.5	53.3	61.8	5.5	9.3	14.7	7.1	51.8	58.9
Uvurkhangai	783.2	2,652.3	3,435.5	12.9	14.1	27.0	770.3	2,638.2	3,408.5	21.3	22.7	44.0	762.0	2,629.6	3,391.5	28.4	29.6	58.0	754.8	2,622.7	3,377.5
Khusvgul	7,284.2	10,339.1	17,623.4	8.7	24.3	33.0	7,275.5	10,314.8	17,590.3	13.3	37.7	51.0	7,271.0	10,301.4	17,572.4	17.3	49.9	67.2	7,266.9	10,289.2	17,556.1
Central Region	*8,134.6*	*17,076.9*	*25,211.5*	*176.4*	*165.0*	*341.4*	*7,958.3*	*16,911.9*	*24,870.1*	*296.2*	*286.3*	*582.5*	*7,838.4*	*16,790.6*	*24,629.0*	*404.5*	*390.4*	*794.9*	*7,730.1*	*16,686.4*	*24,416.6*
Goveisumber	58.7	105.3	164.1	0.0	1.9	1.9	58.7	103.5	162.2	0.0	3.1	3.1	58.7	102.2	161.0	0.0	4.1	4.1	58.7	101.3	160.0
Darkhan-Uul	32.2	533.6	565.8	16.3	2.6	18.9	15.9	531.1	547.0	30.5	5.4	35.9	1.7	528.2	530.0	41.6	6.3	47.9	-9.4	527.3	518.0
Dornogovi	896.5	2,258.9	3,155.4	0.0	28.8	28.8	896.5	2,230.2	3,126.7	0.0	60.0	60.0	896.5	2,198.9	3,095.4	0.0	85.0	85.0	896.5	2,173.9	3,070.4
Dundgovi	830.1	2,068.6	2,898.6	0.0	16.8	16.8	830.1	2,051.7	2,881.8	0.0	26.2	26.2	830.1	2,042.4	2,872.5	0.0	34.8	34.8	830.1	2,033.8	2,863.9
Umnugovi	1,522.8	3,660.4	5,183.1	4.7	9.8	14.5	1,518.1	3,650.6	5,168.7	8.3	16.8	25.1	1,514.5	3,643.5	5,158.1	11.1	22.7	33.9	1,511.6	3,637.6	5,149.2
Selenge	2,775.5	4,149.5	6,925.0	147.2	4.9	152.1	2,628.3	4,144.6	6,772.9	243.7	9.9	253.6	2,531.8	4,139.6	6,671.4	333.7	13.0	346.7	2,441.8	4,136.5	6,578.3
Tuv	2,018.9	4,300.5	6,319.4	8.2	100.3	108.5	2,010.7	4,200.2	6,210.9	13.8	164.9	178.7	2,005.1	4,135.6	6,140.7	18.2	224.6	242.7	2,000.8	4,075.9	6,076.7
Eastern Region	*2,826.8*	*15,720.4*	*18,547.2*	*39.4*	*72.3*	*111.6*	*2,787.4*	*15,648.2*	*18,435.5*	*64.2*	*126.2*	*190.4*	*2,762.6*	*15,594.3*	*18,356.8*	*87.7*	*173.1*	*260.8*	*2,739.1*	*15,547.3*	*18,286.4*
Dornod	539.6	9,062.6	9,602.1	17.4	25.9	43.3	522.2	9,036.6	9,558.8	28.8	48.9	77.7	510.8	9,013.6	9,524.4	39.7	68.5	108.2	499.8	8,994.1	9,493.9
Sukhbaatar	532.8	2,482.3	3,015.1	0.0	19.9	19.9	532.8	2,462.4	2,995.2	0.0	30.2	30.2	532.8	2,452.1	2,985.0	0.0	39.7	39.7	532.8	2,442.6	2,975.4
Khenti	1,754.4	4,175.6	5,929.9	22.0	26.4	48.4	1,732.3	4,149.2	5,881.5	35.5	47.0	82.5	1,718.9	4,128.5	5,847.4	47.9	64.9	112.8	1,706.4	4,110.7	5,817.1
Ulaanbaatar	*412.2*	*246.4*	*658.6*	*14.0*	*144.3*	*158.3*	*398.3*	*102.0*	*500.3*	*28.8*	*169.4*	*198.2*	*383.5*	*77.0*	*460.5*	*38.9*	*229.7*	*268.5*	*373.4*	*16.7*	*390.1*

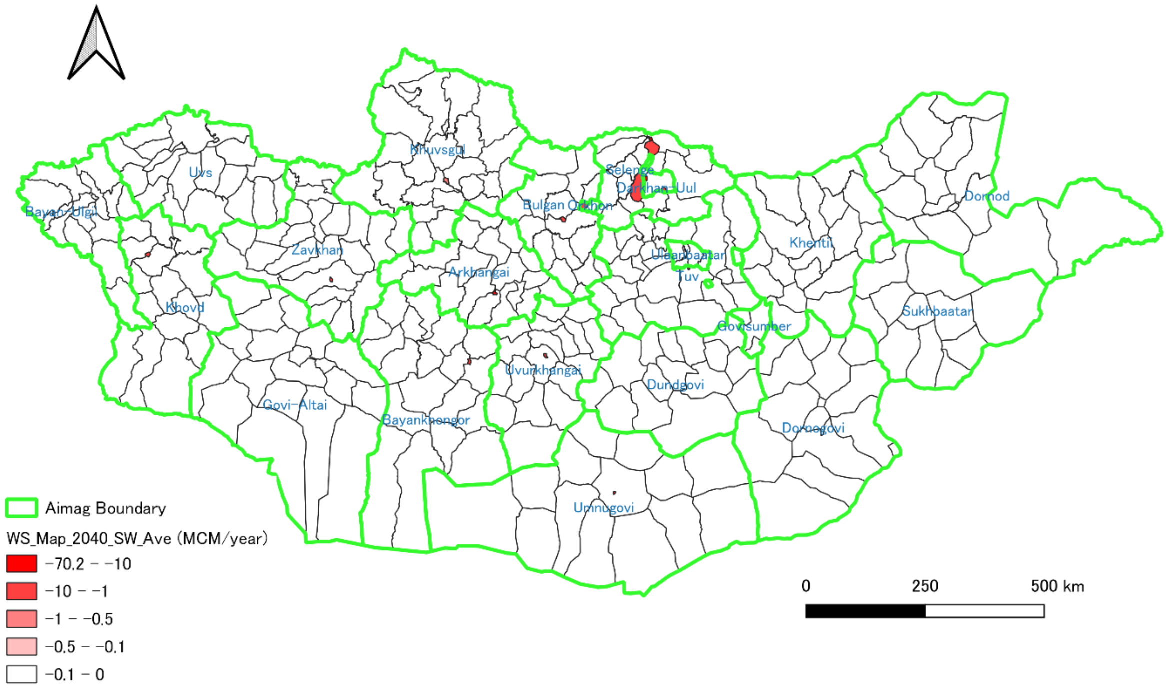
Source: JICA Project Team

Table 3.5.29 Water Supply and Demand Balance by Aimag using JPT's Water Potential Estimation (Dry Year)

Unit: million m^3/year

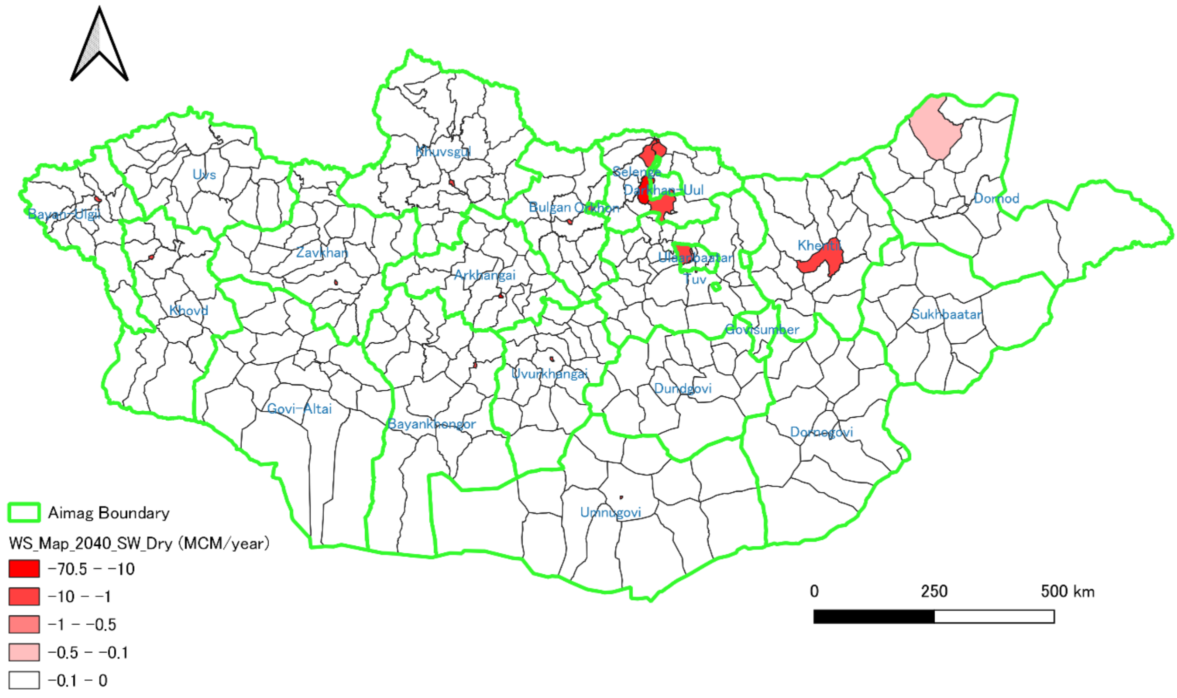
Aimag Name	Water Availability (Dry Year)			Water Demand in 2018			Gap in 2018			Water Demand in 2030			Gap in 2030			Water Demand in 2040			Gap in 2040		
	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total	SW	GW	Total
	a	b	c=a+b	d	e	f=d+e	g=c-d	h=c-e	i=c-f	j	k	l=j+k	m=c-j	n=c-k	o=c-l	p	q	r=p+q	s=c-p	t=c-q	u=c-r
Mongolia	**22,080.6**	**42,739.7**	**64,820.3**	**352.7**	**505.0**	**857.7**	**21,727.9**	**42,234.6**	**63,962.6**	**596.7**	**779.9**	**1,376.6**	**21,483.9**	**41,959.8**	**63,443.7**	**811.4**	**1,051.4**	**1,862.8**	**21,269.2**	**41,688.3**	**62,957.5**
Western Region	*7,767.8*	*8,987.0*	*16,754.8*	*42.4*	*38.2*	*80.5*	*7,725.4*	*8,948.8*	*16,674.3*	*66.6*	*59.5*	*126.1*	*7,701.2*	*8,927.5*	*16,628.7*	*88.5*	*75.6*	*164.2*	*7,679.3*	*8,911.4*	*16,590.6*
Bayan-Ulgii	1,716.0	1,045.2	2,761.2	7.7	4.5	12.3	1,708.2	1,040.7	2,748.9	12.5	7.5	19.9	1,703.5	1,037.7	2,741.3	16.5	10.1	26.5	1,699.5	1,035.1	2,734.7
Gove-Altai	1,691.7	2,398.2	4,089.9	1.8	12.1	13.9	1,689.9	2,386.1	4,076.0	3.0	18.6	21.6	1,688.7	2,379.7	4,068.3	4.1	23.3	27.4	1,687.6	2,374.9	4,062.5
Zavkhan	1,124.0	2,077.8	3,201.8	9.7	5.7	15.3	1,114.3	2,072.1	3,186.4	14.6	8.7	23.3	1,109.4	2,069.1	3,178.5	18.9	11.0	29.9	1,105.0	2,066.8	3,171.9
Uvs	1,643.5	1,741.4	3,384.8	18.0	6.9	24.8	1,625.5	1,734.5	3,360.0	26.8	10.6	37.3	1,616.7	1,730.8	3,347.5	35.8	13.5	49.4	1,607.6	1,727.8	3,335.4
Khovd	1,592.7	1,724.4	3,317.1	5.2	9.0	14.2	1,587.5	1,715.4	3,302.9	9.8	14.2	24.0	1,582.9	1,710.2	3,293.1	13.2	17.7	30.9	1,579.5	1,706.7	3,286.2
Khangai Region	*9,735.5*	*16,709.2*	*26,444.7*	*80.6*	*85.2*	*165.8*	*9,654.8*	*16,624.0*	*26,278.8*	*140.9*	*138.5*	*279.4*	*9,594.6*	*16,570.7*	*26,165.2*	*191.8*	*182.6*	*374.4*	*9,543.7*	*16,526.6*	*26,070.3*
Arkhangai	2,950.8	4,071.1	7,021.9	32.6	12.9	45.4	2,918.2	4,058.3	6,976.5	64.0	20.5	84.5	2,886.8	4,050.6	6,937.4	89.6	27.6	117.2	2,861.2	4,043.5	6,904.7
Bayankhongor	793.0	1,611.7	2,404.7	6.1	11.4	17.6	786.8	1,600.2	2,387.1	10.5	19.8	30.2	782.5	1,591.9	2,374.4	13.8	26.3	40.1	779.2	1,585.4	2,364.6
Bulgan	1,817.1	3,514.7	5,331.7	17.7	19.2	36.9	1,799.3	3,495.5	5,294.8	27.8	30.1	58.0	1,789.2	3,484.5	5,273.8	37.2	39.9	77.2	1,779.8	3,474.7	5,254.6
Orkhon	6.2	33.3	39.6	2.6	3.4	6.0	3.6	30.0	33.6	4.1	7.7	11.8	2.1	25.7	27.8	5.5	9.3	14.7	0.7	24.1	24.8
Uvurkhangai	318.7	1,326.4	1,645.1	12.9	14.1	27.0	305.9	1,312.3	1,618.1	21.3	22.7	44.0	297.5	1,303.7	1,601.1	28.4	29.6	58.0	290.3	1,296.8	1,587.1
Khusvgul	3,849.7	6,152.1	10,001.8	8.7	24.3	33.0	3,841.0	6,127.7	9,968.7	13.3	37.7	51.0	3,836.4	6,114.3	9,950.8	17.3	49.9	67.2	3,832.4	6,102.1	9,934.5
Central Region	*3,194.1*	*8,407.3*	*11,601.4*	*176.4*	*165.0*	*341.4*	*3,017.7*	*8,242.3*	*11,260.0*	*296.2*	*286.3*	*582.5*	*2,897.9*	*8,121.0*	*11,018.9*	*404.5*	*390.4*	*794.9*	*2,789.5*	*8,016.9*	*10,806.4*
Goveisumber	22.7	50.5	73.3	0.0	1.9	1.9	22.7	48.7	71.4	0.0	3.1	3.1	22.7	47.4	70.1	0.0	4.1	4.1	22.7	46.5	69.2
Darkhan-Uul	18.2	344.3	362.5	16.3	2.6	18.9	1.9	341.7	343.6	30.5	5.4	35.9	-12.2	338.8	326.6	41.6	6.3	47.9	-23.3	338.0	314.6
Dornogovi	57.3	855.0	912.3	0.0	28.8	28.8	57.3	826.3	883.6	0.0	60.0	60.0	57.3	795.0	852.3	0.0	85.0	85.0	57.3	770.0	827.3
Dundgovi	248.8	955.4	1,204.2	0.0	16.8	16.8	248.8	938.6	1,187.4	0.0	26.2	26.2	248.8	929.2	1,178.0	0.0	34.8	34.8	248.8	920.7	1,169.4
Umnugovi	342.2	1,312.0	1,654.1	4.7	9.8	14.5	337.5	1,302.2	1,639.7	8.3	16.8	25.1	333.9	1,295.2	1,629.1	11.1	22.7	33.9	331.0	1,289.2	1,620.2
Selenge	1,595.4	2,745.9	4,341.3	147.2	4.9	152.1	1,448.2	2,741.0	4,189.2	243.7	9.9	253.6	1,351.7	2,736.0	4,087.8	333.7	13.0	346.7	1,261.7	2,732.9	3,994.7
Tuv	909.5	2,144.2	3,053.7	8.2	100.3	108.5	901.3	2,043.9	2,945.2	13.8	164.9	178.7	895.7	1,979.3	2,875.0	18.2	224.6	242.7	891.3	1,919.6	2,810.9
Eastern Region	*1,201.6*	*8,485.4*	*9,686.9*	*39.4*	*72.3*	*111.6*	*1,162.2*	*8,413.1*	*9,575.3*	*64.2*	*126.2*	*190.4*	*1,137.4*	*8,359.2*	*9,496.6*	*87.7*	*173.1*	*260.8*	*1,113.9*	*8,312.3*	*9,426.2*
Dornod	189.9	4,999.2	5,189.1	17.4	25.9	43.3	172.5	4,973.3	5,145.8	28.8	48.9	77.7	161.1	4,950.3	5,111.4	39.7	68.5	108.2	150.1	4,930.7	5,080.9
Sukhbaatar	78.7	1,199.2	1,277.9	0.0	19.9	19.9	78.7	1,179.2	1,258.0	0.0	30.2	30.2	78.7	1,169.0	1,247.7	0.0	39.7	39.7	78.7	1,159.4	1,238.1
Khenti	933.0	2,287.0	3,220.0	22.0	26.4	48.4	911.0	2,260.6	3,171.6	35.5	47.0	82.5	897.6	2,239.9	3,137.5	47.9	64.9	112.8	885.1	2,222.1	3,107.2
Ulaanbaatar	*181.7*	*150.8*	*332.5*	*14.0*	*144.3*	*158.3*	*167.8*	*6.4*	*174.2*	*28.8*	*169.4*	*198.2*	*152.9*	*-18.6*	*134.3*	*38.9*	*229.7*	*268.5*	*142.8*	*-78.9*	*63.9*

Source: JICA Project Team



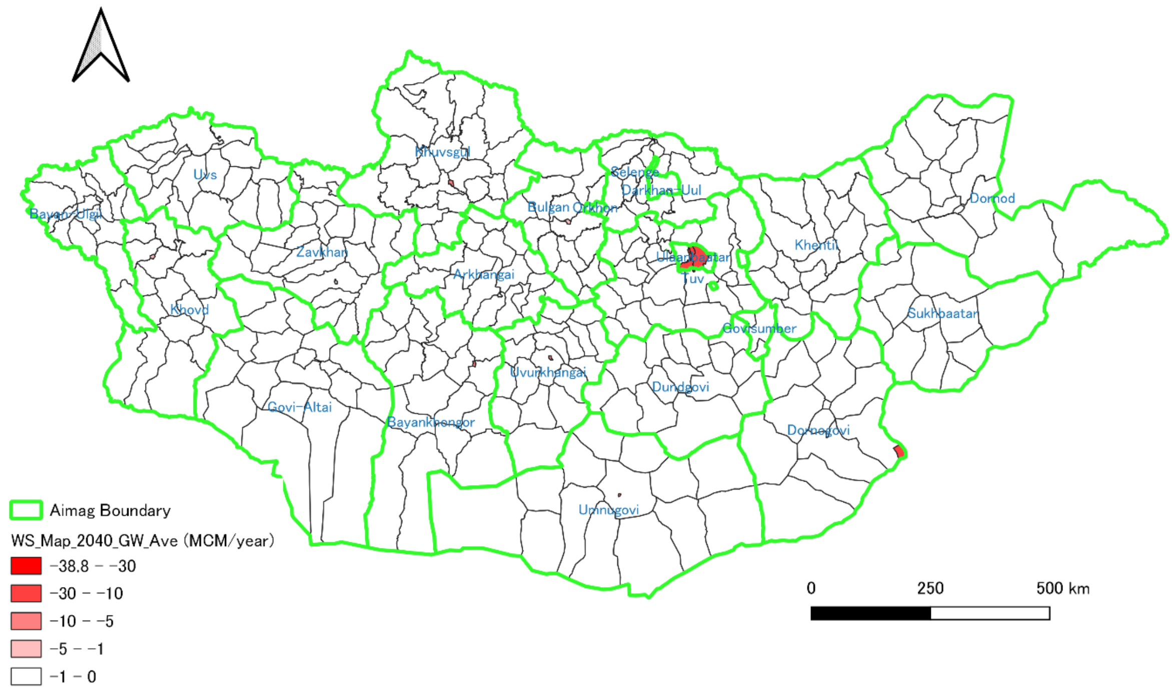
Source: JICA Project Team

Figure 3.5.27 Map of Estimated Surface Water Deficit by Soum in 2040 (Average)



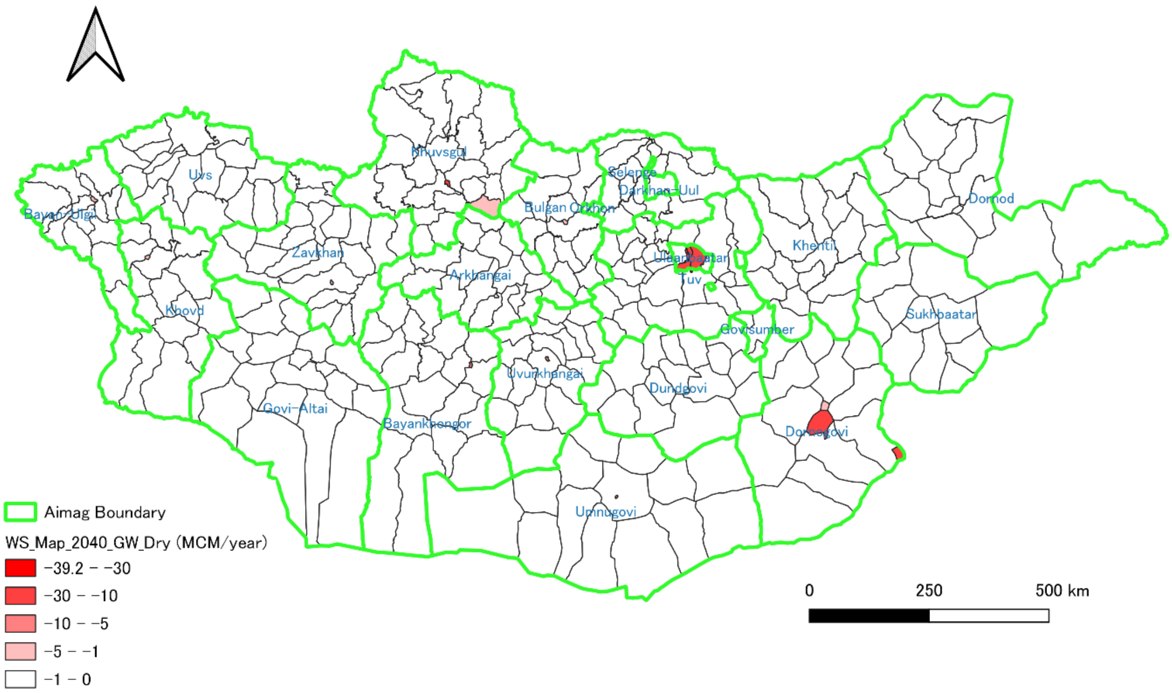
Source: JICA Project Team

Figure 3.5.28 Map of Estimated Surface Water Deficit by Soum in 2040 (Dry Year)



Source: JICA Project Team

Figure 3.5.29 Map of Estimated Groundwater Deficit by Soum in 2040 (Average)



Source: JICA Project Team

Figure 3.5.30 Map of Estimated Groundwater Deficit by Soum in 2040 (Dry Year)

Table 3.5.30 Water Supply and Demand Balance by Soum using JPT's Water Potential Estimation (Average Year)

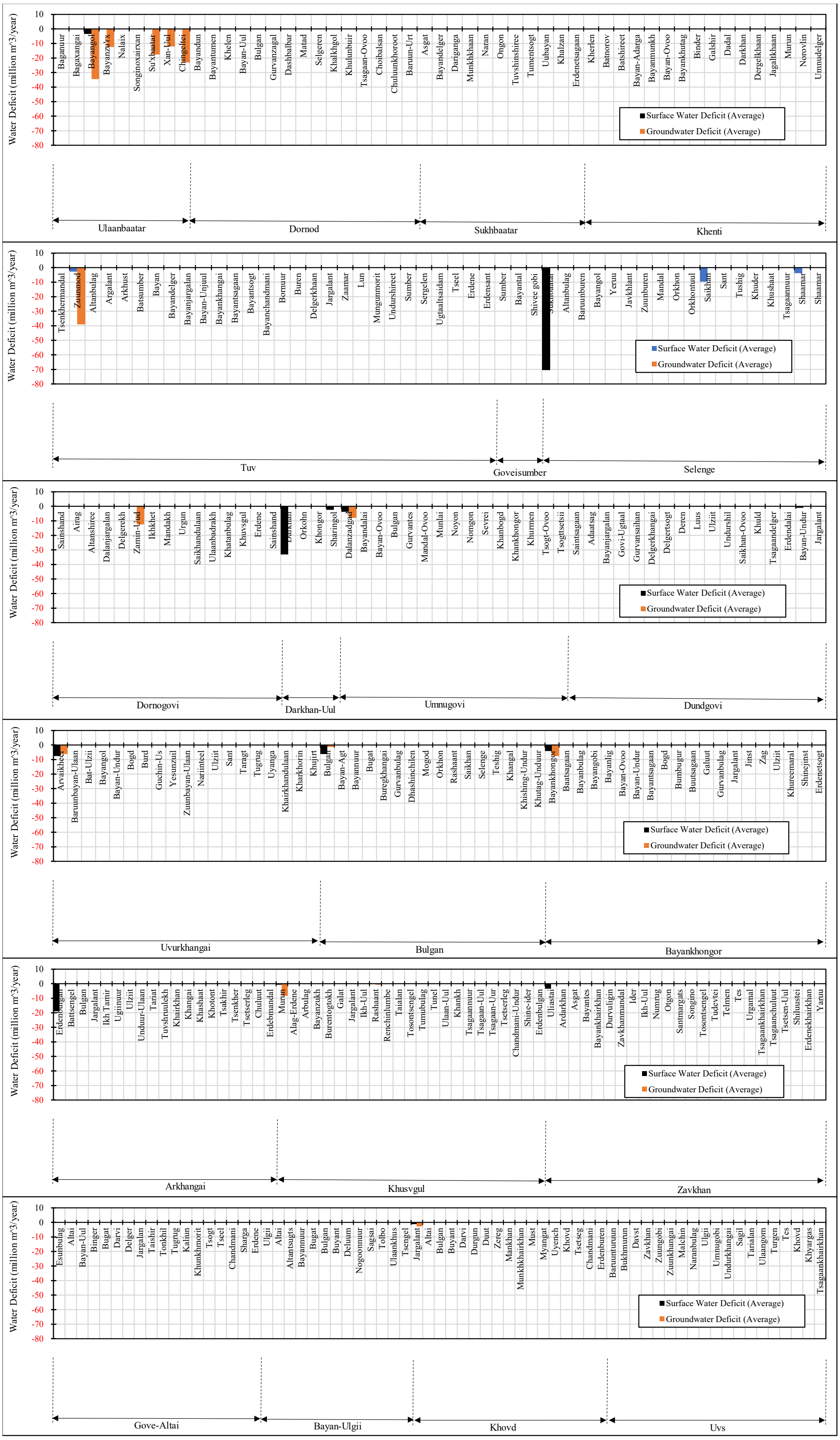
ID	Aimag	Soum Name	Water Balance (Average)			ID	Aimag	Soum Name	Water Balance (Average)			ID	Aimag	Soum Name	Water Balance (Average)		
			SW	GW	Total				SW	GW	Total				SW	GW	Total
1101	Ulaanbaatar	Baganuur	30.81	36.24	67.05	4440	Dornogovi	Erdene	92.17	138.02	230.20	6704	Khusvgul	Alag-Erdene	510.05	442.85	952.90
1104	Ulaanbaatar	Bagaxangai	1.54	2.27	3.81	4443	Dornogovi	Sainshand	2.62	0.34	2.96	6707	Khusvgul	Arbulag	156.90	229.19	386.09
1107	Ulaanbaatar	Bayangol	-3.58	-34.42	-38.01	4501	Darkhan-Uul	Darkhan	-32.96	3.56	-29.40	6710	Khusvgul	Bayanzukh	191.00	279.17	470.17
1110	Ulaanbaatar	Bayanzu'rx	150.27	-12.37	137.90	4504	Darkhan-Uul	Orkohn	4.46	120.41	124.88	6713	Khusvgul	Burentogtokh	171.68	245.36	417.03
1113	Ulaanbaatar	Nalaix	125.38	44.11	169.50	4507	Darkhan-Uul	Khongor	21.66	389.63	411.29	6716	Khusvgul	Galat	227.68	83.42	311.10
1116	Ulaanbaatar	Songinoxairxan	2.20	33.65	35.84	4510	Darkhan-Uul	Sharingol	-2.52	13.74	11.23	6719	Khusvgul	Jargalant	80.95	160.83	241.78
1119	Ulaanbaatar	Su'xbaatar	17.07	-17.43	-0.36	4601	Umnugovi	Dalanzadgad	-3.77	-7.81	-11.58	6722	Khusvgul	Ikh-Uul	106.72	718.19	824.92
1121	Ulaanbaatar	Xan-Uul	45.16	-12.12	33.04	4604	Umnugovi	Bayandalai	65.38	194.18	259.56	6725	Khusvgul	Rashaant	573.61	-0.79	572.82
1125	Ulaanbaatar	Chingeltei	4.52	-23.20	-18.68	4607	Umnugovi	Bayan-Ovoo	72.47	177.90	250.37	6728	Khusvgul	Renchinlumbe	307.86	737.62	1,045.49
2104	Dornod	Bayandun	4.07	1,017.34	1,021.41	4610	Umnugovi	Bulgan	100.93	191.62	292.55	6731	Khusvgul	Taialan	182.43	1,227.07	1,409.50
2107	Dornod	Bayantumen	7.02	300.90	307.92	4613	Umnugovi	Gurvantes	171.65	509.66	681.31	6734	Khusvgul	Tosontsengel	109.58	737.46	847.04
2107	Dornod	Bayantumen	7.02	300.90	307.92	4616	Umnugovi	Mandal-Ovoo	87.95	166.98	254.93	6737	Khusvgul	Tumubulag	110.16	142.15	252.31
2110	Dornod	Bayan-Uul	3.15	949.92	953.08	4619	Umnugovi	Munlai	84.42	214.24	298.66	6740	Khusvgul	Tunel	410.83	347.17	758.00
2113	Dornod	Bulgan	48.87	173.64	222.51	4622	Umnugovi	Noyon	64.95	192.78	257.73	6743	Khusvgul	Ulaan-Uul	404.28	968.78	1,373.06
2116	Dornod	Gurvanzagal	1.39	256.81	258.20	4625	Umnugovi	Nomgon	101.69	343.77	445.46	6746	Khusvgul	Khankh	712.46	620.29	1,332.76
2119	Dornod	Dashbalbar	2.23	1,081.40	1,083.63	4628	Umnugovi	Sevrei	82.10	176.75	258.85	6749	Khusvgul	Tsagaannuur	225.69	540.86	766.55
2122	Dornod	Matad	158.67	561.87	720.54	4631	Umnugovi	Khanbogd	284.81	631.77	916.59	6752	Khusvgul	Tsagaan-Uul	256.16	374.39	630.55
2125	Dornod	Selgeren	8.68	364.25	372.92	4634	Umnugovi	Khankhongor	169.10	298.42	467.52	6755	Khusvgul	Tsagaan-Uur	991.30	989.91	1,981.22
2128	Dornod	Khalkhgol	201.41	2,346.41	2,547.82	4637	Umnugovi	Khurmen	77.67	230.53	308.19	6758	Khusvgul	Tsetserleg	392.38	167.86	560.23
2131	Dornod	Khulunbuir	13.45	136.31	149.76	4640	Umnugovi	Tsogt-Ovoo	107.21	189.18	296.39	6761	Khusvgul	Chandmani-Undur	494.52	407.54	902.06
2134	Dornod	Tsagaan-Ovoo	17.99	449.11	467.11	4643	Umnugovi	Tsogttsetsii	45.08	127.64	172.72	6764	Khusvgul	Shine-ider	93.03	132.78	225.80
2137	Dornod	Choibalsan	2.88	402.24	405.12	4801	Dundgovi	Saintsagaan	54.97	85.80	140.77	6767	Khusvgul	Erdenbulgan	558.19	745.45	1,303.64
2140	Dornod	Chuluunkhoroot	1.83	616.45	618.28	4804	Dundgovi	Adaatsag	20.60	116.40	137.00	8101	Zavkhan	Uliastai	-3.53	-0.47	-4.00
2201	Sukhbaatar	Baruun-Urt	90.04	303.72	393.76	4807	Dundgovi	Bayanjargalan	33.74	59.55	93.28	8104	Zavkhan	Ardarkhan	131.90	336.91	468.81
2204	Sukhbaatar	Asgat	50.71	177.39	228.11	4810	Dundgovi	Govi-Ugtaal	28.66	50.15	78.82	8107	Zavkhan	Asgat	29.83	12.84	42.67
2207	Sukhbaatar	Bayandelger	53.21	184.09	237.30	4813	Dundgovi	Gurvansaihan	57.87	102.12	159.99	8110	Zavkhan	Bayantes	227.89	89.33	317.22
2210	Sukhbaatar	Dariganga	29.09	223.59	252.69	4816	Dundgovi	Delgerkhangai	38.52	220.11	258.63	8113	Zavkhan	Bayankhairkhan	134.37	52.66	187.03
2213	Sukhbaatar	Munkhkhaan	27.98	265.82	293.81	4819	Dundgovi	Delgertsogt	26.50	46.30	72.81	8116	Zavkhan	Durvuligin	264.11	163.05	427.16
2216	Sukhbaatar	Naran	20.38	157.02	177.41	4822	Dundgovi	Deren	38.34	67.15	105.49	8119	Zavkhan	Zavkhanmandal	33.75	157.34	191.08
2219	Sukhbaatar	Ongon	41.90	322.36	364.26	4825	Dundgovi	Luus	19.57	111.30	130.88	8122	Zavkhan	Ider	113.77	227.87	341.64
2225	Sukhbaatar	Tuvshinshiree	30.91	106.63	137.54	4828	Dundgovi	Ulziit	253.19	445.13	698.32	8125	Zavkhan	Ikh-Uul	115.27	232.26	347.53
2228	Sukhbaatar	Tumentsogt	8.06	75.84	83.90	4831	Dundgovi	Undurshil	51.46	91.15	142.60	8128	Zavkhan	Numrug	100.52	201.18	301.70
2231	Sukhbaatar	Uubayan	34.80	120.60	155.41	4834	Dundgovi	Saikhan-Ovoo	25.10	142.88	167.98	8131	Zavkhan	Otgon	91.90	508.86	600.76
2234	Sukhbaatar	Khalzan	26.73	93.04	119.77	4837	Dundgovi	Khuld	99.46	173.77	273.23	8134	Zavkhan	Santmargats	22.27	104.76	127.03
2237	Sukhbaatar	Erdenetsagaan	119.01	412.45	531.46	4840	Dundgovi	Tsagaandelger	36.68	64.99	101.66	8137	Zavkhan	Songino	125.88	49.34	175.22
2301	Khenti	Kherlen	-0.02	117.54	117.52	4843	Dundgovi	Erdendalai	45.40	257.03	302.43	8140	Zavkhan	Tosontsengel	161.02	324.59	485.60
2304	Khenti	Batnorov	15.17	175.34	190.50	6101	Orkhon	Bayan-Undur	-1.18	10.94	9.76	8143	Zavkhan	Tudevtei	138.24	54.17	192.41
2307	Khenti	Batshireet	345.09	483.15	828.24	6104	Orkhon	Jargalant	8.27	40.83	49.10	8146	Zavkhan	Telmen	106.03	212.52	318.54
2310	Khenti	Bayan-Adarga	129.86	226.82	356.68	6201	Uvurkhangai	Arvaikheer	-7.39	-6.26	-13.66	8149	Zavkhan	Tes	47.15	18.37	65.52
2313	Khenti	Bayanmunkh	16.71	29.90	46.61	6204	Uvurkhangai	Baruunbayan-Ulaan	52.96	101.17	154.13	8152	Zavkhan	Urgamal	32.77	153.02	185.79
2316	Khenti	Bayan-Ovoo	11.64	120.91	132.55	6207	Uvurkhangai	Bat-Ulzii	72.94	304.27	377.21	8155	Zavkhan	Tsagaankhairkhan	48.27	123.43	171.71
2319	Khenti	Bayankhutag	21.38	217.21	238.59	6210	Uvurkhangai	Bayangol	20.79	124.29	145.08	8158	Zavkhan	Tsagaanchuluut	48.57	136.24	184.81
2322	Khenti	Binder	265.44	371.71	637.15	6213	Uvurkhangai	Bayan-Undur	19.22	115.20	134.42	8161	Zavkhan	Tsetsen-Uul	22.63	106.58	129.21
2325	Khenti	Galshir	45.43	162.98	208.41	6216	Uvurkhangai	Bogd	135.04	257.64	392.68	8164	Zavkhan	Shiluustei	52.69	150.84	203.54
2328	Khenti	Dadal	213.24	341.72	554.96	6219	Uvurkhangai	Burd	11.37	219.70	231.07	8167	Zavkhan	Erdenekhairkhan	39.03	182.30	221.32
2331	Khenti	Darkhan	24.47	45.99	70.46	6222	Uvurkhangai	Guchin-Us	64.29	122.56	186.85	8170	Zavkhan	Yaruu	94.58	229.23	323.81
2334	Khenti	Dergelkhaan	25.20	45.07	70.27	6225	Uvurkhangai	Yesunzuil	9.68	189.63	199.31	8201	Gove-Altai	Esunbulag	34.55	29.39	63.94
2337	Khenti	Jagaltkhaan	18.46	33.13	51.59	6228	Uvurkhangai	Zuunbayan-Ulaan	14.58	88.61	103.18	8204	Gove-Altai	Altai	429.47	686.41	1,115.88
2340	Khenti	Murun	14.19	25.52	39.71	6231	Uvurkhangai	Nariinteel	35.70	68.57	104.27	8207	Gove-Altai	Bayan-Uul	212.98	130.36	343.34
2343	Khenti	Norovlin	3.78	926.56	930.34	6234	Uvurkhangai	Ulziit	48.08	106.22	154.30	8210	Gove-Altai	Binger	74.78	76.81	151.58
2346	Khenti	Umnudelger	535.46	749.75	1,285.21	6237	Uvurkhangai	Sant	15.40	92.86	108.26	8213	Gove-Altai	Bugat	539.33	487.60	1,026.93
2349	Khenti	Tsenkhermandal	20.92	37.40	58.33	6240	Uvurkhangai	Taragt	20.99	124.73	145.72	8216	Gove-Altai	Darvi	54.07	85.56	139.62
4101	Tuv	Zuunmod	-2.85	-38.76	-41.61	6243	Uvurkhangai	Tugrug	73.35	139.87	213.22	8219	Gove-Altai	Delger	129.44	133.18	262.62
4103	Tuv	Altanbulag	210.78	221.45	432.23	6246	Uvurkhangai	Uyanga	16.52	106.39	122.91	8222	Gove-Altai	Jargalan	69.31	192.98	262.28
4107	Tuv	Argalant	13.22	66.54	79.77	6249	Uvurkhangai	Khairkhandulaan	55.27	105.70	160.97	8225	Gove-Altai	Taishir	65.29	185.26	250.55
4110	Tuv	Arkhust	5.48	6.98	12.46	6252	Uvurkhangai	Kharkhorin	55.88	271.51	327.39	8228	Gove-Altai	Tonkhil	399.17	444.70	843.87
4113	Tuv	Batsumber	20.91	156.20	177.11	6255	Uvurkhangai	Khujirt	40.15	90.04	130.19	8231	Gove-Altai	Tugrug	93.68	74.71	168.39
4116	Tuv	Bayan	20.22	31.06	51.28	6301	Bulgan	Bulgan	-6.16	-1.41	-7.58	8234	Gove-Altai	Kaliun	89.60	71.30	160.91
4119	Tuv	Bayandelger	14.54	22.65	37.19	6304	Bulgan	Bayan-Agt	163.16	1,105.49	1,268.65	8237	Gove-Altai	Khunkhmorit	229.30	140.68	369.98
4122	Tuv	Bayanjargalan	19.64	31.26	50.89	6307	Bulgan	Bayannuur	9.14	120.43	129.57	8240	Gove-Altai	Tsogt	361.92	857.62	1,219.53
4125	Tuv	Bayan-Unjuul	67.34	228.00	295.34	6310	Bulgan	Bugat	343.83	277.40	621.23	8243	Gove-Altai	Tseel	121.31	287.25	408.56
4128	Tuv	Bayankhangai	11.75	59.16	70.90	6313	Bulgan	Buregkhangai	33.68	416.06	449.74	8246	Gove-Altai	Chandmani	89.87	92.44	182.31
4131	Tuv	Bayantsagaan	62.03	107.34	169.37	6316	Bulgan	Gurvanbulag	10.66	227.87	238.52	8249	Gove-Altai	Sharga	87.73	89.39	177.13
4134	Tuv	Bayantsogt	17.91	90.86	108.77	6319	Bulgan	Dhashinchilen	21.77	275.81	297.58	8252	Gove-Altai	Erdene	532.45	851.13	1,383.58
4137	Tuv	Bayanchandmani	6.70	38.63	45.34	6322	Bulgan	Mogod	75.58	315.88	391.47	8301	Bayan-Ulgii	Ulgii	2.67	-0.15	2.52
4140	Tuv	Bornuur	14.21	86.15	100.36	6325	Bulgan	Orkhon	57.86	289.26	347.12	8304	Bayan-Ulgii	Altai	282.25	119.06	401.31
4143	Tuv	Buren	18.94	225.12	244.06	6328	Bulgan	Rashaant	3.14	58.43	61.57	8307	Bayan-Ulgii	Altantsugts	103.09	137.41	240.50
4146	Tuv	Delgerkhaan	10.93	129.89	140.82	6331	Bulgan	Saikhan	71.69	301.57	373.26	8310	Bayan-Ulgii	Bayannuur	84.31	52.05	136.36
4149	Tuv	Jargalant	23.20	142.76	165.96	6334	Bulgan	Selenge	523.63	422.49	946.11	8313	Bayan-Ulgii	Bugat	169.16	67.09	236.24
4152	Tuv	Zaamar	27.54	324.66	352.19	6337	Bulgan	Teshig	791.81	1,405.13	2,196.94	8316	Bayan-Ulgii	Bulgan	268.23	388.35	656.59
4155	Tuv	Lun	48.51	411.03	459.54	6340	Bulgan	Khangal	171.07	137.45	308.52	8319	Bayan-Ulgii	Buyant	176.83	60.03	236.87
4158	Tuv	Mungunmorit	339.29	436.37	775.66	6343	Bulgan	Khishing-Undur	64.66	271.82	336.48	8322	Bayan-Ulgii	Deluum	253.72	282.13	535.85
4161	Tuv	Undurshireet	50.33	427.00	477.32	6346	Bulgan	Khutag-Unduur	603.91	487.09	1,090.99	8325	Bayan-Ulgii	Nogoonnuur	331.19	170.58	501.77
4164	Tuv	Sumber	4.25	25.46	29.71	6401	Bayankhongor	Bayankhongor	-4.02	-7.64	-11.65	8328	Bayan-Ulgii	Sagsai	288.57	112.10	400.68
4167	Tuv	Sergelen	39.89	67.34	107.23	6404	Bayankhongor	Baatsagaan	144.58	149.45	294.03	8331	Bayan-Ulgii	Tolbo	286.75	97.37	384.12
4170	Tuv	Ugtaaltsaidam	15.19	179.15	194.34	6407	Bayankhongor	Bayanbulag	61.33	63.35	124.68	8334	Bayan-Ulgii	Ulaankhus	577.43	207.12	784.55
4173	Tuv	Tseel	23.91	112.37	136.28	6410	Bayankhongor	Bayangobi	60.78	129.08	189.86	8340	Bayan-Ulgii	Tsengel	582.74	226.43	809.17
4176	Tuv	Erdene	901.65	306.09	1,207.74	6413	Bayankhongor	Bayanlig	155.81	330.76	486.57	8401	Khovd	Jargalant	-1.11	-2.87	-3.98
4179	Tuv	Erdensant	15.26	181.18	196.44	6416	Bayankhongor	Bayan-Ovoo	46.59	91.84	138.43	8404	Khovd	Altai	480.01	498.06	978.06
4201	Goveisumber	Sumber	39.70	68.22	107.92	6419	Bayankhongor	Bayan-Undur	155.42	304.78	460.19	8407	Khovd	Bulgan	440.27	636.41	1,076.68
4204	Goveisumber	Bayantal	9.50	16.73	26.23	6422	Bayankhongor	Bayantsagaan	61.59	189.27	250.86	8410	Khovd	Buyant	169.35	155.93	325.28
4207	Goveisumber	Shivee gobi	9.55	16.32	25.87	6425	Bayankhongor	Bogd	53.32	101.26	154.58	8413	Khovd	Darvi	222.32	76.69	299.01
4301	Selenge	Sukhbaatar	-70.19	11.18	-59.01	6428	Bayankhongor	Bumbugur	43.96	86.68	130.64	8416	Khovd	Durgun	149.28	91.82	241.09
4304	Selenge	Altanbulag	246.75	168.09	414.84	6431	Bayankhongor	Buutsagaan	104.62	107.96	212.58	8419	Khovd	Duut	78.86	143.00	221.85
4307	Selenge	Baruunburen	32.36	204.95	237.31	6434	Bayankhongor	Galuut	72.94	143.81	216.75	8422	Khovd	Zereg	100.24	34.28	134.52
4310	Selenge	Bayangol	9.52	172.59	182.11	6437	Bayankhongor	Gurvanbulag	76.14	392.98	469.12	8425	Khovd	Mankhan	159.57	289.38	448.95
4313	Selenge	Yeruu	934.54	906.15	1,840.69	6440	Bayankhongor	Jargalant	61.04	120.34	181.38	8428	Khovd	Munkhkhairkhan	94.44	171.25	265.70
4316	Selenge	Javkhlant	9.16	322.54	331.70	6443	Bayankhongor	Jinst	75.22	148.28	223.50	8431	Khovd	Must	158.91	54.65	213.56
4319	Selenge	Zuunburen	6.90	323.97	330.87	6446	Bayankhongor	Zag	36.99	72.92	109.90	8434	Khovd	Myangat	119.76	73.52	193.28
4322	Selenge	Mandal	431.23	328.97	760.20	6449	Bayankhongor	Ulziit	53.01	100.68	153.69	8437	Khovd	Uyench	364.76	602.79	967.55
4325	Selenge	Orkhon	12.10	94.17	106.27	6452	Bayankhongor	Khureemaral	84.62	87.49	172.10	8440	Khovd	Khovd	132.11	121.59	253.70
4328	Selenge	Orkhontuul	32.63	214.11	246.74	6455	Bayankhongor	Shinejinst	311.50	610.84	922.34	8443	Khovd	Tsetseg	139.22	47.84	187.07
4331	Selenge	Saikhan	-9.62	93.42	83.80	6458	Bayankhongor	Erdenetsogt	58.52	115.37	173.89	8446	Khovd	Chandmani	221.02	136.10	357.12
4334	Selenge	Sant	14.01	98.15	112.16	6501	Arkhangai	Erdenbulgan	-19.08	3.30	-15.78	8449	Khovd	Erdenburen	67.65	148.79	216.44
4337	Selenge	Tushig	239.83	259.59	499.43	6504	Arkhangai	Battsengel	86.39	417.96	504.35	8504	Uvs	Baruunturuun	125.83	252.20	378.03
4340	Selenge	Khuder	280.83	185.52	466.35	6507	Arkhangai	Bulgan	82.17	504.11	586.28	8507	Uvs	Bukhmurun	166.47	60.01	226.47
4343	Selenge	Khushaat	96.62	196.52	293.14	6510	Arkhangai	Jargalant	550.82	654.77	1,205.59	8510	Uvs	Davst	255.80	509.96	765.76
4346	Selenge	Tsagaannuur	178.53	370.95	549.48	6513	Arkhangai	Ikh Tamir	125.31	925.85	1,051.16	8513	Uvs	Zavkhan	251.32	155.33	406.65
4349	Selenge	Shaamar	-3.94	180.74	176.80	6516	Arkhangai	Ugiinuur	40.51	201.62	242.13	8516	Uvs	Zuungobi	156.87	313.97	470.84
4352	Selenge	Shaamar	0.52	4.91	5.43	6519	Arkhangai	Ulziit	43.60	191.54	235.14	8519	Uvs	Zuunkhangai	137.15	53.86	191.01
4401	Dornogovi	Sainshand	19.66	2.55	22.21	6522	Arkhangai	Unduur-Ulaan	31.65	472.39	504.04	8522	Uvs	Malchin	156.86	313.81	470.68
4404	Dornogovi	Airag	52.50	179.98	232.49	6525	Arkhangai	Tariat	802.37	528.85	1,331.23	8525	Uvs	Naranbulag	202.45	405.60	608.06
4407	Dornogovi	Altanshiree	50.34	175.53	225.86	6528	Arkhangai	Tuvshruulekh	27.72	141.86	169.58	8528	Uvs	Ulgii	85.92	53.29	139.21
4410	Dornogovi	Dalanjargalan	28.31	96.05	124.35	6531	Arkhangai	Khairkhan	19.49	272.10	291.59	8531	Uvs	Umnugobi	112.94	70.19	183.14
4413	Dornogovi	Delgerekh	33.82	116.59	150.42	6534	Arkhangai	Khangai	768.90	506.33	1,275.24	8534	Uvs	Undurkhangai	167.75	103.89	271.64
4416	Dornogovi	Zamin-Uud	4.03	-12.39	-8.37	6537	Arkhangai	Khashaat	9.07	220.88	229.94	8537	Uvs	Sagil	244.81	126.32	371.13
4419	Dornogovi	Ikhkhet	29.33	100.53	129.86	6540	Arkhangai	Khotont	52.83	136.11	188.93	8540	Uvs	Tarialan	136.72	293.73	430.45
4422	Dornogovi	Mandakh	114.35	188.27	302.62	6543	Arkhangai	Tsakhir	651.58	428.97	1,080.55	8540	Uvs	Tarialan	136.72	293.73	430.45
4425	Dornogovi	Urgun	59.11	205.55	264.66	6546	Arkhangai	Tsenkher	77.61	494.22	571.82	8543	Uvs	Turgen	82.04	164.71	246.75
4428	Dornogovi	Saikhandulaan	67.07	234.40	301.47	6549	Arkhangai	Tsetserleg	546.02	50.91	596.93	8546	Uvs	Tes	121.51	245.45	366.96
4431	Dornogovi	Ulaanbadrakh	112.14	169.82	281.95	6552	Arkhangai	Chuluut	703.75	499.71	1,203.47	8549	Uvs	Khovd	125.19	45.12	170.32
4434	Dornogovi	Khatanbulag	155.27	454.62	609.89	6555	Arkhangai	Erdebmandal	23.60	367.23	390.83	8552	Uvs	Khyargas	126.29	252.98	379.27
4437	Dornogovi	Khuvsgul	75.76	124.09	199.85	6701	Khusvgul	Murun	-0.56	-8.34	-8.90	8555	Uvs	Tsagaankhairkhan	147.79	91.44	239.24

Source: JICA Project Team

Table 3.5.31 Water Supply and Demand Balance by Soum Using JPT's Water Potential Estimation (Dry Year)

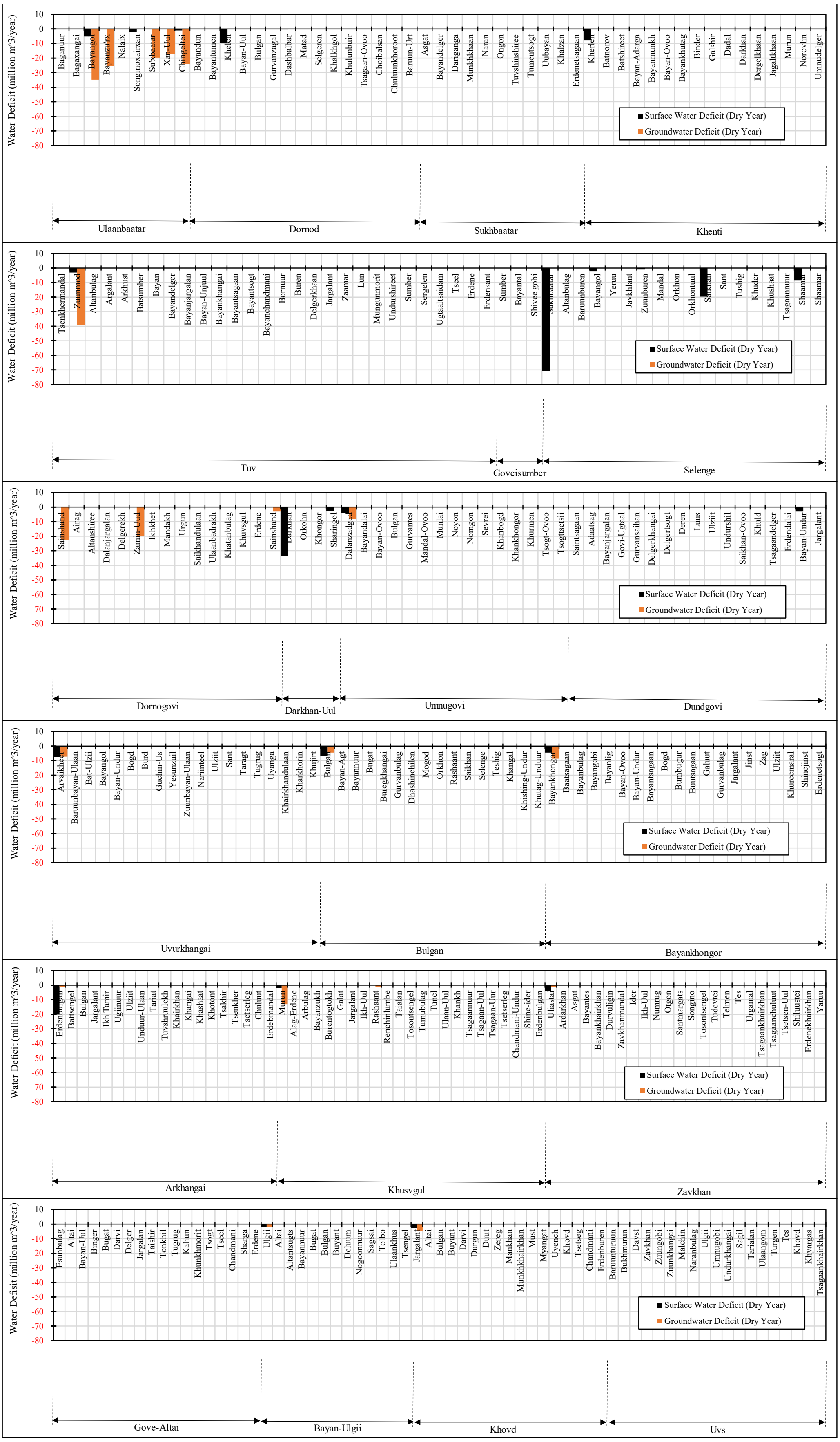
ID	Aimag	Soum Name	Water Balance (Dry Year)			ID	Aimag	Soum Name	Water Balance (Dry Year)			ID	Aimag	Soum Name	Water Balance (Dry Year)		
			SW	GW	Total				SW	GW	Total				SW	GW	Total
1101	Ulaanbaatar	Baganuur	18.58	20.46	39.04	4440	Dornogovi	Erdene	1.37	19.34	20.72	6704	Khusvgul	Alag-Erdene	253.17	228.07	481.24
1104	Ulaanbaatar	Bagaxangai	0.52	0.72	1.24	4443	Dornogovi	Sainshand	0.04	-3.03	-2.99	6707	Khusvgul	Arbulag	95.31	130.91	226.22
1107	Ulaanbaatar	Bayangol	-5.03	-34.67	-39.70	4501	Darkhan-Uul	Darkhan	-33.56	0.19	-33.37	6710	Khusvgul	Bayanzukh	116.07	159.60	275.67
1110	Ulaanbaatar	Bayanzu'rx	51.54	-25.42	26.12	4504	Darkhan-Uul	Orkohn	1.45	94.19	95.65	6713	Khusvgul	Burentogtokh	102.92	139.11	242.03
1113	Ulaanbaatar	Nalaix	61.49	19.26	80.75	4507	Darkhan-Uul	Khongor	11.64	235.48	247.13	6716	Khusvgul	Galat	138.72	56.69	195.41
1116	Ulaanbaatar	Songinoxairxan	-2.22	1.79	-0.43	4510	Darkhan-Uul	Sharingol	-2.88	8.11	5.23	6719	Khusvgul	Jargalant	51.25	104.39	155.64
1119	Ulaanbaatar	Su'xbaatar	4.16	-19.62	-15.46	4601	Umnugovi	Dalanzadgad	-4.05	-8.17	-12.23	6722	Khusvgul	Ikh-Uul	60.61	557.85	618.46
1121	Ulaanbaatar	Xan-Uul	14.71	-17.29	-2.57	4604	Umnugovi	Bayandalai	3.54	69.03	72.57	6725	Khusvgul	Rashaant	287.58	-1.10	286.48
1125	Ulaanbaatar	Chingeltei	-0.93	-24.13	-25.06	4607	Umnugovi	Bayan-Ovoo	18.98	49.95	68.93	6728	Khusvgul	Renchinlumbe	173.32	402.51	575.83
2104	Dornod	Bayandun	1.08	565.96	567.04	4610	Umnugovi	Bulgan	39.05	97.08	136.14	6731	Khusvgul	Taialan	103.66	953.22	1,056.88
2107	Dornod	Bayantumen	-9.25	112.62	103.37	4613	Umnugovi	Gurvantes	9.42	181.38	190.80	6734	Khusvgul	Tosontsengel	62.23	572.81	635.04
2107	Dornod	Bayantumen	-9.25	112.62	103.37	4616	Umnugovi	Mandal-Ovoo	34.05	84.63	118.68	6737	Khusvgul	Tumubulag	72.76	43.98	116.74
2110	Dornod	Bayan-Uul	0.32	522.07	522.39	4619	Umnugovi	Munlai	26.28	76.23	102.50	6740	Khusvgul	Tunel	205.24	202.94	408.17
2113	Dornod	Bulgan	3.13	90.02	93.15	4622	Umnugovi	Noyon	3.65	68.72	72.36	6743	Khusvgul	Ulaan-Uul	227.73	529.03	756.76
2116	Dornod	Gurvanzagal	0.18	116.12	116.31	4625	Umnugovi	Nomgon	4.87	90.94	95.81	6746	Khusvgul	Khankh	354.07	320.64	674.71
2119	Dornod	Dashbalbar	-0.25	609.91	609.66	4628	Umnugovi	Sevrei	40.87	85.44	126.31	6749	Khusvgul	Tsagaannuur	127.16	295.44	422.61
2122	Dornod	Matad	11.11	292.15	303.25	4631	Umnugovi	Khanbogd	68.87	161.36	230.23	6752	Khusvgul	Tsagaan-Uul	155.66	214.02	369.68
2125	Dornod	Selgeren	2.02	190.76	192.79	4634	Umnugovi	Khankhongor	44.00	135.20	179.20	6755	Khusvgul	Tsagaan-Uur	491.33	563.91	1,055.24
2128	Dornod	Khalkhgol	117.19	1,371.65	1,488.84	4637	Umnugovi	Khurmen	4.35	82.16	86.51	6758	Khusvgul	Tsetserleg	168.23	41.74	209.97
2131	Dornod	Khulunbuir	5.36	72.92	78.28	4640	Umnugovi	Tsogt-Ovoo	27.85	85.63	113.47	6761	Khusvgul	Chandmani-Undur	245.95	234.81	480.76
2134	Dornod	Tsagaan-Ovoo	6.68	194.35	201.03	4643	Umnugovi	Tsogttsetsii	9.31	29.65	38.96	6764	Khusvgul	Shine-ider	55.72	75.13	130.85
2137	Dornod	Choibalsan	0.45	189.30	189.75	4801	Dundgovi	Saintsagaan	14.39	32.85	47.24	6767	Khusvgul	Erdenbulgan	285.90	289.49	575.39
2140	Dornod	Chuluunkhoroot	0.20	453.77	453.96	4804	Dundgovi	Adaatsag	5.03	52.10	57.13	8101	Zavkhan	Uliastai	-4.06	-1.34	-5.40
2201	Sukhbaatar	Baruun-Urt	7.24	152.37	159.62	4807	Dundgovi	Bayanjargalan	13.04	28.09	41.13	8104	Zavkhan	Ardarkhan	45.58	192.70	238.28
2204	Sukhbaatar	Asgat	4.08	92.15	96.23	4810	Dundgovi	Govi-Ugtaal	11.08	23.42	34.50	8107	Zavkhan	Asgat	12.67	3.18	15.85
2207	Sukhbaatar	Bayandelger	4.28	94.65	98.93	4813	Dundgovi	Gurvansaihan	22.37	48.16	70.52	8110	Zavkhan	Bayantes	108.66	14.99	123.65
2210	Sukhbaatar	Dariganga	9.68	82.72	92.40	4816	Dundgovi	Delgerkhangai	9.41	99.86	109.27	8113	Zavkhan	Bayankhairkhan	64.04	8.81	72.84
2213	Sukhbaatar	Munkhkhaan	12.20	142.20	154.40	4819	Dundgovi	Delgertsogt	10.24	21.59	31.83	8116	Zavkhan	Durvuligin	140.36	92.58	232.94
2216	Sukhbaatar	Naran	6.78	58.32	65.10	4822	Dundgovi	Deren	14.82	31.39	46.21	8119	Zavkhan	Zavkhanmandal	15.33	75.14	90.47
2219	Sukhbaatar	Ongon	13.94	119.48	133.42	4825	Dundgovi	Luus	4.78	50.20	54.98	8122	Zavkhan	Ider	72.14	148.77	220.92
2225	Sukhbaatar	Tuvshinshiree	2.49	54.68	57.16	4828	Dundgovi	Ulziit	66.29	201.28	267.56	8125	Zavkhan	Ikh-Uul	72.74	151.44	224.18
2228	Sukhbaatar	Tumentsogt	3.51	40.22	43.74	4831	Dundgovi	Undurshil	19.89	43.16	63.05	8128	Zavkhan	Numrug	63.78	131.37	195.15
2231	Sukhbaatar	Uubayan	2.80	62.11	64.90	4834	Dundgovi	Saikhan-Ovoo	6.13	64.50	70.64	8131	Zavkhan	Otgon	46.28	264.97	311.26
2234	Sukhbaatar	Khalzan	2.15	48.11	50.26	4837	Dundgovi	Khuld	26.04	77.98	104.02	8134	Zavkhan	Santmargats	9.99	49.96	59.95
2237	Sukhbaatar	Erdenetsagaan	9.57	212.42	222.00	4840	Dundgovi	Tsagaandelger	14.18	30.79	44.96	8137	Zavkhan	Songino	60.01	8.27	68.27
2301	Khenti	Kherlen	-8.06	54.63	46.57	4843	Dundgovi	Erdendalai	11.09	115.29	126.39	8140	Zavkhan	Tosontsengel	101.57	211.62	313.19
2304	Khenti	Batnorov	4.59	92.49	97.08	6101	Orkhon	Bayan-Undur	-3.24	1.94	-1.31	8143	Zavkhan	Tudevtei	65.87	9.05	74.92
2307	Khenti	Batshireet	191.59	268.79	460.38	6104	Orkhon	Jargalant	3.98	22.14	26.13	8146	Zavkhan	Telmen	67.20	138.72	205.92
2310	Khenti	Bayan-Adarga	71.79	136.11	207.90	6201	Uvurkhangai	Arvaikheer	-7.62	-7.21	-14.84	8149	Zavkhan	Tes	22.16	2.79	24.94
2313	Khenti	Bayanmunkh	6.94	11.15	18.10	6204	Uvurkhangai	Baruunbayan-Ulaan	20.19	51.10	71.29	8152	Zavkhan	Urgamal	14.86	73.06	87.92
2316	Khenti	Bayan-Ovoo	4.45	64.63	69.09	6207	Uvurkhangai	Bat-Ulzii	42.37	159.63	202.00	8155	Zavkhan	Tsagaankhairkhan	16.64	70.58	87.22
2319	Khenti	Bayankhutag	8.51	116.45	124.96	6210	Uvurkhangai	Bayangol	4.35	56.36	60.71	8158	Zavkhan	Tsagaanchuluut	19.04	74.08	93.12
2322	Khenti	Binder	146.71	205.90	352.61	6213	Uvurkhangai	Bayan-Undur	3.97	52.20	56.17	8161	Zavkhan	Tsetsen-Uul	10.13	50.82	60.96
2325	Khenti	Galshir	2.37	84.27	86.64	6216	Uvurkhangai	Bogd	51.71	130.33	182.04	8164	Zavkhan	Shiluustei	25.02	80.16	105.18
2328	Khenti	Dadal	118.61	196.05	314.67	6219	Uvurkhangai	Burd	5.29	120.75	126.04	8167	Zavkhan	Erdenekhairkhan	17.68	87.04	104.72
2331	Khenti	Darkhan	7.25	12.91	20.16	6222	Uvurkhangai	Guchin-Us	24.69	62.06	86.75	8170	Zavkhan	Yaruu	37.38	128.04	165.41
2334	Khenti	Dergelkhaan	10.52	16.87	27.39	6225	Uvurkhangai	Yesunzuil	4.43	104.16	108.59	8201	Gove-Altai	Esunbulag	10.85	5.74	16.60
2337	Khenti	Jagaltkhaan	7.57	12.20	19.77	6228	Uvurkhangai	Zuunbayan-Ulaan	2.81	40.01	42.82	8204	Gove-Altai	Altai	203.92	320.47	524.39
2340	Khenti	Murun	5.73	9.28	15.01	6231	Uvurkhangai	Nariinteel	13.34	34.41	47.74	8207	Gove-Altai	Bayan-Uul	113.29	73.60	186.89
2343	Khenti	Norovlin	1.02	510.04	511.06	6234	Uvurkhangai	Ulziit	19.23	46.02	65.25	8210	Gove-Altai	Binger	30.85	31.82	62.67
2346	Khenti	Umnudelger	296.68	416.30	712.98	6237	Uvurkhangai	Sant	3.09	42.02	45.11	8213	Gove-Altai	Bugat	250.37	218.68	469.05
2349	Khenti	Tsenkhermandal	8.77	14.05	22.82	6240	Uvurkhangai	Taragt	4.51	56.64	61.16	8216	Gove-Altai	Darvi	18.88	31.79	50.67
4101	Tuv	Zuunmod	-3.06	-39.21	-42.27	6243	Uvurkhangai	Tugrug	28.14	70.79	98.93	8219	Gove-Altai	Delger	53.44	55.32	108.76
4103	Tuv	Altanbulag	46.96	136.05	183.00	6246	Uvurkhangai	Uyanga	2.24	47.36	49.60	8222	Gove-Altai	Jargalan	27.39	104.73	132.12
4107	Tuv	Argalant	7.33	40.17	47.51	6249	Uvurkhangai	Khairkhandulaan	20.99	53.32	74.31	8225	Gove-Altai	Taishir	31.24	98.32	129.56
4110	Tuv	Arkhust	2.33	0.94	3.27	6252	Uvurkhangai	Kharkhorin	31.24	138.52	169.76	8228	Gove-Altai	Tonkhil	181.90	214.97	396.87
4113	Tuv	Batsumber	12.03	92.10	104.13	6255	Uvurkhangai	Khujirt	15.36	38.33	53.69	8231	Gove-Altai	Tugrug	39.14	30.73	69.87
4116	Tuv	Bayan	8.88	9.29	18.17	6301	Bulgan	Bulgan	-6.86	-4.44	-11.30	8234	Gove-Altai	Kaliun	37.42	29.22	66.64
4119	Tuv	Bayandelger	6.40	7.02	13.43	6304	Bulgan	Bayan-Agt	92.20	858.77	950.97	8237	Gove-Altai	Khunkhmorit	122.00	79.58	201.59
4122	Tuv	Bayanjargalan	8.68	10.22	18.91	6307	Bulgan	Bayannuur	1.87	62.97	64.84	8240	Gove-Altai	Tsogt	185.25	459.07	644.31
4125	Tuv	Bayan-Unjuul	38.27	127.70	165.96	6310	Bulgan	Bugat	225.16	129.28	354.44	8243	Gove-Altai	Tseel	62.06	153.58	215.64
4128	Tuv	Bayankhangai	6.52	35.74	42.26	6313	Bulgan	Buregkhangai	8.70	218.74	227.44	8246	Gove-Altai	Chandmani	37.10	38.38	75.48
4131	Tuv	Bayantsagaan	23.75	49.16	72.91	6316	Bulgan	Gurvanbulag	4.32	124.64	128.96	8249	Gove-Altai	Sharga	29.65	31.43	61.08
4134	Tuv	Bayantsogt	9.98	55.35	65.32	6319	Bulgan	Dhashinchilen	5.17	144.69	149.86	8252	Gove-Altai	Erdene	252.83	397.48	650.31
4137	Tuv	Bayanchandmani	3.33	19.90	23.23	6322	Bulgan	Mogod	44.34	149.33	193.68	8301	Bayan-Ulgii	Ulgii	-1.58	-1.61	-3.19
4140	Tuv	Bornuur	7.39	48.23	55.62	6325	Bulgan	Orkhon	27.53	156.96	184.49	8304	Bayan-Ulgii	Altai	133.98	66.60	200.58
4143	Tuv	Buren	9.84	117.63	127.47	6328	Bulgan	Rashaant	0.77	30.46	31.23	8307	Bayan-Ulgii	Altantsugts	50.35	76.36	126.71
4146	Tuv	Delgerkhaan	5.68	67.96	73.65	6331	Bulgan	Saikhan	41.80	142.21	184.01	8310	Bayan-Ulgii	Bayannuur	44.51	29.38	73.89
4149	Tuv	Jargalant	12.22	81.73	93.96	6334	Bulgan	Selenge	342.93	196.93	539.86	8313	Bayan-Ulgii	Bugat	82.12	37.23	119.35
4152	Tuv	Zaamar	7.31	164.91	172.22	6337	Bulgan	Teshig	447.63	846.47	1,294.10	8316	Bayan-Ulgii	Bulgan	146.16	213.57	359.72
4155	Tuv	Lun	8.05	65.91	73.97	6340	Bulgan	Khangal	111.29	62.83	174.12	8319	Bayan-Ulgii	Buyant	91.32	31.96	123.28
4158	Tuv	Mungunmorit	207.98	266.90	474.88	6343	Bulgan	Khishing-Undur	37.72	128.21	165.93	8322	Bayan-Ulgii	Deluum	114.20	143.63	257.82
4161	Tuv	Undurshireet	8.48	70.02	78.50	6346	Bulgan	Khutag-Unduur	395.28	226.67	621.95	8325	Bayan-Ulgii	Nogoonnuur	169.76	87.91	257.67
4164	Tuv	Sumber	2.19	13.97	16.15	6401	Bayankhongor	Bayankhongor	-4.55	-8.46	-13.01	8328	Bayan-Ulgii	Sagsai	139.88	62.18	202.05
4167	Tuv	Sergelen	15.18	29.77	44.95	6404	Bayankhongor	Baatsagaan	59.53	62.33	121.86	8331	Bayan-Ulgii	Tolbo	148.12	51.84	199.96
4170	Tuv	Ugtaaltsaidam	4.09	91.45	95.54	6407	Bayankhongor	Bayanbulag	25.22	26.36	51.58	8334	Bayan-Ulgii	Ulaankhus	298.15	110.46	408.61
4173	Tuv	Tseel	11.57	58.57	70.14	6410	Bayankhongor	Bayangobi	25.99	58.90	84.89	8340	Bayan-Ulgii	Tsengel	282.58	125.64	408.21
4176	Tuv	Erdene	412.18	205.61	617.79	6413	Bayankhongor	Bayanlig	66.95	151.51	218.46	8401	Khovd	Jargalant	-2.89	-4.39	-7.27
4179	Tuv	Erdensant	7.75	92.50	100.25	6416	Bayankhongor	Bayan-Ovoo	20.15	42.40	62.55	8404	Khovd	Altai	262.70	241.85	504.55
4201	Goveisumber	Sumber	15.34	31.20	46.54	6419	Bayankhongor	Bayan-Undur	84.32	155.27	239.59	8407	Khovd	Bulgan	239.86	349.47	589.33
4204	Goveisumber	Bayantal	3.67	7.88	11.55	6422	Bayankhongor	Bayantsagaan	25.12	86.02	111.14	8410	Khovd	Buyant	78.35	78.55	156.90
4207	Goveisumber	Shivee gobi	3.69	7.41	11.10	6425	Bayankhongor	Bogd	20.45	51.03	71.48	8413	Khovd	Darvi	101.81	36.15	137.96
4301	Selenge	Sukhbaatar	-70.53	8.15	-62.38	6428	Bayankhongor	Bumbugur	18.95	39.90	58.86	8416	Khovd	Durgun	79.26	51.95	131.21
4304	Selenge	Altanbulag	147.42	119.68	267.10	6431	Bayankhongor	Buutsagaan	42.95	44.80	87.75	8419	Khovd	Duut	34.61	63.84	98.45
4307	Selenge	Baruunburen	11.00	111.79	122.78	6434	Bayankhongor	Galuut	31.57	66.42	97.99	8422	Khovd	Zereg	45.74	15.95	61.69
4310	Selenge	Bayangol	-2.46	105.98	103.51	6437	Bayankhongor	Gurvanbulag	37.79	198.95	236.75	8425	Khovd	Mankhan	70.02	129.18	199.21
4313	Selenge	Yeruu	558.30	616.15	1,174.45	6440	Bayankhongor	Jargalant	26.45	55.64	82.09	8428	Khovd	Munkhkhairkhan	41.46	76.48	117.94
4316	Selenge	Javkhlant	1.10	252.37	253.47	6443	Bayankhongor	Jinst	32.72	68.79	101.51	8431	Khovd	Must	72.68	25.64	98.32
4319	Selenge	Zuunburen	-1.19	253.47	252.28	6446	Bayankhongor	Zag	16.00	33.66	49.66	8434	Khovd	Myangat	63.50	41.48	104.97
4322	Selenge	Mandal	235.56	233.62	469.18	6449	Bayankhongor	Ulziit	20.26	50.64	70.90	8437	Khovd	Uyench	222.87	375.15	598.02
4325	Selenge	Orkhon	2.27	51.31	53.59	6452	Bayankhongor	Khureemaral	34.85	36.51	71.36	8440	Khovd	Khovd	61.05	61.16	122.21
4328	Selenge	Orkhontuul	10.31	116.76	127.07	6455	Bayankhongor	Shinejinst	169.21	311.61	480.82	8443	Khovd	Tsetseg	63.65	22.43	86.08
4331	Selenge	Saikhan	-19.46	50.52	31.06	6458	Bayankhongor	Erdenetsogt	25.22	53.11	78.33	8446	Khovd	Chandmani	117.46	77.14	194.60
4334	Selenge	Sant	3.77	53.51	57.28	6501	Arkhangai	Erdenbulgan	-19.94	-0.88	-20.82	8449	Khovd	Erdenburen	27.33	64.67	92.00
4337	Selenge	Tushig	162.19	184.32	346.51	6504	Arkhangai	Battsengel	48.81	215.09	263.90	8504	Uvs	Baruunturuun	69.36	110.80	180.15
4340	Selenge	Khuder	171.40	132.20	303.60	6507	Arkhangai	Bulgan	37.00	286.47	323.47	8507	Uvs	Bukhmurun	104.80	27.00	131.80
4343	Selenge	Khushaat	22.25	103.49	125.74	6510	Arkhangai	Jargalant	381.49	361.82	743.31	8510	Uvs	Davst	141.75	224.40	366.15
4346	Selenge	Tsagaannuur	38.10	195.26	233.37	6513	Arkhangai	Ikh Tamir	74.83	480.15	554.98	8513	Uvs	Zavkhan	133.43	88.20	221.64
4349	Selenge	Shaamar	-8.46	141.35	132.88	6516	Arkhangai	Ugiinuur	22.35	103.57	125.92	8516	Uvs	Zuungobi	86.58	137.99	224.57
4352	Selenge	Shaamar	0.18	3.02	3.20	6519	Arkhangai	Ulziit	24.66	90.60	115.26	8519	Uvs	Zuunkhangai	65.09	8.93	74.02
4401	Dornogovi	Sainshand	0.29	-22.76	-22.47	6522	Arkhangai	Unduur-Ulaan	16.60	311.83	328.43	8522	Uvs	Malchin	86.62	137.94	224.56
4404	Dornogovi	Airag	4.22	91.74	95.96	6525	Arkhangai	Tariat	531.43	331.81	863.24	8525	Uvs	Naranbulag	111.63	178.21	289.84
4407	Dornogovi	Altanshiree	4.05	90.92	94.97	6528	Arkhangai	Tuvshruulekh	14.92	72.75	87.67	8528	Uvs	Ulgii	45.26	30.13	75.39
4410	Dornogovi	Dalanjargalan	2.28	48.47	50.75	6531	Arkhangai	Khairkhan	11.54	161.80	173.35	8531	Uvs	Umnugobi	59.21	39.59	98.80
4413	Dornogovi	Delgerekh	2.72	59.74	62.46	6534	Arkhangai	Khangai	509.71	317.83	827.53	8534	Uvs	Undurkhangai	88.65	58.85	147.50
4416	Dornogovi	Zamin-Uud	0.55	-19.90	-19.35	6537	Arkhangai	Khashaat	2.95	121.30	124.26	8537	Uvs	Sagil	125.44	65.20	190.64
4419	Dornogovi	Ikhkhet	2.36	51.22	53.58	6540	Arkhangai	Khotont	26.01	71.54	97.55	8540	Uvs	Tarialan	69.91	126.47	196.38
4422	Dornogovi	Mandakh	9.56	27.64	37.20	6543	Arkhangai	Tsakhir	432.04	269.30	701.34	8540	Uvs	Tarialan	69.91	126.47	196.38
4425	Dornogovi	Urgun	4.75	106.21	110.96	6546	Arkhangai	Tsenkher	33.24	280.44	313.68	8543	Uvs	Turgen	45.14	72.33	117.46
4428	Dornogovi	Saikhandulaan	5.39	121.66	127.06	6549	Arkhangai	Tsetserleg	254.59	22.08	276.67	8546	Uvs	Tes	66.45	107.58	174.03
4431	Dornogovi	Ulaanbadrakh	1.67	25.44	27.11	6552	Arkhangai	Chuluut	447.13	303.69	750.82	8549	Uvs	Khovd	78.69	20.23	98.92
4434	Dornogovi	Khatanbulag	11.69	155.66	167.35	6555	Arkhangai	Erdebmandal	11.89	242.31	254.19	8552	Uvs	Khyargas	69.64	111.16	180.80
4437	Dornogovi	Khuvsgul	6.33	17.67	24.00	6701	Khusvgul	Murun	-2.22	-13.08	-15.30	8555	Uvs	Tsagaankhairkhan	78.27	51.86	130.13

Source: JICA Project Team



Source: JICA Project Team

Figure 3.5.31 Estimated Water Deficit by Soum in 2040 (Average)



Source: JICA Project Team

Figure 3.5.32 Estimated Water Deficit by Soum in 2040 (Dry Year)

3.6 Development Plan for Water Resources with Priority Projects

3.6.1 Criteria for water resources development planning with priority projects

(1) IWMP criteria

The IWMP proposes the following criteria for selecting priority projects of water resources development:

- Projects with a large ratio of foreign financial sources (projects that seem to be difficult to implement with national and local funds only);
- Projects with high investment costs during the IWMP Phase II (2017-2021); and
- Projects that should be continued after the IWMP implementation plan.

These criteria support implementation of major water resources development projects by introducing donors' financial aids but would not ensure financial and economic viability of the priority projects thus selected. Moreover, effects on social and natural environment will have to be carefully assessed before final decisions are made for implementation.

(2) NCDP criteria for SDGs and SDV2030

In Mongolia, endowments of water resources are limited and their distribution is very skewed in the vast territory. Therefore, proper development and management of water resources are critically important for realization of sustainable development as pursued by the NCDP reflecting the SDV2030 and SDGs. For the NCDP, water resources development and management are taken as instrument to pursue green development as important component of the basic strategy.

As the SDGs and therefore the SDV2030 call for a shift in development paradigm away from the 20th century development model characterized by resource-intensive and economic efficiency-oriented development, projects to be prioritized should satisfy the following conditions:

(a) Projects that would help to cause desirable structural changes in spatial and economic development,
(b) Projects at advanced stage of preparation to realize early effects, and
(c) Projects for which immediate actions can be taken mainly by mobilizing domestic resources.

(3) Priority projects

The following projects are proposed in the water resources sector:

(a) Erdeneburen hydropower plant,
(b) Eg river hydropower plant,
(c) Tuul water complex development,
(d) Renovation and expansion of water supply network with increased number of connected water supply kiosks,
(e) Wastewater treatment plants renovation and construction,
(f) Sewerage network renovation and development,
(g) Small wastewater treatment plans at Soum centers with sewage recycling,
(h) Water sources renovation and construction focusing on high productivity pastureland and desertification threat areas,
(i) Water diversion from the Orkhon river to the Govi (feasibility study),
(j) Selenge river hydropower dam development (feasibility study), and

(k) Sanitation and wastewater disposal in Ger district.

3.6.2 Tuul water complex

(1) Background

The amount of groundwater development in the Ulaanbaatar city has reached the upper limit, and the development of surface water such as dams will be required to overcome the water shortages expected in the future. Especially in winter (dry) season, it is predicted that the groundwater level will decrease, and water shortages will occur.

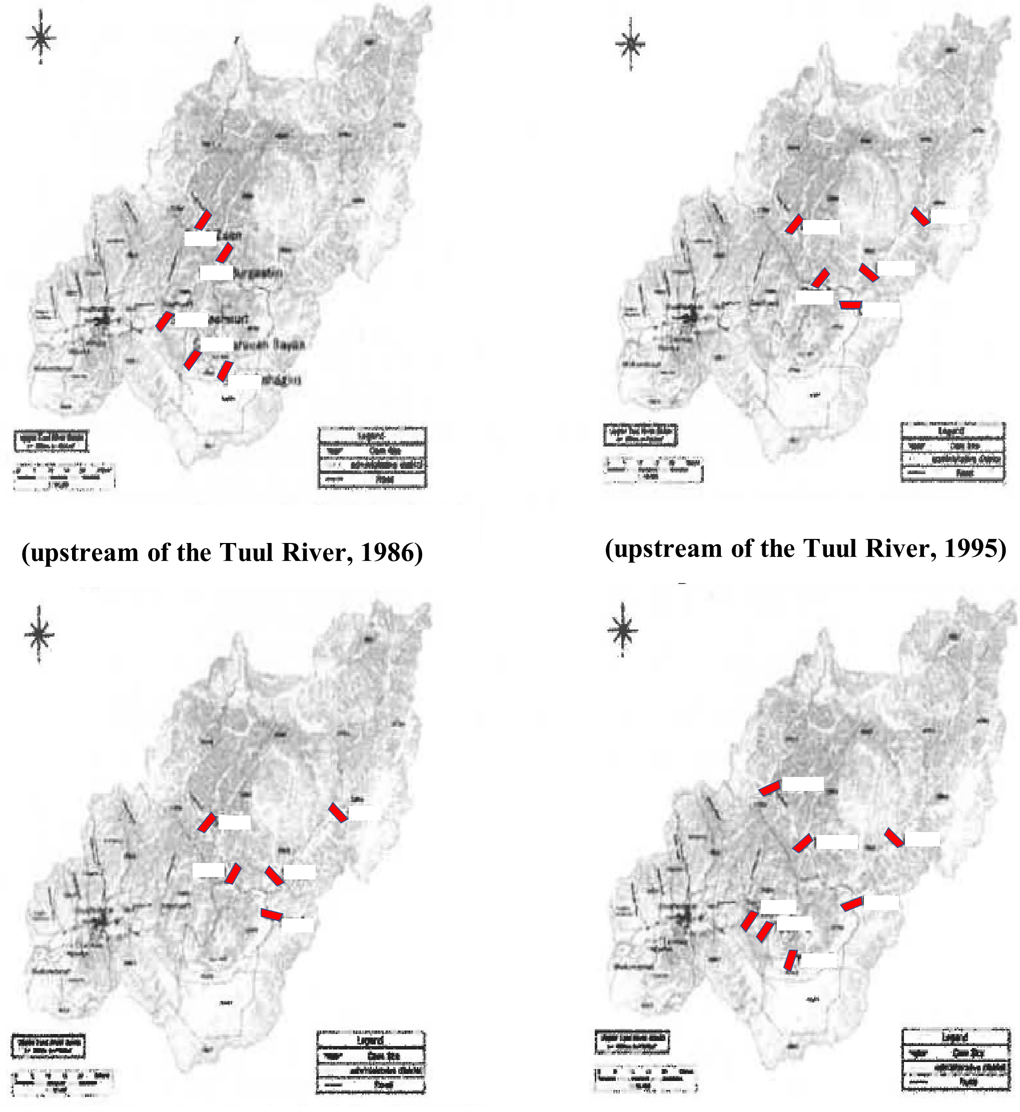
(2) Previous study on Tuul water complex

A feasibility study for a new water supply source of Ulaanbaatar was executed in 1981-83 with the assistance of then-Soviet Union's experts. This feasibility study suggested a scenario to use 11 sites with groundwater resources in a 200 km circle around Ulaanbaatar. According to comparison of these sources, one scenario to establish a dam 2.5 km upstream of the Gachuurt village and to supply water to Ulaanbaatar from open reservoir was selected as the most beneficial one. Therefore, investigations and designs have been carried out in 1989.

Monhydroconstruction LLC implemented a 'pre-investigation work for formulating the feasibility study to establish hydro-construction on the Tuul River between November 2007 and April 2008 upon request of the then Ministry of Nature, Environment and Tourism and the Water Authority. Under this project some three dam sites have been selected. The first dam site selected to be in Khar Us at a bend of the river in Gachuurt and it overlaps with the dam site which was previously selected by the Soviet Union's experts. The second dam site was selected to be 2 km downstream of the second site previously selected by Soviet Union's experts. The third one selected locates 70 km upstream of Ulaanbaatar or 4km downstream of Tuul-Terelj confluence.

Also, Prestige Engineering LLC studied the Tuul water complex in 2010-11 for the purpose of regulating the Tuul River runoff, safe water supply for Ulaanbaatar in the future, and hydropower production, establishing complex hydro-construction including water refreshing facilities, solution of water supply for large factories and objects, and creating a convenient ecosystem environment in the Tuul River basin. A preliminary feasibility study has been carried out and four dam sites were selected.

Figure 3.6.1 shows a series of plans for developing the dam in the upstream of the Tuul River to supply water in Ulaanbaatar. The plans include: the Russian development plan (draft), which continued from 1981 through 1986; the development plan (draft) as proposed by JICA from 1993 through 1995; the Mongolian development plan (draft); and a recent Tuul & Terelj River Plan as proposed by the Overseas Contractors Association (OCA) in a preliminary survey in 2009. Most of the plans need to be modified and updated because they have been neglected for a long time without any further concrete progress except for the site selection.



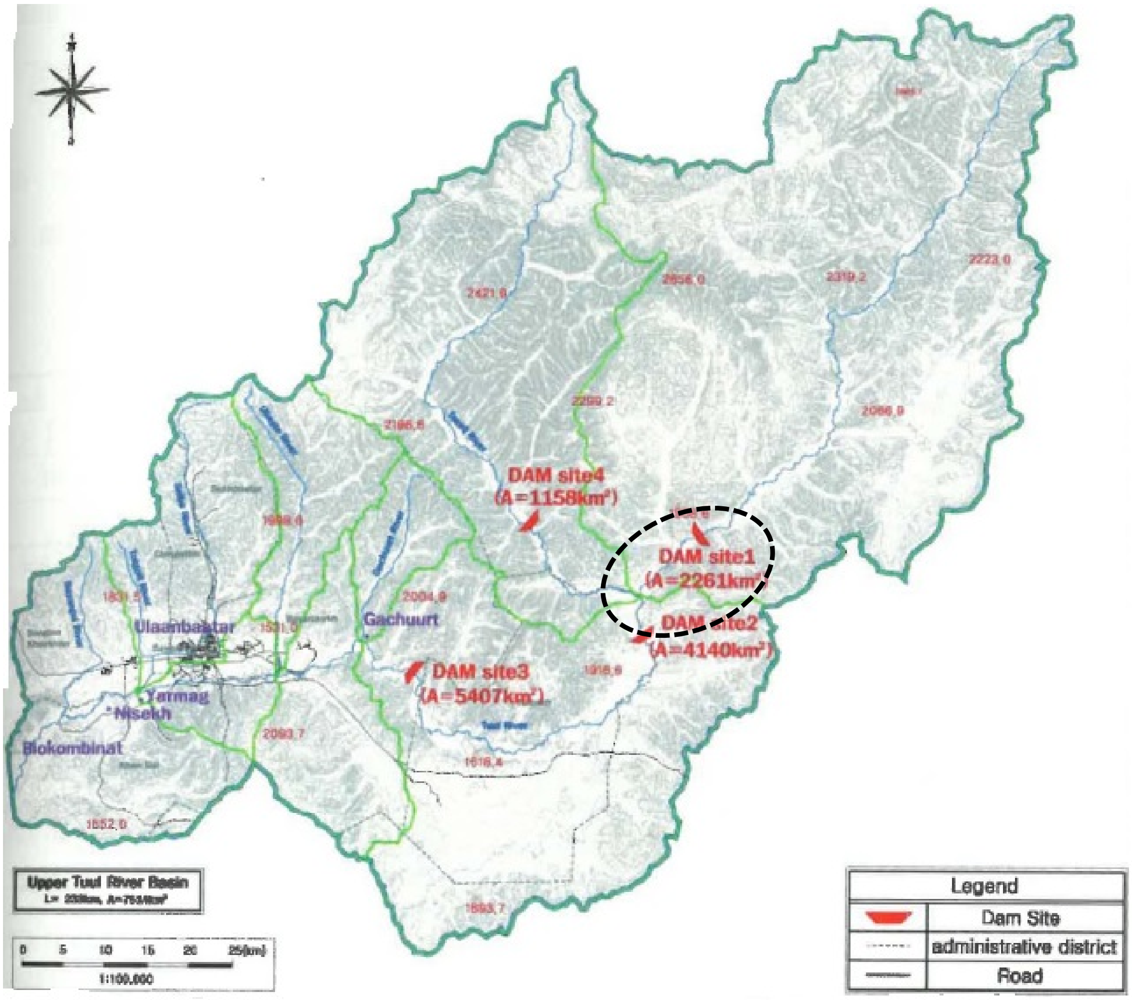
(upstream of the Tuul River, 1986) (upstream of the Tuul River, 1995)

(upstream of the Tuul River, 1990s) (upstream of the Tuul River, 2009)

Source: USUG/ KOICA, Dec. 2012

Figure 3.6.1 Previous Plans and Studies of Tuul Water Complex

As seen in Figure 3.6.2, the four alternative dam sites were finally selected by USUG/KOICA M/P (2012) by examining the existing data from the previous dam development plans and conducting a site investigation to identify a change in surrounding conditions. The determination of an optimal dam site should be based on not only technical details of the dam site, but also social, economic, natural, and political details in and around the dam site. The M/P focused on 1) compatibility with the purpose of dam development; 2) problems of construction and natural conditions (e.g. topographic and geologic characteristics); 3) connection with the local economy, and conciliation with vested rights to use water; 4) correlation with future development potential; 5) possible development of single dam or multiple dams; and 6) compatibility and preservation of natural environment for the defemination of an optimal



Source: USUG/KOICA, 2012

Figure 3.6.2 Location Map of Alternative Dam Sites (Dam site-1 was selected by USUG/KOICA, 2012)

Since it is impossible to meet the water supply of the city only with groundwater in 2040 and thereafter, the development of a dam to secure surface water is required. With regard to this, the four alternative dam sites were analytically compared with one another in terms of their optimality for dam development in M/P by USUG/KOICA (2012). As a result, Site 1 located in the upper Thuul River was found to be the most favorable in terms of the rate of water use and economic feasibility. Accordingly, this site was determined herein as an optimal site for dam development. The optimal scale of dam development at this site was so determined that it would satisfy water demand requirements for the target year 2040.

(3) Updating of plan of the Tuul dam project

Using the latest meteorological and hydrological data, the JPT re-evaluated the plan for the alternative dam Site 1 proposed in USUG/KOICA (2012). For the inflow of dam, a simulation of reservoir operation calculation was performed using the results of the Tank model (Sub-basin-1) for 30 years (Annex to this chapter). The specifications of the dam used the results of USUG/KOICA (2012) F/S. Table 3.6.1 shows the specifications of the dam indicated by the F/S of USUG/KOICA (2012).

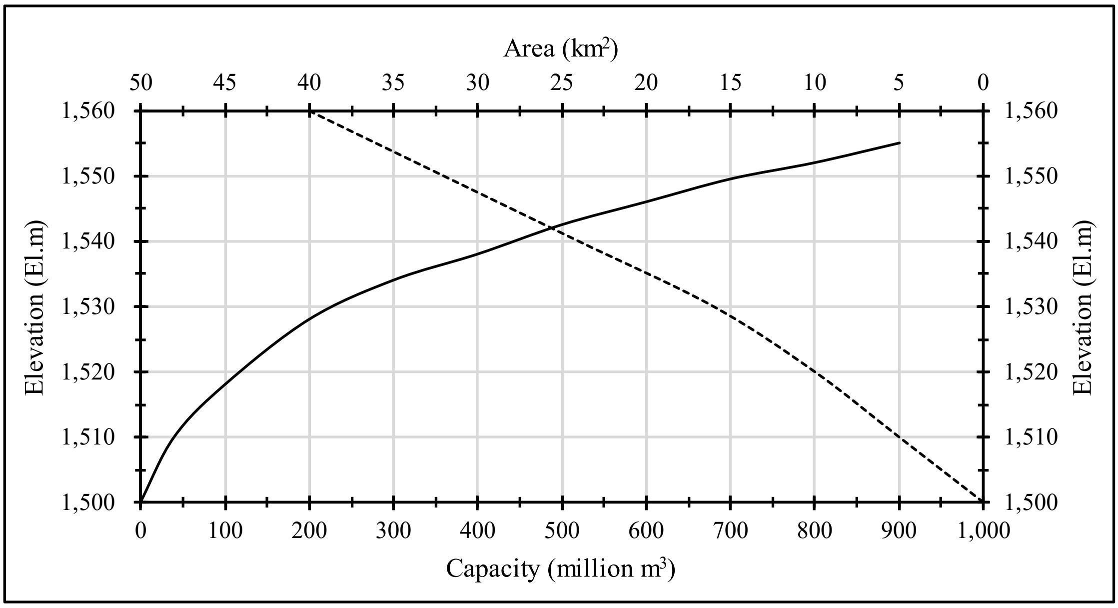
Table 3.6.1 Major Specification of the Tuul Dam Project (Dam Site-1) as planned in F/S

Item	Unit	Description
1. Basin characteristics		
- Catchment area	km²	2,261.1

- Annual mean precipitation	mm	310.3
- Annual mean runoff	10^6 m^3/year	388.1
2. Reservoir		
- Maximum water level (MWL)	EL.m	1,529.20
- Flood water level (FWL)	EL.m	1,525.90
- Normal water level (NWL)	EL.m	1,524.30
- Low water level (LWL)	EL.m	1,515.00
- Total storage	10^6 m^3	210.5
- Effective Storage	10^6 m^3	82.6
- Inactive storage	10^6 m^3	49.9
3. Dam		
- Location	-	48-01-54, 107-41-35
- Type	-	C.F.R.D.
- Crest level	EL.m	1531.60
- Length	m	1,080
- Height	m	42.5
4. Effectiveness		
Water supply	10^6 m^3/year	184.9
- Domestic & industrial water	10^6 m^3/year	145.7
- Agricultural water	10^6 m^3/year	16.2
- Instream flow	10^6 m^3/year	23.0
Flood control		
- Maximum inflow (design flood)	m^3/s	757
- Maximum outflow	m^3/s	440
- Maximum discharge	m^3/s	317
5. Hydropower generation		
- Installed capacity	kW	240 (123 x 2EA)
- annual mean electricity generation	MWh/year	1,754
6. Submerged area		
- Submerged area	km^2	12.4 (Submergence EL.1524.3m)
7. Project costs		
- Construction costs	1,000 US$	176,081
- Consulting expense	1,000 US$	11,269
- Compensation expense	1,000 US$	3,988
- Contingencies	1,000 US$	19,134
- VAT	1,000 US$	18,735
- Total costs	1,000 US$	229,207

Source: USUG/KOICA, Master Plan for Water Resource Development in Ulaanbaatar, 2012.

Stage-capacity-area curve at the Tuul dam Site1 by USUG/KOICA (2012) is shown in Figure 3.6.3.



Source: USUG/KOICA (2012)

Figure 3.6.3 Stage-Capacity-Area Curve at Tuul Dam#1 Reservoir

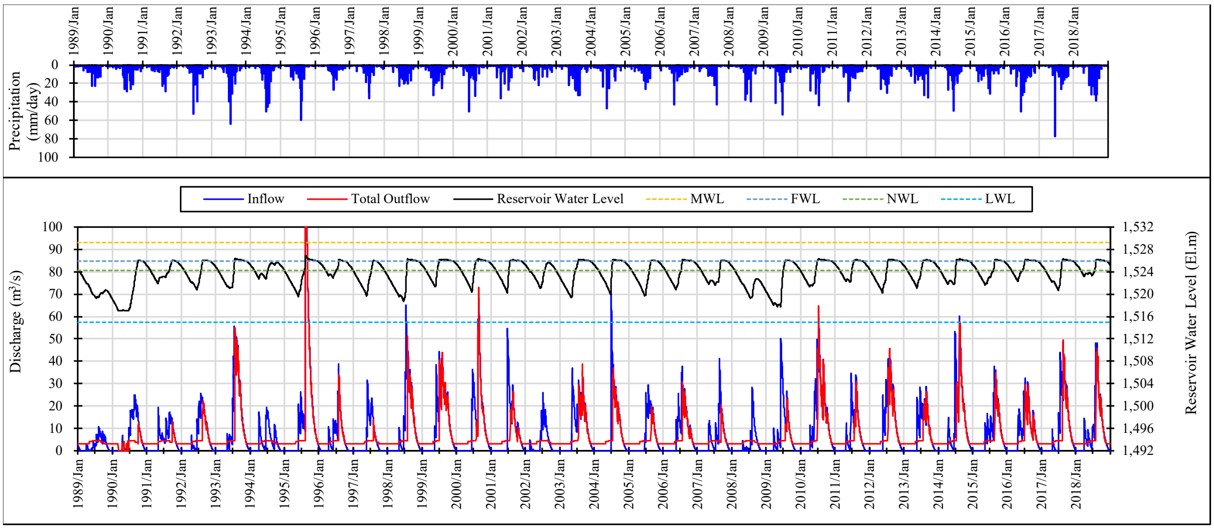
For domestic and industrial water demand, the water shortage of 75 MCM/year (268.5 MCM-193.5 MCM = 75 MCM = 2.38 m^3/s) in 2040 shown in Appendix. The values of USUG/KOICA (2012) were used for agricultural water demand and environmental flow. The monthly water demand used in this study is shown in Table 3.6.2.

Table 3.6.2 Monthly Water Demand for Dam Site-1 Project in Ulaanbaatar

Month		Water Demand			
		Domestic & Industrial	Agricultural	Instream	Total
		(m3/s)	(m3/s)	(m3/s)	(m3/s)
1	Jan	2.38	0.06	0.73	3.17
2	Feb	2.38	0.06	0.73	3.17
3	Mar	2.38	0.13	0.73	3.24
4	Apr	2.38	0.13	0.73	3.24
5	May	2.38	1.10	0.73	4.21
6	Jun	2.38	1.27	0.73	4.38
7	Jul	2.38	1.23	0.73	4.34
8	Aug	2.38	1.23	0.73	4.34
9	Sep	2.38	0.75	0.73	3.86
10	Oct	2.38	0.06	0.73	3.17
11	Nov	2.38	0.06	0.73	3.17
12	Dec	2.38	0.06	0.73	3.17
Mean		2.38	0.51	0.73	3.62

Source: JICA Project Team and USUG/KOICA (2012)

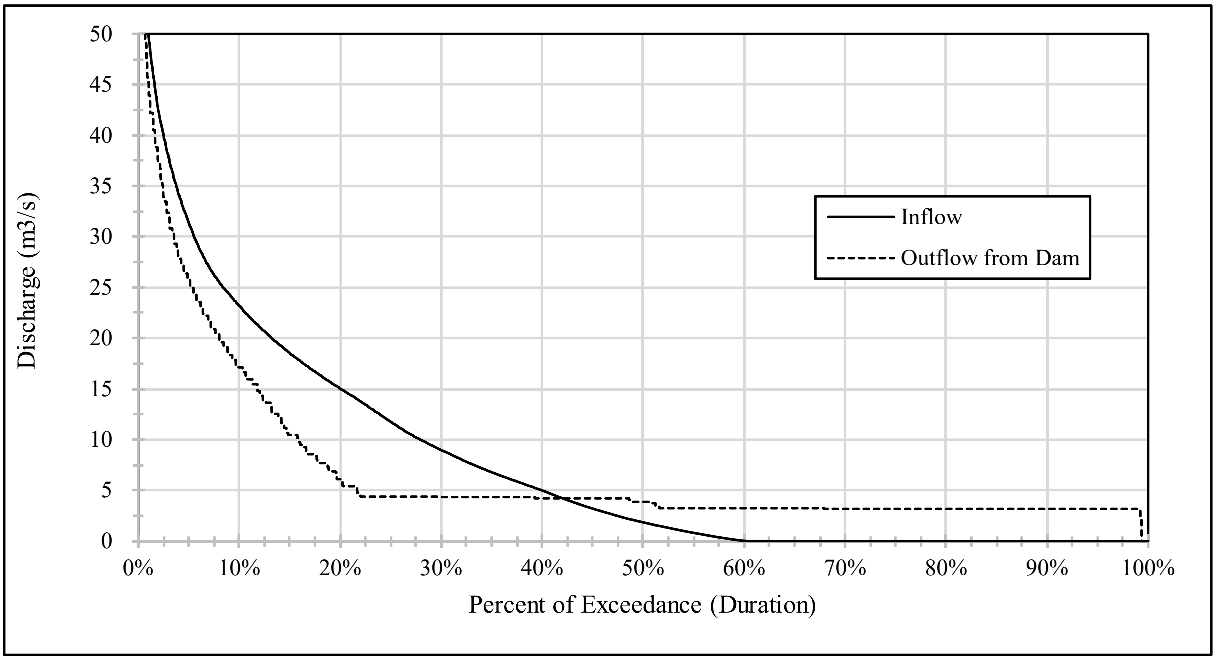
The results of reservoir operation simulation for 30 years are shown in Figure 3.6.4 and Table 3.6.3. It can be seen that in some drought years, surface water demand cannot be met in 1990, but in most year, water demand is met even in the dry season. The proposed dam/reservoir is a multipurpose dam that can hold water for flood control, irrigation, domestic and industrial water, hydropower and environmental flow. Water can be effectively stored in the rainy season for release in the dry season.



Source: JICA Project Team

Figure 3.6.4 Result of Reservoir Operation Simulation of Tuul Dam (Site 1)

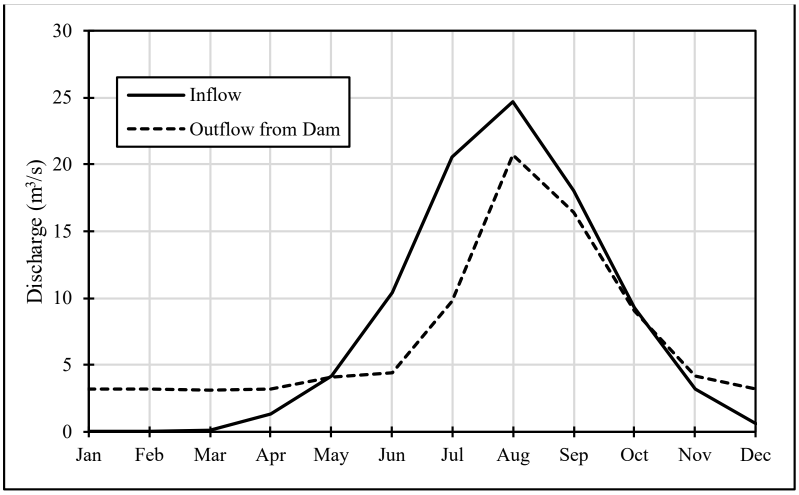
Mean monthly discharge and flow duration curve of inflow and outflow from Tuul dam Site1 are shown in Figure 3.6.5 and Figure 3.6.6. It can be seen that the discharge after adjustment by the dam contributes greatly to the improvement of discharge especially in the dry season (winter season).



Source: JICA Project Team

Figure 3.6.5 Flow Duration Curve of Inflow and Outflow from Tuul Dam Site 1

Month		Mean Monthly Discharge Inflow (m3/s)	Mean Monthly Discharge Outflow (m3/s)
1	Jan	0.06	3.17
2	Feb	0.03	3.17
3	Mar	0.11	3.15
4	Apr	1.35	3.18
5	May	4.21	4.09
6	Jun	10.45	4.42
7	Jul	20.56	9.78
8	Aug	24.66	20.71
9	Sep	18.02	16.45
10	Oct	9.27	9.03
11	Nov	3.24	4.16
12	Dec	0.62	3.21
Average		7.72	7.04



Source: JICA Project Team

Figure 3.6.6 Mean Monthly Discharge of Inflow and Outflow from Tuul Dam Site 1

Table 3.6.3 Domestic and Industrial Water Supply from Tuul Dam Site 1 in Ulaanbaatar (1/2)

(Unit: m3/s)

Year	1 Jan	2 Feb	3 Mar	4 Apr	5 May	6 Jun	7 Jul	8 Aug	9 Sep	10 Oct	11 Nov	12 Dec	Annual Mean
1989	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
1990	2.38	2.38	0.38	1.19	0.54	1.82	2.38	2.38	2.38	2.38	2.38	2.38	1.91
1991	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
1992	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
1993	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
1994	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
1995	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
1996	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
1997	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
1998	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
1999	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2000	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2001	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2002	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2003	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2004	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2005	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2006	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2007	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2008	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2009	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2010	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2011	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2012	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2013	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2014	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2015	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2016	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2017	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
2018	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
Average	2.38	2.38	2.31	2.34	2.32	2.36	2.38	2.38	2.38	2.38	2.38	2.38	2.36

Source: JICA Project Team

Table 3.6.3 Domestic and Industrial Water Supply from Tuul Dam Site 1 in Ulaanbaatar (2/2)

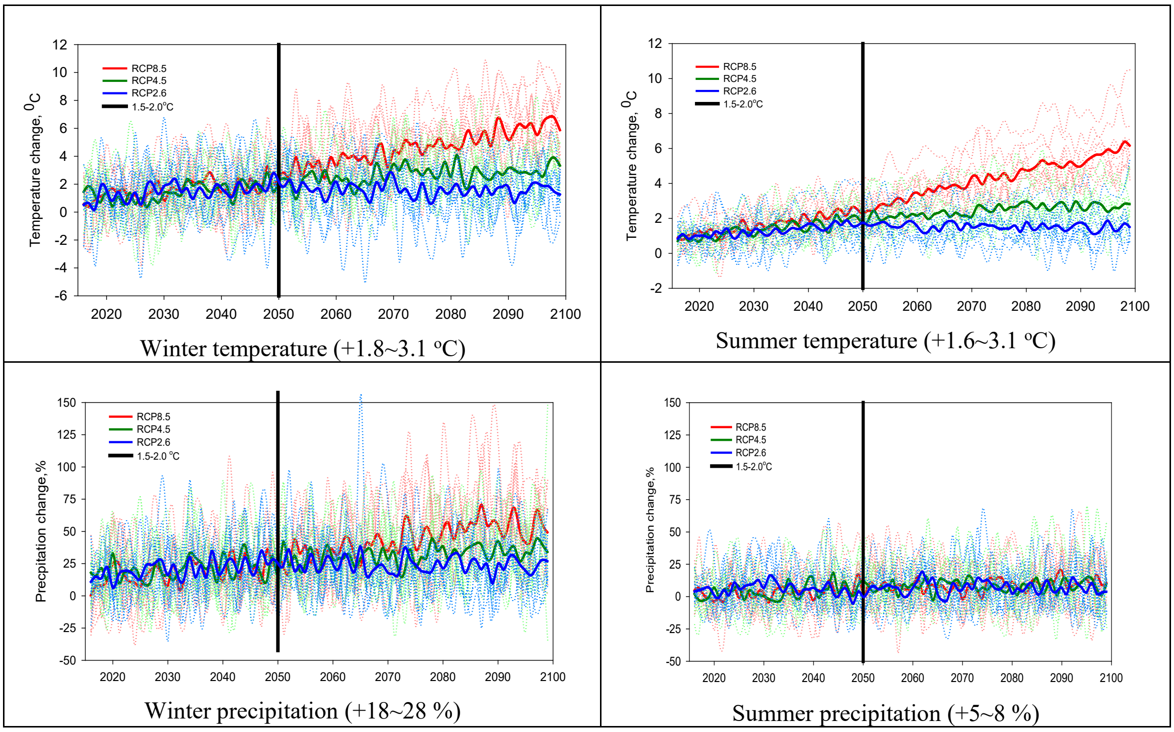
Unit: million m3/month

Year	1 Jan	2 Feb	3 Mar	4 Apr	5 May	6 Jun	7 Jul	8 Aug	9 Sep	10 Oct	11 Nov	12 Dec	Annual (MCM/Year)
1989	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
1990	6.37	5.75	1.03	3.08	1.44	4.73	6.37	6.37	6.16	6.37	6.16	6.37	60.21
1991	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
1992	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
1993	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
1994	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
1995	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
1996	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
1997	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
1998	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
1999	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2000	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2001	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2002	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2003	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2004	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2005	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2006	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2007	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2008	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2009	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2010	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2011	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2012	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2013	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2014	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2015	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2016	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2017	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
2018	6.37	5.75	6.37	6.16	6.37	6.16	6.37	6.37	6.16	6.37	6.16	6.37	75.00
Average	6.37	5.75	6.19	6.06	6.21	6.12	6.37	6.37	6.16	6.37	6.16	6.37	74.51

Source: JICA Project Team

(4) Climate change

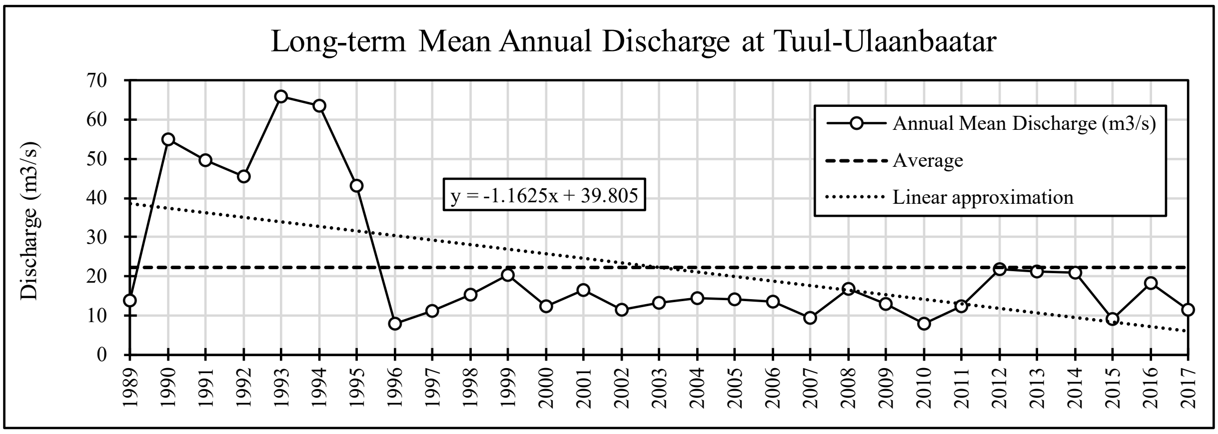
Furthermore, it is expected that evapotranspiration will increase due to temperature rise due to future climate change (Figure 3.6.7), and the construction of a reservoir is effective, as there is a concern that the flow of the Tuul River will decrease especially in dry season (winter and spring).



Source: Long-term Development Plan Vision-2050, the Government of Mongolia, 2020

Figure 3.6.7 Future Changes in Seasonal Temperatures and Precipitation

Figure 3.6.8 shows the long-term changes in the annual average discharge at the Tuul-Uraanbaatar station. It can be seen that the annual average discharge has decreased over the past 28 years.



Source: JPT based on data of NAMEM

Figure 3.6.8 Long-term Mean Annual Discharge at Tuul-Ulaanbaatar

(5) Environment and social impact

The Tuul River water complex is intended to become an important multifunctional project for a reliable water supply source for Ulaanbaatar, hydropower use of Tuul River water, flood protection, river ecology conservation, condition for aquatic sports, tourism and aquatic animal breeding, etc.

Environmental impacts assessment (EIA) was conducted in the M/P and F/S by USUG/KOICA in 2012. The results of the EIA indicate that the project will cause inevitable impacts on socioeconomic environment including an increase in the discharge of various pollutants, ecosystem fragmentation by dam construction, a change in water quality and aquatic ecosystems, residents' resettlement, etc. in the project area and its surrounding areas during the construction and operation.

A project implementer should formulate a proper mitigation plan to reduce the environmental impacts of the project at each stage of the project. A sustainable monitoring plan should also be introduced to minimize unexpected environmental damages. The general mitigation plans to reduce the impacts of the project on air quality, water quality, noise, and ecosystems are required.

The Mongolian Law on Environmental Impact Assessment (2002) stipulates that the EIA must be conducted prior to the implementation of development projects whose scale is larger than a pre-set scale. Accordingly, future water resource development projects, including the development of a dam, should accompany an EIA to assess their environmental impacts in advance. The results of such EIA should be reflected into any detailed planning and designing. An optimal mitigation plan to reduce environmental impacts should also be formulated to achieve environment-friendly and sustainable development.

The mitigation plan including the introduction of renewable energy, installation of a silt protector and the creation of ecological wetland and the follow-up monitoring have important implications for the minimization of the possible adverse environmental impacts of the project. In addition, an environmental management system should be implemented to provide systematic environmental management and training.

(6) Alignment with development policy

The project is consistent with the policies set out in item 6.3.9 of the Long-term Development Policy 2050 by the Government of Mongolia" as part of "the Blue Horse Project" to conduct a feasibility study and design in order to start construction work of multipurpose serial impoundments with flow regulations on large rivers located in high-mountainous zones such as the Selenge, Orkhon, Eg, Kherlen and Khovd.

3.6.3 Urban water supply

(1) Background and objectives

In the base year 2010, 86.7% of the urban population received water from a protected source, which is already above the Millennium Development Goals (MDGs) target for 2015 (70%). However, the SDV2030 set for the new targets of 90% of the population receiving safe drinking water for the year 2030. In addition, according to the trend of urbanization and population increase, the gap between demand and supply of water supply will be widen in the case of insufficient intervention. Therefore, water supply improvement should be realized step by step.

The project is to supply safe drinking water to Ulaanbaatar City, 21 Aimags centers and other larger urban areas such as Kharkhorin, Bor-Undur, Zamiin-Uud, Shariin Gol, Saikhan/Khutul, Mandal/Zuunkharaa, Khanbogd and Tsogttsetsii.

(2) Project components

The project will cover the following:

- Extension of water supply distribution network at Ulaanbaatar City,
- Construction of 400 kiosks,
- Extension of water supply distribution networks of 21 Aimag centers and other large urban areas, and
- Taishir-Altai project to improve water supply in Altai City supported by Austria.

The Ministry of Construction and Urban Development (MCUD) of Mongolia and Austria's Tiroler Rohre GmbH will jointly implement the project with the funding of EUR 14 million within the financial cooperation agreement established between the Governments of Mongolia and Austria. According to the project, the water will be supplied from the Taishir hydropower plant water reservoir through 52km water transmission pipeline; this will not involve adverse effect on the environment.

3.6.4 Rural water supply

(1) Background and objectives

Water supply in rural areas of Mongolia face the following problems:

- Operational water points are insufficient;
- In some pastureland, grazing pressure is excessively high to reduce water availability;
- Number of operating water points is declining; and
- Livestock water supply systems are generally inadequate in both water quantity and water quality.

The project is to improve water supply in rural areas for livelihood and livestock farming.

(2) Project components

The project covers the following:

- Number of boreholes constructed or rehabilitated: 2011-2015 2,466 boreholes, 2016-2021 6,050 boreholes.
- Number of ponds rehabilitated: 5; constructed: 54 (2011-2015).
- Number of ponds rehabilitated: 7; constructed: 125 (2016-2021).

3.6.5 Wastewater treatment plants

(1) Background and objectives

The number of wastewater treatment plants in normal operation in urban areas was 17 in 2010. This number was planned to increase to 32 in 2015 and 40 in 2021. With this increase in operational WWTPs the percentage of treated wastewater in urban areas will be nearly 100% in 2021. The effluents from wastewater treatment plants of many Aimag and Soum centers are polluting the surface water due to poor operation of the facilities.

The project is to provide adequate wastewater treatment in Ulaanbaatar, 21 Aimag centers and other larger urban areas.

(2) Project components

The project covers the following.

- Renovation, improvement and extension of WWTP's for Ulaanbaatar City: 1) central WWTP renovation with membrane reactor; 2) central WWTP improvement of equipment and efficiency; 3) Nisekh/Yarmag new WWTP; 4) Emelt new WWTP; and 5) small treatment plants installation.
- Construction of a new WWTP in Ulaanbaatar City (with Chinese soft loan to cover project cost of US$300 million) with capacity at 250,000 m^3/day, introducing environmentally friendly, advanced technology to treat sewage sludge and produce electricity.
- Renovation and construction of WWTP's in 21 Aimag centers and other larger urban areas: Kharkhorin, Bor-Undur, Saikhan, Khutul, Zamiin-Uud, Shariin Gol, Mandal, Zuunkharaa, Khanbogd, Baganuur until 2015 and Kharkhorin, Mandal, Zuunkharaa, Tsogtsetsii until 2021
- Construction of new WWTPs and rehabilitation of existing WWTPs in Aimag centers (with Polish Government cocessional loan) of Bayan-Ulgii, Uvs, Zavkhan, Dornod and Gobisumber with total project cost of MNT 50,697 million.

- "Darkhan improvement of municipal wastewater management (with ADB loan: MON-3244/3245, 2015-2020) with US$18.5 million out of total project cost at US$20.68 million; the sewage pipeline has been constructed and commissioned with 6.8 km; implementation as of 2019 at 64%.
- Extension of WWTP of Erdenet (with French soft loan FR-01, 2013-06-28-2018-09-01) with Euro 9.54 million; implementation as of 2019 at 93.3%.

3.6.6 Ulaanbaatar central sewage treatment plant for industrial water of combined heat plants

(1) Background and objectives

The Ulaanbaatar central wastewater treatment plant (WWTP) for industrial water of combined heat plant (CHP) is constructed as MCC (Millennium Challenge Corporation) project. The plant reuses the treated water from the central WWTP in Ulaanbaatar City (constructed by the Mongolian Government with a soft loan by China) as cooling water for CHP3 and CHP4; treated water (greywater) can also be used for toilet drainage.

Currently, CHP3 and CHP4 use groundwater of 21.0 million m^3/year (50,000 m^3/day) for cooling water; approximately 70% (15.0 million m^3/year) is covered by groundwater pumping. It is expected that these cooling waters will be provided up to 18.0 million m^3/year by 2034 by reusing treated sewage water to conserve groundwater.

The objective of the project is to treat industrial effluent from the combined heat plant by environmentally sound advanced technology so that the effluent can be used as cooling water to save groundwater.

(2) Project components

The project will construct a central WWTP for industrial water discharged from combined heat plants by applying advanced technology.

3.6.7 Sewage network renovation and extension

(1) Background and objectives

In addition to increasing treatment capacity of WWTPs, renovation and extension of sewage networks are indispensable to ensure adequate wastewater treatment. The project is to renovate and expand the sewage networks in Ulaanbaatar, 21 Aimag centers and other larger urban areas to contribute to realizing pleasant living environment for urban residents.

(2) Project components

The project covers extension and renovation of sewerage systems in parts of Ulaanbaatar City, Aimag centers and other larger urban areas: Kharkhorin, Bor-Undur, Saikhan. Khutul, Zamiin-Uud, Shariin Gol, Mandal. Zuunkharaa, Khanbogd, Tsogtsetsii and Baganuur.

3.6.8 Small wastewater treatment plants in Soum centers

Objectives of the projects are to provide adequate wastewater treatment in rural areas, and to improve living environment. The project covers construction of 15 WWTPs in stage 1 and additional WWTPs for 36 Soum centers in stage 2.

3.6.9 Innovative wastewater treatment plant for livestock farms

(1) Background and objectives

The Tuul River basin provides water for Ulaanbaatar with groundwater, but use of the river water will be necessary as the water demand increase with increasing population. The river water, however, is already seriously polluted. In addition to untreated or inadequately treated industrial wastewater, livestock farms are significant sources of pollution. Wastewater from livestock farms, pig and poultry farms are discharged without treatment in most cases. Even where a treatment plant exists, treatment efficiency is reduced during winter due to extremely low temperature.

The project is to experiment innovative wastewater treatment technology adoptable to cold climate for application to wastewater from livestock farms.

(2) Project components

The project will be pilot implemented as follows:

- Study of existing conditions of wastewater generation and treatment by livestock activities,
- Examination of technological, legal and institutional conditions related to livestock wastewater discharge and treatment in Mongolia,
- Study of advanced wastewater treatment of livestock wastes and wastewater in other countries,
- Assessment of alternative technologies for wastewater treatment of livestock farms,
- Planning for stage-wide development of wastewater treatment plant for livestock farms, and
- Pilot implementation of wastewater treatment plant with selected appropriate technology.

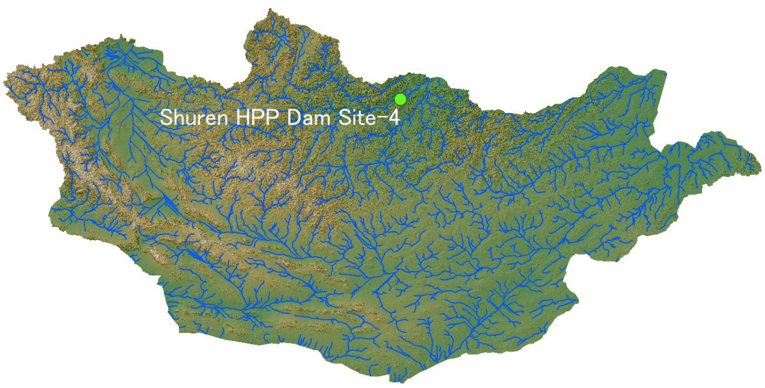
Full implementation will follow subject to the stage-wise development plan.

3.6.10 Selenge River hydropower dam development

(1) Background

The energy production capacity needs to increase to meet growing demand and to reduce dependency on imported power. Hydropower development provides domestic energy sources to reduce dependence on imported energy.
The key goal of the Shuren hydropower plant (HPP) project is to supply the electricity demanded by the mining sector and to cover electricity deficits faced by the Country. Secondary goals are to provide renewable energy, enable energy independence from the Russian power system and increase low-cost supply of renewable energy.

A pre-feasibility study was conducted including an options assessment and initial screening for environmental, social, financial and economic impacts of a hydropower plant on the Selenge River. Its results were discussed and agreed with the working group of the Ministry of Energy. The pre-feasibility study finds that the investigated area at the Selenge River between Khyalganat and Zuunburen is suited for the construction of the proposed Shuren HPP. Within this area, six possible dam sites have been identified based on the pre-feasibility study and the Russian feasibility study from 1973 as shown in Figure 3.6.9.



Source: JICA Project Team based on MINIS, 2016

Figure 3.6.9 Location Map of Shuren HPP

Two locations, Sites No. 4 and No. 6, were identified as best suited for the construction of a hydropower plant and have to be further investigated in the feasibility study. Thus both sites will need to be studied in sufficient detail to make an informed recommendation based on their environmental and social impacts and performance. Environmental and social criteria will be important part of the decision making for site selection.

The initial screening of potential sites for the proposed Shuren HPP was followed by preliminary investigations for the Site No. 4 in the pre-feasibility study, which indicated that the proposed Shuren HPP is an important and feasible project for the future generation of power for the Central Electric System. The environment and social impact assessment (ESIAs) conducted in the context of the feasibility study shall review all previously studied sites to confirm the preliminary investigations of Site No. 4 and Site No. 6 to allow an informed choice of the best alternative. For both sites, location-specific factors, and design options would be taken into account by comparing the two alternatives. The best alternative would then be further analyzed in terms of design feasibility.

(2) Project components

The key elements of the planned project would consist of a dam (roller-compacted concrete; RCC) of an approximate height of 65 m and a crest length of 1,200 m. The dam base is estimated to be 900 m wide, the dam volume estimated to 4,8 billion m3. The project would create a reservoir with a total storage of 4.5 billion m3 of which 3.8 billion m3 would be useful storage. The elevation of the reservoir's full supply level (FSL) would lie at 761m above sea level (ASL), the minimum operational level (MOL) at 739 m ASL.

The project would include a construction camp, later to be converted into logistical support structures (staff housing, storage, workshops); power house; switchyard; new access road (225 km) and connecting roads; and a transmission line of approximately 73 km to connect the HPPs to the grid. During construction, quarries for rock fill and/or aggregates will be operated, the tentative volume to be sourced would be 4 million m^3.

3.6.11 Orkhon River water diversion to Gobi

(1) Background

Orkhon River:

The Orkhon River is the largest tributary of the Selenge River. Its watershed covers 53,786 km^2, or 143,372 km^2 including watershed of its tributaries: Tuul, Kharaa, and Eroo Rivers. The total length of the river is 1,124 km and it is the longest river in Mongolia. The Selenge River is international river and flows further north into Russia and Lake Baikal. Therefore, implementation of the project requires the Russian consent.

Basic description of the system:

The system consists of two main parts: dam (roller-compacted concrete (RCC) dam), reservoir and water intake structure for water collection and storage, and the pipelines, pump stations, and water treatment system for transmission and distribution of water to customers.

Collection and storage:

The dam will be located at approximately 20 km upstream from the "Orhon" observation station. The dam crest will be 300 m long and have a maximum height of 70 m. The dam base is estimated to be 80m wide, the dam volume estimated to be 675,000 m^3. It will be constructed from rock and earth fill materials mined from the surrounding area, with an impervious core constructed of concrete. The dam design will incorporate measures for fish passage as required based on the results of the Environmental Impact Assessment (EIA). The drainage and intake structure, which will be concrete construction, will include a 30 MW hydroelectric turbine that will generate electricity for operation of the dam facilities and first pump station.

The reservoir impoundment is estimated to be approximately 575 million m^3, covering an area of 23 km^2. The reservoir will extend approximately 18 km upstream from the dam.

(2) Project components

The water will be transferred from the dam, pumped by the first pump station. The initial pipe diameter is presently set at 1500 mm and the diameter will be reduced along the way as the water is delivered to customers. The route of the pipeline, which will be finally determined in the feasibility study, will generally head south to the Tavan Tolgoi in 613 km, where three branches will continue to the Mandalgovi with 96 km, Dalanzadgad with 85 km and to the Oyu Tolgoi with 123 km.

The Orhon-Gobi diversion project will bring positive benefits to the people of Mongolia as follows:

- Improved water supply for two cities and eight Soum centers, benefitting 50,000 people,
- Outlets at 50 locations for people and for animal watering – covering 100,000 ha and capable of supporting 135,000 animals, providing opportunity for economic stability, settlement development, and transition from nomadic herder lifestyle,
- Irrigation water to support 2,000-3,000 ha for planting vegetables, animal feeding improving the yield and quality of harvest,
- Enhanced and sustainable water supply to support mining developments and energy generation,
- Water to support greening projects such as planting trees that can reduce desertification and improve the Gobi ecology,
- Hydropower for clean, reliable electricity supply that will contribute to making Mongolia energy self-sufficient and reduce foreign trade deficit, and
- Recreational and tourism opportunities with associated economic benefits.

Figure 3.6.10 Location Map of Project Site

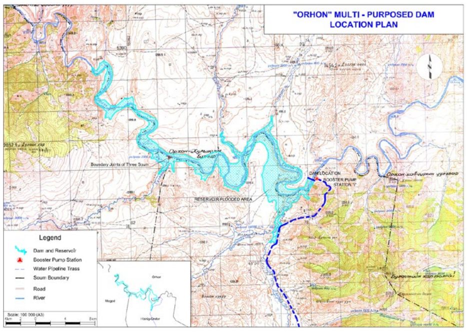


Figure 3.6.11 Orkhon Multi-Purpose Dam

Source: Mongolian National Water Programme Support Center (Water Center), "Orhon – Gobi" Multi-Purposed Water Transmission Complex Project, Oct. 2007.

Figure 3.6.12 Route of Pipeline of Orkhon-Gobi Project

3.7 Climate Change Assessment for Water Resources in Mongolia

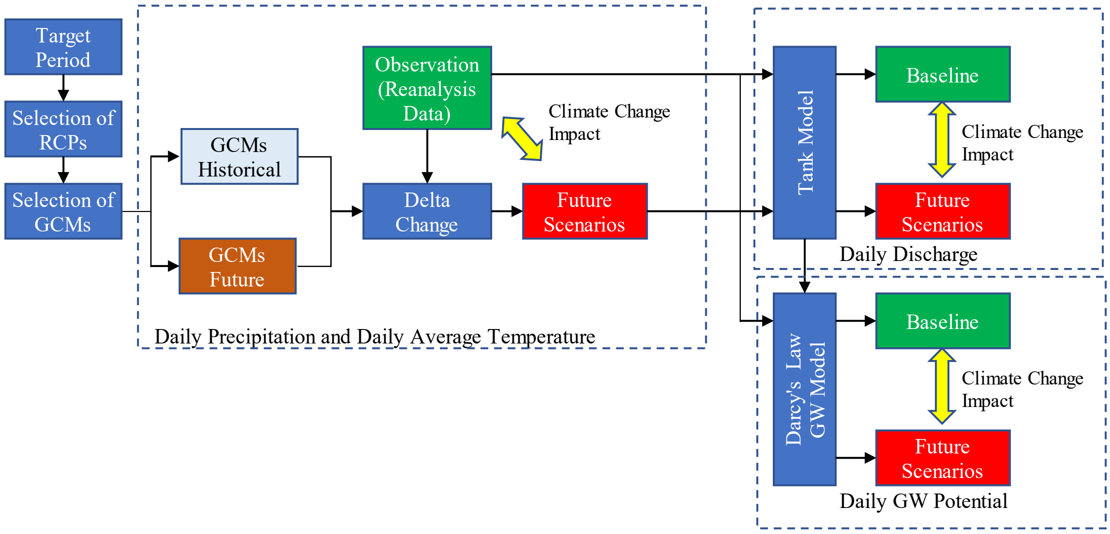
3.7.1 Preliminary assessment on possible climate change impacts in Mongolia

In the upstream areas of the Mongolia, snow mountains and glaciers are located and these melt water contributes annual runoff, in particular from spring to summer runoff. The seasonal patterns indicate that some of rainfall in winter accumulates as snow in the mountainous areas, and as increase of temperature in spring to summer, snow-melt water contributes runoff during spring with less rainfall. Considering the hydrological characteristics above, possible impact to the project in the mountainous area due to climate change might be as follows:

- Intense rainfall events may increase flood damages along the river.
- Changes of precipitation pattern may change flow regime in the basin.
- Temperature rises may increase evapotranspiration and increase the risk of drought.
- Temperature rises may reduce snow accumulation in winter and shift snow-melt season earlier.
- Temperature rises may also affect increase of glacier lakes and consequently an increase of glacier-related hazards, such as glacial lake outburst floods (GLOFs).

3.7.2 Future climate scenarios for climate change impact assessment

The goal of climate change impact assessment is to identify and evaluate the effects of climate change on the water resources in Mongolia. Figure 3.7.1 shows the flowchart of the impact assessment. For the assessment, climate change projections derived from General Circulation Models (GCMs) in Coupled Model Intercomparison Project Phase 5 (CMIP5) were used to develop future climate scenarios of temperature and precipitation. Runoff was simulated by a runoff model (the Tank Model and Darcy's Groundwater Model) by feeding the developed temperature and precipitation. Then, climate change impacts were evaluated by comparing baseline and future scenarios for the target periods. Details and results of each procedure is described below.



Source: JICA Project Team

Figure 3.7.1 Flowchart for Climate Change Impact Assessment

3.7.3 Target period

Target periods for the assessment were set as follows:

- Present period (baseline): 1979 - 2016 (38 years)
- Medium-term future period: 2038 - 2062 (25 years with the median year 2050)
- Long-term future period: 2076 - 2100 (25 years)

The period of 30 years and 25 years was selected to discuss climate change impacts as a trend of the present and future periods since climate change projection at any single year cannot represent the response of the climate system due to interannual variability. The present period was selected by the availability of historical data derived from GCMs in CMIP5, which is 1850 - 2005 for the historical runs.

3.7.4 Development of future climate scenarios of temperature and precipitation

(1) Uncertainty in climate change projection

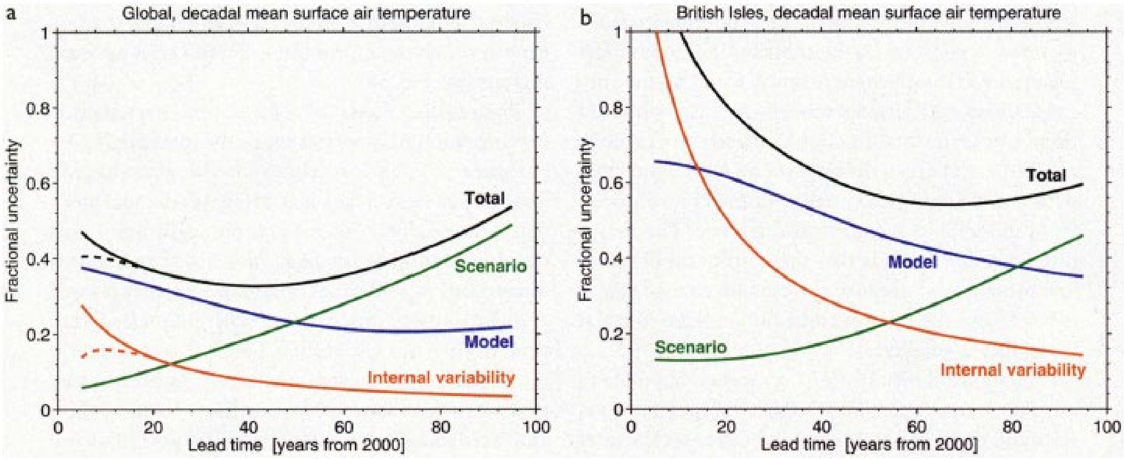
Climate change projections are subject to considerable uncertainty. Uncertainty in climate projections arises from three distinct sources: (i) Model uncertainty; (ii) Scenario uncertainty; and (iii) Internal variability of the climate system[77].

The relative importance of the three sources of uncertainty varies with prediction lead time and with spatial averaging scale as shown in Figure 3.7.2. According to Figure 3.7.2b, the model uncertainty is the most dominant source around the future period for the assessment (2038 - 2062) in the regional projection. Figure 3.7.3 shows another example, which indicates that the model uncertainty is more dominant than the scenario uncertainty. Therefore, to narrow uncertainty for the impact assessment, multiple GCMs were selected.

For decision making under deep uncertainty, new methods, such as Robust Decision Making (RDM), have been applied in some adaptation studies[78]. RDM provide techniques for evaluating the performance

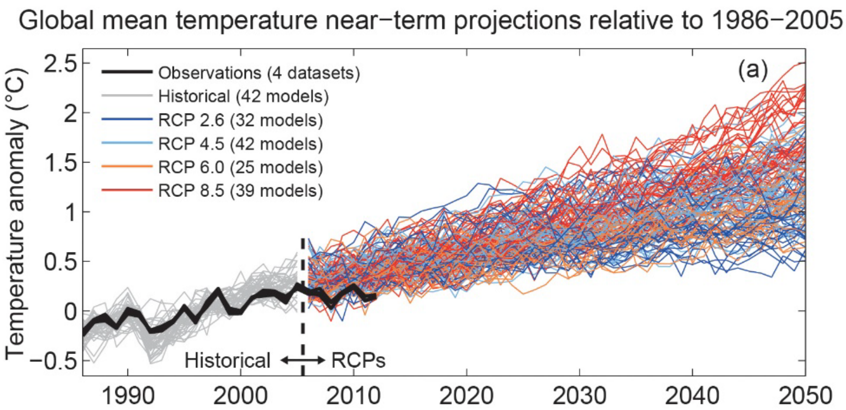
77 Hawkins E, Sutton R (2009) The potential to narrow uncertainty in regional climate predictions. Bull. Amer. Met. Soc. 90:1095–1107. doi:10.1175/2009BAMS2607.1
78 Kaila et al. (2015) Robust Decision-Making in the Water Sector A Strategy for Implementing Lima's Long-Term Water Resources Master Plan Policy. Research Working Paper 7439, World Bank Group

of a project over a wide range of plausible futures and then developing strategies that are robust across these futures. Rather than weighting futures probabilistically to define an optimal strategy, the methodology identifies the vulnerabilities of a project and then evaluate the key trade-offs among different adaptive strategies. However, since RDM requires a large amount of time and computing resources on the simulation runs for multiple cases of model projections, future scenarios, and adaptation options, this study was not able to apply RDM for the adaptation assessment.



Source: Hawkins E, Sutton R (2009)

Figure 3.7.2 Relative Importance of Each Source of Uncertainty in Decadal Mean Surface Temperature Projections (a: global and b: regional)



Source: IPCC AR5 WG1 Technical Summary

Figure 3.7.3 Near-term Projections of Global Mean Temperature until 2050

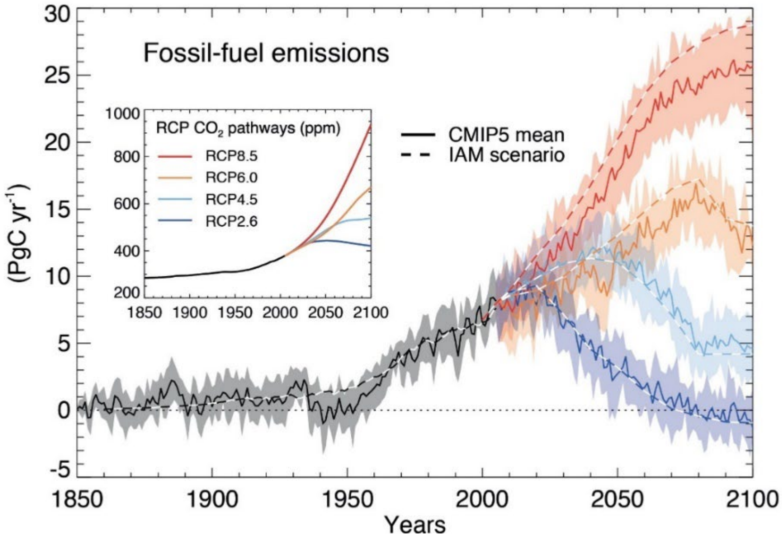
(2) Selection of RCPs

In the Fifth Assessment Report (AR5), which is the latest assessment report of the Intergovernmental Panel on Climate Change (IPCC), the Representative Concentration Pathways (RCPs) describe four different 21st century pathways of greenhouse gas (GHG) emissions and atmospheric concentrations, air pollutant emissions and land use[79]. The RCPs include a stringent mitigation scenario (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0) and one scenario with very high GHG emissions (RCP8.5). Figure 3.7.4 shows CO_2 Pathways of the four RCPs. CO_2 pathways of four RCPs are within the smaller range around 2050 compared with that around 2100. RCP4.5 and RCP6.0 are almost same

79 IPCC, 2014. AR5, available at https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

until around 2060.

For the impact assessment, two intermediated scenarios (RCP4.5 and RCP8.5) were selected because of median cases (RCP4.5) as more possible future scenario than other scenarios and for comparison of high forecast scenarios (RCP8.5).



Source: IPCC AR5 WG1 TS Fig.TS-19

Figure 3.7.4 RCP CO2 Pathways

(3) Selection of GCMs

Multiple GCMs were selected by following criteria:

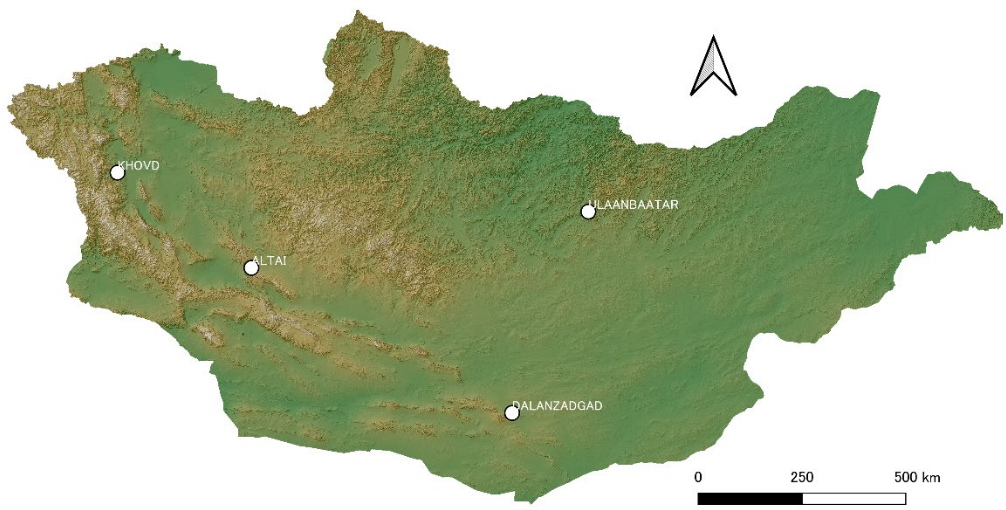
- GCM's ability to reproduce:
  - historical seasonal pattern at the target gird where 4 meteorological stations locate
  - historical regional large-scale circulation over the entire areas of Mongolia (as a reference)
- Availability of daily precipitation and temperature data derived from GCMs in CMIP5 for the historical and future runs

Temporal Correlation of Climatic Means (*TCCM*)

The ability of GCMs in reproducing seasonal pattern of the variables was verified by computing the linear correlation between the observed and simulated multi-year monthly climatic means. The indicator was denominated Temporal Correlation of Climatic Means (*TCCM*) at the grid where Altai, Dalanzadgad, Ulaanbaatar, Khovd meteorological stations locate and calculated as Equation 1.

$$TCCM = \frac{\Sigma\left(V_j^{\mathrm{OBS}}-\bar{V}_j^{\mathrm{OBS}}\right)\left(V_j^{\mathrm{MOD}}-\bar{V}_j^{\mathrm{MOD}}\right)}{\sqrt{\Sigma\left(V_j^{\mathrm{OBS}}-\bar{V}_j^{\mathrm{OBS}}\right)^2}\sqrt{\Sigma\left(V_j^{\mathrm{MOD}}-\bar{V}_j^{\mathrm{MOD}}\right)^2}}. \quad \text{(Eq. 1)}$$

Where $\bar{V}_j$: Mean of a variable V_j corresponding to the month j



Source: Prepared by JICA Project Team based Location Data of Meteorological Stations by NAMEM

Figure 3.7.5 Location Map of Calibrated Meteorological Stations

Spatial Correlation of Climatic Means (*SCCM*)

Although the most important ability of GCM is the reproducibility at the target grid by *TCCM*, the ability of GCMs in reproducing regional large-scale circulation over the entire Mongolia also should be evaluated to check the ability in regional climatology. The indicator was denominated Spatial Correlation of Climatic Means (*SCCM*) and was calculated for each month over the entire areas of Mongolia according to Equation 2. The sums in the equation are applied to all grids in the target areas and the subscript j∈[1,12] makes reference to the month. For the grid-to-grid comparison, observed and simulated data were spatially interpolated into the reference grid scale (0.5°x0.5°).

$$SCCM_j = \frac{\Sigma\left(\bar{V}_j^{\mathrm{OBS}} - \bar{\bar{V}}_j^{\mathrm{OBS}}\right)\left(\bar{V}_j^{\mathrm{MOD}} - \bar{\bar{V}}^{\mathrm{MOD}}\right)}{\sqrt{\Sigma\left(\bar{V}_j^{\mathrm{OBS}} - \bar{\bar{V}}_j^{\mathrm{OBS}}\right)^2}\sqrt{\Sigma\left(\bar{V}_j^{\mathrm{MOD}} - \bar{\bar{V}}_j^{\mathrm{MOD}}\right)^2}}. \qquad \text{(Eq. 2)}$$

Where

$\bar{V}_j$: Climatic mean of a single grid corresponding to the month j, obtained by averaging all V_{kj} in the analyzed period.

$\bar{\bar{V}}_j$: Spatially averaged climatic mean corresponding to the month j. It is obtained by averaging all $\bar{V}_j$ in the analyzed region.

Since the ability of GCM to reproduce regional large-scale circulation is generally low, in particular precipitation, the evaluation by *SCCM* was considered as a reference for the model selection to reject models with relatively poor performance. Lower outliers among all GCMs in CMIP5 were evaluated by a box plot.

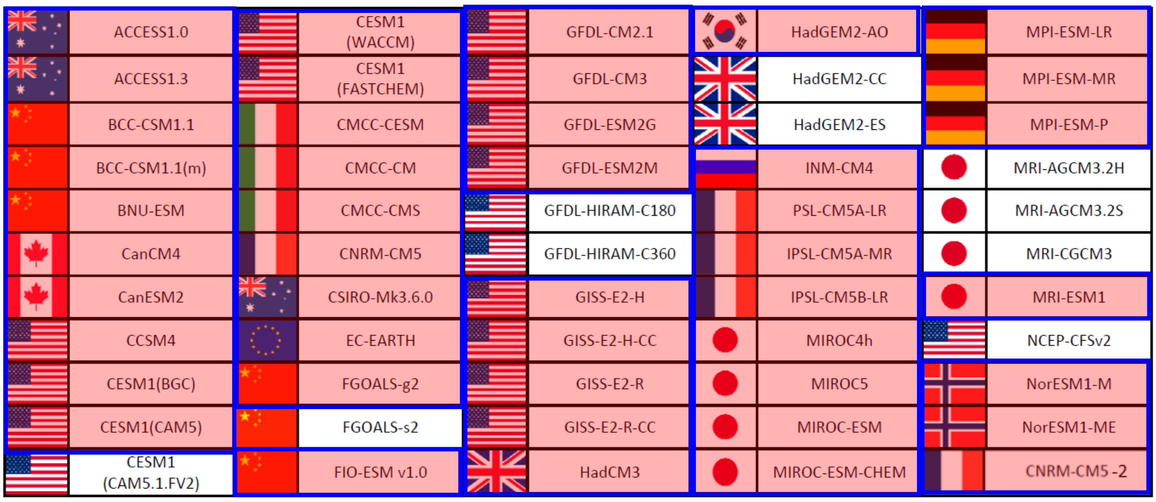
Table 3.7.1 summarizes methodology of GCM selection. Ground observed data of daily rainfall and temperature in the Mongolia are available at meteorological stations, and not spatially enough for the GCM selection. Therefore, reanalysis data of EWEMBI[80], which provides total precipitation in 0.5-degree grids was used as observed data. Figure 3.7.6 shows selected 46-GCM models.

80 https://www.isimip.org/gettingstarted/details/27/

Table 3.7.1 Methodology of GCM Selection

Item	Methodology
Target Area	TCCM: Grid where Altai, Dalanzadgad, Ulaanbaatar, Khovd meteorological stations locate SCCM: Areas covering Mongolia 40.250N-54.750N, 85.250E-122.250E
Data	Observation: Reanalysis data(EWEMBI) GCM: All 46 GCMs available in CMIP5 Historical: 46-GCM models Year 2050 RCP4.5: 37- GCM models Year 2050 RCP8.5 : 38- GCM models Year 2100 RCP4.5: 13- GCM models Year 2100 RCP 8.5: 8- GCM models
Variables	Precipitation, Temperature
Period	Present period (baseline): 1979 - 2018 (38 years) Medium-term future period: 2038 - 2062 (25 years) Long-term future period: 2076 - 2100 (25 years)
Temporal Scale	Monthly
Selection Criteria	*TCCM* of precipitation and temperature: 0.95 *SCCM* of temperature: 0.70 *SCCM* of precipitation: Lower outliers by a box plot among all GCMs in CMIP5

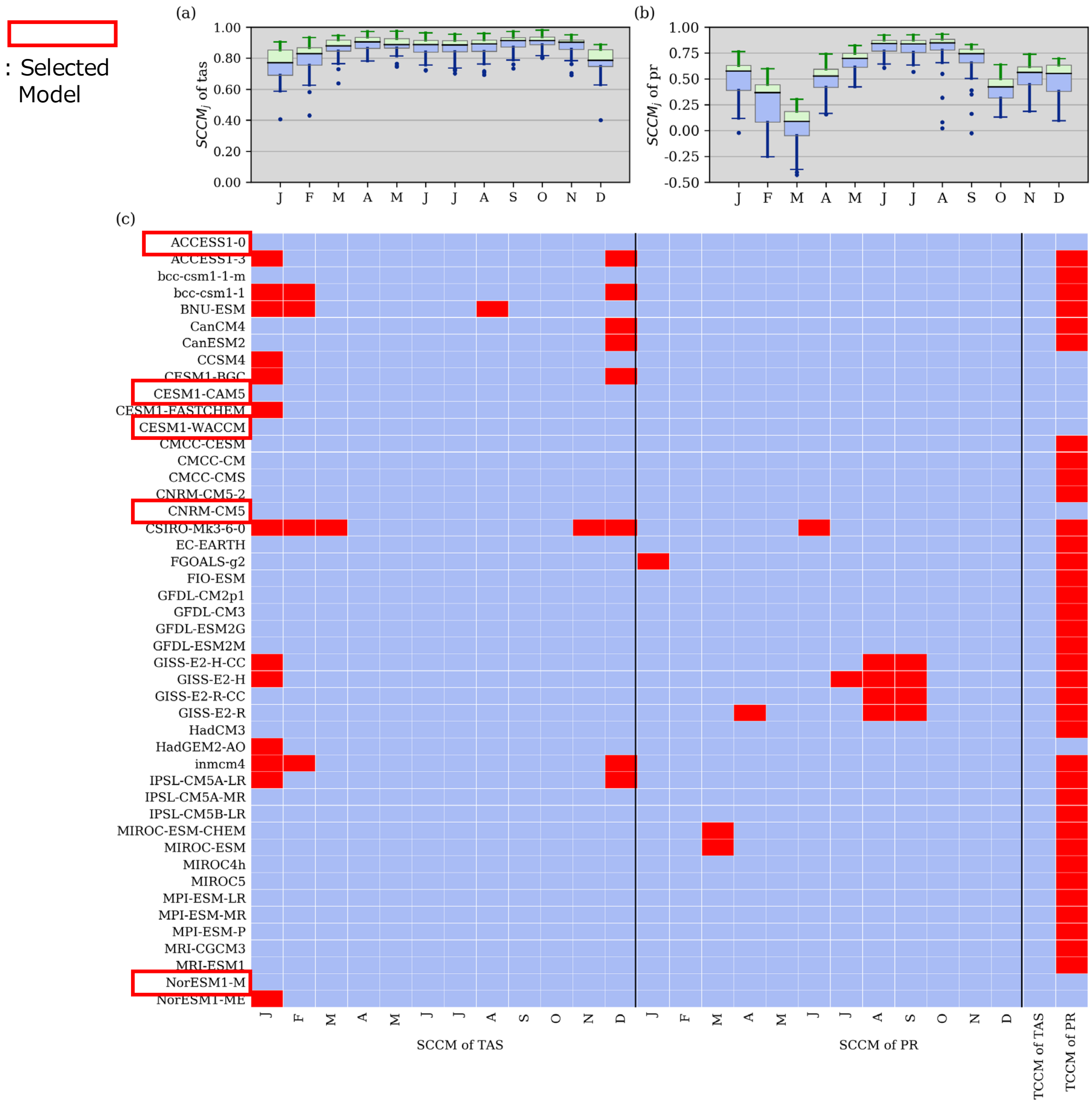
Source: JICA Project Team



Source: Prepared by JICA Project Team based IPCC Information

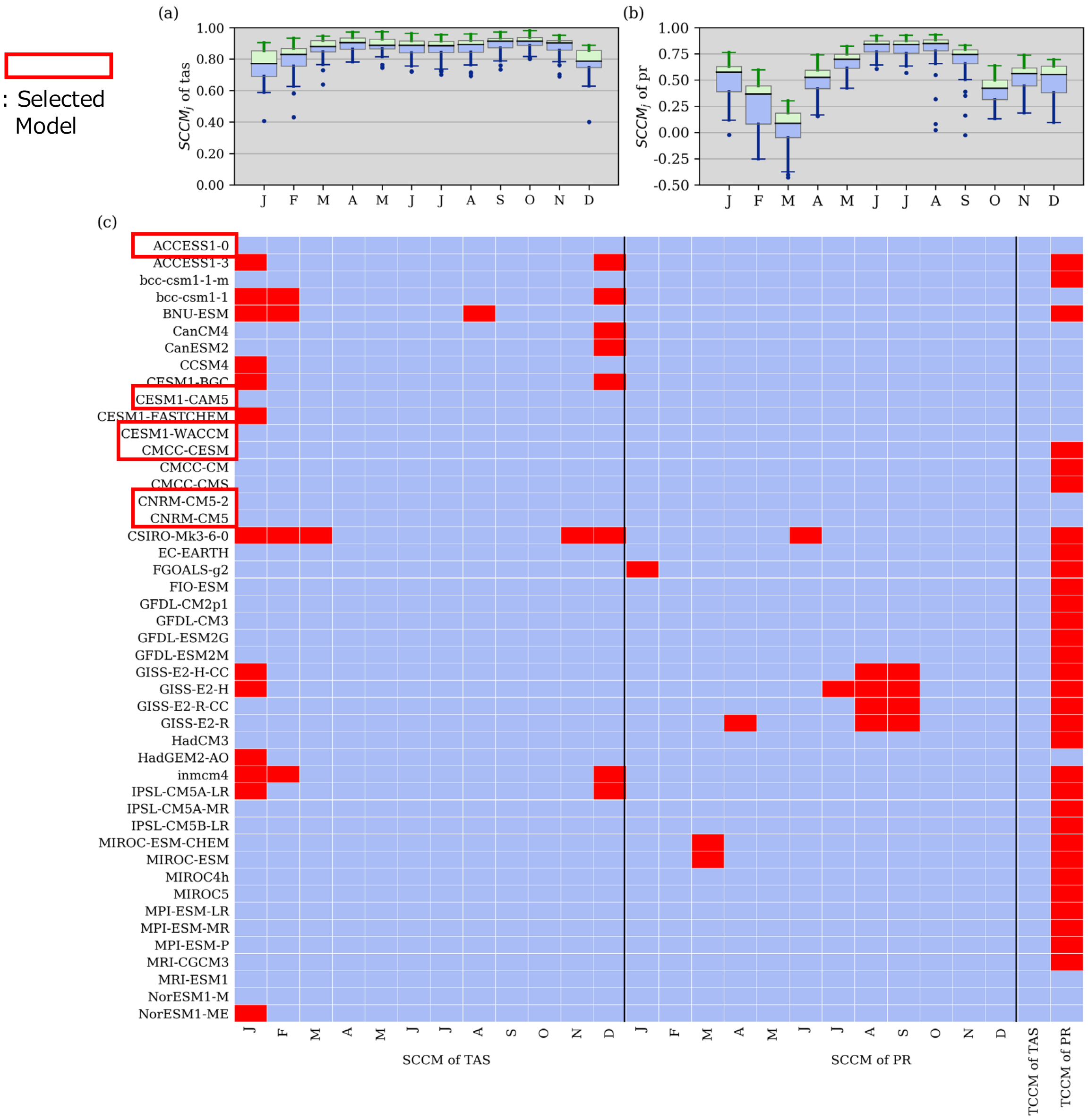
Figure 3.7.6 Selected GCMs

Figure 3.7.7 to Figure 3.7.10 shows results of GCM's ability evaluated by *TCCM* and *SCCM* for temperature and precipitation, (a) box plot for *SCCM* of temperature, (b) box plot for *SCCM* of precipitation, and (c) heat map of *SCCM* and *TCCM*. Among all 46 GCMs in CMIP5, 11 GCMs satisfies the selection criteria. Figure 3.7.11 to Figure 3.7.14 shows reproducibility of GCMs for seasonal pattern of precipitation and temperature. Selected GCMs well reproduce seasonal patterns, such as dry winter and wet summer.



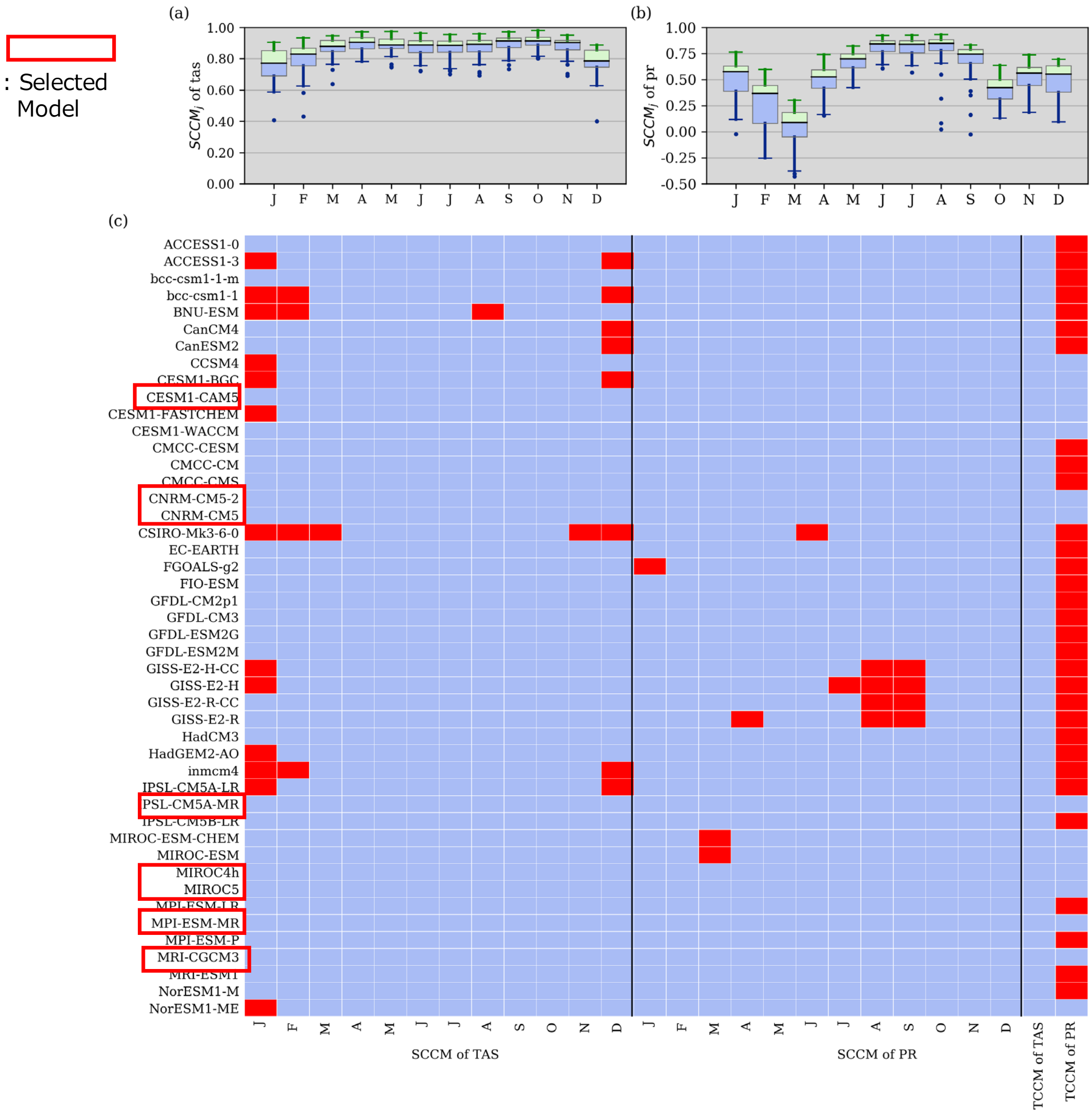
Legend: Blue: Satisfy the selection criteria, Red: Not satisfy the criteria
Source: JICA Project Team

Figure 3.7.7 Result of GCM Performance Evaluation by SCCM and TCCM at Altai



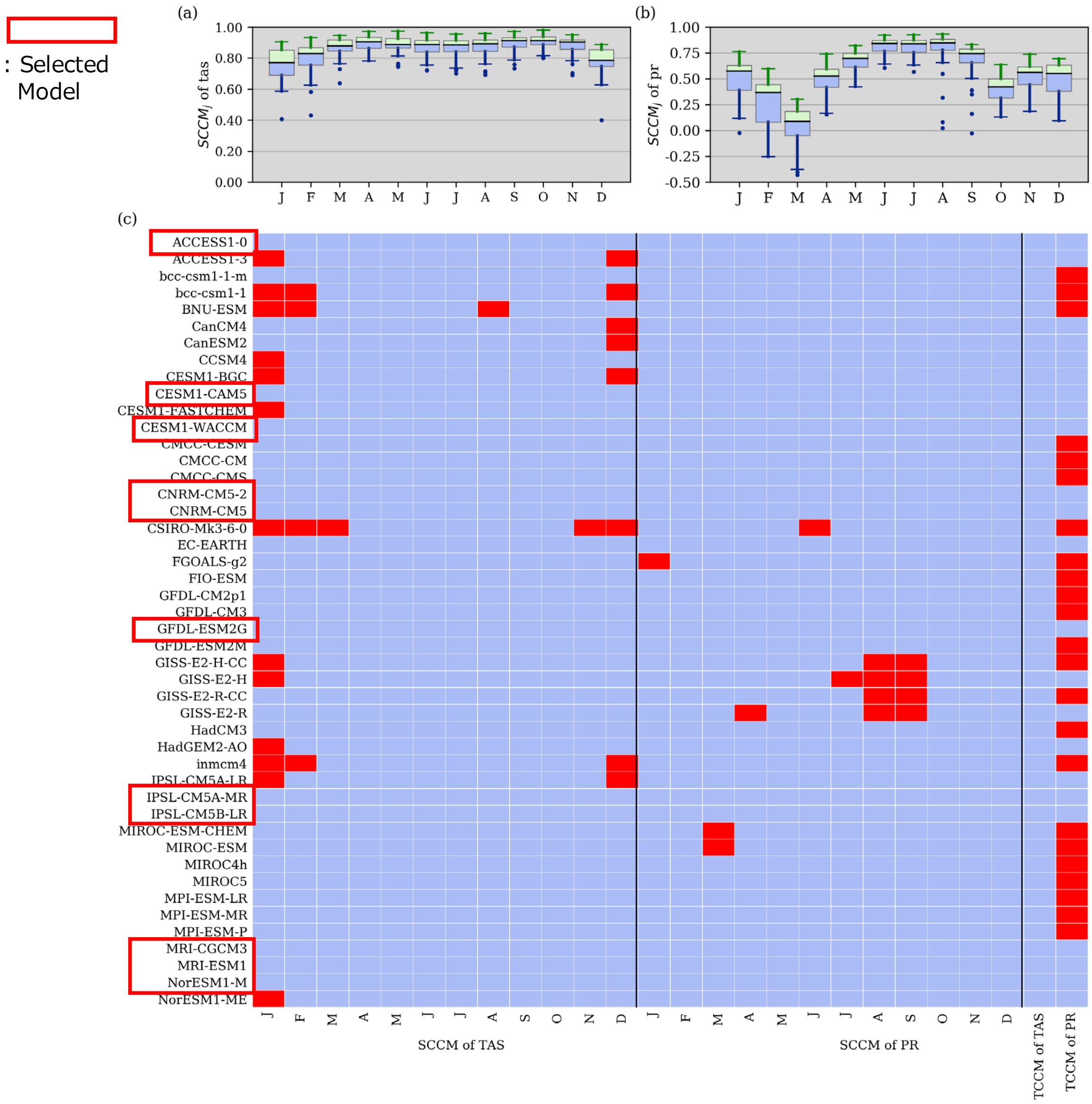
Legend: Blue: Satisfy the selection criteria, Red: Not satisfy the criteria
Source: JICA Project Team

Figure 3.7.8 Result of GCM Performance Evaluation by SCCM and TCCM at Dalanzadgad



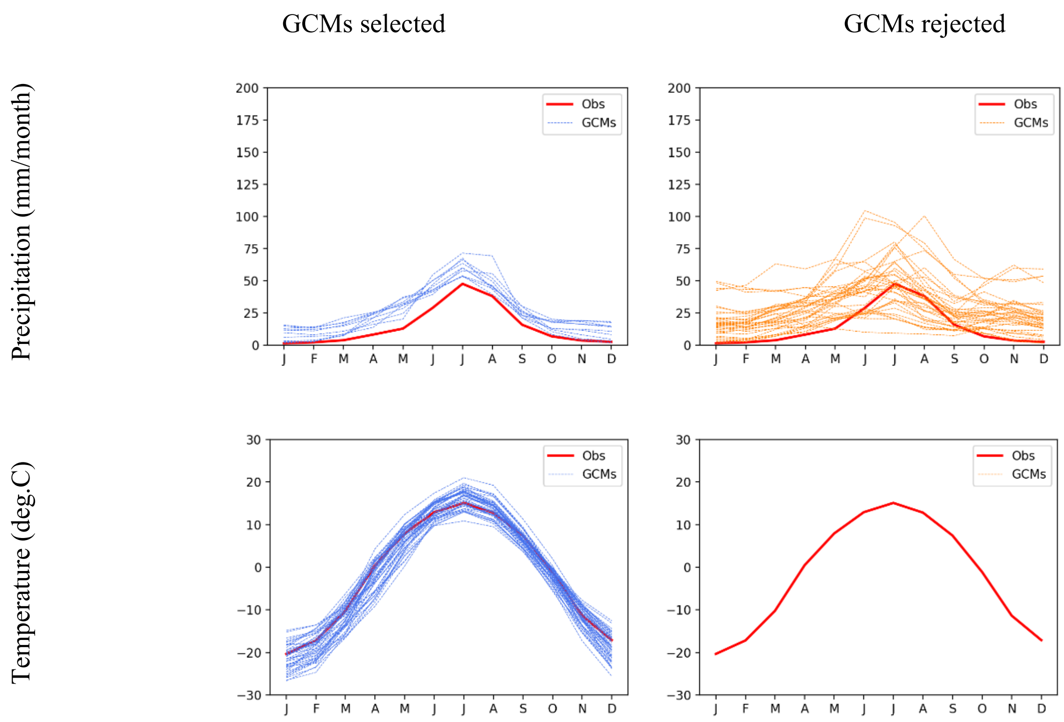
Legend: Blue: Satisfy the selection criteria, Red: Not satisfy the criteria
Source: JICA Project Team

Figure 3.7.9 Result of GCM Performance Evaluation by SCCM and TCCM at Khovd



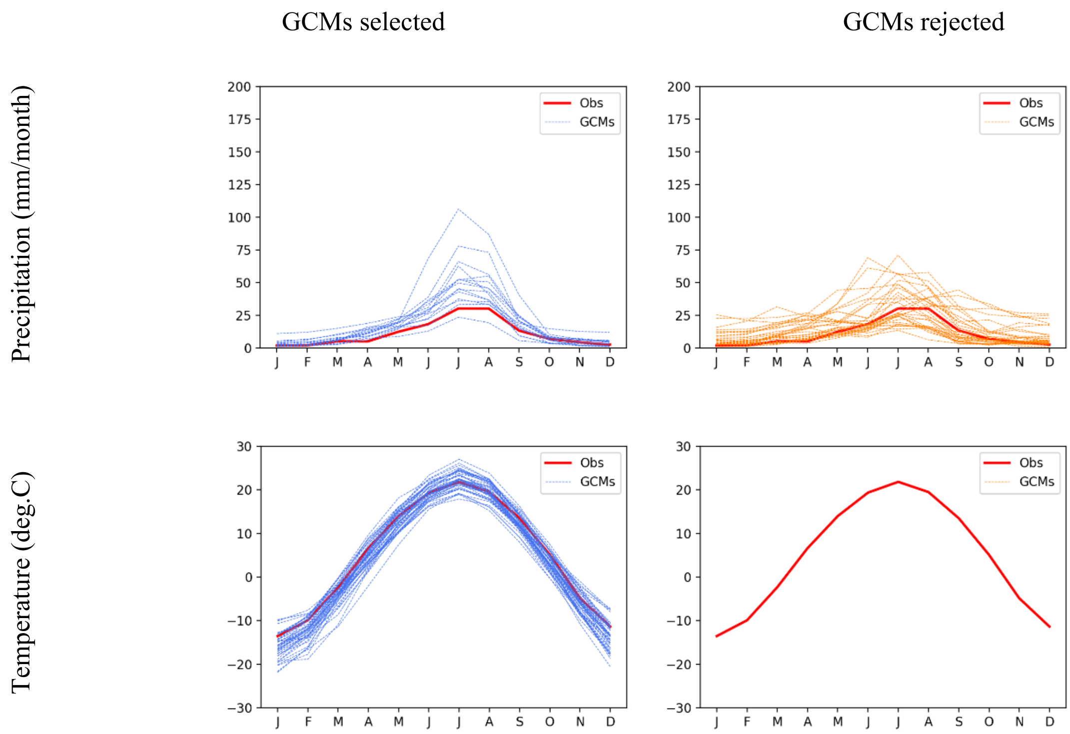
Legend: Blue: Satisfy the selection criteria, Red: Not satisfy the criteria
Source: JICA Project Team

Figure 3.7.10 Result of GCM Performance Evaluation by SCCM and TCCM at Ulaanbaatar



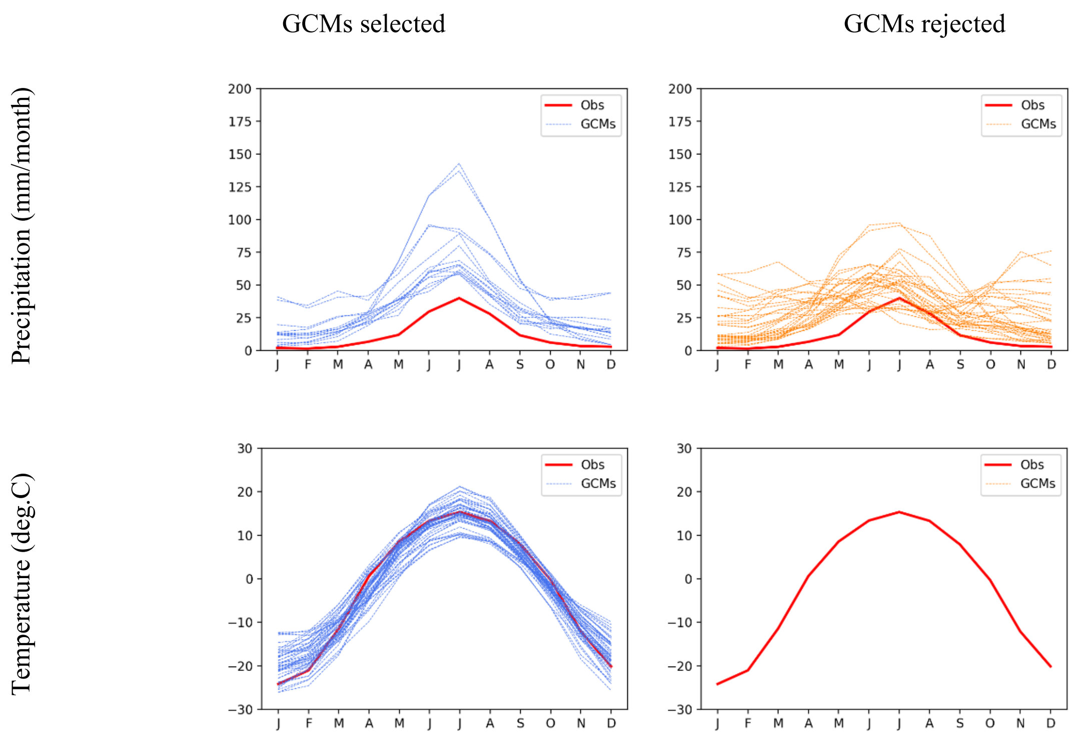
Source: JICA Project Team

Figure 3.7.11 Reproducibility of GCMs for Seasonal Pattern of Precipitation and Temperature at Altai



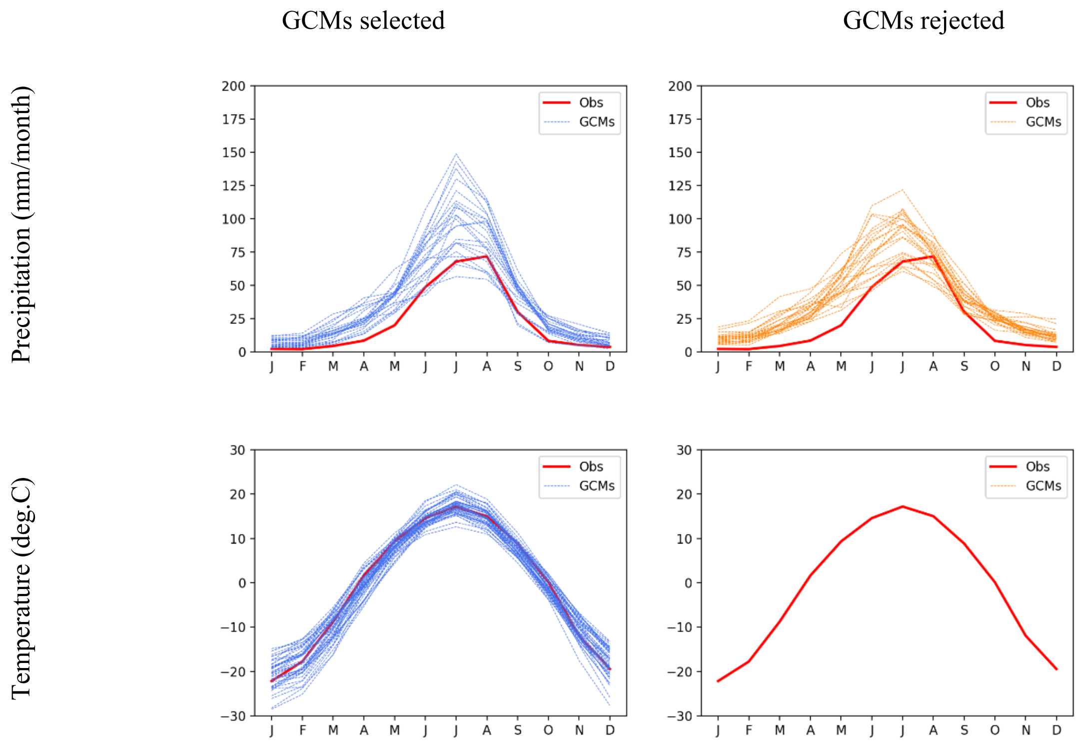
Source: JICA Project Team

Figure 3.7.12 Reproducibility of GCMs for Seasonal Pattern of Precipitation and Temperature at Dalanzadgad



Source: JICA Project Team

Figure 3.7.13 Reproducibility of GCMs for Seasonal Pattern of Precipitation and Temperature at Khovd



Source: JICA Project Team

Figure 3.7.14 Reproducibility of GCMs for Seasonal Pattern of Precipitation and Temperature at Ulaanbaatar

Finally, five (5) cases of GCMs were selected for the impact assessment as shown in Table 3.7.2. If both *TCCM* and *SCCM* are clear (if selected), GCM with 3 points or more (maximum 4 points because it is evaluated at 4 points) was extracted as 1 point. In addition, RCP4.5 and RCP8.5 and the existence of data up to the analysis period of 2100 were confirmed, and the following five (5) models were selected from a total of 46 GCMs. In this study, average of each GCMs were used.

Table 3.7.2 GCM Selected for Climate Change Impact Assessment

No.	GCM	Country of Issue
1	ACCESS1.0	UK
2	CESM1(CAM5)	USA
3	CNRM-CM5	France
4	EC-EARTH	EC (EU)
5	NorESM1-M	Norway

Source: JICA Project Team

(4) Development of future climate scenario by change factor method

For the impact assessment, the change factor method (also referred to as delta change method) was applied to generate future climate scenarios of precipitation and temperature. Figure 3.7.15 shows the schematic diagram of the change factor method applied for temperature. The method uses the differences of GCM simulations between future and control (historical) periods as change factor, and then applies the factor to the observations.

As shown in Equation-3, the change factor is calculated at each percentile of the cumulative distribution function (CDF) of GCM simulations and is applied to the CDF of observations at the same percentile. The CDFs are developed from daily variables for each month. For temperature, an additive change factor is calculated by the arithmetic difference between a GCM variable derived from a current climate simulation and derived from a future climate scenario taken at the same GCM grid location. This difference is then added to the observations to obtain the future values. On the other hand, for precipitation, a multiplicative change factor, which is a ratio between the future and current GCM simulations, is applied to generate the future values. This multiplicative method assumes that the GCM produces a reasonable estimate of the relative change in the value of precipitation.

$$X_{i,p}^{Fut} = \begin{cases} CF_{i,p} + X_{i,p}^{OBS} & (for\ Temperature) \\ CF_{i,p} \cdot X_{i,p}^{OBS} & (for\ Precipitation) \end{cases} \qquad \text{(Eq. 3)}$$

$$CF_{i,p} = \begin{cases} X_{i,p}^{GCM\_fut} - X_{i,p}^{GCM\_his} & (for\ Temperature) \\ X_{i,p}^{GCM\_fut} / X_{i,p}^{GCM\_his} & (for\ Precipitation) \end{cases}$$

where

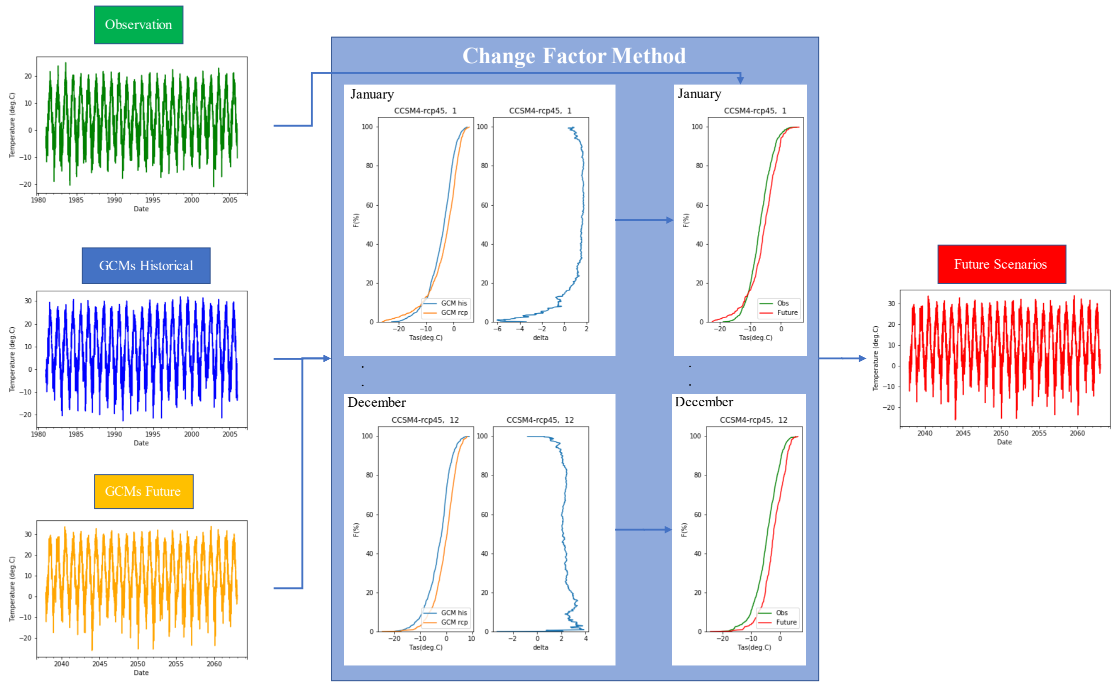
$X_{i,p}^{Fut}$: Daily value of the variable projected by the delta change method for the future period correspondent to the month i and the percentile p,

$CF_{i,p}$: Change Factor (delta) at the month i and the percentile p,

$X_{i,p}^{OBS}$: Daily value of the observed variable correspondent to the month i and the percentile p,

$X_{i,p}^{GCM\_his}$: Daily value of the variable derived from GCM for the historical period correspondent to the month i and the percentile p, and

$X_{i,p}^{GCM\_fut}$: Daily value of the variable derived from GCM for the future period correspondent to the month i and the percentile p.

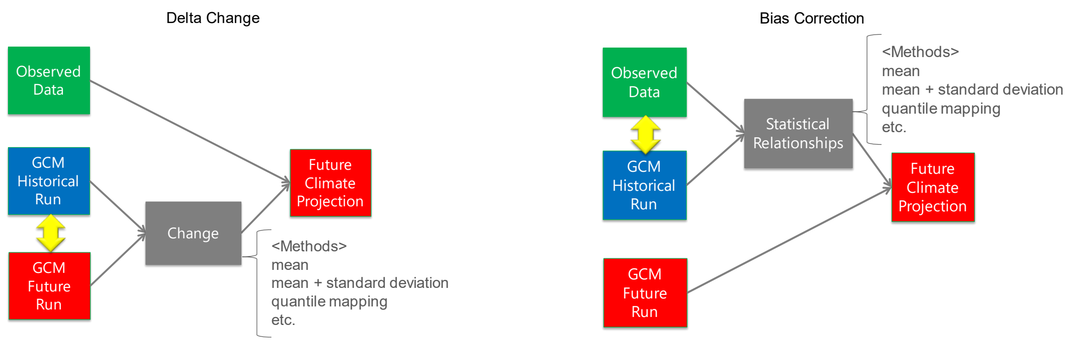


Source: JICA Project Team

Figure 3.7.15 Schematic Diagram of Change Factor Method

The change factor method and bias correction method share the same underlying idea to establish statistical relationships between variables derived from GCM and local observations to correct GCM errors. Figure 3.7.16 shows the schematic diagram of the change factor method and the bias correction method. The bias correction method firstly constructs a transfer function (i.e., some kind of statistical relationship) between observations and the GCM simulations for the control period. Then, the transfer function is applied to correct the GCM outputs for the future period.

The major advantage of the change factor method is the ease and speed of applications, and the direct scaling of the observations in line with changes suggested by the GCM simulations. Hence the change factor method is used in many climate change impact assessment studies[81]. However, there are also some disadvantages, for example, the temporal sequencing of wet and dry days generally remains unchanged and the change factor method may not be helpful in circumstances where changes in event frequency and antecedent conditions are important to the impact assessment.



Source: JICA Project Team

Figure 3.7.16 Schematic Diagram of Delta Change Method and Bias Correction

81 For example, Anandhi, A., et al. (2011), Examination of change factor methodologies for climate change impact assessment, Water Resources. Res.,47, W03501, doi:10.1029/ 2010WR009104.

3.7.5 Climate change impact assessment

In this study, following base case (present condition) and 4 scenarios of climate change were assessed.

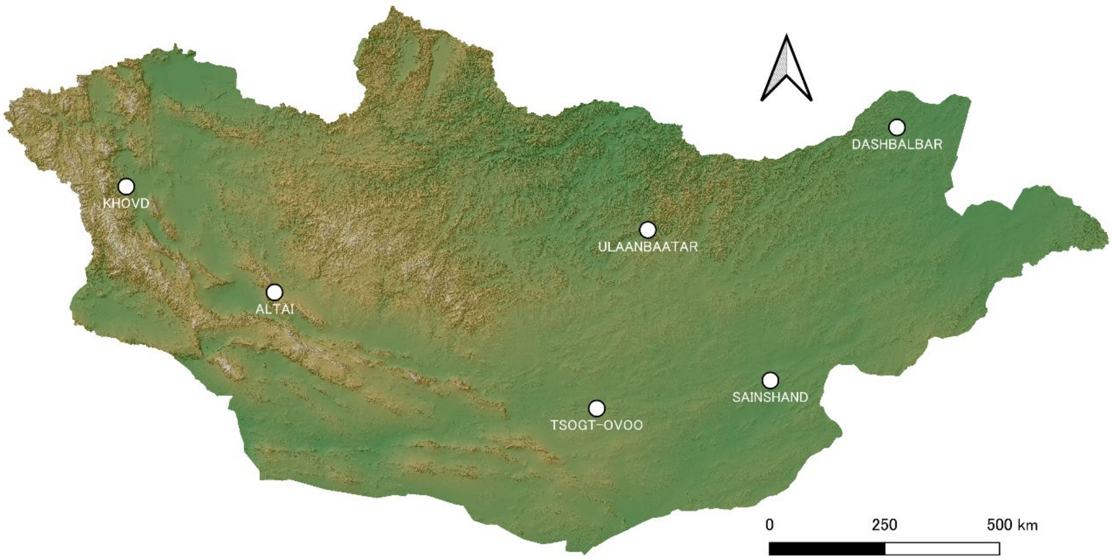
Table 3.7.3 Climate Change Scenarios

Base Case	Present Condition (1979-2016; 38-years)
Case-1	Average of Selected GCMs 2050-RCP4.5 (2038-2062; 25-years)
Case-2	Average of Selected GCMs 2050-RCP8.5 (2038-2062; 25-years)
Case-3	Average of Selected GCMs 2100-RCP4.5 (2076-2100; 25-years)
Case-4	Average of Selected GCMs 2100-RCP4.5 (2076-2100; 25-years)

Source: JICA Project Team

(1) Climate change impact on mean monthly precipitation at representative meteorological stations by GCMs

Figure 3.7.17 shows the location map of the representative meteorological stations.



Source: JICA Project Team

Figure 3.7.17 Location Map of Representative Meteorological Stations

Figure 3.7.18 and Figure 3.7.19 shows the climate change impact on mean monthly precipitation at representative meteorological stations by each GCMs.

In Ulaanbaatar, the mean monthly precipitation in the summer of 2050 tends to increase significantly compared to the present condition, but in 2100 the summer precipitation tends to decrease compared to the present. In 2050, precipitation from October to December also tends to increase, but on the contrary, it tends to decrease to 2100.

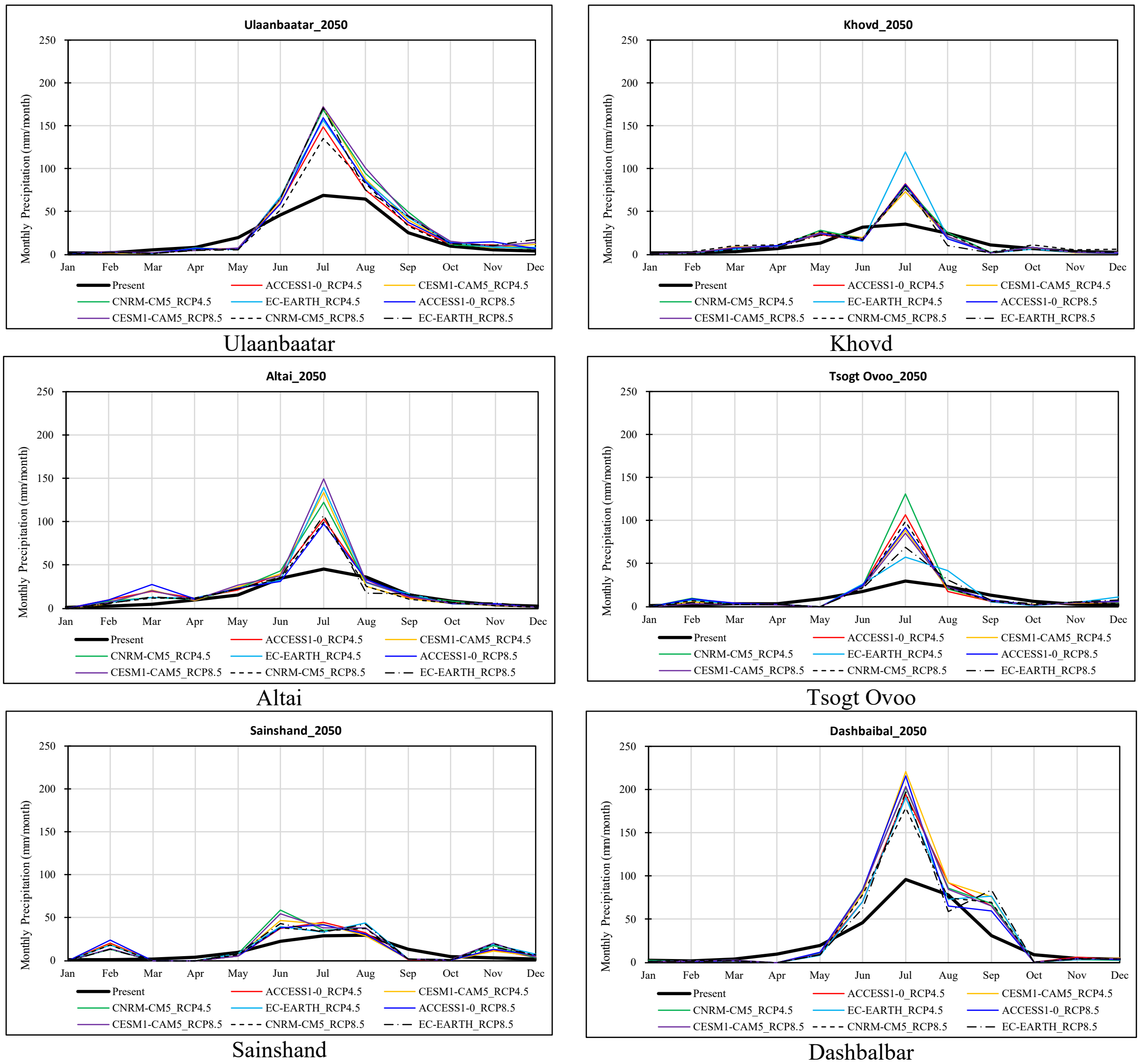
In Khovd, many GCMs tend to have higher precipitation in May and July 2050, while other months tend to have lower precipitation than present condition. On the other hand, in 2100, precipitation tends to increase from June to August, but decreases from the current situation in other months.

In Altai, precipitation in March and July of 2050 tends to increase, but precipitation in July and August tends to increase significantly in 2100.

In Tsogt Ovoo, precipitation in July 2050 tends to increase significantly, while precipitation tends to decrease in other months. On the other hand, in 2100, precipitation increases slightly in February, but tends to be less than the current precipitation in other months.

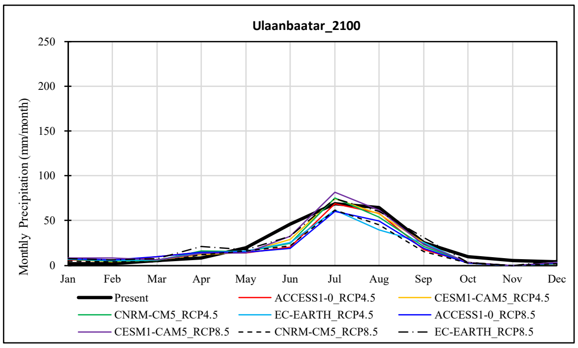
In Sainshand, average monthly precipitation is only about 30 mm/month, which is a small area even at present, but in 2050, precipitation tends to increase slightly in February, summer, and November. However, in 2100, it tends to be much lower than the current rainfall in most months, and there are concerns about desertification and drought.

In Dashbalbar, precipitation in the summer of 2050 will increase sharply and floods are a concern, while precipitation from winter to spring tends to decrease from the current level. In 2100, there is not much tendency for precipitation to increase in summer, and precipitation decreases from August to winter.

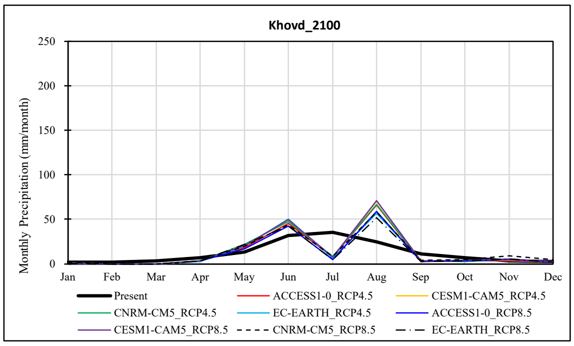


Source: JICA Project Team

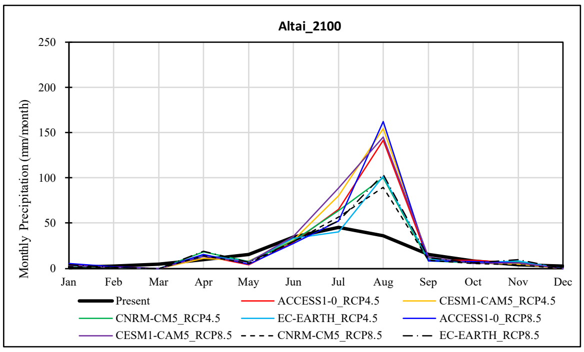
Figure 3.7.18 Future Change of Mean Monthly Precipitation at Representative Meteorological Stations by GCMs in 2050



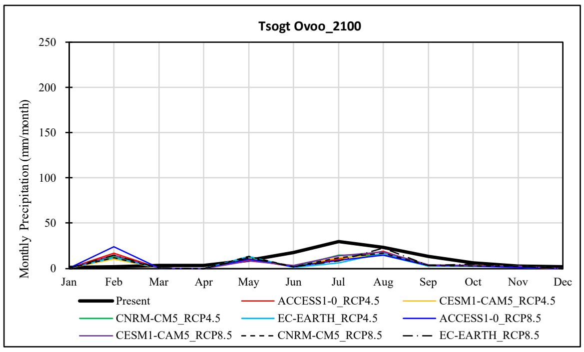
Ulaanbaatar



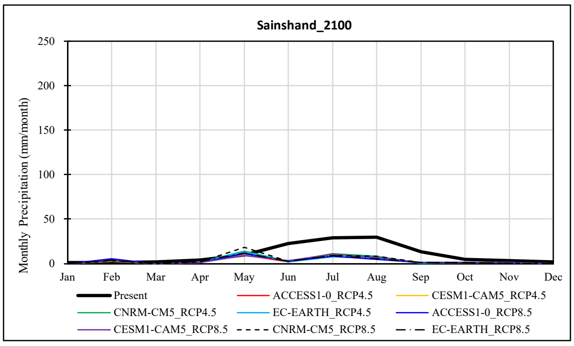
Khovd



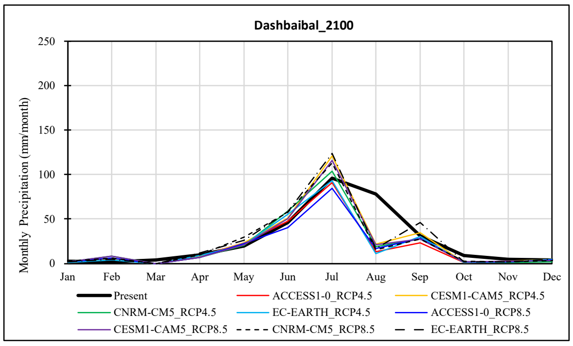
Altai



Tsogt Ovoo



Sainshand



Dashbalbar

Source: JICA Project Team

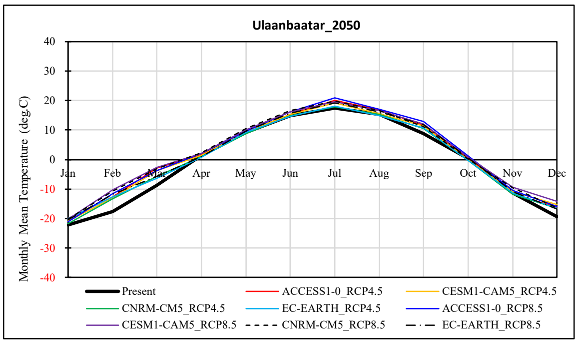
Figure 3.7.19 Future Change of Mean Monthly Precipitation at Representative Meteorological Stations by GCMs in 2100

(2) Climate change impact on mean monthly temperature at representative meteorological stations by GCMs

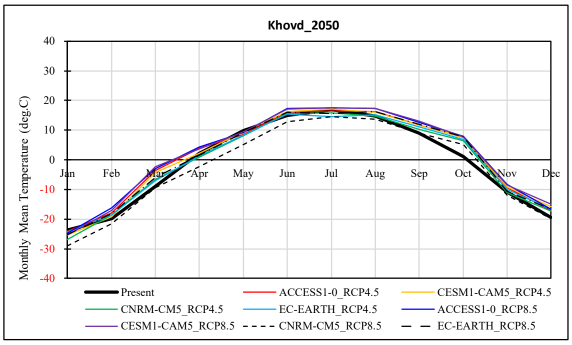
Figure 3.7.20 and Figure 3.7.21 shows the climate change impact on mean monthly temperature at representative meteorological stations by each GCMs,

In 2050, the average monthly temperature will tend to rise in all regions and all months in all GCMs.

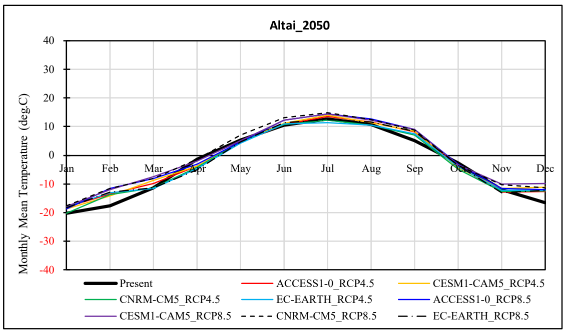
However, in 2100, the average monthly temperature from January to February tends to be lower than present condition in some areas (Ulaanbaatar, Khovd, Altai).



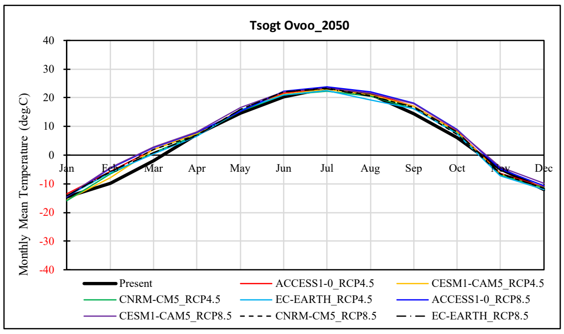
Ulaanbaatar



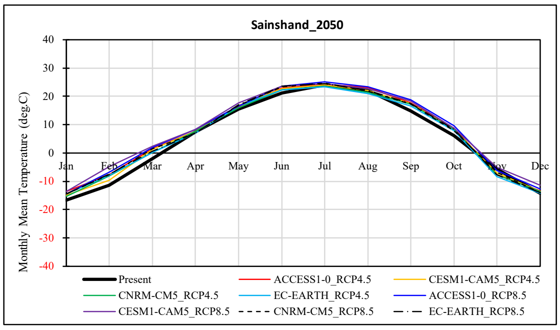
Khovd



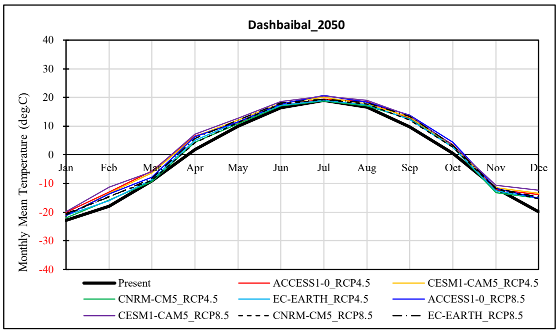
Altai



Tsogt Ovoo



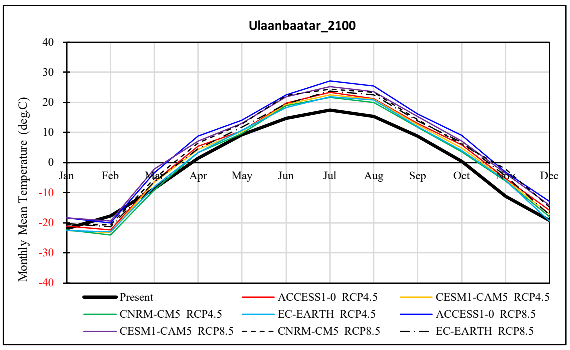
Sainshand



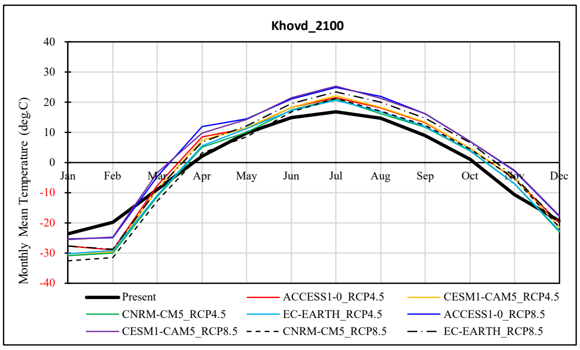
Dashbalbar

Source: JICA Project Team

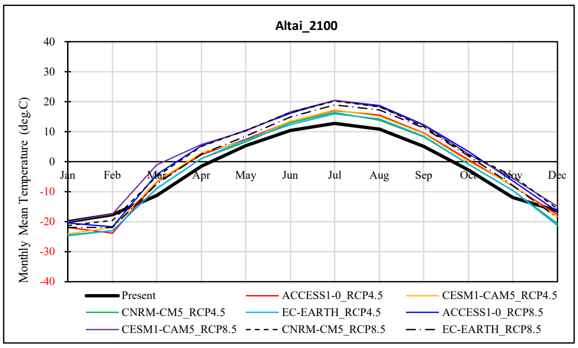
Figure 3.7.20 Future Change of Mean Monthly Temperature at Representative Meteorological Stations by GCMs in 2050



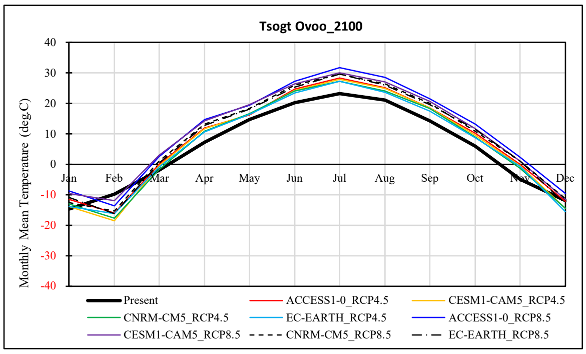
Ulaanbaatar



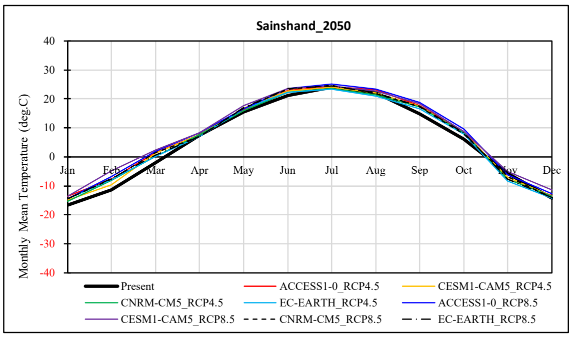
Khovd



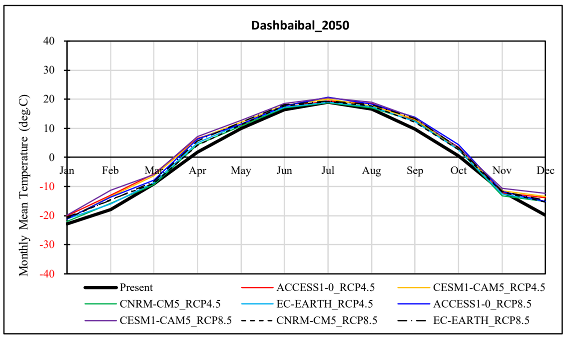
Altai



Tsogt Ovoo



Sainshand



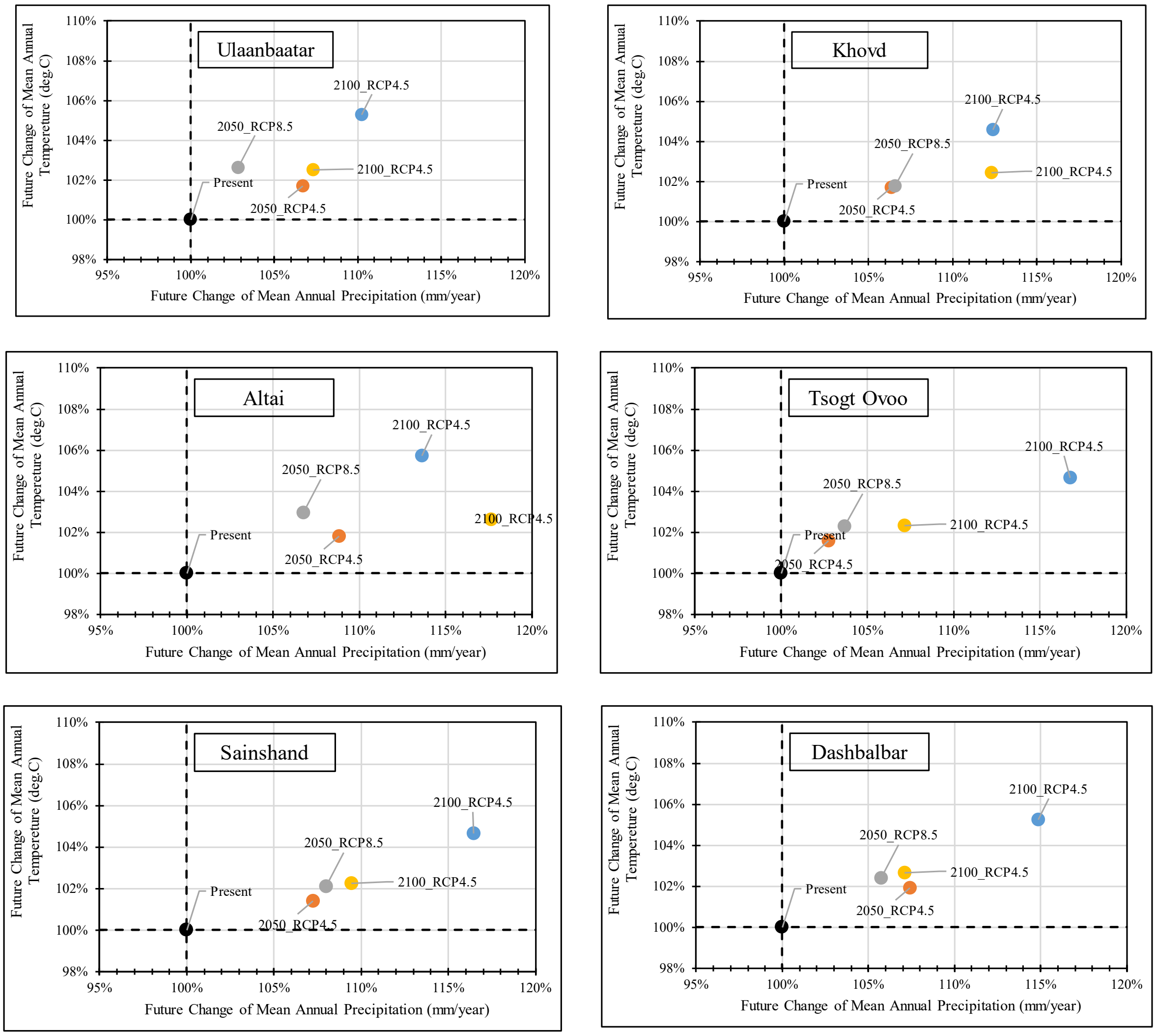
Dashbalbar

Source: JICA Project Team

Figure 3.7.21 Future Change of Mean Monthly Temperature at Representative Meteorological Stations by GCMs in 2100

(3) Climate change impact on mean monthly precipitation and mean monthly temperature at representative meteorological stations by average of selected GCMs

Figure 3.7.22 to Figure 3.7.24 and Table 3.7.4 to Table 3.7.15 show future change of annual precipitation and annual mean temperature at the representative meteorological stations. Mean annual temperature of all climate scenarios are projected to rise compared with the present condition, whereas projected trend of mean annual precipitation vary among the scenarios.

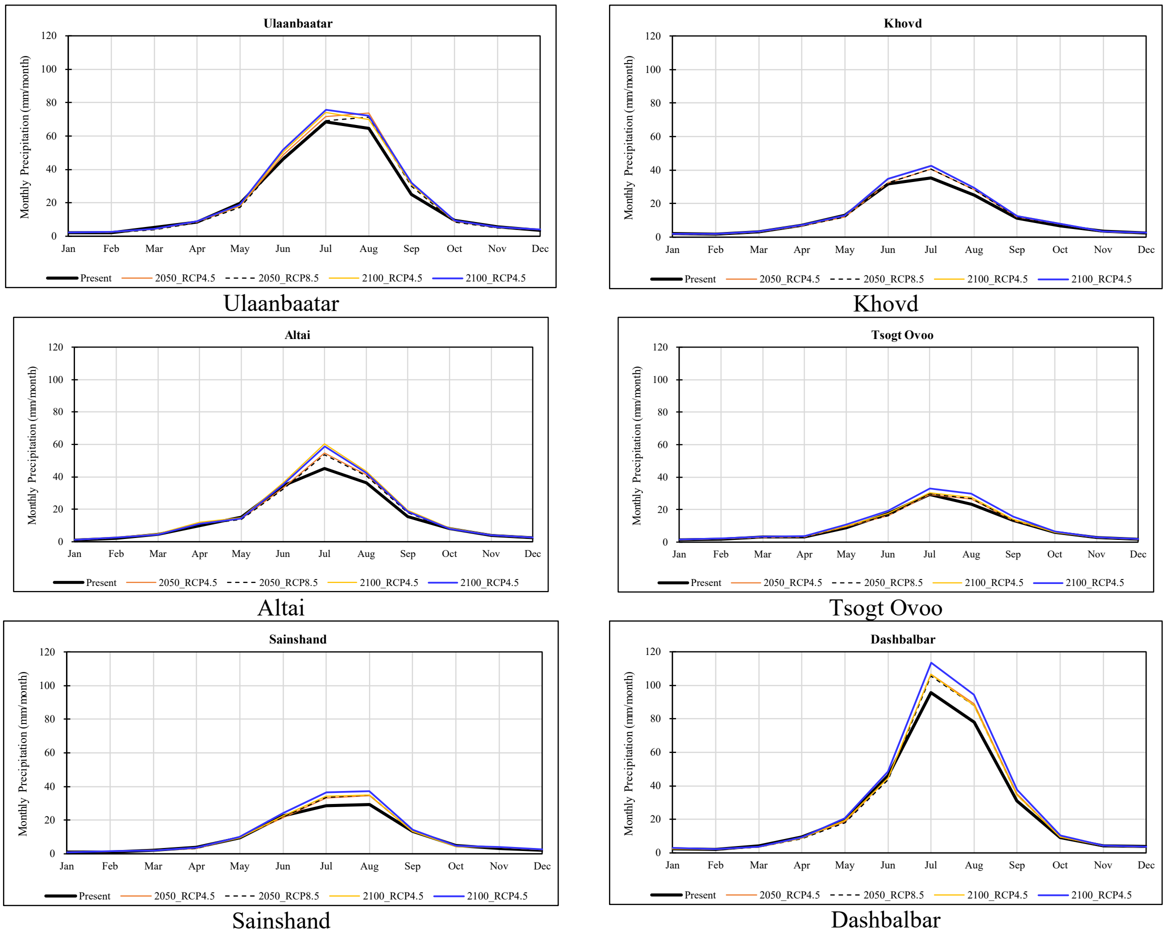


Source: JICA Project Team

Figure 3.7.22 Future Change of Annual Precipitation and Annual Mean Temperature at Representative Meteorological Stations

Among the four (4) cases of RCP4.5 and RCP8.5 in 2050 and 2100, Case-1 (107%), Case-2 (106%), Case-3 (107%) and Case-4 (115%) project larger annual precipitation than present condition (100%) in Ulaanbaatar. While, for temperature increase, among the four (4) cases, Case-1 (102%), Case-2 (102%), Case-3 (103%) and Case-4 (105%) project larger mean annual temperature than present condition (100%) in Ulaanbaatar.

All in the representative meteorological stations, precipitation and temperature in future will be increased.



Source: JICA Project Team

Figure 3.7.23 Future Change of Mean Monthly Precipitation at Representative Meteorological Stations

All in the representative meteorological stations, mean monthly precipitation in future will be increased especially in summer. It is predicted that there will be little change in winter.

Table 3.7.4 Future Change of Mean Monthly and Annual Precipitation at Representative Meteorological Stations (Ulaanbaatar)

Ulaanbaatar Latitude: 47.75 Longitude: 106.75 Elevation (m): 1,451 Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	2.12	2.15	5.11	8.52	19.89	46.37	68.61	64.56	25.12	9.66	5.57	3.66	261.34
2050_RCP4.5	2.30	2.28	4.11	8.38	17.86	48.81	71.72	73.88	31.30	8.97	5.27	3.96	278.83
2050_RCP8.5	2.20	2.18	3.94	8.05	17.14	47.09	69.33	71.22	30.15	8.57	5.05	3.76	268.67
2100_RCP4.5	2.34	2.47	4.11	8.86	18.35	50.57	74.07	69.90	31.19	9.19	5.33	4.08	280.47
2100_RCP8.5	2.40	2.54	4.24	9.11	18.91	51.86	75.84	72.10	32.03	9.42	5.49	4.18	288.13

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	0.18	0.13	-1.01	-0.14	-2.02	2.44	3.11	9.32	6.18	-0.69	-0.30	0.30	17.49
2050_RCP8.5	0.08	0.03	-1.17	-0.46	-2.75	0.72	0.72	6.65	5.03	-1.10	-0.52	0.10	7.33
2100_RCP4.5	0.22	0.32	-1.00	0.34	-1.54	4.20	5.46	5.34	6.08	-0.47	-0.24	0.42	19.13
2100_RCP8.5	0.28	0.39	-0.87	0.60	-0.98	5.49	7.23	7.53	6.91	-0.24	-0.08	0.52	26.79

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	108%	106%	80%	98%	90%	105%	105%	114%	125%	93%	95%	108%	107%
2050_RCP8.5	104%	101%	77%	95%	86%	102%	101%	110%	120%	89%	91%	103%	103%
2100_RCP4.5	110%	115%	80%	104%	92%	109%	108%	108%	124%	95%	96%	111%	107%
2100_RCP8.5	113%	118%	83%	107%	95%	112%	111%	112%	128%	98%	99%	114%	110%

Source: JICA Project Team

Table 3.7.5 Future Change of Mean Monthly and Annual Precipitation at Representative Meteorological Stations (Khovd)

Khovd Latitude: 47.75 Longitude: 91.75 Elevation (m): 2,074 Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	1.99	1.69	3.27	7.15	13.06	31.70	35.15	24.92	11.21	6.72	3.47	2.29	142.62
2050_RCP4.5	1.87	1.57	3.04	6.76	11.96	32.47	40.60	28.24	12.01	7.73	3.07	2.38	151.71
2050_RCP8.5	1.90	1.60	3.08	6.81	11.96	32.51	40.47	28.30	12.12	7.71	3.11	2.41	151.99
2100_RCP4.5	1.95	1.82	3.15	7.20	12.72	34.63	42.79	29.37	12.61	8.07	3.27	2.57	160.17
2100_RCP8.5	1.97	1.85	3.19	7.25	12.74	34.76	42.63	29.34	12.67	8.02	3.30	2.60	160.32

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	-0.12	-0.12	-0.23	-0.38	-1.10	0.77	5.45	3.32	0.80	1.02	-0.40	0.09	9.09
2050_RCP8.5	-0.09	-0.09	-0.18	-0.34	-1.11	0.81	5.32	3.38	0.91	1.00	-0.36	0.12	9.37
2100_RCP4.5	-0.04	0.13	-0.12	0.06	-0.34	2.94	7.64	4.45	1.40	1.35	-0.20	0.28	17.55
2100_RCP8.5	-0.02	0.15	-0.08	0.10	-0.33	3.06	7.48	4.42	1.46	1.31	-0.17	0.31	17.70

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	94%	93%	93%	95%	92%	102%	116%	113%	107%	115%	88%	104%	106%
2050_RCP8.5	96%	94%	94%	95%	92%	103%	115%	114%	108%	115%	90%	105%	107%
2100_RCP4.5	98%	108%	96%	101%	97%	109%	122%	118%	112%	120%	94%	112%	112%
2100_RCP8.5	99%	109%	98%	101%	97%	110%	121%	118%	113%	119%	95%	113%	112%

Source: JICA Project Team

Table 3.7.6 Future Change of Mean Monthly and Annual Precipitation at Representative Meteorological Stations (Altai)

Altai Latitude: 46.25 Longitude: 96.25 Elevation (m): 2,663 Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	1.12	2.17	4.50	9.93	15.19	34.66	45.24	36.22	15.62	8.16	3.81	2.36	178.98
2050_RCP4.5	1.22	2.33	4.51	10.87	14.08	33.11	54.71	41.37	18.23	7.97	3.81	2.54	194.74
2050_RCP8.5	1.19	2.27	4.40	10.63	13.77	32.48	53.78	40.62	17.93	7.77	3.72	2.48	191.04
2100_RCP4.5	1.27	2.75	4.82	11.82	14.97	36.37	60.46	43.37	19.34	8.47	4.11	2.81	210.57
2100_RCP8.5	1.21	2.59	4.56	11.17	14.18	35.24	58.88	42.41	18.56	7.99	3.88	2.66	203.33

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	0.09	0.16	0.01	0.94	-1.11	-1.55	9.46	5.15	2.61	-0.19	0.01	0.17	15.76
2050_RCP8.5	0.07	0.10	-0.10	0.70	-1.42	-2.18	8.54	4.40	2.31	-0.39	-0.09	0.11	12.06
2100_RCP4.5	0.15	0.58	0.33	1.89	-0.22	1.71	15.22	7.15	3.72	0.31	0.30	0.45	31.59
2100_RCP8.5	0.09	0.42	0.07	1.24	-1.01	0.58	13.64	6.19	2.94	-0.18	0.07	0.30	24.35

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	108%	108%	100%	109%	93%	96%	121%	114%	117%	98%	100%	107%	109%
2050_RCP8.5	106%	105%	98%	107%	91%	94%	119%	112%	115%	95%	98%	105%	107%
2100_RCP4.5	114%	127%	107%	119%	99%	105%	134%	120%	124%	104%	108%	119%	118%
2100_RCP8.5	108%	119%	101%	112%	93%	102%	130%	117%	119%	98%	102%	113%	114%

Source: JICA Project Team

Table 3.7.7 Future Change of Mean Monthly and Annual Precipitation at Representative Meteorological Stations (Tsogt Ovoo)

Tsogt Ovoo Latitude: 44.25 Longitude: 105.25 Elevation (m): 1,261 Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	1.33	1.72	3.04	3.26	8.74	17.52	29.39	23.39	13.25	6.15	2.79	1.67	112.26
2050_RCP4.5	1.28	2.00	2.86	3.24	9.51	16.08	29.37	26.52	13.55	6.37	2.72	1.84	115.34
2050_RCP8.5	1.33	2.04	2.92	3.33	9.77	16.33	29.48	26.67	13.36	6.44	2.79	1.90	116.36
2100_RCP4.5	1.39	1.99	3.12	3.47	9.85	17.80	30.32	27.43	14.28	6.01	2.72	1.91	120.28
2100_RCP8.5	1.53	2.19	3.42	3.79	10.70	19.33	32.94	29.79	15.69	6.60	2.98	2.09	131.05

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	-0.06	0.28	-0.18	-0.02	0.77	-1.44	-0.03	3.14	0.30	0.22	-0.07	0.17	3.08
2050_RCP8.5	-0.00	0.32	-0.12	0.07	1.03	-1.19	0.08	3.28	0.12	0.29	-0.00	0.22	4.10
2100_RCP4.5	0.06	0.27	0.08	0.21	1.11	0.28	0.92	4.04	1.03	-0.15	-0.07	0.24	8.02
2100_RCP8.5	0.20	0.47	0.38	0.54	1.96	1.81	3.54	6.40	2.44	0.45	0.19	0.41	18.79

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	96%	116%	94%	99%	109%	92%	100%	113%	102%	104%	97%	110%	103%
2050_RCP8.5	100%	119%	96%	102%	112%	93%	100%	114%	101%	105%	100%	113%	104%
2100_RCP4.5	104%	116%	103%	106%	113%	102%	103%	117%	108%	98%	97%	114%	107%
2100_RCP8.5	115%	127%	113%	116%	122%	110%	112%	127%	118%	107%	107%	125%	117%

Source: JICA Project Team

Table 3.7.8 Future Change of Mean Monthly and Annual Precipitation at Representative Meteorological Stations (Sainshand)

Sainshand Latitude: 44.75 Longitude: 110.25 Elevation (m): 889 Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.96	1.08	2.15	3.71	9.58	22.69	28.70	29.32	13.40	5.01	3.33	1.97	121.90
2050_RCP4.5	0.99	1.45	2.01	3.08	9.76	21.60	33.13	34.52	13.32	4.42	3.86	2.57	130.71
2050_RCP8.5	1.00	1.46	2.01	3.08	9.75	21.78	33.44	34.94	13.35	4.41	3.84	2.55	131.61
2100_RCP4.5	0.95	1.47	1.97	3.38	9.57	22.71	34.36	34.93	13.44	4.34	3.76	2.56	133.43
2100_RCP8.5	1.01	1.54	2.09	3.60	10.16	24.18	36.52	37.17	14.39	4.60	4.00	2.71	141.98

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	0.03	0.37	-0.14	-0.63	0.18	-1.09	4.43	5.20	-0.09	-0.59	0.53	0.60	8.81
2050_RCP8.5	0.04	0.37	-0.14	-0.63	0.17	-0.91	4.73	5.62	-0.05	-0.61	0.51	0.59	9.71
2100_RCP4.5	-0.01	0.39	-0.18	-0.33	-0.00	0.02	5.66	5.61	0.04	-0.68	0.42	0.59	11.53
2100_RCP8.5	0.05	0.46	-0.06	-0.11	0.59	1.49	7.82	7.85	0.99	-0.42	0.66	0.75	20.08

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	103%	134%	93%	83%	102%	95%	115%	118%	99%	88%	116%	131%	107%
2050_RCP8.5	104%	135%	94%	83%	102%	96%	116%	119%	100%	88%	115%	130%	108%
2100_RCP4.5	99%	136%	92%	91%	100%	100%	120%	119%	100%	86%	113%	130%	109%
2100_RCP8.5	105%	143%	97%	97%	106%	107%	127%	127%	107%	92%	120%	138%	116%

Source: JICA Project Team

Table 3.7.9 Future Change of Mean Monthly and Annual Precipitation at Representative Meteorological Stations (Dashbalbar)

Dashbalbar Latitude: 49.75 Longitude: 114.25 Elevation (m): 849 Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	2.57	2.00	4.19	9.37	19.49	46.20	95.70	77.95	31.09	9.07	4.30	3.82	305.77
2050_RCP4.5	2.66	1.95	3.54	8.78	18.62	44.74	106.70	88.91	35.29	9.69	4.17	3.43	328.47
2050_RCP8.5	2.59	1.90	3.47	8.55	18.14	43.84	105.54	87.79	34.58	9.44	4.06	3.34	323.25
2100_RCP4.5	2.60	1.98	3.54	8.72	19.37	44.98	106.55	87.95	34.76	9.60	4.13	3.36	327.52
2100_RCP8.5	2.81	2.14	3.83	9.41	20.82	48.38	113.67	94.39	37.43	10.30	4.46	3.64	351.27

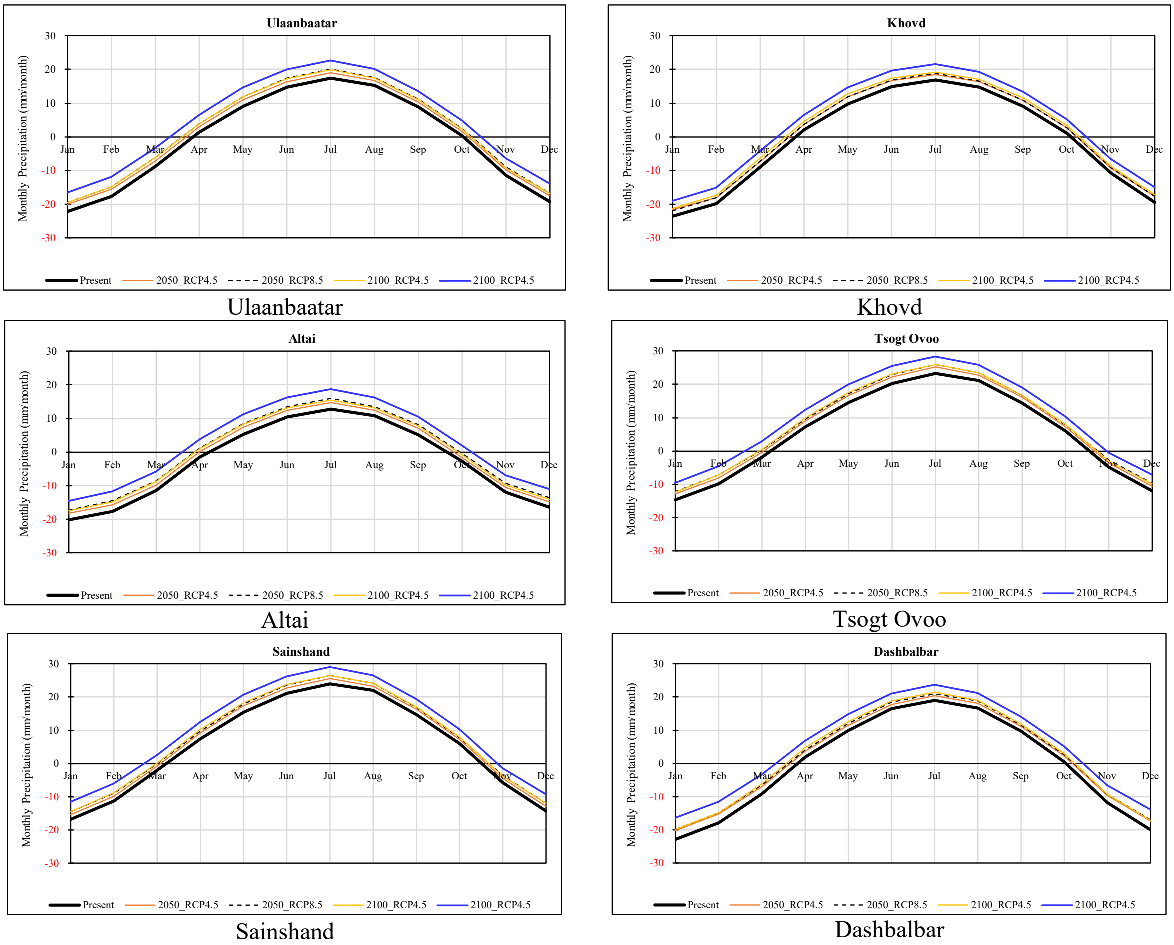
Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	0.09	-0.05	-0.65	-0.59	-0.87	-1.47	10.99	10.96	4.20	0.62	-0.14	-0.39	22.71
2050_RCP8.5	0.02	-0.10	-0.72	-0.81	-1.35	-2.37	9.84	9.85	3.48	0.37	-0.24	-0.48	17.48
2100_RCP4.5	0.03	-0.03	-0.66	-0.64	-0.12	-1.22	10.84	10.01	3.66	0.53	-0.18	-0.46	21.75
2100_RCP8.5	0.23	0.13	-0.37	0.05	1.32	2.18	17.97	16.44	6.33	1.24	0.15	-0.18	45.50

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	103%	97%	85%	94%	96%	97%	111%	114%	113%	107%	97%	90%	107%
2050_RCP8.5	101%	95%	83%	91%	93%	95%	110%	113%	111%	104%	94%	87%	106%
2100_RCP4.5	101%	99%	84%	93%	99%	97%	111%	113%	112%	106%	96%	88%	107%
2100_RCP8.5	109%	107%	91%	101%	107%	105%	119%	121%	120%	114%	104%	95%	115%

Source: JICA Project Team



Source: JICA Project Team

Figure 3.7.24 Future Change of Mean Monthly Temperature at Representative Meteorological Stations

It is predicted that the mean monthly temperature will be higher than the current level in all months at all stations. In the RCP8.5 case of 2100, there is a point where the temperature rises by 5 to 6 ° C compared with present condition.

Table 3.7.10 Future Change of Mean Monthly and Annual Temperature at Representative Meteorological Stations (Ulaanbaatar)

Ulaanbaatar Latitude: 47.75 Longitude: 106.75 Elevation (m): 1,451 Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	-22.09	-17.72	-8.81	1.35	9.13	14.73	17.38	15.21	8.82	0.31	-11.35	-19.32	-1.03
2050_RCP4.5	-20.00	-15.58	-7.12	2.97	11.05	16.31	19.01	16.63	10.34	1.56	-9.90	-17.40	0.66
2050_RCP8.5	-19.40	-14.78	-6.08	3.82	11.94	17.34	20.11	17.68	11.20	2.43	-8.90	-16.70	1.55
2100_RCP4.5	-19.45	-14.79	-6.11	3.87	11.98	17.27	19.95	17.47	10.95	2.27	-9.32	-16.84	1.44
2100_RCP8.5	-16.53	-11.81	-3.28	6.48	14.57	19.94	22.71	20.15	13.53	4.90	-6.42	-13.90	4.19

Difference from Present Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	2.09	2.14	1.69	1.62	1.93	1.58	1.63	1.42	1.52	1.25	1.45	1.92	1.69
2050_RCP8.5	2.69	2.94	2.72	2.47	2.81	2.61	2.73	2.47	2.38	2.12	2.45	2.62	2.58
2100_RCP4.5	2.64	2.93	2.70	2.53	2.85	2.53	2.57	2.26	2.13	1.96	2.03	2.48	2.47
2100_RCP8.5	5.56	5.91	5.53	5.13	5.44	5.21	5.33	4.94	4.71	4.59	4.93	5.42	5.22

Difference from Present Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	103%	103%	102%	102%	102%	101%	101%	101%	101%	101%	102%	102%	102%
2050_RCP8.5	103%	104%	103%	102%	103%	102%	102%	102%	102%	102%	103%	103%	103%
2100_RCP4.5	103%	104%	103%	102%	103%	102%	102%	102%	102%	102%	102%	103%	102%
2100_RCP8.5	107%	107%	106%	105%	105%	105%	105%	104%	104%	105%	106%	107%	105%

Source: JICA Project Team

Table 3.7.11 Future Change of Mean Monthly and Annual Temperature at Representative Meteorological Stations (Khovd)

Khovd Latitude: 47.75 Longitude: 91.75 Elevation (m): 2,074 Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	-23.59	-19.77	-8.98	2.15	9.75	15.01	16.81	14.74	9.02	1.12	-10.78	-19.40	-1.16
2050_RCP4.5	-21.67	-17.97	-7.36	3.65	11.83	16.68	18.50	16.30	10.82	2.59	-9.34	-17.61	0.54
2050_RCP8.5	-22.00	-18.09	-7.08	3.72	11.86	16.90	18.79	16.50	10.81	2.72	-9.10	-17.74	0.61
2100_RCP4.5	-21.19	-17.29	-6.33	4.62	12.73	17.46	19.24	17.01	11.46	3.35	-8.76	-17.13	1.27
2100_RCP8.5	-18.99	-15.04	-4.18	6.43	14.70	19.70	21.57	19.22	13.36	5.16	-6.55	-14.92	3.37

Difference from Present Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	1.92	1.80	1.62	1.50	2.08	1.68	1.70	1.56	1.80	1.48	1.44	1.79	1.70
2050_RCP8.5	1.59	1.67	1.90	1.57	2.11	1.90	1.98	1.76	1.79	1.60	1.68	1.66	1.77
2100_RCP4.5	2.39	2.48	2.65	2.48	2.98	2.45	2.43	2.27	2.45	2.23	2.02	2.26	2.43
2100_RCP8.5	4.60	4.73	4.80	4.28	4.95	4.69	4.77	4.48	4.34	4.04	4.23	4.48	4.53

Difference from Present Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	103%	102%	102%	101%	102%	101%	101%	101%	102%	101%	102%	102%	102%
2050_RCP8.5	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
2100_RCP4.5	103%	103%	103%	102%	103%	102%	102%	102%	102%	102%	102%	103%	102%
2100_RCP8.5	106%	106%	105%	104%	105%	104%	104%	104%	104%	104%	105%	106%	105%

Source: JICA Project Team

Table 3.7.12 Future Change of Mean Monthly and Annual Temperature at Representative Meteorological Stations (Altai)

Altai Latitude: 46.25 Longitude: 96.25 Elevation (m): 2,663 Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	-20.15	-17.67	-11.37	-1.48	5.28	10.46	12.77	10.77	5.15	-2.79	-11.96	-16.50	-3.13
2050_RCP4.5	-18.23	-15.65	-9.88	0.14	7.49	12.35	14.68	12.40	7.11	-1.55	-10.61	-14.79	-1.38
2050_RCP8.5	-17.28	-14.51	-8.61	1.18	8.49	13.52	15.91	13.57	8.11	-0.47	-9.33	-13.64	-0.25
2100_RCP4.5	-17.53	-14.79	-8.79	1.03	8.39	13.09	15.40	13.09	7.72	-0.81	-9.85	-14.05	-0.59
2100_RCP8.5	-14.49	-11.67	-5.81	3.81	11.35	16.27	18.67	16.28	10.64	1.96	-6.84	-10.97	2.43

Difference from Present Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	1.92	2.02	1.48	1.62	2.21	1.90	1.91	1.63	1.96	1.24	1.35	1.71	1.75
2050_RCP8.5	2.87	3.16	2.76	2.66	3.22	3.07	3.14	2.80	2.96	2.32	2.64	2.86	2.87
2100_RCP4.5	2.61	2.88	2.57	2.51	3.11	2.63	2.63	2.33	2.56	1.98	2.11	2.45	2.53
2100_RCP8.5	5.66	6.00	5.56	5.29	6.07	5.82	5.90	5.52	5.49	4.75	5.13	5.53	5.56

Difference from Present Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	102%	102%	102%	102%	102%	102%	102%	101%	102%	101%	102%	102%	102%
2050_RCP8.5	104%	104%	103%	103%	103%	103%	103%	103%	103%	102%	103%	103%	103%
2100_RCP4.5	103%	104%	103%	103%	103%	102%	102%	102%	102%	102%	102%	103%	103%
2100_RCP8.5	107%	107%	106%	105%	106%	105%	105%	105%	105%	105%	106%	107%	106%

Source: JICA Project Team

Table 3.7.13 Future Change of Mean Monthly and Annual Temperature at Representative Meteorological Stations (Tsogt Ovoo)

Tsogt Ovoo Latitude: 44.25 Longitude: 105.25 Elevation (m): 1,261 Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	-14.71	-9.84	-1.88	7.30	14.61	20.28	23.27	21.13	14.35	6.01	-4.90	-12.02	5.30
2050_RCP4.5	-12.92	-8.08	-0.46	9.07	16.64	22.20	25.19	22.68	16.08	7.24	-3.66	-10.47	6.96
2050_RCP8.5	-12.11	-7.14	0.37	9.60	17.24	22.91	25.90	23.40	16.66	7.80	-2.75	-9.57	7.69
2100_RCP4.5	-12.33	-7.19	0.52	9.97	17.63	23.11	26.00	23.45	16.77	7.92	-3.03	-9.81	7.75
2100_RCP8.5	-9.53	-4.57	2.91	12.35	19.96	25.47	28.44	25.82	19.10	10.31	-0.57	-7.06	10.22

Difference from Present Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	1.79	1.76	1.42	1.77	2.04	1.92	1.92	1.55	1.73	1.23	1.24	1.55	1.66
2050_RCP8.5	2.60	2.70	2.25	2.30	2.63	2.64	2.63	2.27	2.31	1.79	2.15	2.45	2.39
2100_RCP4.5	2.38	2.65	2.40	2.67	3.03	2.83	2.72	2.33	2.43	1.91	1.87	2.21	2.45
2100_RCP8.5	5.18	5.27	4.79	5.05	5.35	5.19	5.17	4.69	4.75	4.30	4.33	4.96	4.92

Difference from Present Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	102%	102%	101%	102%	102%	102%	102%	101%	102%	101%	101%	102%	102%
2050_RCP8.5	103%	103%	102%	102%	102%	102%	102%	102%	102%	102%	102%	103%	102%
2100_RCP4.5	103%	103%	102%	102%	103%	102%	102%	102%	102%	102%	102%	103%	102%
2100_RCP8.5	106%	106%	105%	105%	105%	104%	104%	104%	104%	104%	105%	106%	105%

Source: JICA Project Team

Table 3.7.14 Future Change of Mean Monthly and Annual Temperature at Representative Meteorological Stations (Sainshand)

Sainshand Latitude: 44.75 Longitude: 110.25 Elevation (m): 889 Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	-16.76	-11.32	-2.02	7.48	15.42	21.19	24.07	22.03	14.74	6.07	-5.65	-14.31	5.08
2050_RCP4.5	-15.34	-9.81	-0.84	9.22	17.34	22.79	25.59	23.38	16.32	7.30	-4.53	-12.91	6.54
2050_RCP8.5	-14.45	-8.86	-0.05	9.74	17.96	23.57	26.42	24.17	16.90	7.84	-3.63	-11.99	7.30
2100_RCP4.5	-14.42	-8.73	0.23	10.21	18.36	23.81	26.58	24.26	17.06	8.02	-3.83	-12.04	7.46
2100_RCP8.5	-11.47	-5.99	2.54	12.57	20.71	26.20	29.06	26.66	19.40	10.36	-1.39	-9.13	9.96

Difference from Present Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	1.42	1.50	1.19	1.74	1.93	1.59	1.52	1.35	1.58	1.23	1.12	1.39	1.46
2050_RCP8.5	2.31	2.46	1.97	2.27	2.55	2.37	2.36	2.14	2.16	1.77	2.02	2.31	2.22
2100_RCP4.5	2.34	2.59	2.25	2.73	2.95	2.61	2.51	2.23	2.31	1.95	1.82	2.27	2.38
2100_RCP8.5	5.29	5.33	4.57	5.09	5.30	5.00	4.99	4.63	4.66	4.29	4.26	5.18	4.88

Difference from Present Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	102%	102%	101%	102%	102%	101%	101%	101%	101%	101%	101%	102%	101%
2050_RCP8.5	103%	103%	102%	102%	102%	102%	102%	102%	102%	102%	102%	103%	102%
2100_RCP4.5	103%	103%	102%	103%	103%	102%	102%	102%	102%	102%	102%	103%	102%
2100_RCP8.5	106%	106%	105%	105%	105%	104%	104%	104%	104%	104%	105%	106%	105%

Source: JICA Project Team

Table 3.7.15 Future Change of Mean Monthly and Annual Temperature at Representative Meteorological Stations (Dashbalbar)

Dashbalbar Latitude: 49.75 Longitude: 114.25 Elevation (m): 849 Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	-22.82	-17.85	-9.05	1.88	9.93	16.49	19.00	16.71	9.68	0.51	-11.76	-19.91	-0.60
2050_RCP4.5	-20.10	-15.23	-6.90	3.71	11.61	17.86	20.36	18.21	11.18	2.21	-9.68	-17.28	1.33
2050_RCP8.5	-19.76	-14.85	-6.44	4.13	12.07	18.47	21.06	18.84	11.62	2.65	-9.24	-16.92	1.80
2100_RCP4.5	-19.76	-14.82	-6.08	4.73	12.61	18.87	21.43	19.09	11.87	2.95	-9.36	-17.06	2.04
2100_RCP8.5	-16.37	-11.60	-3.38	6.90	14.81	21.08	23.67	21.27	14.07	5.16	-6.45	-13.78	4.61

Difference from Present Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	2.72	2.61	2.15	1.83	1.68	1.37	1.36	1.50	1.50	1.70	2.08	2.63	1.93
2050_RCP8.5	3.06	2.99	2.61	2.26	2.14	1.98	2.06	2.13	1.94	2.14	2.52	2.99	2.40
2100_RCP4.5	3.05	3.03	2.97	2.85	2.68	2.39	2.43	2.38	2.19	2.44	2.39	2.85	2.64
2100_RCP8.5	6.44	6.24	5.67	5.02	4.88	4.59	4.67	4.55	4.39	4.65	5.30	6.13	5.21

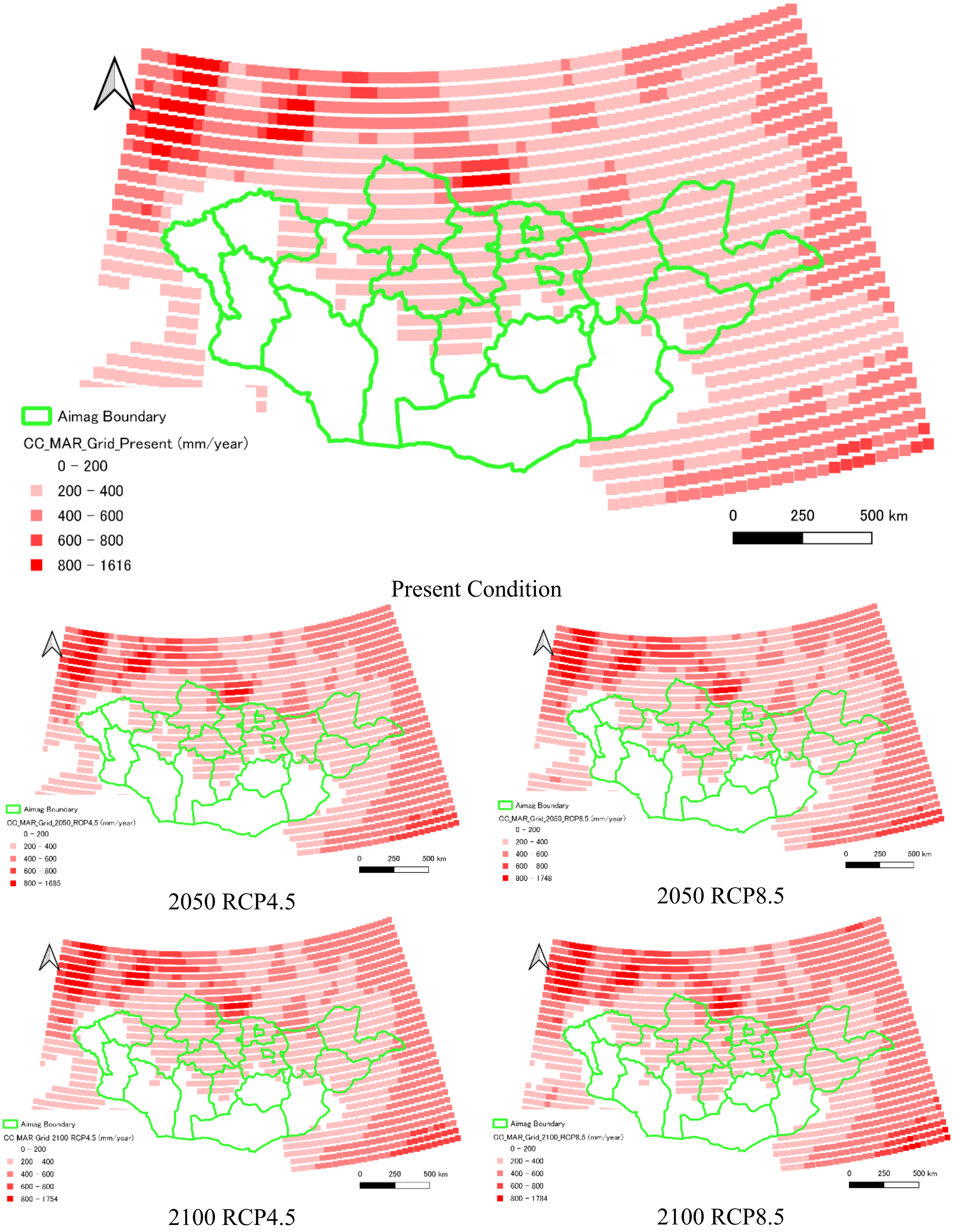
Difference from Present Unit: deg.C

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	104%	103%	102%	102%	102%	101%	101%	101%	101%	102%	102%	103%	102%
2050_RCP8.5	104%	104%	103%	102%	102%	102%	102%	102%	102%	102%	103%	104%	102%
2100_RCP4.5	104%	104%	103%	103%	102%	102%	102%	102%	102%	102%	103%	104%	103%
2100_RCP8.5	108%	108%	106%	105%	104%	104%	104%	104%	104%	105%	106%	108%	105%

Source: JICA Project Team

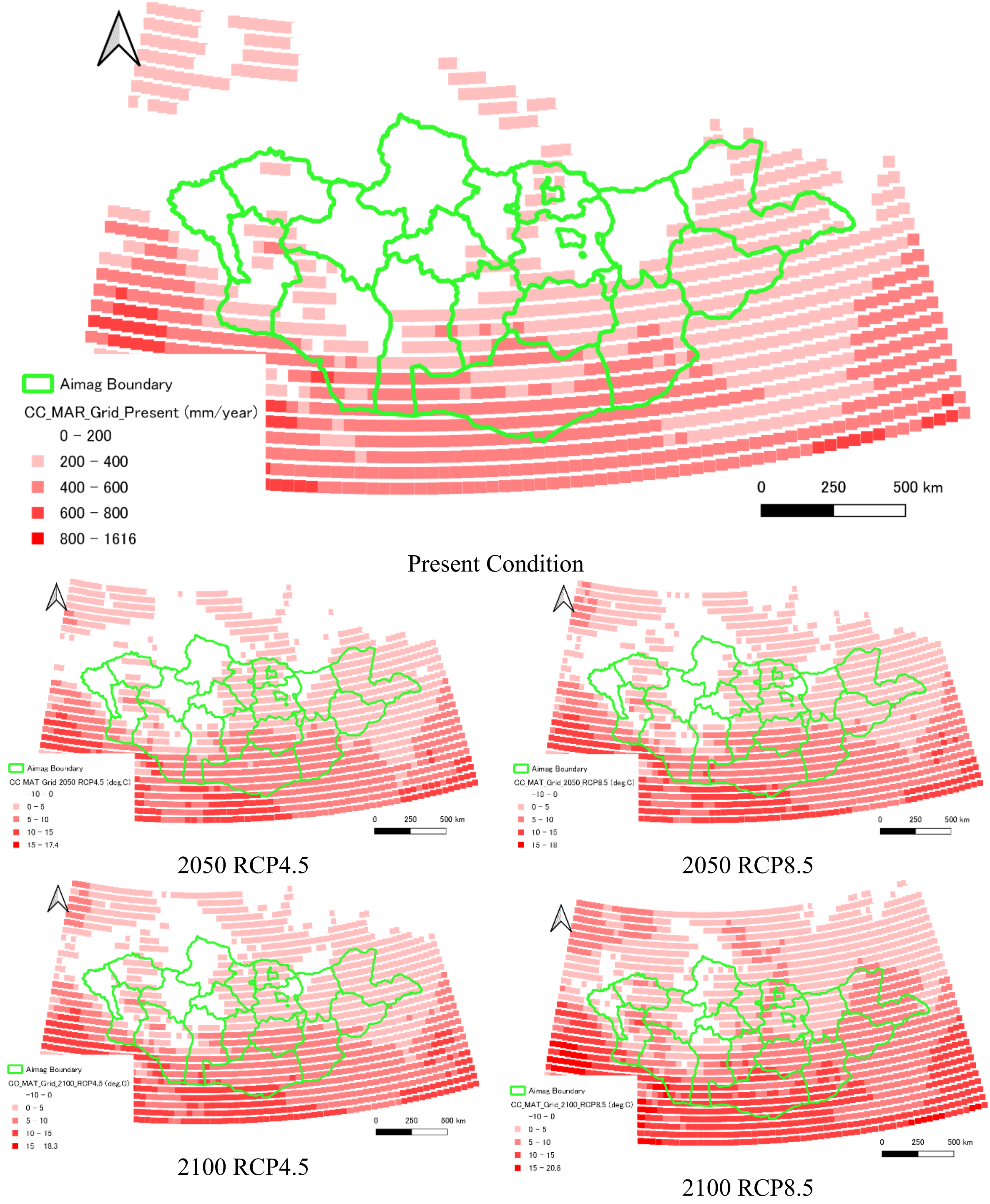
(4) Climate change impact on spatial distribution of precipitation and temperature

Figure 3.7.25 and Figure 3.7.26 shows spatial distribution of mean annual precipitation and meand annual temperature. The mean annual precipitation is high in northern Mongolia, while low in the Gobi region in the south. This trend will not change much in the future. On the other hand, the current mean annual temperature is high in southern Mongolia, but it is predicted that it will become hot in the northern region due to future climate change.



Source: JICA Project Team

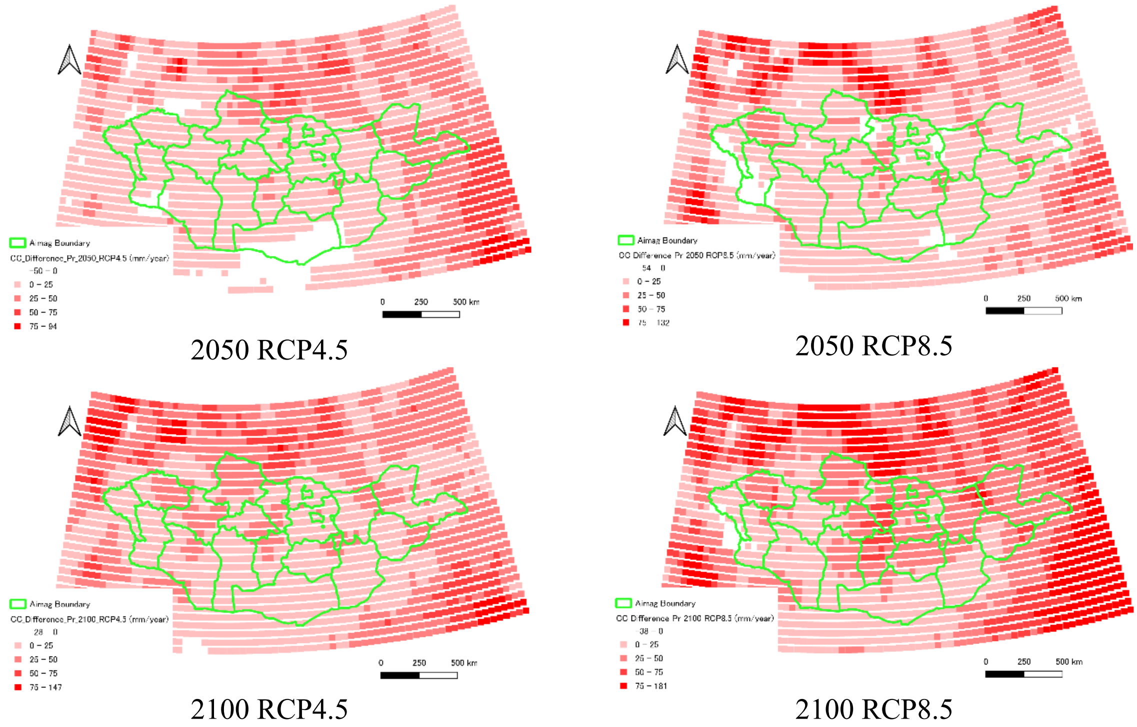
Figure 3.7.25 Spatial Distribution of Mean Annual Precipitation by Climate Change Scenarios



Source: JICA Project Team

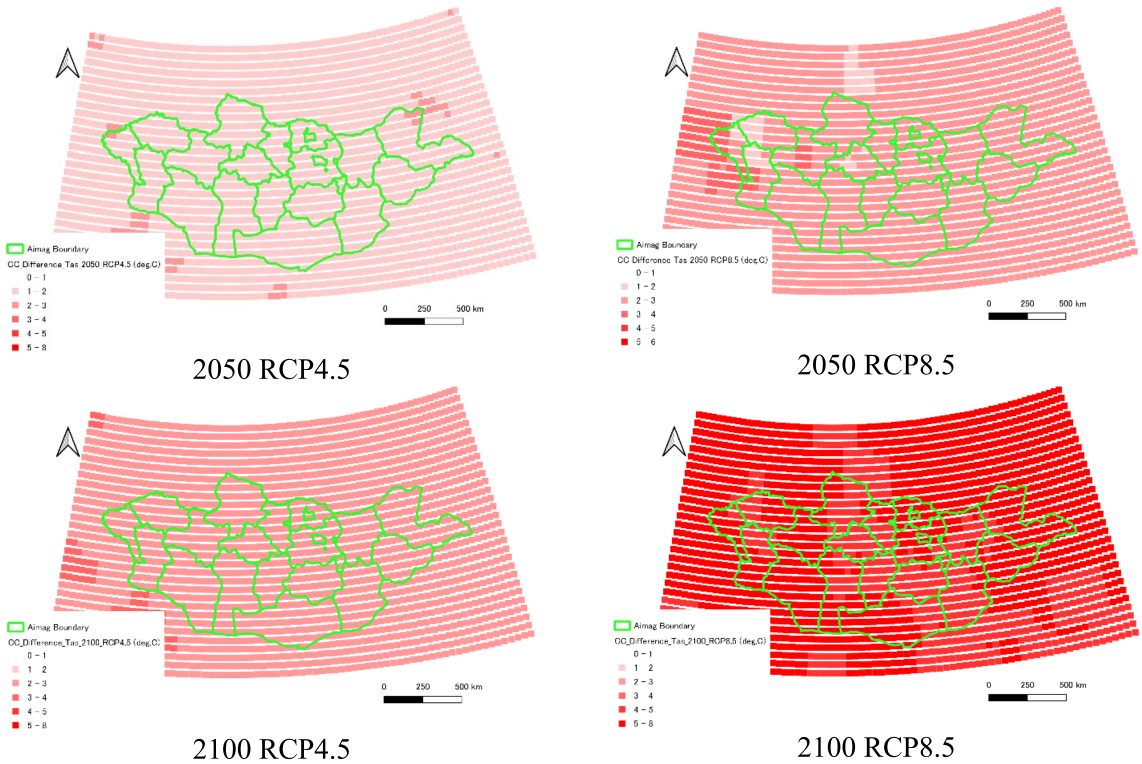
Figure 3.7.26 Spatial Distribution of Mean Annual Temperature by Climate Change Scenarios

Figure 3.7.27 and Figure 3.7.28 shows difference between current and future mean annual precipitation and mean annual temperature by climate change scenarios. Mean annual precipitation tends to increase nationwide in the future, especially in northern Mongolia. On the other hand, the increase in mean annual temperature tends to increase nationwide.



Source: JICA Project Team

Figure 3.7.27 Difference Between Current and Future Mean Annual Precipitation by Climate Change Scenarios

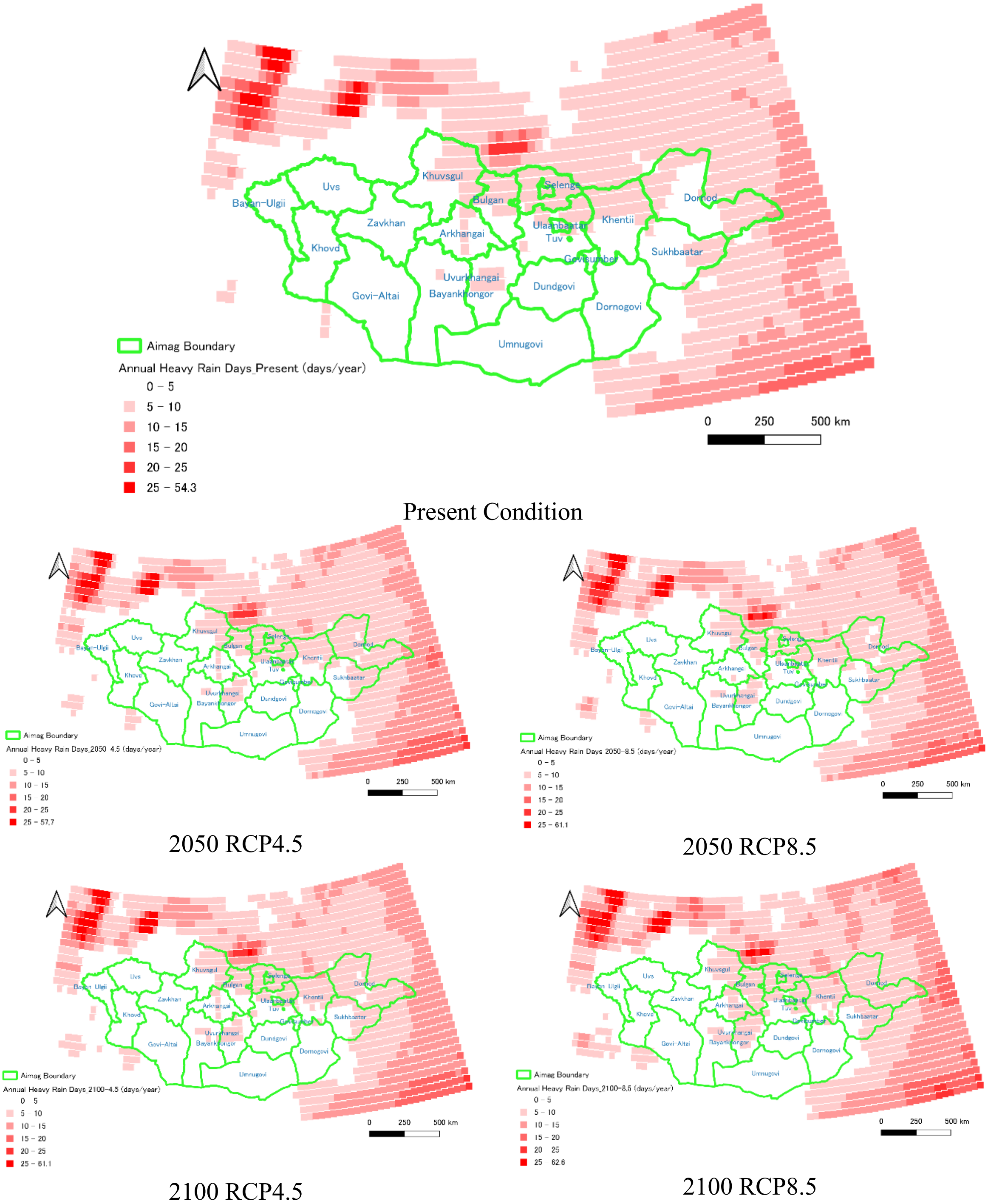


Source: JICA Project Team

Figure 3.7.28 Difference Between Current and Future Mean Annual Temperature by Climate Change Scenarios

(5) Climate change impact on extreme precipitation (flood)

Figure 3.7.29 shows spatial distribution of average annual heavy rain days. The average annual heavy rain days is calculated by using daily rainfall over 10 mm/day in year. The average number of days of heavy rainfall tends to increase in 2100 from the northern part to the central part of Mongolia.

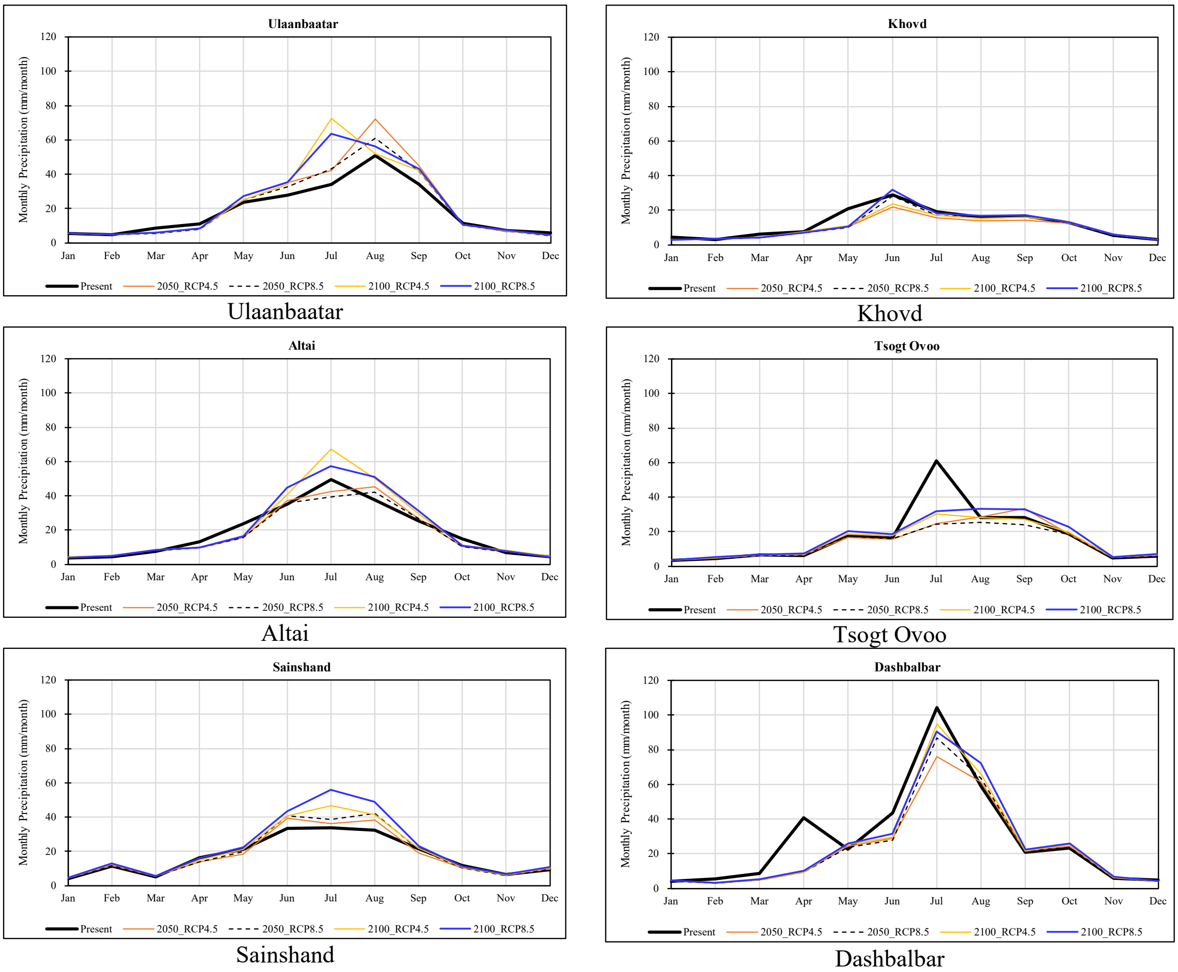


Source: JICA Project Team

Figure 3.7.29 Spatial Distribution of Average Annual Heavy Rain Days by Climate Change Scenarios

Figure 3.7.30 and Table 3.7.16 to Table 3.7.21 shows monthly and annual maximum precipitation in representative meteorological stations by climate change scenarios.

In Ulaanbaatar, Altai and Sainshand, the maximum monthly rainfall in summer tends to increase in the future, which may increase the risk of flooding.



Source: JICA Project Team

Figure 3.7.30 Future Change of Monthly Maximum Precipitation at Representative Meteorological Stations by Climate Change Scenarios

Table 3.7.16 Future Change of Monthly Maximum Precipitation at Representative Meteorological Stations by Climate Change Scenarios (Ulaanbaatar)

Ulaanbaatar Latitude: 47.75 Longitude: 106.75 Elevation (m): 1,451 Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	5.58	4.73	8.67	11.13	23.50	27.88	34.05	50.73	34.16	11.58	7.08	5.79	50.73
2050_RCP4.5	5.53	4.76	5.69	8.19	27.17	35.06	42.16	72.29	44.90	10.58	7.04	4.33	72.29
2050_RCP8.5	5.48	4.63	5.64	8.04	24.97	32.77	43.19	60.92	41.91	10.40	6.87	4.14	60.92
2100_RCP4.5	5.68	4.86	5.80	8.16	24.98	34.07	72.65	52.01	42.27	10.58	7.06	4.41	72.65
2100_RCP8.5	5.81	5.01	5.93	8.32	27.32	35.40	63.54	56.21	42.86	10.57	7.34	4.59	63.54

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	-0.05	0.03	-2.98	-2.94	3.67	7.18	8.11	21.56	10.74	-1.00	-0.04	-1.46	21.56
2050_RCP8.5	-0.10	-0.10	-3.03	-3.09	1.47	4.89	9.14	10.19	7.75	-1.18	-0.21	-1.65	10.19
2100_RCP4.5	0.10	0.13	-2.87	-2.97	1.48	6.19	38.60	1.28	8.11	-1.00	-0.02	-1.38	21.92
2100_RCP8.5	0.23	0.28	-2.74	-2.81	3.82	7.52	29.49	5.48	8.70	-1.01	0.26	-1.20	12.81

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	99%	101%	66%	74%	116%	126%	124%	142%	131%	91%	99%	75%	142%
2050_RCP8.5	98%	98%	65%	72%	106%	118%	127%	120%	123%	90%	97%	72%	120%
2100_RCP4.5	102%	103%	67%	73%	106%	122%	213%	103%	124%	91%	100%	76%	143%
2100_RCP8.5	104%	106%	68%	75%	116%	127%	187%	111%	125%	91%	104%	79%	125%

Source: JICA Project Team

Table 3.7.17 Future Change of Monthly Maximum Precipitation at Representative Meteorological Stations by Climate Change Scenarios (Khovd)

Khovd Latitude: 47.75 Longitude: 91.75 Elevation (m): 2,074 Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	4.51	3.21	6.32	7.77	20.87	28.88	19.24	15.86	16.74	12.78	5.50	3.04	28.88
2050_RCP4.5	2.97	3.44	4.20	7.18	10.32	21.76	15.74	13.96	14.19	12.60	5.76	2.93	21.76
2050_RCP8.5	2.91	3.39	4.15	7.01	9.92	28.18	16.94	16.14	16.13	12.71	5.59	2.88	28.18
2100_RCP4.5	3.07	3.55	4.36	7.61	10.94	23.69	16.92	15.20	15.87	13.64	5.99	3.03	23.69
2100_RCP8.5	3.05	3.54	4.30	7.21	10.62	31.86	18.32	16.71	17.05	13.17	5.89	3.01	31.86

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	-1.54	0.23	-2.12	-0.59	-10.55	-7.12	-3.50	-1.90	-2.55	-0.18	0.26	-0.11	-7.12
2050_RCP8.5	-1.60	0.18	-2.17	-0.76	-10.95	-0.70	-2.30	0.28	-0.61	-0.07	0.09	-0.16	-0.70
2100_RCP4.5	-1.44	0.34	-1.96	-0.16	-9.93	-5.19	-2.32	-0.66	-0.87	0.86	0.49	-0.01	-5.19
2100_RCP8.5	-1.46	0.33	-2.02	-0.56	-10.25	2.98	-0.92	0.85	0.31	0.39	0.39	-0.03	2.98

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	66%	107%	67%	92%	49%	75%	82%	88%	85%	99%	105%	96%	75%
2050_RCP8.5	65%	106%	66%	90%	48%	98%	88%	102%	96%	99%	102%	95%	98%
2100_RCP4.5	68%	111%	69%	98%	52%	82%	88%	96%	95%	107%	109%	100%	82%
2100_RCP8.5	68%	110%	68%	93%	51%	110%	95%	105%	102%	103%	107%	99%	110%

Source: JICA Project Team

Table 3.7.18 Future Change of Monthly Maximum Precipitation at Representative Meteorological Stations by Climate Change Scenarios (Altai)

Altai Latitude: 46.25 Longitude: 96.25 Elevation (m): 2,663 Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	3.70	4.58	7.58	13.19	23.78	35.27	49.47	37.72	25.40	14.80	7.02	4.55	49.47
2050_RCP4.5	3.97	4.93	8.15	9.52	15.46	37.17	42.48	45.43	26.69	10.52	7.50	4.32	45.43
2050_RCP8.5	3.84	4.75	8.04	9.54	15.46	35.80	39.29	42.01	26.87	10.53	7.41	4.16	42.01
2100_RCP4.5	4.32	5.28	8.74	10.22	16.30	40.81	67.30	50.01	29.69	11.21	8.14	4.65	67.30
2100_RCP8.5	3.97	4.90	8.35	9.93	16.44	44.60	57.19	50.90	31.00	10.94	7.73	4.32	57.19

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	0.27	0.35	0.57	-3.67	-8.32	1.90	-6.99	7.71	1.29	-4.28	0.48	-0.23	-4.04
2050_RCP8.5	0.14	0.17	0.46	-3.65	-8.32	0.53	-10.18	4.29	1.47	-4.27	0.39	-0.39	-7.46
2100_RCP4.5	0.62	0.70	1.16	-2.97	-7.48	5.54	17.83	12.29	4.29	-3.59	1.12	0.10	17.83
2100_RCP8.5	0.27	0.32	0.77	-3.26	-7.34	9.33	7.72	13.18	5.60	-3.86	0.71	-0.23	7.72

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	107%	108%	108%	72%	65%	105%	86%	120%	105%	71%	107%	95%	92%
2050_RCP8.5	104%	104%	106%	72%	65%	102%	79%	111%	106%	71%	106%	91%	85%
2100_RCP4.5	117%	115%	115%	77%	69%	116%	136%	133%	117%	76%	116%	102%	136%
2100_RCP8.5	107%	107%	110%	75%	69%	126%	116%	135%	122%	74%	110%	95%	116%

Source: JICA Project Team

Table 3.7.19 Future Change of Monthly Maximum Precipitation at Representative Meteorological Stations by Climate Change Scenarios (Tsogt Ovoo)

Tsogt Ovoo Latitude: 44.25 Longitude: 105.25 Elevation (m): 1,261 Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	3.43	4.62	6.43	6.08	17.35	16.47	60.96	28.07	28.15	18.74	4.80	5.97	60.96
2050_RCP4.5	3.38	4.86	6.07	6.38	16.82	15.64	24.81	28.66	33.41	18.73	5.04	6.24	33.41
2050_RCP8.5	3.43	4.80	6.20	6.52	17.46	16.08	24.48	25.24	24.07	18.57	4.95	6.36	25.24
2100_RCP4.5	3.44	4.87	6.38	6.91	18.65	17.76	30.25	28.36	27.22	19.82	5.16	6.59	30.25
2100_RCP8.5	3.75	5.32	6.77	7.45	20.17	18.71	31.87	33.23	32.97	22.69	5.49	6.94	33.23

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	-0.05	0.24	-0.36	0.30	-0.53	-0.83	-36.15	0.59	5.26	-0.01	0.24	0.27	-27.55
2050_RCP8.5	0.00	0.18	-0.23	0.44	0.11	-0.39	-36.48	-2.83	-4.08	-0.17	0.15	0.39	-35.72
2100_RCP4.5	0.01	0.25	-0.05	0.83	1.30	1.29	-30.71	0.29	-0.93	1.08	0.36	0.62	-30.71
2100_RCP8.5	0.32	0.70	0.34	1.37	2.82	2.24	-29.09	5.16	4.82	3.95	0.69	0.97	-27.73

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	99%	105%	94%	105%	97%	95%	41%	102%	119%	100%	105%	104%	55%
2050_RCP8.5	100%	104%	96%	107%	101%	98%	40%	90%	86%	99%	103%	106%	41%
2100_RCP4.5	100%	105%	99%	114%	107%	108%	50%	101%	97%	106%	108%	110%	50%
2100_RCP8.5	109%	115%	105%	123%	116%	114%	52%	118%	117%	121%	114%	116%	55%

Source: JICA Project Team

Table 3.7.20 Future Change of Monthly Maximum Precipitation at Representative Meteorological Stations by Climate Change Scenarios (Sainshand)

Sainshand Latitude: 44.75 Longitude: 110.25 Elevation (m): 889 Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	4.23	11.42	5.33	16.49	21.17	33.39	33.90	32.42	21.60	11.69	6.41	9.34	33.90
2050_RCP4.5	4.41	11.90	5.51	13.88	18.58	39.46	36.37	38.27	19.17	10.48	6.15	9.80	39.46
2050_RCP8.5	4.42	11.79	5.43	13.89	19.90	40.93	38.77	42.05	21.15	10.44	6.02	9.66	42.05
2100_RCP4.5	4.43	12.59	5.45	14.94	21.27	40.63	46.60	41.53	21.85	10.90	6.19	10.23	46.60
2100_RCP8.5	4.67	13.11	5.81	16.26	22.56	43.50	55.85	49.01	23.15	11.36	6.63	10.76	55.85

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	0.18	0.48	0.18	-2.61	-2.59	6.07	2.47	5.85	-2.43	-1.21	-0.26	0.46	5.56
2050_RCP8.5	0.19	0.37	0.10	-2.60	-1.27	7.54	4.87	9.63	-0.45	-1.25	-0.39	0.32	8.15
2100_RCP4.5	0.20	1.17	0.12	-1.55	0.10	7.24	12.70	9.11	0.25	-0.79	-0.22	0.89	12.70
2100_RCP8.5	0.44	1.69	0.48	-0.23	1.39	10.11	21.95	16.59	1.55	-0.33	0.22	1.42	21.95

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	104%	104%	103%	84%	88%	118%	107%	118%	89%	90%	96%	105%	116%
2050_RCP8.5	104%	103%	102%	84%	94%	123%	114%	130%	98%	89%	94%	103%	124%
2100_RCP4.5	105%	110%	102%	91%	100%	122%	137%	128%	101%	93%	97%	110%	137%
2100_RCP8.5	110%	115%	109%	99%	107%	130%	165%	151%	107%	97%	103%	115%	165%

Source: JICA Project Team

Table 3.7.21 Future Change of Monthly Maximum Precipitation at Representative Meteorological Stations by Climate Change Scenario (Dashbalbar)

Dashbalbar Latitude: 49.75 Longitude: 114.25 Elevation (m): 849 Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	4.12	5.44	8.53	40.59	22.77	43.56	104.32	58.82	20.74	23.19	5.99	4.97	104.32
2050_RCP4.5	4.39	3.02	4.89	9.49	24.46	29.03	75.96	61.32	21.56	24.41	6.27	4.14	75.96
2050_RCP8.5	4.25	2.94	4.79	9.43	23.51	27.74	86.95	63.29	21.56	23.53	6.13	4.00	86.95
2100_RCP4.5	4.33	3.05	4.86	9.44	25.24	29.49	94.78	65.96	21.39	25.30	6.14	4.10	94.78
2100_RCP8.5	4.60	3.21	5.17	10.29	25.79	31.67	90.63	72.43	22.43	26.05	6.73	4.33	90.63

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2050_RCP4.5	0.27	-2.42	-3.64	-31.10	1.69	-14.53	-28.36	2.50	0.82	1.22	0.28	-0.83	-28.36
2050_RCP8.5	0.13	-2.50	-3.74	-31.16	0.74	-15.82	-17.37	4.47	0.82	0.34	0.14	-0.97	-17.37
2100_RCP4.5	0.21	-2.39	-3.67	-31.15	2.47	-14.07	-9.54	7.14	0.65	2.11	0.15	-0.87	-9.54
2100_RCP8.5	0.48	-2.23	-3.36	-30.30	3.02	-11.89	-13.69	13.61	1.69	2.86	0.74	-0.64	-13.69

Difference from Present Unit: mm/month or mm/year

Case	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Present	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2050_RCP4.5	106%	56%	57%	23%	107%	67%	73%	104%	104%	105%	105%	83%	73%
2050_RCP8.5	103%	54%	56%	23%	103%	64%	83%	108%	104%	101%	102%	80%	83%
2100_RCP4.5	105%	56%	57%	23%	111%	68%	91%	112%	103%	109%	102%	83%	91%
2100_RCP8.5	112%	59%	61%	25%	113%	73%	87%	123%	108%	112%	112%	87%	87%

Source: JICA Project Team

(6) Climate change impact on potential evapotranspiration and drought

Using mean annual temperature described in above, the potential evapotranspiration at each grid was estimated by Hamon's formula as follows.

[Hamon Potential Evapotranspiration]

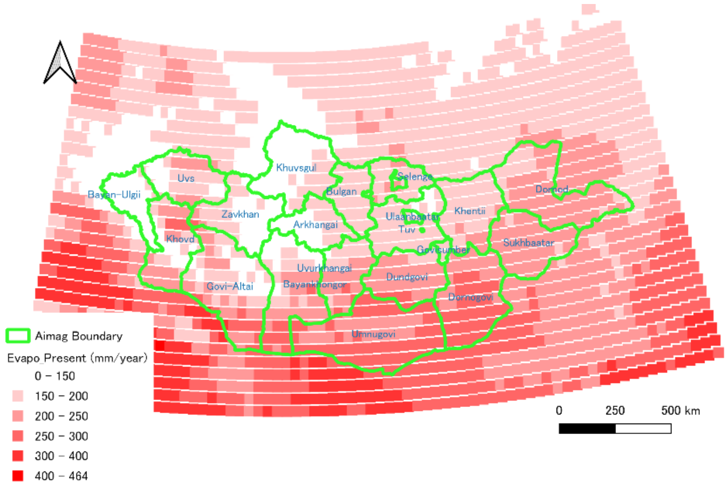
$$E_p = 0.14 \times {D_0}^2 \times P_t \qquad \text{(Eq..4)}$$

$$P_t = 216.7 \times \left(\frac{e}{273.15+t}\right)$$

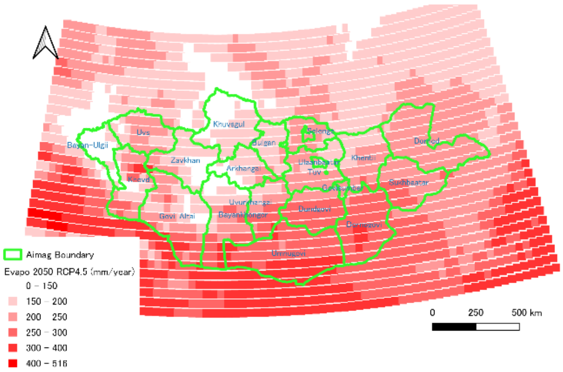
$$e_{sat} = 6.1078 \times 10^{7.5/(273.3+t)}$$

where, E_p: potential evapotranspiration [mm/day], D_0: daytime length [x/12 hours], P_t: saturated absolute humidity for daily mean temperature [g/m^3], e: water vapour pressure [hPa], t: average monthly temperature [ºC], e_{sat}: saturated water vapor pressure [hPa].

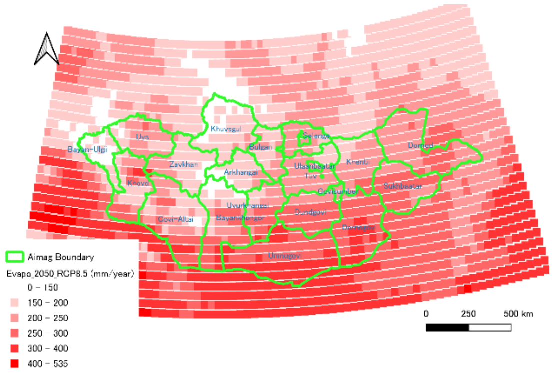
Figure 3.7.31 shows the potential evapotranspiration at each grid by climate change scenarios. At present, the potential evapotranspiration is high in the south and southeast, but 2100 shows high evapotranspiration in other areas besides the south area.



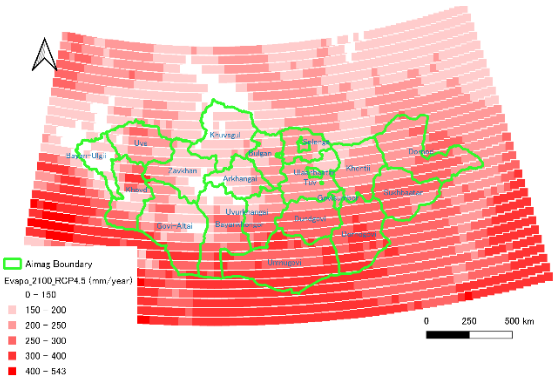
Present Condition



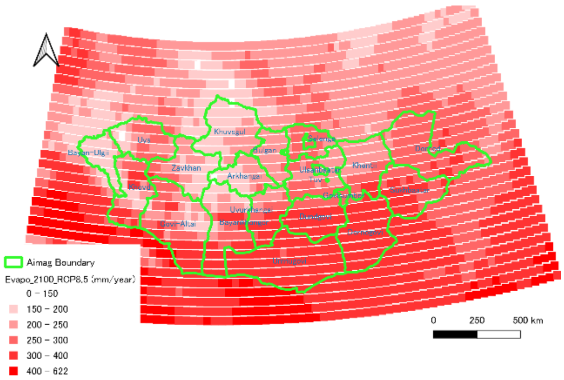
2050 RCP4.5



2050 RCP8.5



2100 RCP4.5

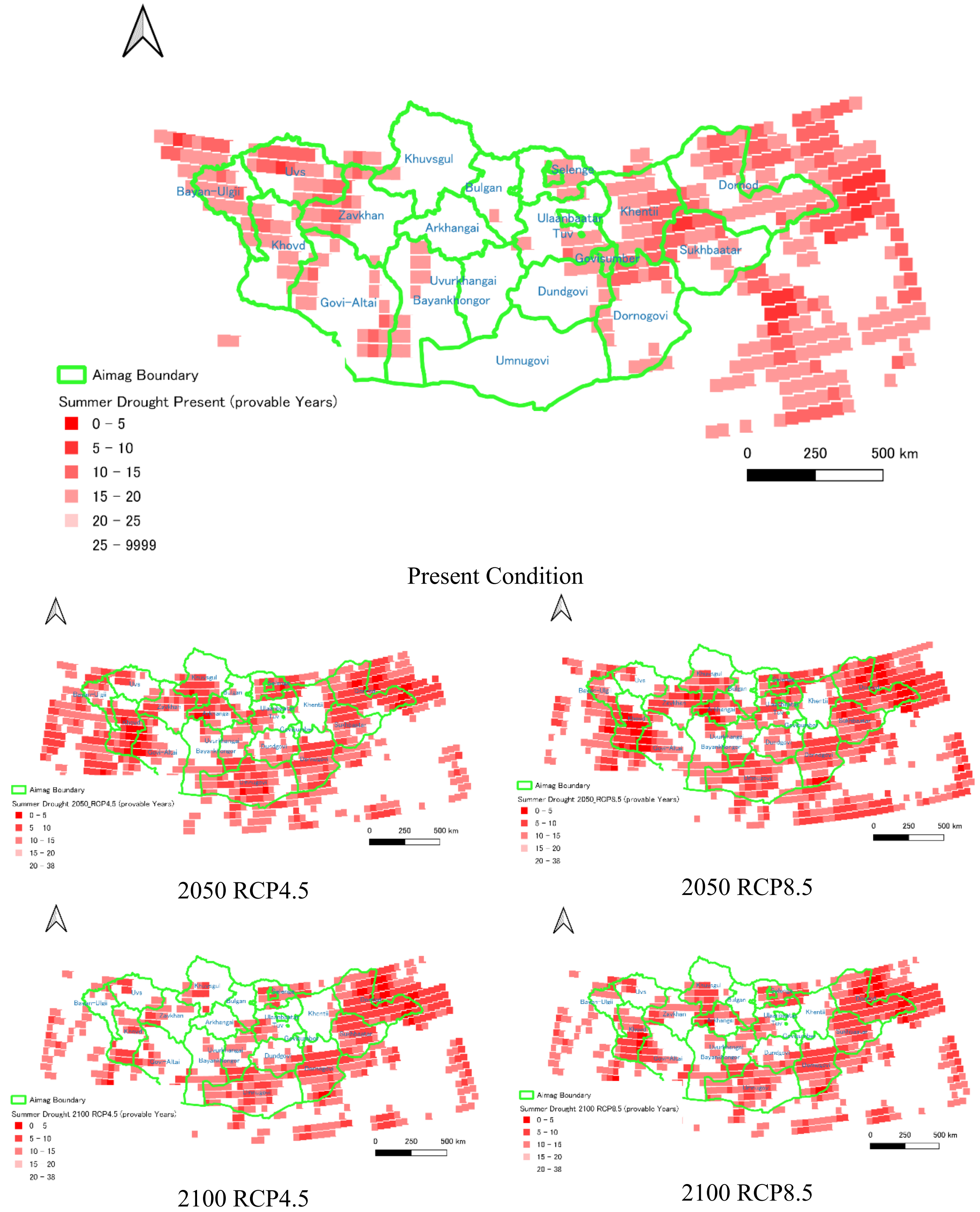


2100 RCP8.5

Source: JICA Project Team

Figure 3.7.31 Spatial Distribution of Average Annual Potential Evapotranspiration by Climate Change Scenarios

Figure 3.7.32 shows drought or dry spell provability maps in present condition and future condition by climate change scenarios. The provable drought year was estimated by using the standardized variate against the average of summer (from May to October) accumulated rainfall is less than -0.5 and the standardized variate of summer (from May to October) mean monthly temperature is more than +0.5. The area of the provable drought year will increase in south, central and eastern area in future.

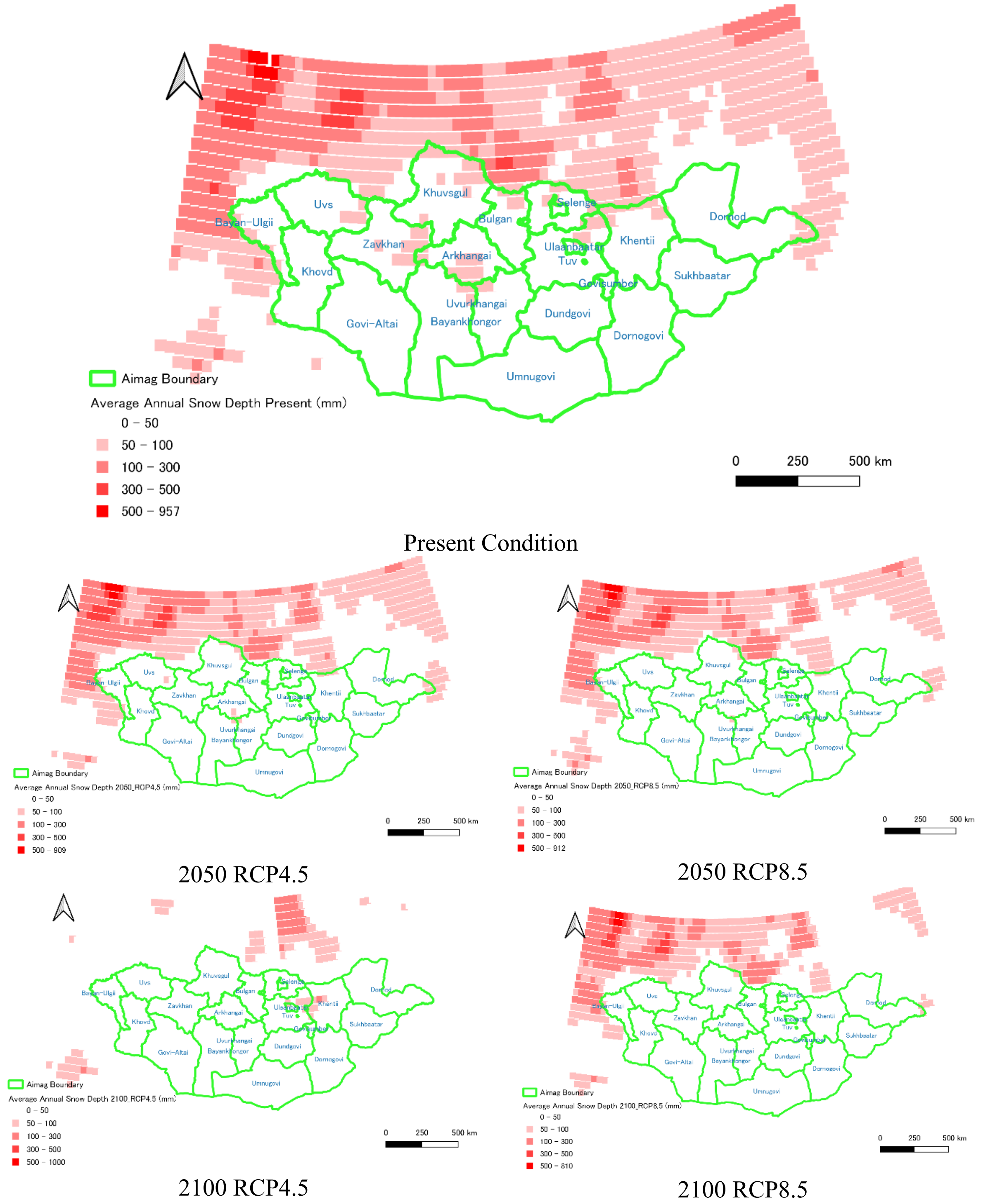


Source: JICA Project Team

Figure 3.7.32 Spatial Distribution of Drought or Dry Spell Provability by Climate Change Scenarios

(7) Climate change impact on snow depth

Figure 3.7.33 shows the map of mean annual show depth by climate change scenarios. Due to the rise in temperature by climate change, it is predicted that the amount of snowfall will decrease throughout Mongolia around 2100, and there is a risk that the amount of snowmelt will decrease from spring to summer. The amount of snowfall was calculated by integrating the amount of precipitation with an average daily temperature of 2 ° C or less.

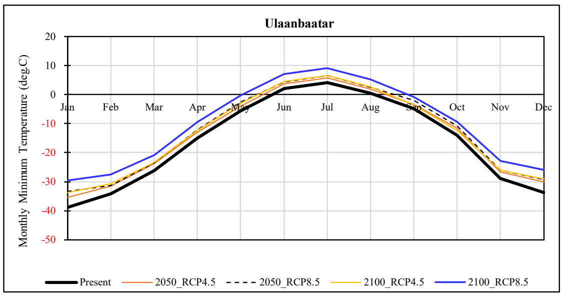


Source: JICA Project Team

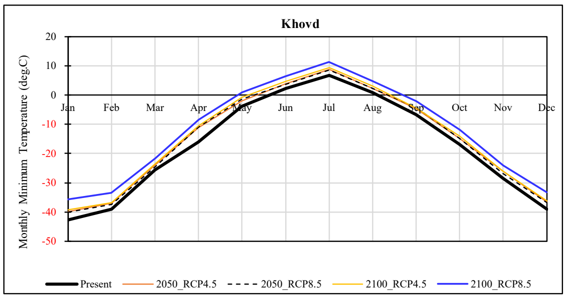
Figure 3.7.33 Spatial Distribution of Mean Annual Show Depth by Climate Change Scenarios

(8) Climate change impact on extreme minimum temperature

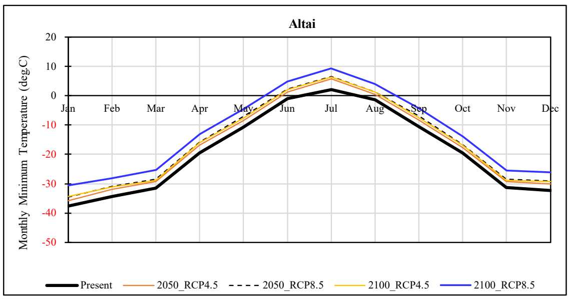
Figure 3.7.34 shows future change of monthly minimum temperature at representative meteorological stations by climate change scenarios. Due to the rising temperature by climate change, the annual minimum temperature tends to rise in whole area. Therefore, the effects of low temperature damage may be mitigated a little.



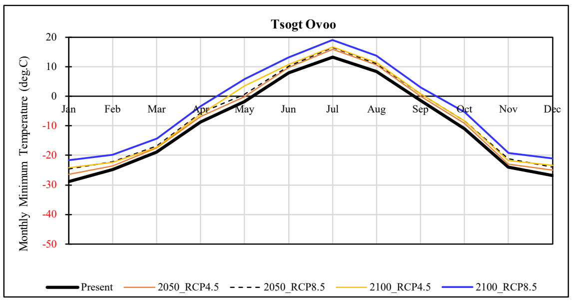
Ulaanbaatar



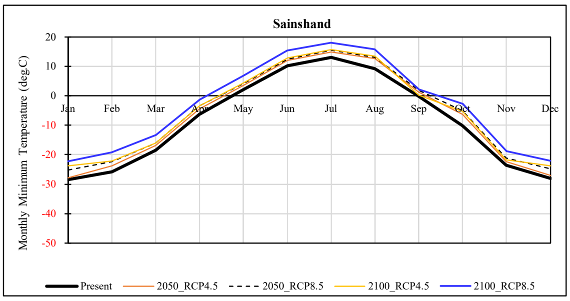
Khovd



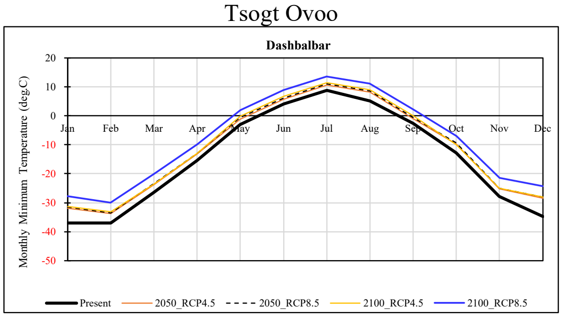
Altai



Tsogt Ovoo



Sainshand



Dashbalbar

Source: JICA Project Team

Figure 3.7.34 Future Change of Monthly Minimum Temperature at Representative Meteorological Stations by Climate Change Scenarios

Table 3.7.22 shows the 1-percentile temperature and the occurrence days and minimum temperature at representative meteorological stations by climate change scenarios. According to this table, both the minimum temperature and the 1-percentile (low temperature) tend to rise due to climate variability, and the frequency of occurrence during the year is also decreasing.

Table 3.7.22 1-Percentile Temperature and the Occurrence Days and Minimum Temperature at Representative Meteorological Stations by Climate Change Scenarios

Ulaanbaatar

Ulaanbaatar	Unit: deg.C	Unit:days	Unit: deg.C
Case	1%Tile Value	Over 1%Tail Days	Minimum Teperature
Present	-28.99	3.63	-38.92
2050_RCP4.5	-26.64	1.24	-35.39
2050_RCP8.5	-25.99	0.64	-33.27
2100_RCP4.5	-25.92	0.52	-33.86
2100_RCP8.5	-22.92	0.04	-29.64

Khovd

Khovd	Unit: deg.C	Unit:days	Unit: deg.C
Case	1%Tile Value	Over 1%Tail Days	Minimum Teperature
Present	-31.25	3.63	-42.66
2050_RCP4.5	-29.90	2.48	-39.84
2050_RCP8.5	-30.55	3.08	-40.03
2100_RCP4.5	-29.57	2.24	-39.19
2100_RCP8.5	-27.20	1.12	-35.75

Altai

Altai	Unit: deg.C	Unit:days	Unit: deg.C
Case	1%Tile Value	Over 1%Tail Days	Minimum Teperature
Present	-28.02	3.63	-37.70
2050_RCP4.5	-26.11	2.00	-35.86
2050_RCP8.5	-25.67	1.44	-34.53
2100_RCP4.5	-25.66	1.76	-34.35
2100_RCP8.5	-22.79	0.12	-30.65

Tsogt Ovoo

Tsogt Ovoo	Unit: deg.C	Unit:days	Unit: deg.C
Case	1%Tile Value	Over 1%Tail Days	Minimum Teperature
Present	-21.29	3.63	-28.87
2050_RCP4.5	-19.95	2.04	-26.47
2050_RCP8.5	-18.73	0.80	-24.64
2100_RCP4.5	-19.16	1.12	-24.16
2100_RCP8.5	-16.54	0.08	-21.61

Sainshand

Sainshand	Unit: deg.C	Unit:days	Unit: deg.C
Case	1%Tile Value	Over 1%Tail Days	Minimum Teperature
Present	-22.87	3.63	-28.44
2050_RCP4.5	-21.85	2.12	-27.92
2050_RCP8.5	-20.72	0.72	-25.17
2100_RCP4.5	-20.68	0.40	-23.85
2100_RCP8.5	-17.59	0.00	-22.33

Dashbalbar

Dashbalbar	Unit: deg.C	Unit:days	Unit: deg.C
Case	1%Tile Value	Over 1%Tail Days	Minimum Teperature
Present	-29.54	3.66	-37.01
2050_RCP4.5	-26.26	0.52	-33.78
2050_RCP8.5	-25.91	0.44	-33.46
2100_RCP4.5	-26.00	0.36	-33.23
2100_RCP8.5	-22.09	0.04	-29.93

Source: JICA Project Team

(9) Climate change impact on extreme meteorological disaster (Dzud)

According to Wikipedia, a Zud or Dzud is a Mongolian term for a severe winter in which large number of livestock die, primarily due to starvation due to being unable to graze, in other cases directly from the cold. There are various kinds of Dzud, including white Dzud, which is an extremely snowy winter in which livestock are unable to find nourishing foodstuff through the snow cover and starve. One-third of Mongolia's population depends entirely on pastoral farming for its livelihood, and harsh Dzuds can cause economic crises and food security issues in the country. This natural disaster is unique to Mongolia[82].

There are different types of Dzud:

- Tsagaan (white) Dzud results from high snowfall that prevents livestock from reaching the grass[83]. It is a frequent and serious disaster that has caused a great number of deaths[84].
- Khar (black) Dzud results from a lack of snow in grazing areas, leading to both animals and humans to suffer a lack of water. This type of Dzud does not occur every year nor does it affect large areas. It mostly happens in the Gobi Desert region.[13]
- Tumer (iron) Dzud results from a short wintertime warming, followed by a return to sub-freezing temperatures. The snow melts and then freezes again, creating an impenetrable ice-cover that prevents livestock from grazing. [13]
- Khuiten (cold) Dzud occurs when temperature drops to very low levels for several days. The cold temperature and the strong winds prevent livestock from grazing; the animals have to use most of their energy to keep warm. [13]
- Khavsarsan (combined) Dzud is a combination of at least two of the above types of Dzud. [13]

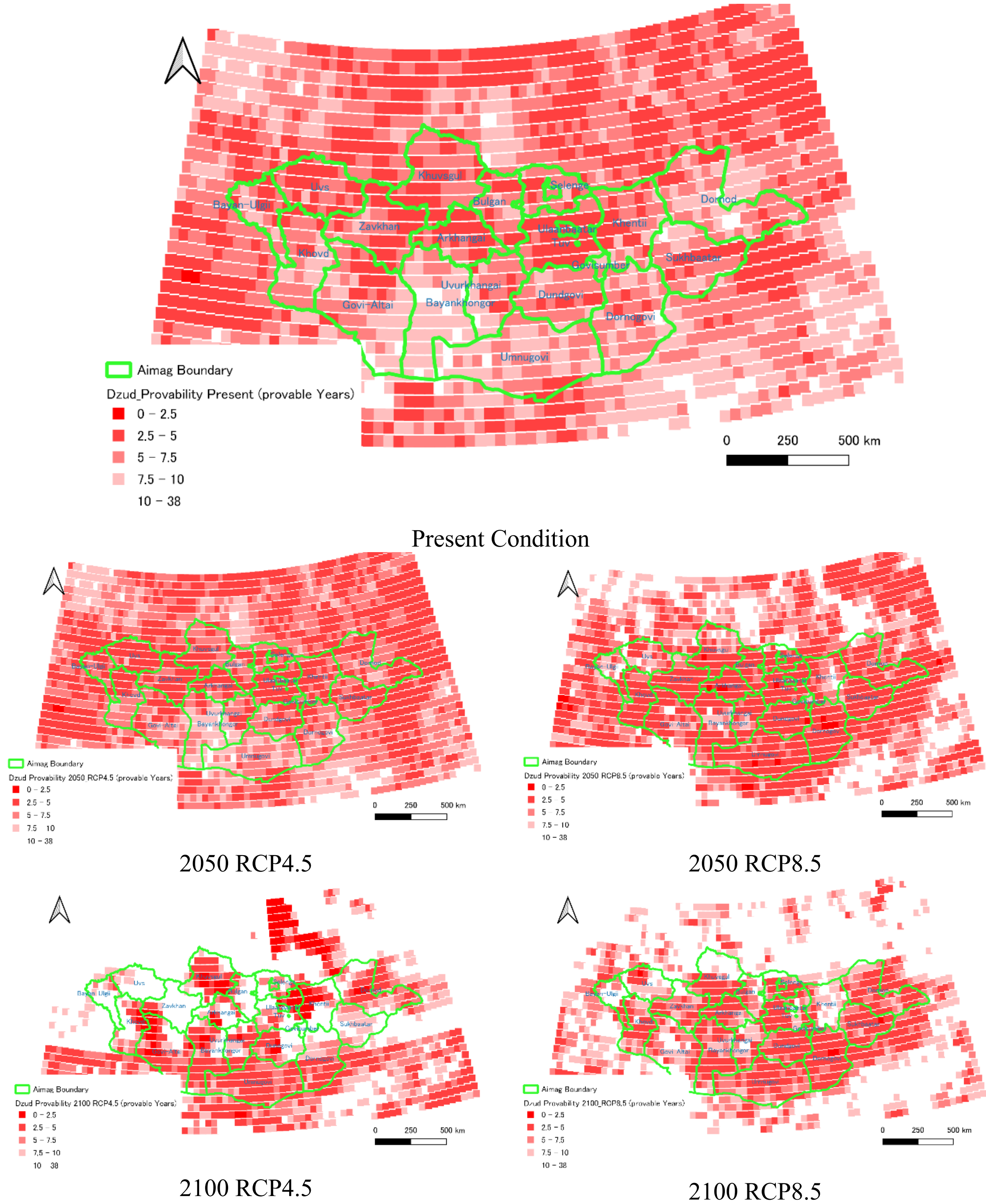
In this study, the Dzud occurrence was evaluated by using the standardized variates as follows:

➢ The standardized variates against the average of previous summer season (from May to October) accumulated rainfall is less than -0.5 and the standardized variate of summer (from May to October) mean monthly temperature is more than +0.5.

[82] https://en.wikipedia.org/wiki/Zud
[83] Neil Leary (2008). Climate Change and Vulnerability. The International STAT Secretariat. p. 76. ISBN 9781849770804.
[84] J.M. Suttie; Stephen G. Reynolds; Caterina Batello (2005). Grasslands of the World. Food and Agriculture Organization of the United Nations. p. 293

- The standardized variates against the average of winter temperature are less than -2.0.
- The standardized variates against the average of accumulated winter snow depth are more than 2.0.
- The standardized variates against the average of spring precipitation are less than -2.0.

Figure 3.7.35 shows the Dzud provability year maps of present condition and by the climate change. The provable Dzud year will be decrease in future, but in south, central and eastern area which Gobi area will still have risk of Dzud in future.



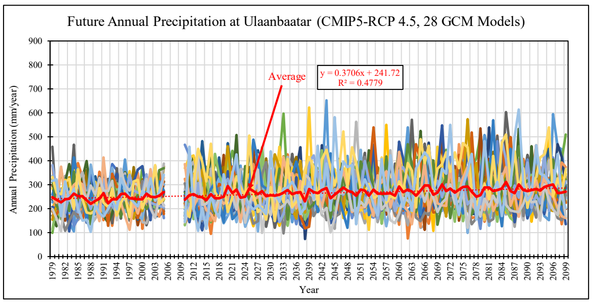
Source: JICA Project Team

Figure 3.7.35 Spatial Distribution of Provability Year of Dzud Disaster by Climate Change Scenarios

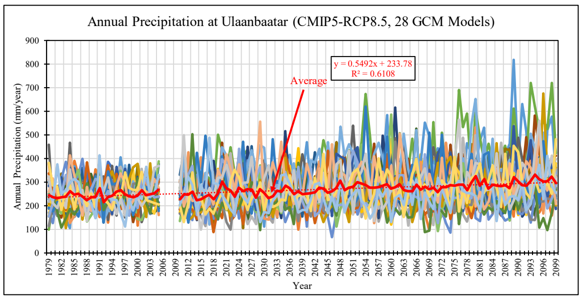
3.7.6 Climate change impact in Ulaanbaatar

(1) Climate change impact on precipitation in Ulaanbaatar

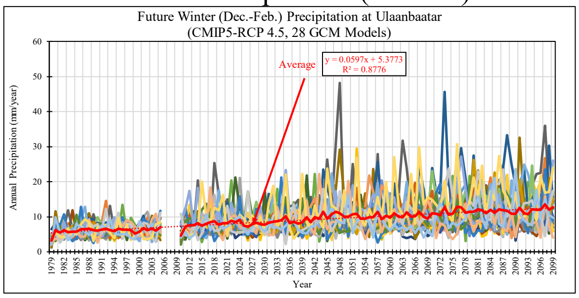
Figure 3.7.36 shows historical and future trend of precipitation in Ulaanbaatar by climate change scenarios of 28-GCMs. According to these figures, the precipitation in winter will be increased in future in Ulaanbaatar, however, precipitation in summer will be thought that it will not change much.



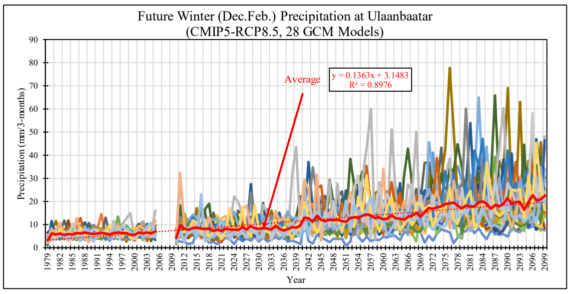
Annual Precipitation (RCP4.5)



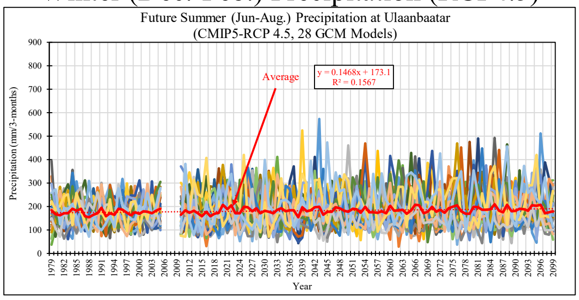
Annual Precipitation (RCP8.5)



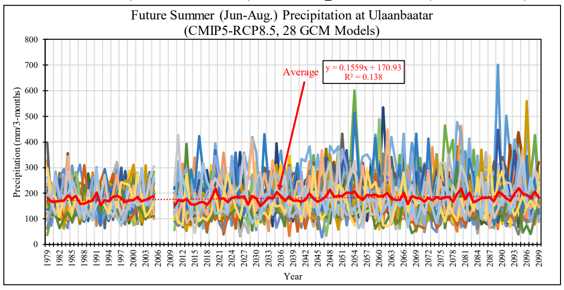
Winter (Dec.-Feb.) Precipitation (RCP4.5)



Winter (Dec.-Feb.) Precipitation (RCP8.5)



Summer (Jun-Aug.) Precipitation (RCP4.5)

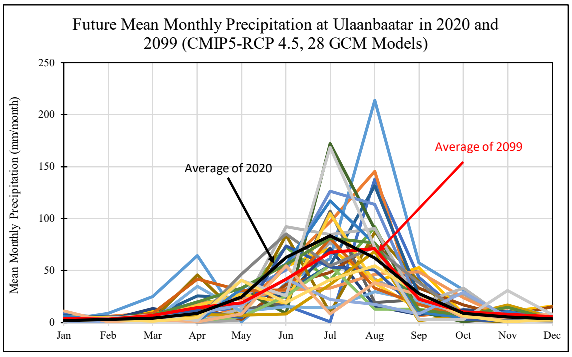


Summer (Jun-Aug.) Precipitation (RCP8.5)

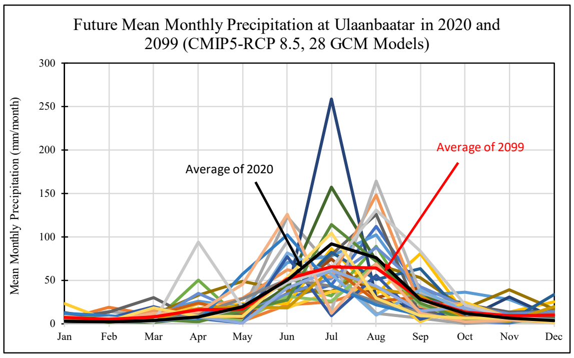
Source: Prepared by JICA Project Team based on Nippon Koei ClimVault bata (https://nk-climvault.com/)

Figure 3.7.36 Future Trend of Precipitation in Ulaanbaatar by Climate Change Scenarios

The comparison of monthly precipitation in future (2099) and present (2020) at Ulaanbaatar is shown in Figure 3.7.37. Monthly precipitation in summer will be decreased in 2099.



Monthly Precipitation (RCP4.5)



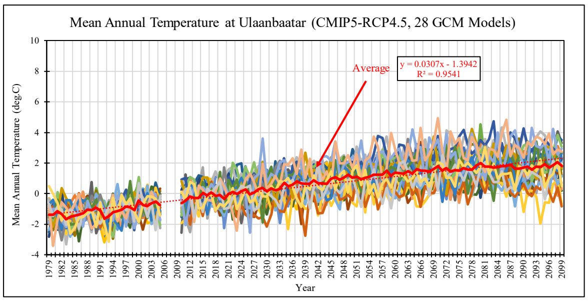
Monthly Precipitation (RCP8.5)

Source: Prepared by JICA Project Team based on Nippon Koei ClimVault bata (https://nk-climvault.com/)

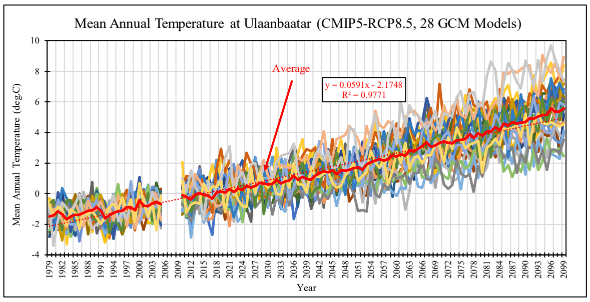
Figure 3.7.37 Future Mean Monthly Precipitation in Ulaanbaatar by Climate Change Scenarios

(2) Climate change impact on temperature in Ulaanbaatar

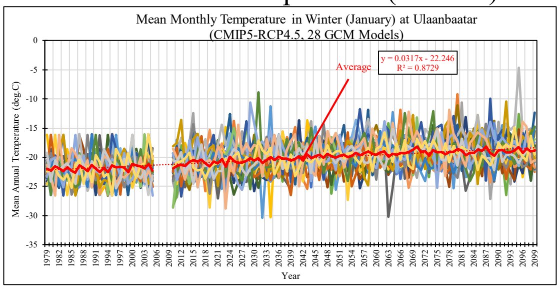
Figure 3.7.38 shows historical and future trend of temperature in Ulaanbaatar by climate change scenarios of 28-GCMs. According to these figures, the mean annual and mean monthly temperature will be increased significantly in future in Ulaanbaatar.



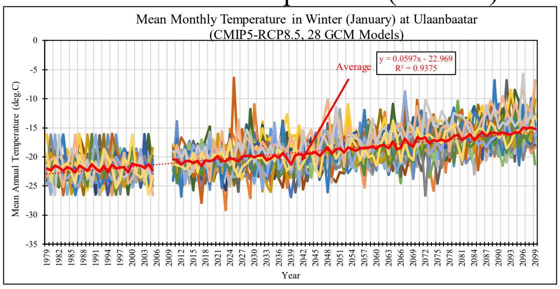
Mean Annual Temperature (RCP4.5)



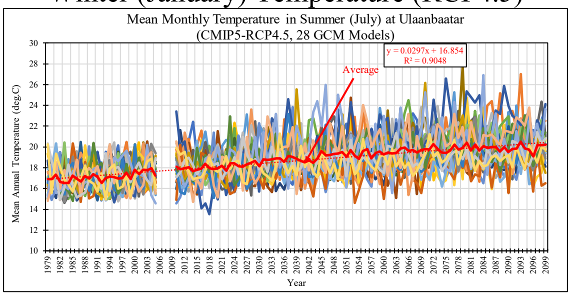
Mean Annual Temperature (RCP8.5)



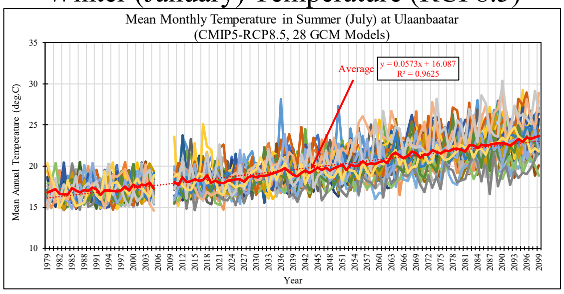
Winter (January) Temperature (RCP4.5)



Winter (January) Temperature (RCP8.5)



Summer (July) Temperature (RCP4.5)

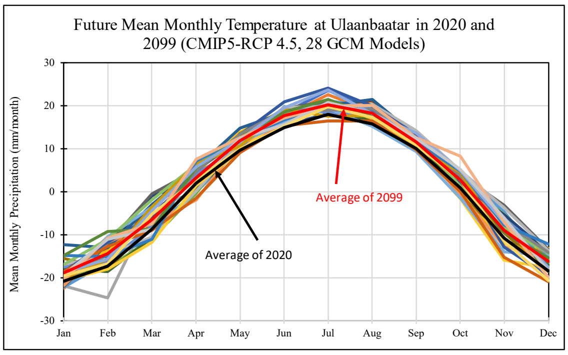


Summer (July) Temperature (RCP8.5)

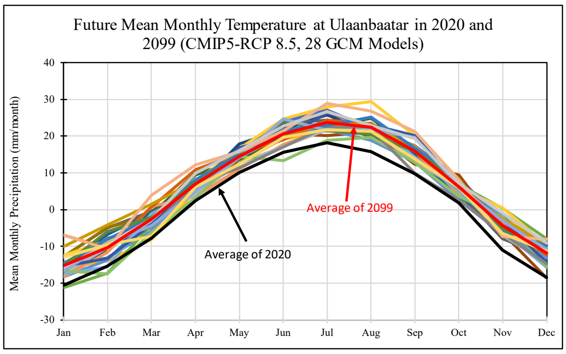
Source: Prepared by JICA Project Team based on Nippon Koei ClimVault bata (https://nk-climvault.com/)

Figure 3.7.38 Future Trend of Temperature in Ulaanbaatar by Climate Change Scenarios

The comparison of mean monthly temperature in future (2099) and present (2020) at Ulaanbaatar is shown in Figure 3.7.39. Mean monthly temperature will be increased significantly in 2099.



Mean Monthly Temperature (RCP4.5)



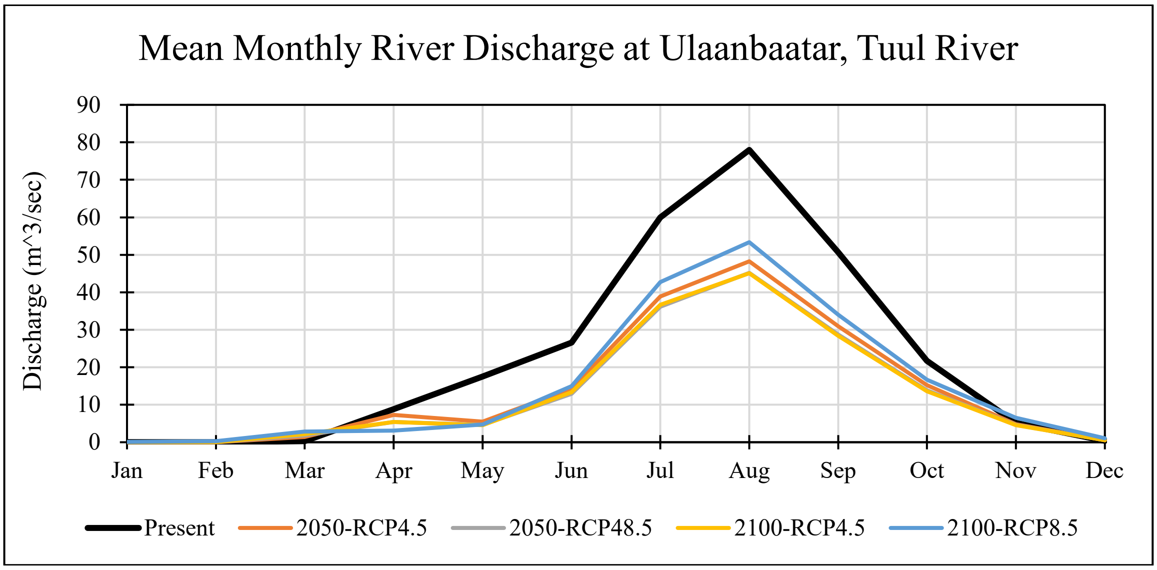
Mean Monthly Temperature (RCP8.5)

Source: Prepared by JICA Project Team based on Nippon Koei ClimVault bata (https://nk-climvault.com/)

Figure 3.7.39 Future Mean Monthly Temperature in Ulaanbaatar by Climate Change Scenarios

(3) Climate change impact on river flow (surface water potential) in Ulaanbaatar

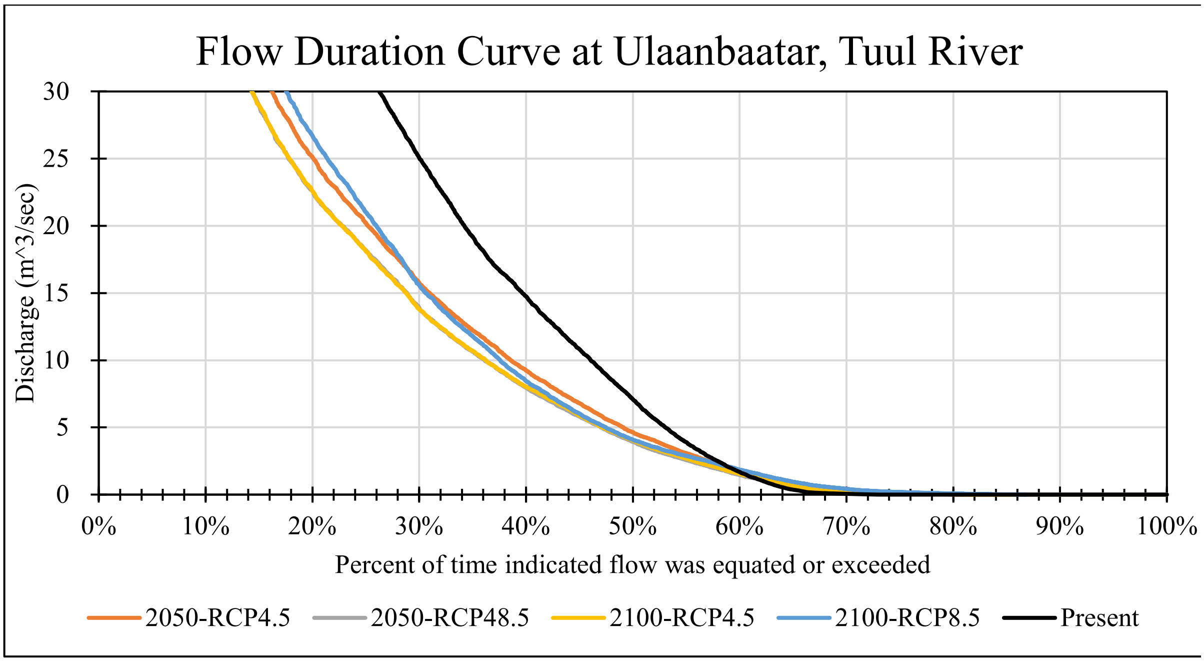
Using projected future precipitation and temperature, the daily and monthly mean discharge were simulated by the Tank Model. Figure 3.7.40 shows the results of mean monthly discharge at Ulaanbaatar, Tuul River basin. It was predicted that river flow would decrease from April to October due to the rise in temperature (increased evapotranspiration) due to climate change and the amount of rainfall that did not change much.



Source: JICA Project Team

Figure 3.7.40 Future Mean Monthly Discharge in Ulaanbaatar, Tuul River, by Climate Change Scenarios

Figure 3.7.41 shows the flow duration curve at Ulaanbaatar (Tuul River) prepared by the results of daily simulation by the Tank Model. In this figure, river flow less than about 60% of year (60% of time indicated flow was equated or exceeded) will be decreased in future condition compared with present condition. The river flow in dry (winter) season will be not changed significantly.



Source: JICA Project Team

Figure 3.7.41 Future Flow Duration Curve at Ulaanbaatar, Tuul River, by Climate Change Scenarios

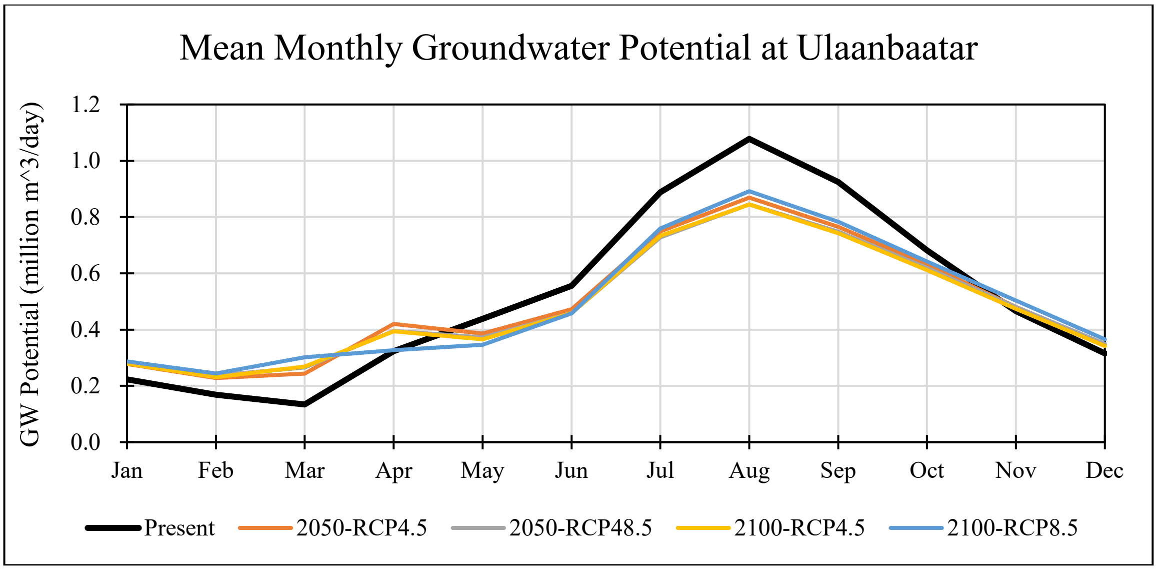
Table 3.7.23 Flow Duration at Ulaanbaatar, Tuul River in Present and Future Condition

Duration %	Discharge					Difference of Discharge				
	Present	2050-RCP4.5	2050-RCP48.5	2100-RCP4.5	2100-RCP8.5	Present	2050-RCP4.5	2050-RCP48.5	2100-RCP4.5	2100-RCP8.5
	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s
5%	92.804	58.493	54.704	54.743	64.584	0.000	-34.310	-38.100	-38.061	-28.220
10%	68.312	41.527	38.387	38.396	45.282	0.000	-26.785	-29.925	-29.916	-23.030
15%	52.099	31.806	28.952	28.999	34.337	0.000	-20.293	-23.147	-23.100	-17.762
20%	40.394	25.144	22.598	22.598	26.709	0.000	-15.250	-17.796	-17.796	-13.685
25%	31.999	20.227	18.182	18.124	21.026	0.000	-11.772	-13.817	-13.875	-10.973
30%	25.072	15.787	13.927	13.791	15.600	0.000	-9.286	-11.145	-11.281	-9.473
35%	19.199	12.219	10.639	10.686	11.776	0.000	-6.979	-8.560	-8.512	-7.423
40%	14.760	9.243	7.971	8.026	8.460	0.000	-5.518	-6.790	-6.735	-6.300
45%	10.821	6.813	5.827	5.889	6.033	0.000	-4.007	-4.994	-4.932	-4.788
50%	7.092	4.647	3.932	4.030	4.081	0.000	-2.445	-3.161	-3.062	-3.011
55%	3.899	3.079	2.580	2.685	2.891	0.000	-0.820	-1.319	-1.213	-1.008
60%	1.688	1.729	1.464	1.551	1.854	0.000	0.041	-0.224	-0.137	0.166
65%	0.365	0.685	0.598	0.650	0.955	0.000	0.320	0.233	0.285	0.589
70%	0.058	0.192	0.199	0.211	0.422	0.000	0.134	0.141	0.153	0.364
75%	0.000	0.078	0.083	0.091	0.187	0.000	0.078	0.083	0.091	0.187
80%	0.000	0.008	0.015	0.020	0.080	0.000	0.008	0.015	0.020	0.080
85%	0.000	0.000	0.000	0.000	0.015	0.000	0.000	0.000	0.000	0.015
90%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: JICA Project Team

(4) Climate change impact on groundwater potential in Ulaanbaatar

Using results of daily percolation from the Tank Model, the groundwater potentials were simulated by Darcy's Law GW Model as shown in Figure 3.7.42. The groundwater potential in the winter season from November to April will be slightly improved. In the summer season from May to October, the groundwater potentials will be slightly decreased in future.



Source: JICA Project Team

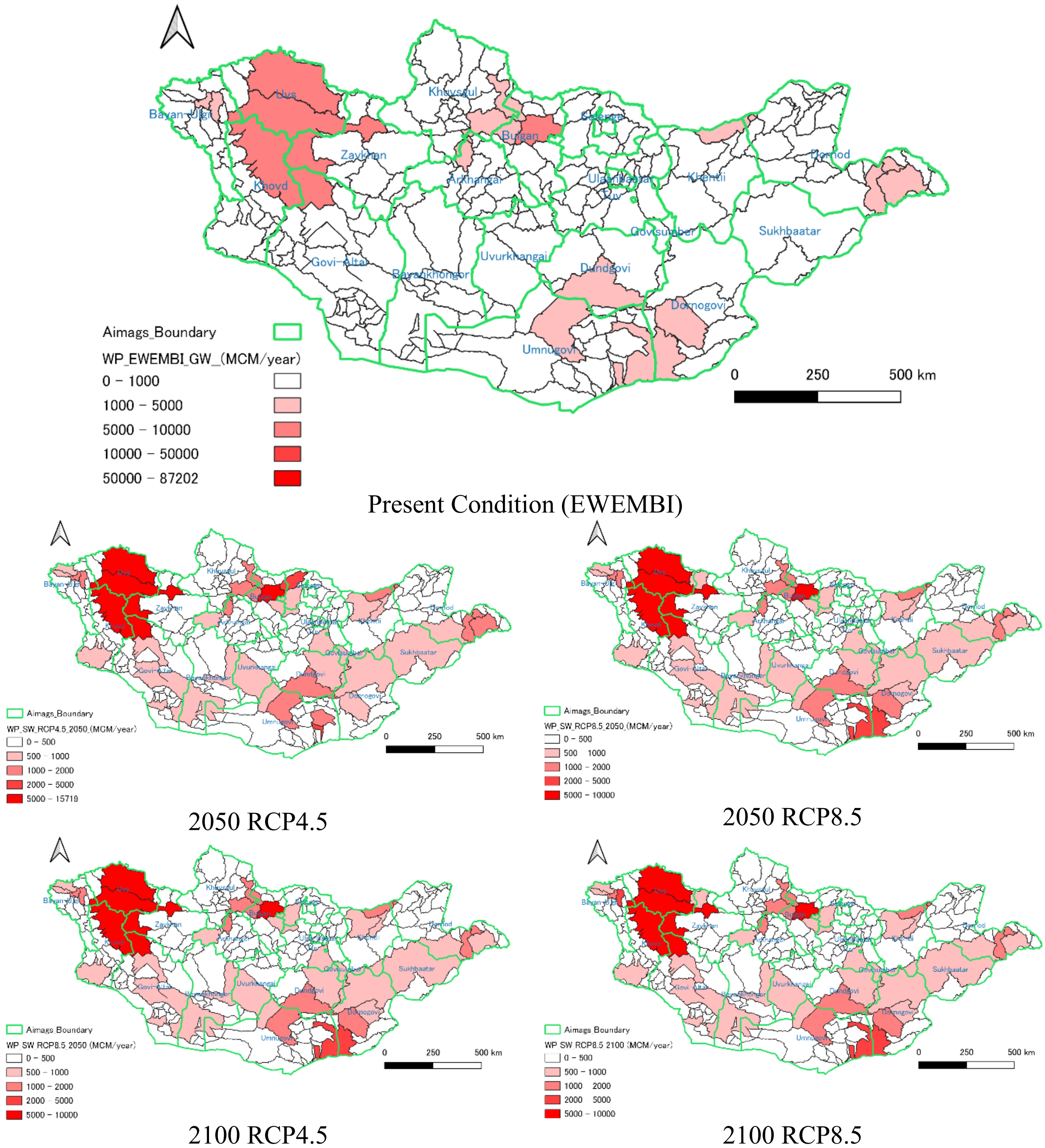
Figure 3.7.42 Future Mean Monthly Groundwater Potentials at Ulaanbaatar by Climate Change Scenarios

3.7.7 Climate change impact for water balance

(1) Water potential

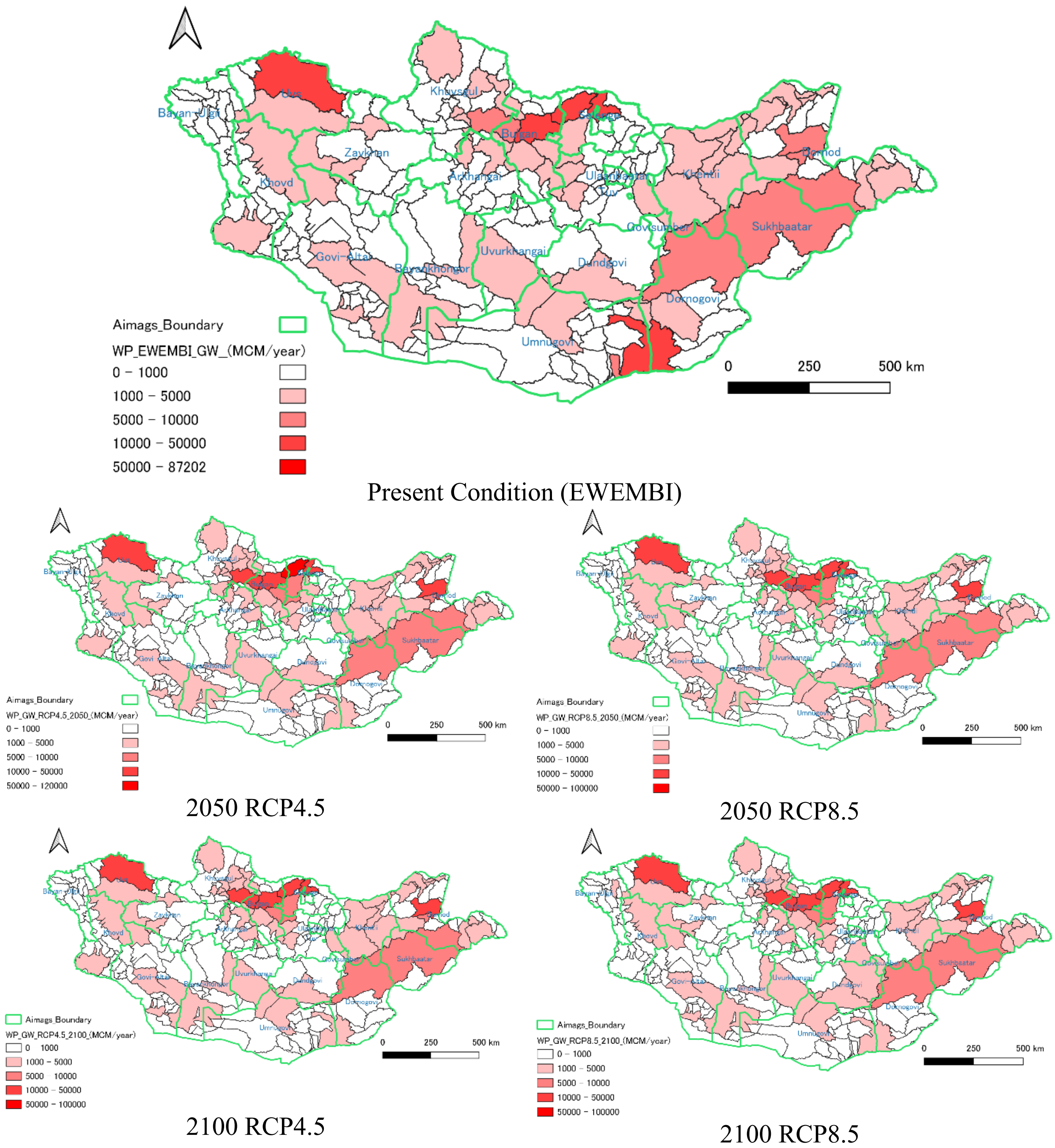
Using the estimated present and future climate condition i.e. daily precipitation and daily temperature, surface water potentials by sub-basins and the Soum are simulated by using the calibrated Tank Model. The groundwater potentials were also simulated by using percolation from the Tank Model and Darcy's

Law GW Model. Figure 3.7.43 and Figure 3.7.44 shows the surface water and groundwater potential by sub-basin. High surface water potential area lies in north-western part, central part and south-east part. While, high groundwater potential area lies in north-western part, central part and eastern part.



Source: JICA Project Team

Figure 3.7.43 Surface Water Potential Map by Sub-basins by Climate Change Scenarios



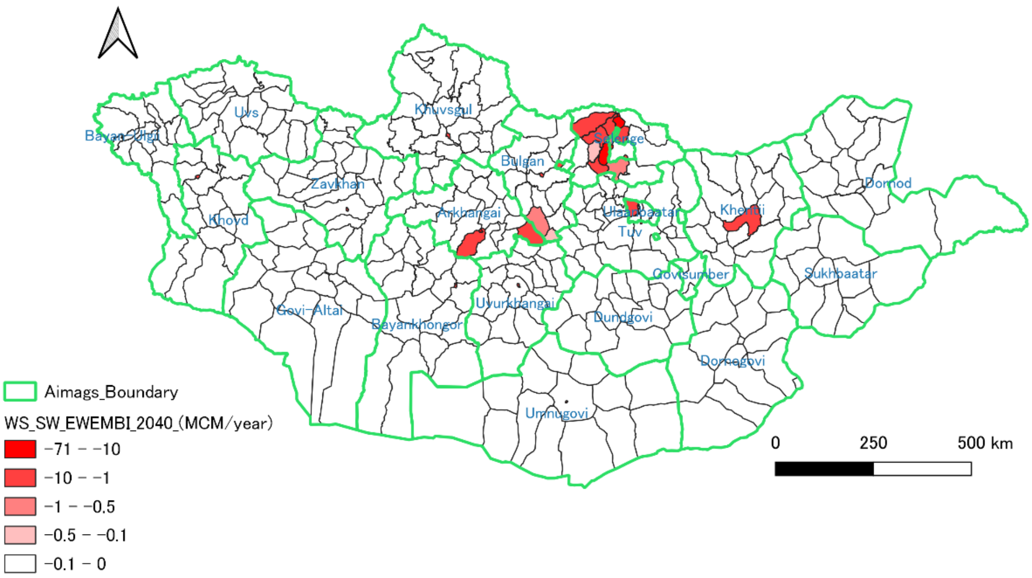
Source: JICA Project Team

Figure 3.7.44 Groundwater Potential Map by Sub-basins by Climate Change Scenarios

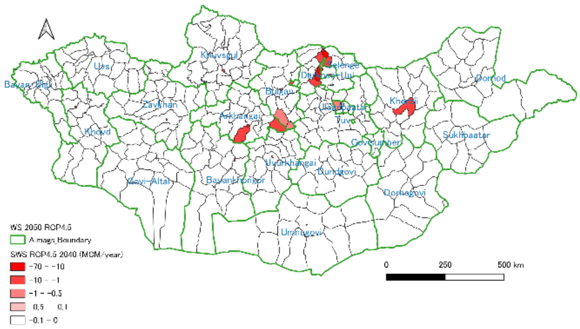
(2) Water balance analysis by Soum

Using estimated water demand in 2030 and 2040 as mentioned above, water potentials at present condition (reanalysis data of EWEMBI) and future water potentials were applied for calculation of water balance analysis. Figure 3.7.45 to Figure 3.7.48 and Figure 3.7.49 to Figure 3.7.53 shows water shortage occurred Soums. Table 3.7.24 to Table 3.7.28 shows the water balance by Soum level. Table 3.7.29 to Table 3.7.33 shows the water balance by Aimag level.

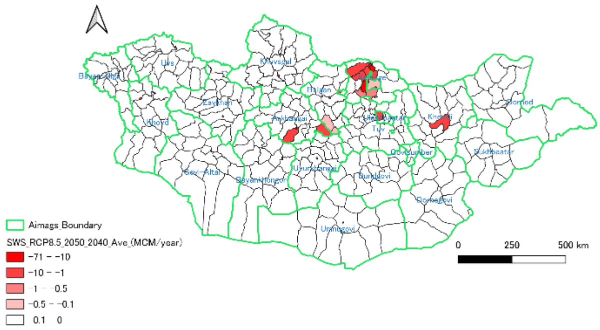
Water shortage is not noticeable at the Aimag level, but there are some Soums that can cause serious water shortage at the Soum level. Water shortages are expected to be severe in these Soums during the dry season, and in areas that rely on groundwater, some measures are needed if there is a shortage of groundwater.



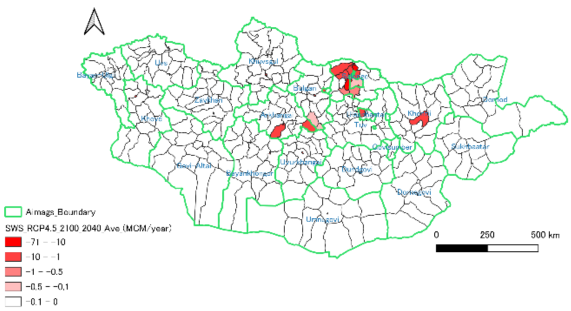
Present Condition (EWEMBI)



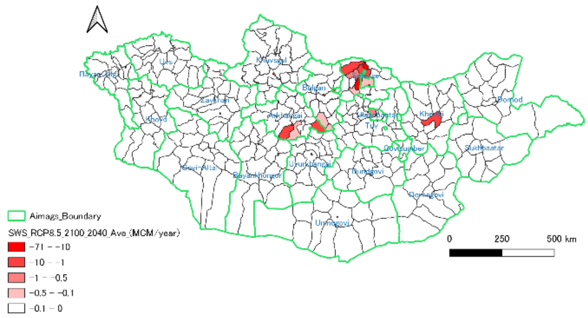
2050 RCP4.5



2050 RCP8.5



2100 RCP4.5

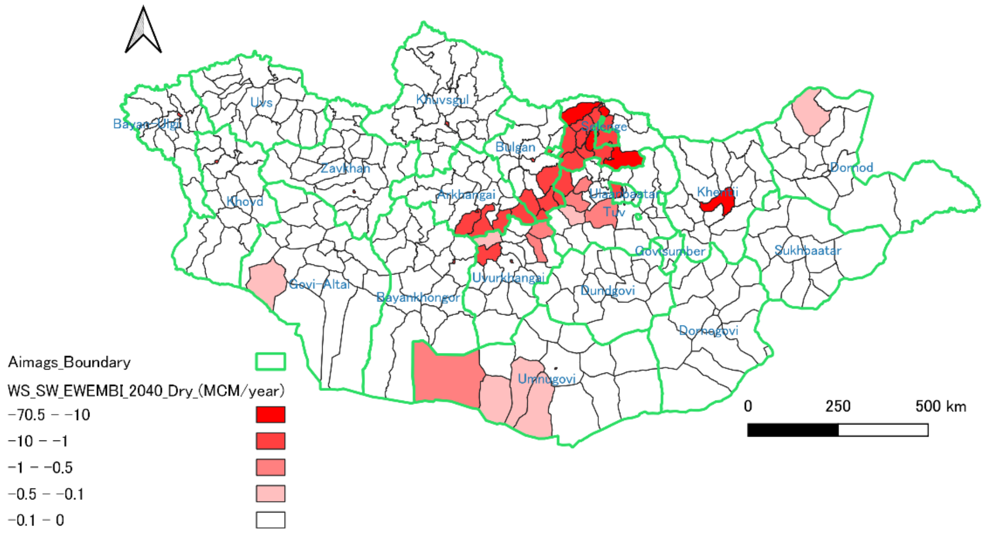


2100 RCP8.5

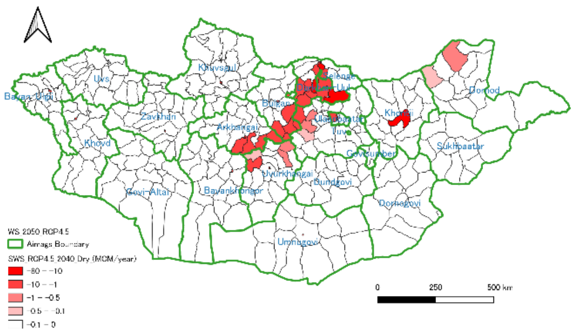
Source: JICA Project Team

Figure 3.7.45 Surface Water Shortage in 2040 Demand by Soum (Average Year) by Climate Change Scenarios

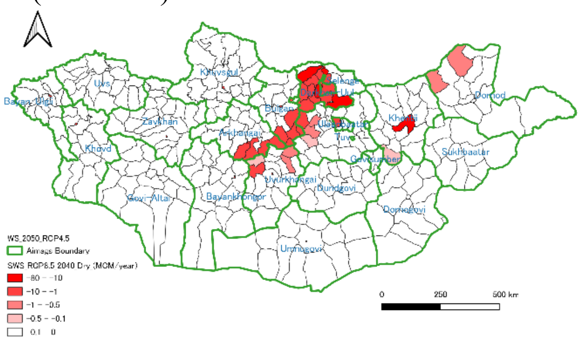
The surface water shortage in 2040 water demand at average year will be occurred in some Soums in Ulaanbaatar, Selenge, Darkhan-Uul, Khentii, Bulgan and Arkhangai Aimags as shown in Figure 3.7.45.



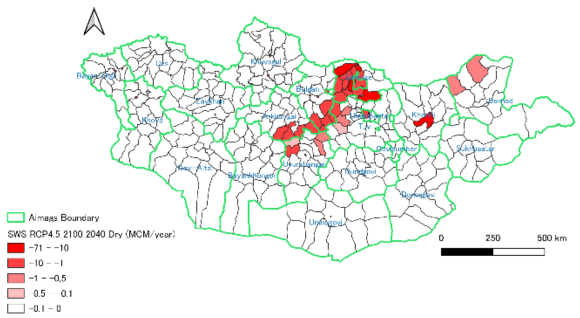
Present Condition (EWEMBI)



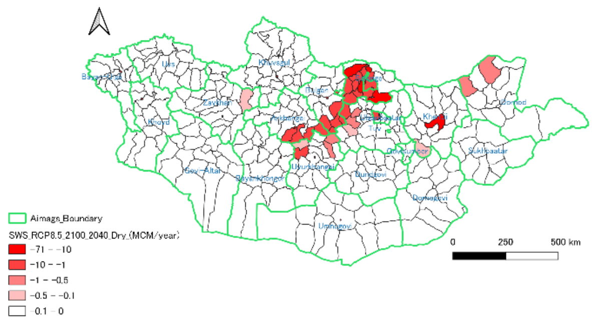
2050 RCP4.5



2050 RCP8.5



2100 RCP4.5

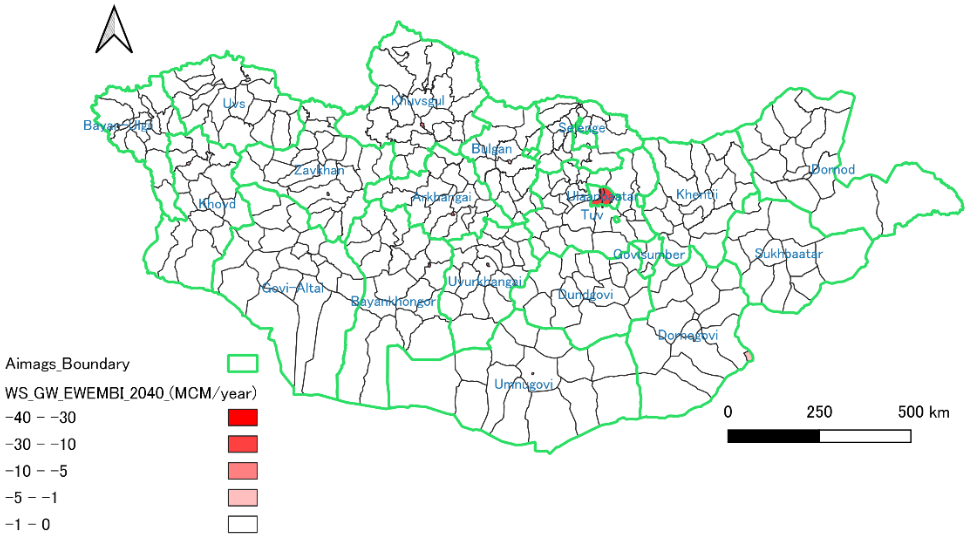


2100 RCP8.5

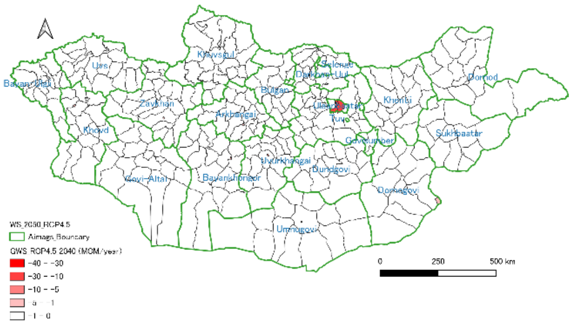
Source: JICA Project Team

Figure 3.7.46 Surface Water Shortage in 2040 Demand by Soum (Dry Year) by Climate Change Scenarios

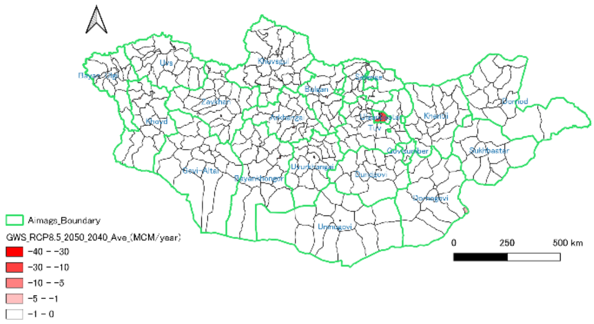
The surface water shortage in 2040 water demand at dry year will be occurred in some Soums in Ulaanbaatar, Selenge, Darkhan-Uul, Khentii, Bulgan, Uvurkhangai, Dornod and Arkhangai Aimags as shown in Figure 3.7.46.



Present Condition (EWEMBI)

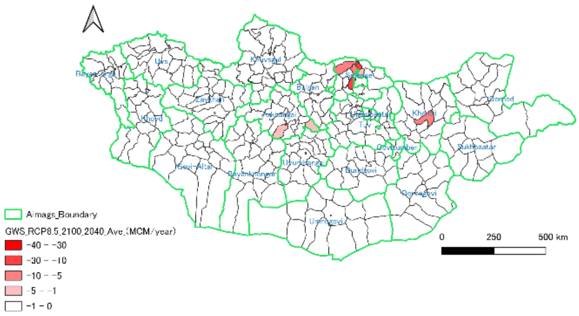


2050 RCP4.5



2050 RCP8.5

2100 RCP4.5

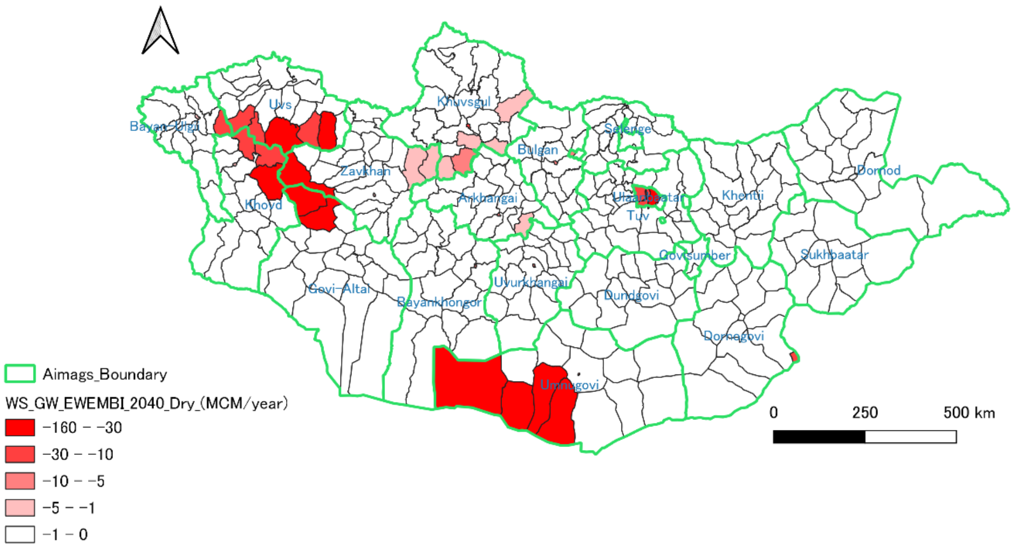


2100 RCP8.5

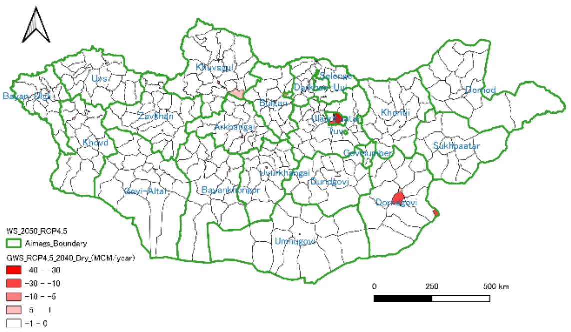
Source: JICA Project Team

Figure 3.7.47 Groundwater Shortage in 2040 Demand by Soum (Average Year) by Climate Change Scenarios

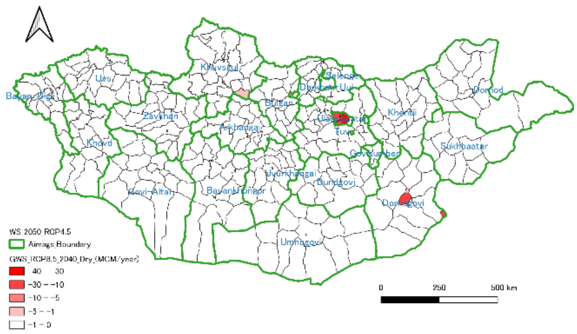
The groundwater shortage in 2040 water demand at average year will be occurred in some Soums in Ulaanbaatar, Arkhangai, Uvurkhangai, Dornogovi, Khentii and Umnugovi Aimags as shown in Figure 3.7.47. In general, average year condition, the volume of groundwater shortage will not so high.



Present Condition (EWEMBI)

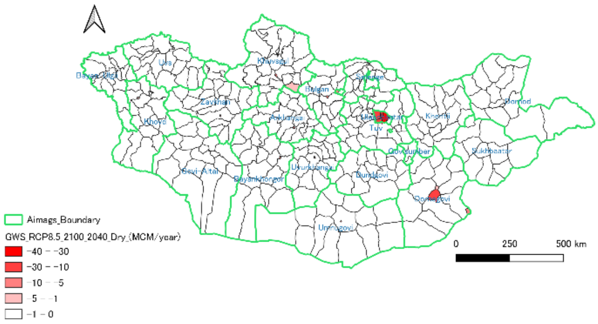


2050 RCP4.5



2050 RCP8.5

2100 RCP4.5

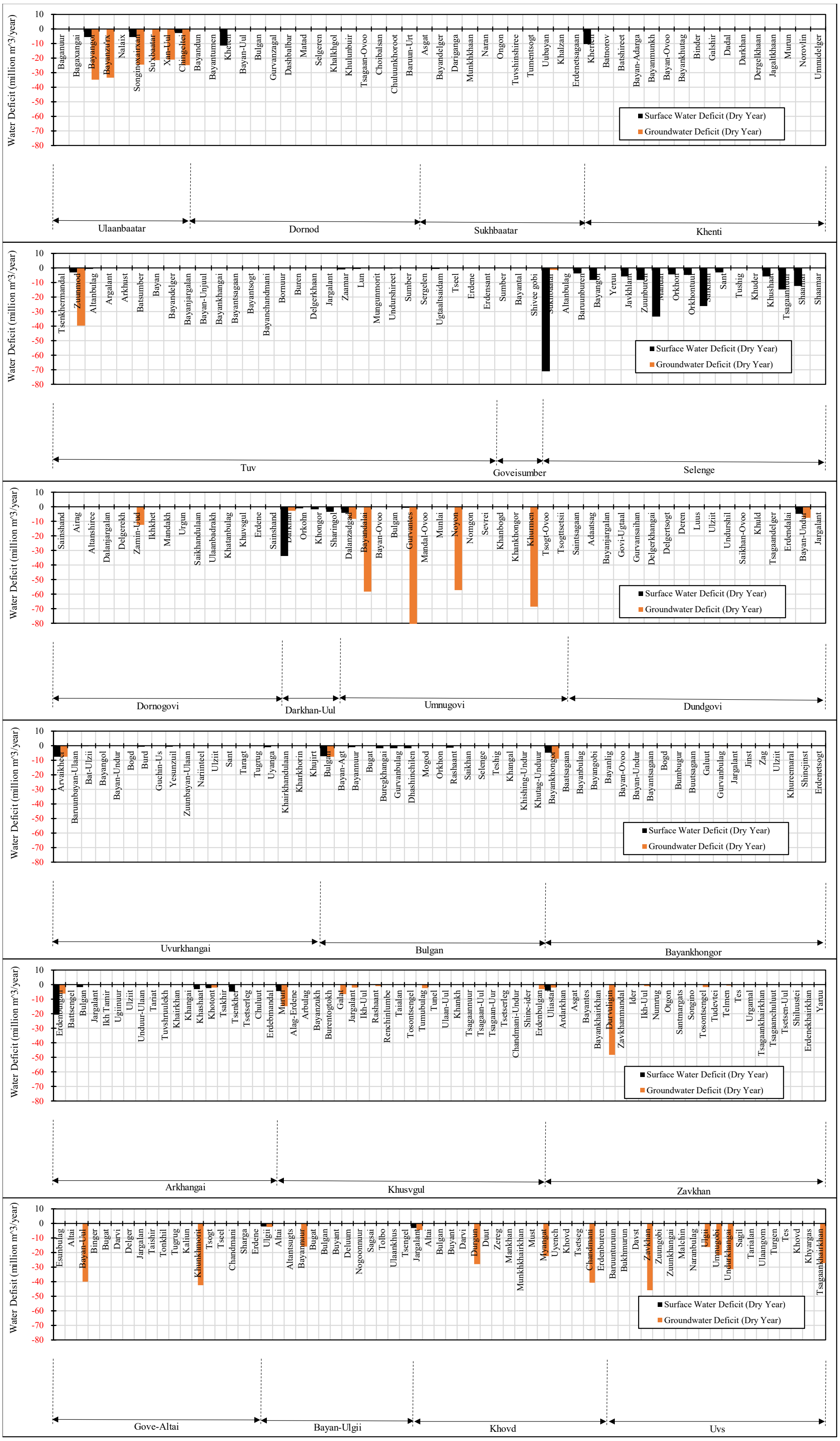


2100 RCP8.5

Source: JICA Project Team

Figure 3.7.48 Groundwater Shortage in 2040 Demand by Soum (Dry Year) by Climate Change Scenarios

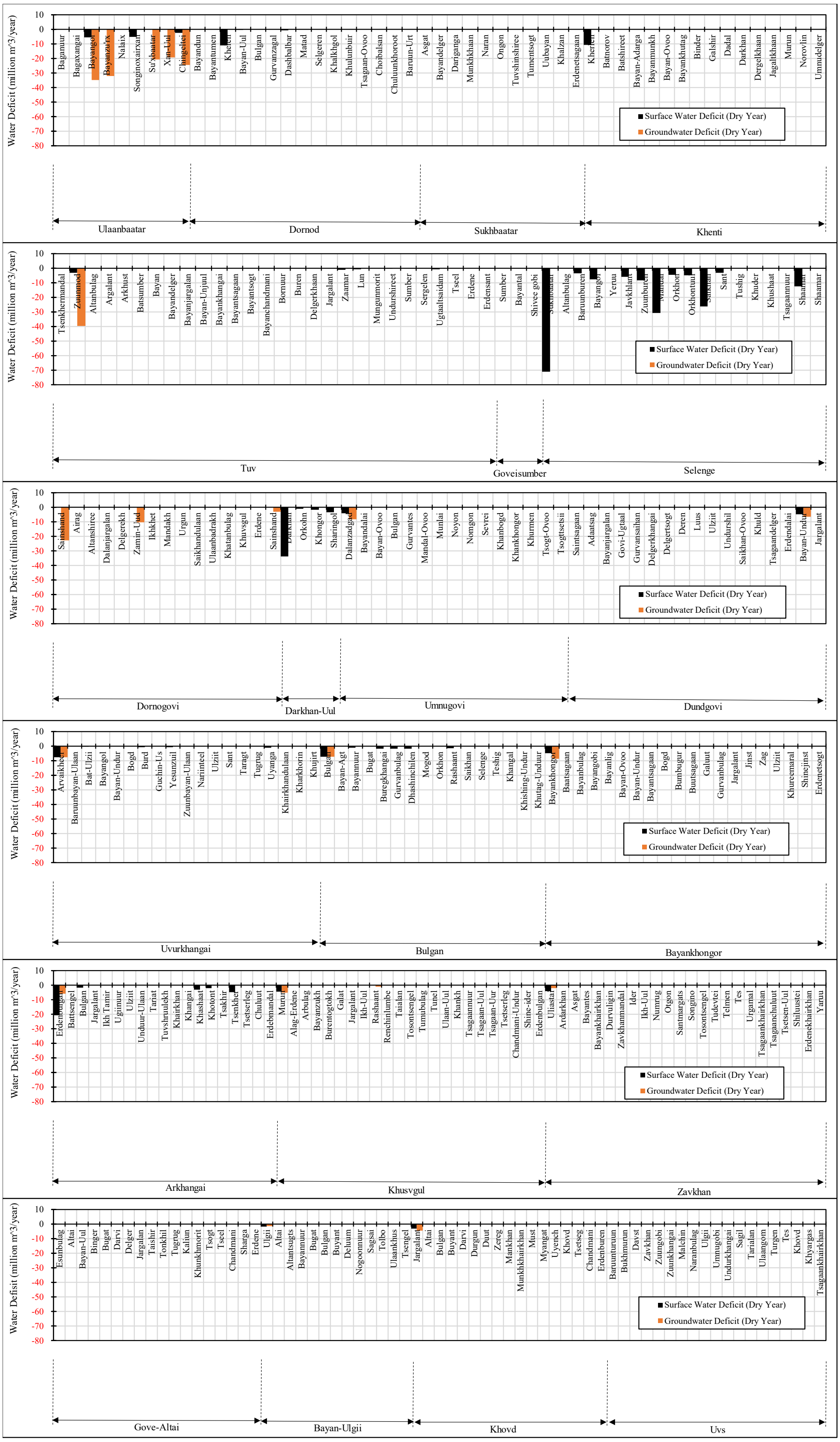
The groundwater shortage in 2040 water demand at dry year will be occurred in some Soums in Ulaanbaatar, Dornogovi, Khuvsgul, Arkhangai, Uvurkhangai and Umnugovi Aimags as shown in Figure 3.7.48. In general, the volume of groundwater shortage will not so high, but in Ulaanbaatar and Dornogovi will increase the groundwater shortage.



Present Condition

Source: JICA Project Team

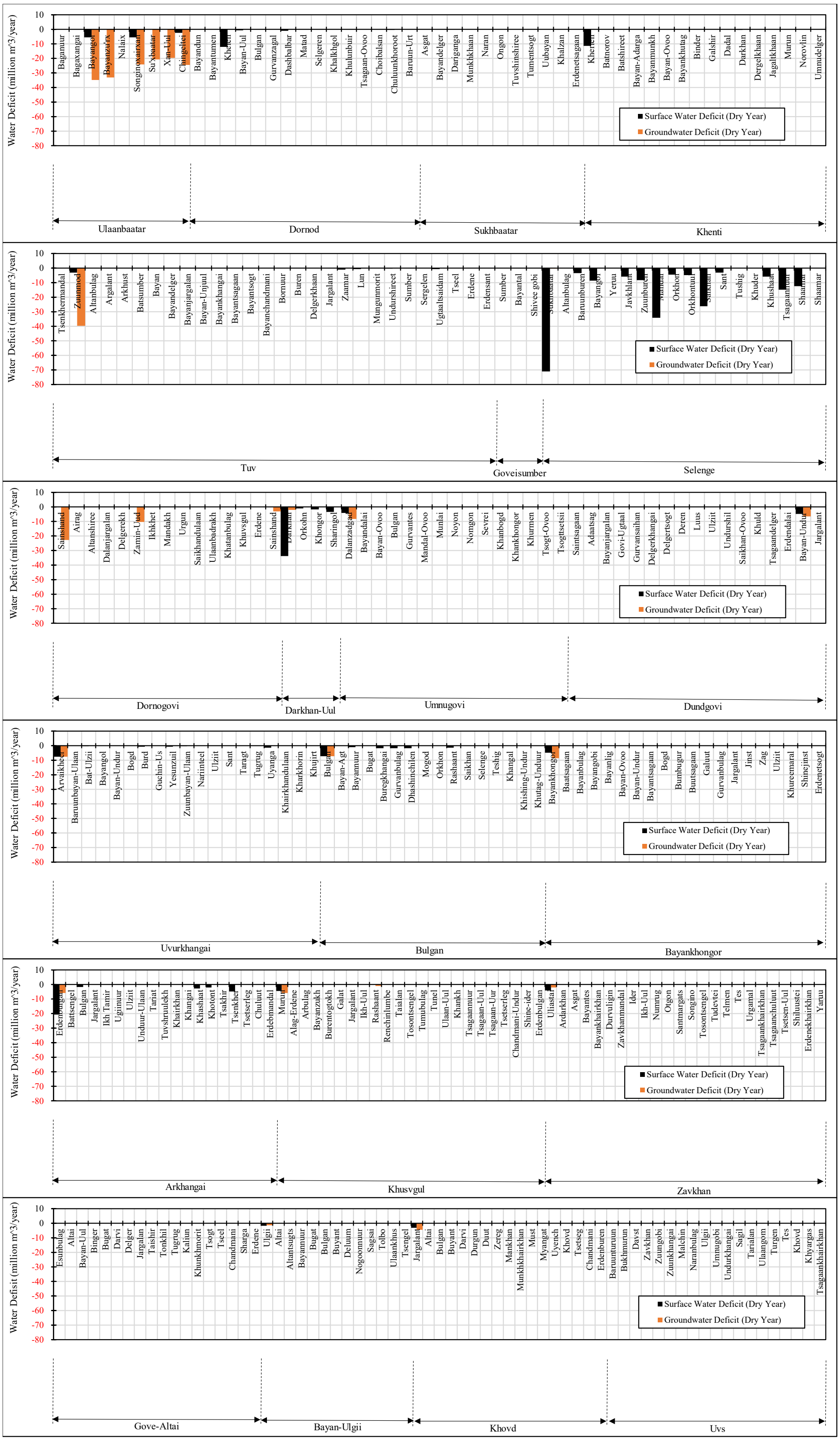
Figure 3.7.49 Surface Water Shortage in 2040 Demand by Soum (Dry Year) by Climate Change Scenarios



2050 RCP4.5 Scenario

Source: JICA Project Team

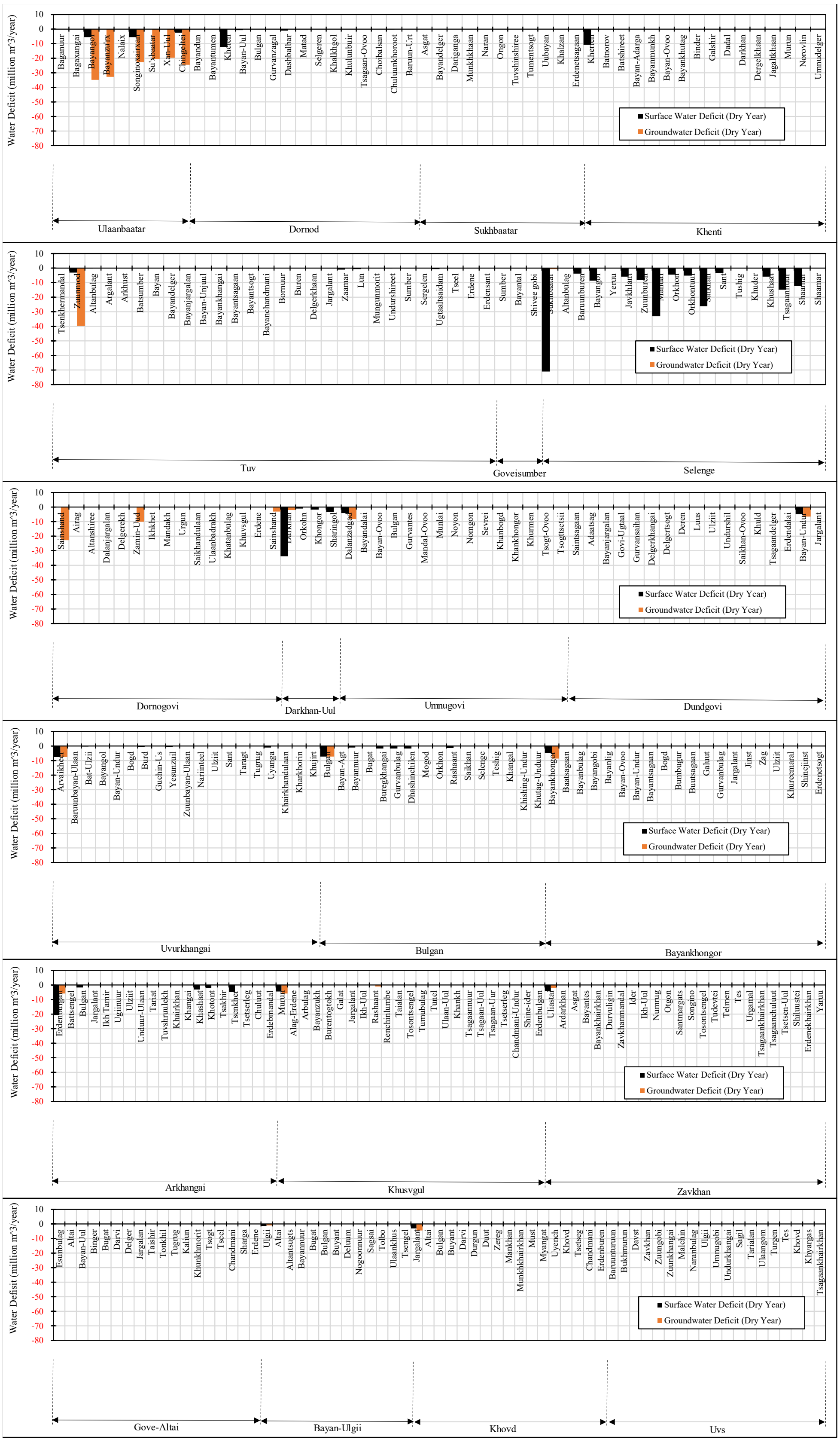
Figure 3.7.50 Surface Water Shortage in 2040 Demand by Soum (Dry Year) by Climate Change Scenarios



2050 RCP8.5 Scenario

Source: JICA Project Team

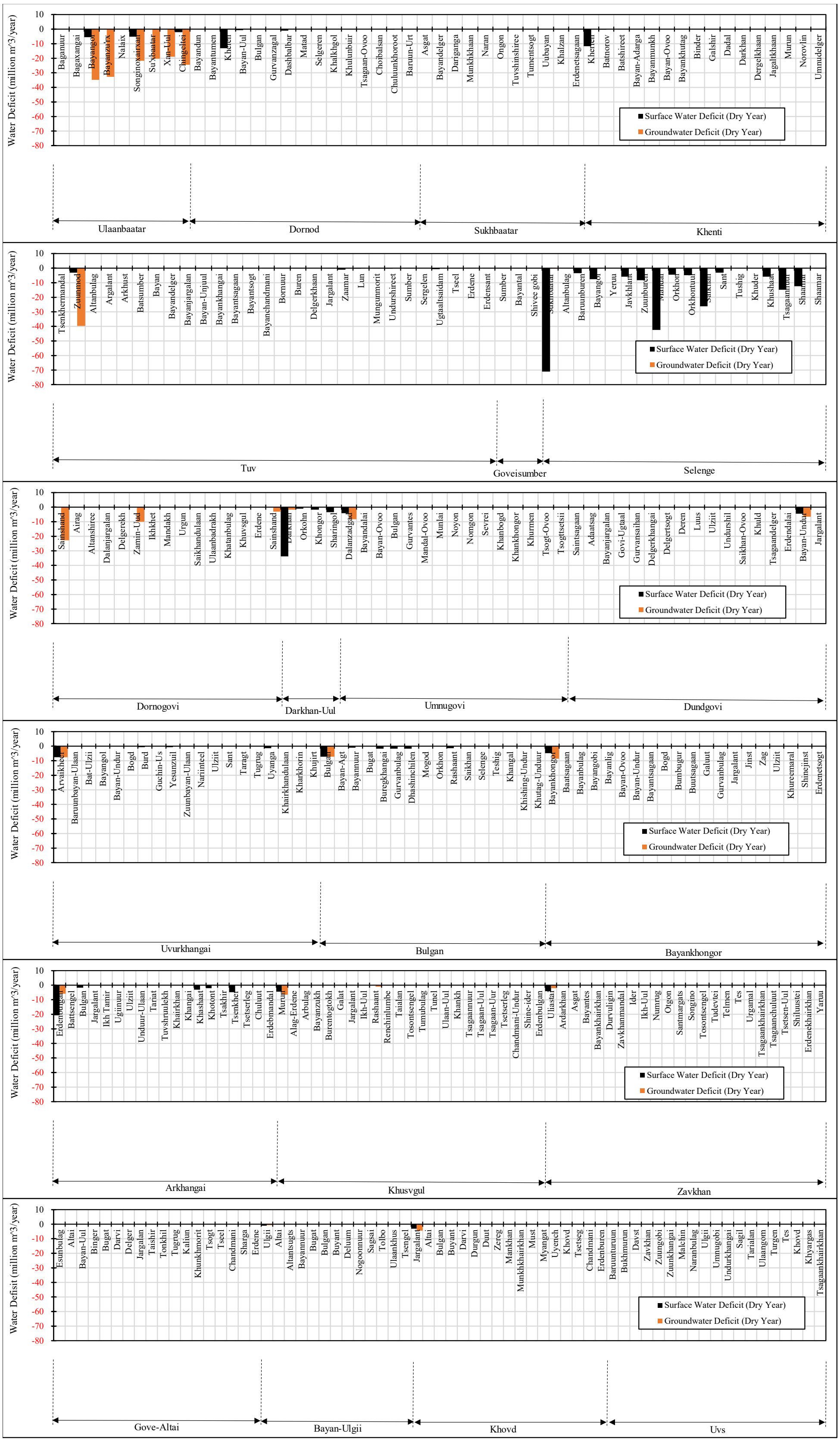
Figure 3.7.51 Surface Water Shortage in 2040 Demand by Soum (Dry Year) by Climate Change Scenarios



2100 RCP4.5 Scenario

Source: JICA Project Team

Figure 3.7.52 Surface Water Shortage in 2040 Demand by Soum (Dry Year) by Climate Change Scenarios



2100 RCP8.5 Scenario

Source: JICA Project Team

Figure 3.7.53 Surface Water Shortage in 2040 Demand by Soum (Dry Year) by Climate Change Scenarios

Table 3.7.24 Water Balance in 2040 Demand by Soum (Dry Year, Present Weather)

ID	Aimag	Soum Name	Water Balance (Dry Year)			ID	Aimag	Soum Name	Water Balance (Dry Year)			ID	Aimag	Soum Name	Water Balance (Dry Year)		
			SW	GW	Total				SW	GW	Total				SW	GW	Total
1101	Ulaanbaatar	Baganuur	12.60	13.40	26.00	4440	Dornogovi	Erdene	213.30	254.03	467.33	6704	Khusvgul	Alag-Erdene	72.57	41.53	114.10
1104	Ulaanbaatar	Bagaxangai	0.50	0.86	1.36	4443	Dornogovi	Sainshand	6.06	3.64	9.70	6707	Khusvgul	Arbulag	22.61	24.58	47.19
1107	Ulaanbaatar	Bayangol	-5.51	-34.85	-40.36	4501	Darkhan-Uul	Darkhan	-33.86	-2.84	-36.70	6710	Khusvgul	Bayanzukh	27.62	30.23	57.85
1110	Ulaanbaatar	Bayanzu'rx	19.34	-33.53	-14.18	4504	Darkhan-Uul	Orkhon	-1.14	12.29	11.15	6713	Khusvgul	Burentogtokh	30.12	51.53	81.64
1113	Ulaanbaatar	Nalaix	29.26	11.28	40.54	4507	Darkhan-Uul	Khongor	-1.65	3.95	2.30	6716	Khusvgul	Galat	23.76	-6.46	17.30
1116	Ulaanbaatar	Songinoxairxan	-5.46	-24.28	-29.74	4510	Darkhan-Uul	Sharingol	-3.37	-0.36	-3.72	6719	Khusvgul	Jargalant	0.83	-2.10	-1.27
1119	Ulaanbaatar	Su'xbaatar	-0.09	-21.21	-21.30	4601	Umnugovi	Dalanzadgad	-4.10	-8.34	-12.43	6722	Khusvgul	Ikh-Uul	28.96	63.28	92.25
1121	Ulaanbaatar	Xan-Uul	4.70	-21.05	-16.35	4604	Umnugovi	Bayandalai	-0.37	-58.03	-58.40	6725	Khusvgul	Rashaant	318.19	-1.09	317.10
1125	Ulaanbaatar	Chingeltei	-2.72	-24.80	-27.52	4607	Umnugovi	Bayan-Ovoo	83.64	233.00	316.64	6728	Khusvgul	Renchinlumbe	144.45	324.96	469.41
2104	Dornod	Bayandun	1.01	528.61	529.62	4610	Umnugovi	Bulgan	16.09	31.98	48.08	6731	Khusvgul	Taialan	49.62	108.51	158.12
2107	Dornod	Bayantumen	-11.44	105.66	94.22	4613	Umnugovi	Gurvantes	-0.83	-151.93	-152.75	6734	Khusvgul	Tosontsengel	29.73	64.96	94.70
2107	Dornod	Bayantumen	-11.44	105.66	94.22	4616	Umnugovi	Mandal-Ovoo	14.05	27.92	41.98	6737	Khusvgul	Tumubulag	18.90	-2.32	16.58
2110	Dornod	Bayan-Uul	0.24	493.56	493.80	4619	Umnugovi	Munlai	85.57	291.00	376.57	6740	Khusvgul	Tunel	60.41	18.16	78.57
2113	Dornod	Bulgan	1.28	43.42	44.70	4622	Umnugovi	Noyon	-0.23	-57.24	-57.47	6743	Khusvgul	Ulaan-Uul	189.84	427.27	617.11
2116	Dornod	Gurvanzagal	0.36	147.80	148.17	4625	Umnugovi	Nomgon	135.34	420.73	556.07	6746	Khusvgul	Khankh	102.10	60.38	162.47
2119	Dornod	Dashbalbar	-0.45	680.86	680.41	4628	Umnugovi	Sevrei	18.52	43.81	62.32	6749	Khusvgul	Tsagaannuur	106.02	238.65	344.67
2122	Dornod	Matad	5.13	141.83	146.97	4631	Umnugovi	Khanbogd	349.91	878.83	1,228.74	6752	Khusvgul	Tsagaan-Uul	37.03	40.51	77.54
2125	Dornod	Selgeren	0.76	150.76	151.52	4634	Umnugovi	Khankhongor	23.91	62.27	86.18	6755	Khusvgul	Tsagaan-Uur	115.40	121.98	237.38
2128	Dornod	Khalkhgol	1,300.97	2,169.25	3,470.22	4637	Umnugovi	Khurmen	-0.28	-68.48	-68.76	6758	Khusvgul	Tsetserleg	67.90	20.21	88.11
2131	Dornod	Khulunbuir	3.04	50.28	53.32	4640	Umnugovi	Tsogt-Ovoo	15.10	39.36	54.46	6761	Khusvgul	Chandmani-Undur	240.04	190.92	430.95
2134	Dornod	Tsagaan-Ovoo	7.71	218.24	225.95	4643	Umnugovi	Tsogttsetsii	35.68	108.46	144.14	6764	Khusvgul	Shine-ider	16.22	27.61	43.83
2137	Dornod	Choibalsan	1.13	264.37	265.50	4801	Dundgovi	Saintsagaan	7.87	9.20	17.07	6767	Khusvgul	Erdenbulgan	82.11	-3.04	79.07
2140	Dornod	Chuluunkhoroot	0.27	626.68	626.95	4804	Dundgovi	Adaatsag	1.31	19.95	21.27	8101	Zavkhan	Uliastai	-4.26	-2.12	-6.37
2201	Sukhbaatar	Baruun-Urt	3.89	68.03	71.93	4807	Dundgovi	Bayanjargalan	12.58	30.83	43.41	8104	Zavkhan	Ardarkhan	12.55	63.96	76.52
2204	Sukhbaatar	Asgat	2.19	44.65	46.84	4810	Dundgovi	Govi-Ugtaal	10.69	25.76	36.44	8107	Zavkhan	Asgat	4.99	1.54	6.52
2207	Sukhbaatar	Bayandelger	2.30	44.81	47.11	4813	Dundgovi	Gurvansaihan	21.57	52.86	74.44	8110	Zavkhan	Bayantes	49.84	14.94	64.78
2210	Sukhbaatar	Dariganga	19.29	151.87	171.16	4816	Dundgovi	Delgerkhangai	2.45	39.74	42.19	8113	Zavkhan	Bayankhairkhan	29.34	8.78	38.12
2213	Sukhbaatar	Munkhkhaan	7.68	98.03	105.71	4819	Dundgovi	Delgertsogt	9.88	23.74	33.62	8116	Zavkhan	Durvuligin	71.66	-48.23	23.43
2216	Sukhbaatar	Naran	13.52	106.77	120.29	4822	Dundgovi	Deren	14.30	34.51	48.81	8119	Zavkhan	Zavkhanmandal	3.94	19.75	23.69
2219	Sukhbaatar	Ongon	27.79	219.07	246.85	4825	Dundgovi	Luus	1.25	19.65	20.89	8122	Zavkhan	Ider	1.49	-0.48	1.00
2225	Sukhbaatar	Tuvshinshiree	1.34	25.72	27.06	4828	Dundgovi	Ulziit	36.27	92.32	128.59	8125	Zavkhan	Ikh-Uul	0.55	-1.06	-0.51
2228	Sukhbaatar	Tumentsogt	2.21	27.50	29.71	4831	Dundgovi	Undurshil	19.18	47.35	66.53	8128	Zavkhan	Numrug	1.42	-0.36	1.06
2231	Sukhbaatar	Uubayan	1.50	29.51	31.01	4834	Dundgovi	Saikhan-Ovoo	1.60	25.33	26.93	8131	Zavkhan	Otgon	12.32	79.63	91.95
2234	Sukhbaatar	Khalzan	1.16	23.07	24.22	4837	Dundgovi	Khuld	14.25	35.18	49.43	8134	Zavkhan	Santmargats	2.40	13.04	15.43
2237	Sukhbaatar	Erdenetsagaan	5.14	100.95	106.10	4840	Dundgovi	Tsagaandelger	13.67	33.77	47.44	8137	Zavkhan	Songino	27.51	8.24	35.75
2301	Khenti	Kherlen	-10.35	32.15	21.79	4843	Dundgovi	Erdendalai	2.89	44.44	47.33	8140	Zavkhan	Tosontsengel	0.66	-1.54	-0.88
2304	Khenti	Batnorov	1.56	62.89	64.45	6101	Orkhon	Bayan-Undur	-4.66	-7.70	-12.36	8143	Zavkhan	Tudevtei	30.17	9.02	39.19
2307	Khenti	Batshireet	210.86	294.59	505.45	6104	Orkhon	Jargalant	1.05	2.14	3.19	8146	Zavkhan	Telmen	1.28	-0.51	0.77
2310	Khenti	Bayan-Adarga	79.82	141.42	221.23	6201	Uvurkhangai	Arvaikheer	-7.68	-7.69	-15.37	8149	Zavkhan	Tes	9.83	2.77	12.60
2313	Khenti	Bayanmunkh	4.06	18.08	22.14	6204	Uvurkhangai	Baruunbayan-Ulaan	8.03	16.63	24.66	8152	Zavkhan	Urgamal	3.78	19.18	22.96
2316	Khenti	Bayan-Ovoo	2.40	44.53	46.93	6207	Uvurkhangai	Bat-Ulzii	-0.30	11.01	10.71	8155	Zavkhan	Tsagaankhairkhan	4.54	23.40	27.94
2319	Khenti	Bayankhutag	4.83	80.45	85.28	6210	Uvurkhangai	Bayangol	0.42	22.40	22.82	8158	Zavkhan	Tsagaanchuluut	2.57	3.13	5.70
2322	Khenti	Binder	161.62	225.86	387.48	6213	Uvurkhangai	Bayan-Undur	0.32	20.71	21.03	8161	Zavkhan	Tsetsen-Uul	2.41	13.25	15.65
2325	Khenti	Galshir	0.62	40.40	41.03	6216	Uvurkhangai	Bogd	20.80	42.66	63.45	8164	Zavkhan	Shiluustei	4.27	11.56	15.83
2328	Khenti	Dadal	140.09	247.44	387.53	6219	Uvurkhangai	Burd	-0.57	25.79	25.21	8167	Zavkhan	Erdenekhairkhan	4.48	22.84	27.32
2331	Khenti	Darkhan	2.17	25.13	27.29	6222	Uvurkhangai	Guchin-Us	10.00	20.39	30.39	8170	Zavkhan	Yaruu	19.24	2.66	21.90
2334	Khenti	Dergelkhaan	6.18	27.29	33.47	6225	Uvurkhangai	Yesunzuil	-0.63	22.13	21.50	8201	Gove-Altai	Esunbulag	25.57	16.67	42.24
2337	Khenti	Jagaltkhaan	4.35	19.93	24.28	6228	Uvurkhangai	Zuunbayan-Ulaan	0.00	15.72	15.72	8204	Gove-Altai	Altai	61.33	126.86	188.19
2340	Khenti	Murun	3.24	15.28	18.52	6231	Uvurkhangai	Nariinteel	5.04	10.88	15.92	8207	Gove-Altai	Bayan-Uul	57.96	-39.83	18.12
2343	Khenti	Norovlin	0.94	482.28	483.22	6234	Uvurkhangai	Ulziit	7.12	17.18	24.30	8210	Gove-Altai	Binger	8.54	9.40	17.93
2346	Khenti	Umnudelger	326.67	456.43	783.10	6237	Uvurkhangai	Sant	0.15	16.60	16.75	8213	Gove-Altai	Bugat	-0.16	34.38	34.22
2349	Khenti	Tsenkhermandal	5.18	22.67	27.85	6240	Uvurkhangai	Taragt	0.57	22.61	23.18	8216	Gove-Altai	Darvi	3.82	11.04	14.86
4101	Tuv	Zuunmod	-3.20	-39.69	-42.88	6243	Uvurkhangai	Tugrug	11.36	23.22	34.58	8219	Gove-Altai	Delger	14.82	16.52	31.34
4103	Tuv	Altanbulag	-0.61	1.15	0.53	6246	Uvurkhangai	Uyanga	-1.18	17.86	16.68	8222	Gove-Altai	Jargalan	4.01	3.99	8.00
4107	Tuv	Argalant	2.41	10.77	13.17	6249	Uvurkhangai	Khairkhandulaan	8.27	17.25	25.53	8225	Gove-Altai	Taishir	5.73	13.94	19.67
4110	Tuv	Arkhust	1.40	3.17	4.57	6252	Uvurkhangai	Kharkhorin	3.67	18.98	22.65	8228	Gove-Altai	Tonkhil	29.05	49.90	78.95
4113	Tuv	Batsumber	5.51	39.66	45.17	6255	Uvurkhangai	Khujirt	4.96	13.55	18.52	8231	Gove-Altai	Tugrug	154.70	123.13	277.84
4116	Tuv	Bayan	5.54	17.33	22.87	6301	Bulgan	Bulgan	-7.33	-7.69	-15.02	8234	Gove-Altai	Kaliun	148.00	117.64	265.63
4119	Tuv	Bayandelger	4.00	12.79	16.80	6304	Bulgan	Bayan-Agt	43.51	97.75	141.26	8237	Gove-Altai	Khunkhmorit	62.44	-42.51	19.94
4122	Tuv	Bayanjargalan	5.45	17.99	23.44	6307	Bulgan	Bayannuur	-1.16	34.14	32.98	8240	Gove-Altai	Tsogt	67.81	339.36	407.16
4125	Tuv	Bayan-Unjuul	7.76	36.58	44.34	6310	Bulgan	Bugat	94.90	16.92	111.82	8243	Gove-Altai	Tseel	22.67	113.43	136.10
4128	Tuv	Bayankhangai	2.14	9.63	11.78	6313	Bulgan	Buregkhangai	-1.69	119.71	118.03	8246	Gove-Altai	Chandmani	10.28	11.44	21.72
4131	Tuv	Bayantsagaan	22.90	54.23	77.13	6316	Bulgan	Gurvanbulag	-1.80	25.59	23.79	8249	Gove-Altai	Sharga	65.72	58.20	123.93
4134	Tuv	Bayantsogt	3.34	15.74	19.08	6319	Bulgan	Dhashinchilen	-1.74	78.89	77.15	8252	Gove-Altai	Erdene	76.06	157.46	233.52
4137	Tuv	Bayanchandmani	1.67	3.05	4.72	6322	Bulgan	Mogod	16.83	40.92	57.75	8301	Bayan-Ulgii	Ulgii	-2.22	-2.27	-4.49
4140	Tuv	Bornuur	4.02	14.13	18.15	6325	Bulgan	Orkhon	6.76	15.32	22.09	8304	Bayan-Ulgii	Altai	47.04	25.19	72.22
4143	Tuv	Buren	1.20	30.46	31.67	6328	Bulgan	Rashaant	-1.48	7.78	6.30	8307	Bayan-Ulgii	Altantsugts	24.84	41.58	66.42
4146	Tuv	Delgerkhaan	0.71	17.74	18.45	6331	Bulgan	Saikhan	15.47	38.48	53.95	8310	Bayan-Ulgii	Bayannuur	22.42	-15.91	6.51
4149	Tuv	Jargalant	6.80	26.84	33.64	6334	Bulgan	Selenge	144.59	25.84	170.42	8313	Bayan-Ulgii	Bugat	69.06	23.79	92.85
4152	Tuv	Zaamar	-1.10	84.74	83.65	6337	Bulgan	Teshig	322.63	659.94	982.57	8316	Bayan-Ulgii	Bulgan	101.91	124.71	226.62
4155	Tuv	Lun	-0.52	41.65	41.13	6340	Bulgan	Khangal	45.68	6.24	51.91	8319	Bayan-Ulgii	Buyant	51.52	17.08	68.60
4158	Tuv	Mungunmorit	143.72	191.03	334.75	6343	Bulgan	Khishing-Undur	14.00	34.73	48.73	8322	Bayan-Ulgii	Deluum	84.77	105.82	190.59
4161	Tuv	Undurshireet	-0.38	44.92	44.54	6346	Bulgan	Khutag-Unduur	166.29	29.14	195.43	8325	Bayan-Ulgii	Nogoonnuur	101.58	49.28	150.86
4164	Tuv	Sumber	1.17	3.63	4.80	6401	Bayankhongor	Bayankhongor	-4.75	-9.02	-13.77	8328	Bayan-Ulgii	Sagsai	112.13	53.56	165.68
4167	Tuv	Sergelen	14.62	33.05	47.67	6404	Bayankhongor	Baatsagaan	16.32	18.92	35.23	8331	Bayan-Ulgii	Tolbo	83.59	27.72	111.32
4170	Tuv	Ugtaaltsaidam	-0.53	47.44	46.91	6407	Bayankhongor	Bayanbulag	6.87	7.93	14.80	8334	Bayan-Ulgii	Ulaankhus	376.77	140.56	517.33
4173	Tuv	Tseel	3.13	0.98	4.11	6410	Bayankhongor	Bayangobi	11.92	28.69	40.60	8340	Bayan-Ulgii	Tsengel	226.56	108.24	334.80
4176	Tuv	Erdene	241.78	151.41	393.19	6413	Bayankhongor	Bayanlig	31.00	74.36	105.36	8401	Khovd	Jargalant	-3.06	-4.52	-7.58
4179	Tuv	Erdensant	0.63	20.58	21.21	6416	Bayankhongor	Bayan-Ovoo	4.39	6.35	10.74	8404	Khovd	Altai	155.21	269.68	424.88
4201	Goveisumber	Sumber	14.80	34.43	49.23	6419	Bayankhongor	Bayan-Undur	18.03	24.27	42.30	8407	Khovd	Bulgan	167.22	203.60	370.81
4204	Goveisumber	Bayantal	3.54	8.65	12.19	6422	Bayankhongor	Bayantsagaan	4.54	15.88	20.42	8410	Khovd	Buyant	69.56	71.76	141.32
4207	Goveisumber	Shivee gobi	3.56	8.19	11.75	6425	Bayankhongor	Bogd	8.25	16.44	24.69	8413	Khovd	Darvi	32.07	11.94	44.01
4301	Selenge	Sukhbaatar	-70.83	-1.31	-72.15	6428	Bayankhongor	Bumbugur	4.04	5.80	9.85	8416	Khovd	Durgun	40.40	-27.72	12.68
4304	Selenge	Altanbulag	10.87	20.91	31.79	6431	Bayankhongor	Buutsagaan	11.62	13.32	24.94	8419	Khovd	Duut	9.40	26.61	36.02
4307	Selenge	Baruunburen	-3.62	12.04	8.42	6434	Bayankhongor	Galuut	6.90	10.00	16.90	8422	Khovd	Zereg	14.21	5.00	19.21
4310	Selenge	Bayangol	-8.38	46.05	37.67	6437	Bayankhongor	Gurvanbulag	1.40	-0.02	1.38	8425	Khovd	Mankhan	19.01	53.84	72.85
4313	Selenge	Yeruu	61.30	60.94	122.25	6440	Bayankhongor	Jargalant	5.82	8.47	14.30	8428	Khovd	Munkhkhairkhan	11.28	31.90	43.18
4316	Selenge	Javkhlant	-5.84	33.17	27.34	6443	Bayankhongor	Jinst	7.38	10.83	18.21	8431	Khovd	Must	22.78	8.32	31.10
4319	Selenge	Zuunburen	-8.16	33.24	25.08	6446	Bayankhongor	Zag	3.48	5.05	8.53	8434	Khovd	Myangat	32.26	-22.54	9.72
4322	Selenge	Mandal	-33.42	39.06	5.64	6449	Bayankhongor	Ulziit	8.11	16.18	24.29	8437	Khovd	Uyench	84.08	181.50	265.58
4325	Selenge	Orkhon	-4.45	5.43	0.98	6452	Bayankhongor	Khureemaral	9.57	11.11	20.67	8440	Khovd	Khovd	54.19	55.86	110.05
4328	Selenge	Orkhontuul	-4.97	12.54	7.57	6455	Bayankhongor	Shinejinst	36.54	49.45	85.98	8443	Khovd	Tsetseg	19.93	7.24	27.17
4331	Selenge	Saikhan	-26.19	4.59	-21.60	6458	Bayankhongor	Erdenetsogt	5.37	7.71	13.08	8446	Khovd	Chandmani	59.98	-40.70	19.28
4334	Selenge	Sant	-3.23	5.71	2.48	6501	Arkhangai	Erdenbulgan	-20.68	-6.13	-26.81	8449	Khovd	Erdenburen	10.41	24.38	34.79
4337	Selenge	Tushig	16.01	38.83	54.83	6504	Arkhangai	Battsengel	6.74	32.73	39.47	8504	Uvs	Baruunturuun	32.71	104.47	137.19
4340	Selenge	Khuder	20.98	23.39	44.37	6507	Arkhangai	Bulgan	-1.56	12.69	11.13	8507	Uvs	Bukhmurun	43.41	13.64	57.05
4343	Selenge	Khushaat	-5.83	16.72	10.88	6510	Arkhangai	Jargalant	144.72	95.97	240.69	8510	Uvs	Davst	67.75	211.62	279.37
4346	Selenge	Tsagaannuur	-14.93	31.41	16.48	6513	Arkhangai	Ikh Tamir	22.88	152.06	174.94	8513	Uvs	Zavkhan	67.99	-45.94	22.05
4349	Selenge	Shaamar	-12.36	18.27	5.91	6516	Arkhangai	Ugiinuur	2.02	15.43	17.45	8516	Uvs	Zuungobi	40.98	130.12	171.10
4352	Selenge	Shaamar	0.01	1.32	1.33	6519	Arkhangai	Ulziit	7.99	24.89	32.88	8519	Uvs	Zuunkhangai	29.55	8.89	38.44
4401	Dornogovi	Sainshand	45.48	27.29	72.77	6522	Arkhangai	Unduur-Ulaan	7.01	225.65	232.67	8522	Uvs	Malchin	41.05	130.08	171.12
4404	Dornogovi	Airag	2.27	42.56	44.83	6525	Arkhangai	Tariat	220.47	163.21	383.68	8525	Uvs	Naranbulag	52.70	168.04	220.75
4407	Dornogovi	Altanshiree	2.18	43.77	45.94	6528	Arkhangai	Tuvshruulekh	0.59	10.62	11.21	8528	Uvs	Ulgii	22.68	-16.14	6.55
4410	Dornogovi	Dalanjargalan	1.22	21.96	23.18	6531	Arkhangai	Khairkhan	4.39	112.63	117.01	8531	Uvs	Umnugobi	29.38	-21.55	7.82
4413	Dornogovi	Delgerekh	1.46	28.06	29.52	6534	Arkhangai	Khangai	212.22	156.54	368.76	8534	Uvs	Undurkhangai	44.75	-31.16	13.59
4416	Dornogovi	Zamin-Uud	3.81	-12.23	-8.42	6537	Arkhangai	Khashaat	-2.94	25.75	22.80	8537	Uvs	Sagil	75.03	36.64	111.67
4419	Dornogovi	Ikhkhet	1.27	23.75	25.02	6540	Arkhangai	Khotont	-2.29	-1.90	-4.19	8540	Uvs	Tarialan	26.57	118.99	145.56
4422	Dornogovi	Mandakh	236.52	406.12	642.64	6543	Arkhangai	Tsakhir	180.06	132.69	312.75	8540	Uvs	Tarialan	26.57	118.99	145.56
4425	Dornogovi	Urgun	2.55	50.84	53.40	6546	Arkhangai	Tsenkher	-4.64	11.51	6.87	8543	Uvs	Turgen	21.20	68.19	89.39
4428	Dornogovi	Saikhandulaan	2.90	58.84	61.74	6549	Arkhangai	Tsetserleg	113.66	10.08	123.75	8546	Uvs	Tes	30.72	101.42	132.14
4431	Dornogovi	Ulaanbadrakh	259.49	310.95	570.44	6552	Arkhangai	Chuluut	111.43	85.57	197.01	8549	Uvs	Khovd	32.40	10.16	42.56
4434	Dornogovi	Khatanbulag	344.66	1,321.00	1,665.66	6555	Arkhangai	Erdebmandal	4.43	175.25	179.68	8552	Uvs	Khyargas	32.89	104.82	137.71
4437	Dornogovi	Khuvsgul	156.70	268.42	425.12	6701	Khusvgul	Murun	-4.31	-14.89	-19.19	8555	Uvs	Tsagaankhairkhan	39.68	-27.25	12.43

Source: JICA Project Team

Table 3.7.25 Water Balance in 2040 Demand by Soum (Dry Year, 2050 RCP4.5)

ID	Aimag	Soum Name	Water Deficit (Dry Year)			ID	Aimag	Soum Name	Water Deficit (Dry Year)			ID	Aimag	Soum Name	Water Deficit (Dry Year)		
			SW	GW	Total				SW	GW	Total				SW	GW	Total
1101	Ulaanbaatar	Baganuur	0.00	0.00	0.00	4440	Dornogovi	Erdene	0.00	0.00	0.00	6704	Khusvgul	Alag-Erdene	0.00	0.00	0.00
1104	Ulaanbaatar	Bagaxangai	0.00	0.00	0.00	4443	Dornogovi	Sainshand	0.00	-3.03	-3.03	6707	Khusvgul	Arbulag	0.00	0.00	0.00
1107	Ulaanbaatar	Bayangol	-5.38	-34.77	-40.15	4501	Darkhan-Uul	Darkhan	-33.82	0.00	-33.82	6710	Khusvgul	Bayanzukh	0.00	0.00	0.00
1110	Ulaanbaatar	Bayanzu'rx	0.00	-31.97	-31.97	4504	Darkhan-Uul	Orkohn	-1.15	0.00	-1.15	6713	Khusvgul	Burentogtokh	0.00	0.00	0.00
1113	Ulaanbaatar	Nalaix	0.00	0.00	0.00	4507	Darkhan-Uul	Khongor	-1.64	0.00	-1.64	6716	Khusvgul	Galat	0.00	0.00	0.00
1116	Ulaanbaatar	Songinoxairxan	-5.02	0.00	-5.02	4510	Darkhan-Uul	Sharingol	-3.37	0.00	-3.37	6719	Khusvgul	Jargalant	0.00	0.00	0.00
1119	Ulaanbaatar	Su'xbaatar	0.00	-20.50	-20.50	4601	Umnugovi	Dalanzadgad	-4.09	-8.32	-12.42	6722	Khusvgul	Ikh-Uul	0.00	0.00	0.00
1121	Ulaanbaatar	Xan-Uul	0.00	-19.37	-19.37	4604	Umnugovi	Bayandalai	0.00	0.00	0.00	6725	Khusvgul	Rashaant	0.00	-1.01	-1.01
1125	Ulaanbaatar	Chingeltei	-2.23	-24.50	-26.73	4607	Umnugovi	Bayan-Ovoo	0.00	0.00	0.00	6728	Khusvgul	Renchinlumbe	0.00	0.00	0.00
2104	Dornod	Bayandun	0.00	0.00	0.00	4610	Umnugovi	Bulgan	0.00	0.00	0.00	6731	Khusvgul	Taialan	0.00	0.00	0.00
2107	Dornod	Bayantumen	-11.17	0.00	-11.17	4613	Umnugovi	Gurvantes	0.00	0.00	0.00	6734	Khusvgul	Tosontsengel	0.00	0.00	0.00
2107	Dornod	Bayantumen	-11.17	0.00	-11.17	4616	Umnugovi	Mandal-Ovoo	0.00	0.00	0.00	6737	Khusvgul	Tumubulag	0.00	0.00	0.00
2110	Dornod	Bayan-Uul	-0.43	0.00	-0.43	4619	Umnugovi	Munlai	0.00	0.00	0.00	6740	Khusvgul	Tunel	0.00	0.00	0.00
2113	Dornod	Bulgan	0.00	0.00	0.00	4622	Umnugovi	Noyon	0.00	0.00	0.00	6743	Khusvgul	Ulaan-Uul	0.00	0.00	0.00
2116	Dornod	Gurvanzagal	0.00	0.00	0.00	4625	Umnugovi	Nomgon	0.00	0.00	0.00	6746	Khusvgul	Khankh	0.00	0.00	0.00
2119	Dornod	Dashbalbar	-0.82	0.00	-0.82	4628	Umnugovi	Sevrei	0.00	0.00	0.00	6749	Khusvgul	Tsagaannuur	0.00	0.00	0.00
2122	Dornod	Matad	0.00	0.00	0.00	4631	Umnugovi	Khanbogd	0.00	0.00	0.00	6752	Khusvgul	Tsagaan-Uul	0.00	0.00	0.00
2125	Dornod	Selgeren	0.00	0.00	0.00	4634	Umnugovi	Khankhongor	0.00	0.00	0.00	6755	Khusvgul	Tsagaan-Uur	0.00	0.00	0.00
2128	Dornod	Khalkhgol	0.00	0.00	0.00	4637	Umnugovi	Khurmen	0.00	0.00	0.00	6758	Khusvgul	Tsetserleg	0.00	0.00	0.00
2131	Dornod	Khulunbuir	0.00	0.00	0.00	4640	Umnugovi	Tsogt-Ovoo	0.00	0.00	0.00	6761	Khusvgul	Chandmani-Undur	0.00	0.00	0.00
2134	Dornod	Tsagaan-Ovoo	0.00	0.00	0.00	4643	Umnugovi	Tsogttsetsii	0.00	0.00	0.00	6764	Khusvgul	Shine-ider	0.00	0.00	0.00
2137	Dornod	Choibalsan	0.00	0.00	0.00	4801	Dundgovi	Saintsagaan	0.00	0.00	0.00	6767	Khusvgul	Erdenbulgan	0.00	0.00	0.00
2140	Dornod	Chuluunkhoroot	0.00	0.00	0.00	4804	Dundgovi	Adaatsag	0.00	0.00	0.00	8101	Zavkhan	Uliastai	-4.25	-2.06	-6.31
2201	Sukhbaatar	Baruun-Urt	0.00	0.00	0.00	4807	Dundgovi	Bayanjargalan	0.00	0.00	0.00	8104	Zavkhan	Ardarkhan	0.00	0.00	0.00
2204	Sukhbaatar	Asgat	0.00	0.00	0.00	4810	Dundgovi	Govi-Ugtaal	0.00	0.00	0.00	8107	Zavkhan	Asgat	0.00	0.00	0.00
2207	Sukhbaatar	Bayandelger	0.00	0.00	0.00	4813	Dundgovi	Gurvansaihan	0.00	0.00	0.00	8110	Zavkhan	Bayantes	0.00	0.00	0.00
2210	Sukhbaatar	Dariganga	0.00	0.00	0.00	4816	Dundgovi	Delgerkhangai	0.00	0.00	0.00	8113	Zavkhan	Bayankhairkhan	0.00	0.00	0.00
2213	Sukhbaatar	Munkhkhaan	0.00	0.00	0.00	4819	Dundgovi	Delgertsogt	0.00	0.00	0.00	8116	Zavkhan	Durvuligin	0.00	0.00	0.00
2216	Sukhbaatar	Naran	0.00	0.00	0.00	4822	Dundgovi	Deren	0.00	0.00	0.00	8119	Zavkhan	Zavkhanmandal	0.00	0.00	0.00
2219	Sukhbaatar	Ongon	0.00	0.00	0.00	4825	Dundgovi	Luus	0.00	0.00	0.00	8122	Zavkhan	Ider	0.00	0.00	0.00
2225	Sukhbaatar	Tuvshinshiree	0.00	0.00	0.00	4828	Dundgovi	Ulziit	0.00	0.00	0.00	8125	Zavkhan	Ikh-Uul	0.00	0.00	0.00
2228	Sukhbaatar	Tumentsogt	0.00	0.00	0.00	4831	Dundgovi	Undurshil	0.00	0.00	0.00	8128	Zavkhan	Numrug	0.00	0.00	0.00
2231	Sukhbaatar	Uubayan	0.00	0.00	0.00	4834	Dundgovi	Saikhan-Ovoo	0.00	0.00	0.00	8131	Zavkhan	Otgon	0.00	0.00	0.00
2234	Sukhbaatar	Khalzan	0.00	0.00	0.00	4837	Dundgovi	Khuld	0.00	0.00	0.00	8134	Zavkhan	Santmargats	0.00	0.00	0.00
2237	Sukhbaatar	Erdenetsagaan	0.00	0.00	0.00	4840	Dundgovi	Tsagaandelger	0.00	0.00	0.00	8137	Zavkhan	Songino	0.00	0.00	0.00
2301	Khenti	Kherlen	-10.76	0.00	-10.76	4843	Dundgovi	Erdendalai	0.00	0.00	0.00	8140	Zavkhan	Tosontsengel	0.00	0.00	0.00
2304	Khenti	Batnorov	0.00	0.00	0.00	6101	Orkhon	Bayan-Undur	-4.65	-6.65	-11.30	8143	Zavkhan	Tudevtei	0.00	0.00	0.00
2307	Khenti	Batshireet	0.00	0.00	0.00	6104	Orkhon	Jargalant	0.00	0.00	0.00	8146	Zavkhan	Telmen	0.00	0.00	0.00
2310	Khenti	Bayan-Adarga	0.00	0.00	0.00	6201	Uvurkhangai	Arvaikheer	-7.68	-7.69	-15.37	8149	Zavkhan	Tes	0.00	0.00	0.00
2313	Khenti	Bayanmunkh	0.00	0.00	0.00	6204	Uvurkhangai	Baruunbayan-Ulaan	0.00	0.00	0.00	8152	Zavkhan	Urgamal	0.00	0.00	0.00
2316	Khenti	Bayan-Ovoo	0.00	0.00	0.00	6207	Uvurkhangai	Bat-Ulzii	-0.42	0.00	-0.42	8155	Zavkhan	Tsagaankhairkhan	0.00	0.00	0.00
2319	Khenti	Bayankhutag	0.00	0.00	0.00	6210	Uvurkhangai	Bayangol	0.00	0.00	0.00	8158	Zavkhan	Tsagaanchuluut	0.00	0.00	0.00
2322	Khenti	Binder	0.00	0.00	0.00	6213	Uvurkhangai	Bayan-Undur	0.00	0.00	0.00	8161	Zavkhan	Tsetsen-Uul	0.00	0.00	0.00
2325	Khenti	Galshir	0.00	0.00	0.00	6216	Uvurkhangai	Bogd	0.00	0.00	0.00	8164	Zavkhan	Shiluustei	0.00	0.00	0.00
2328	Khenti	Dadal	0.00	0.00	0.00	6219	Uvurkhangai	Burd	-0.58	0.00	-0.58	8167	Zavkhan	Erdenekhairkhan	0.00	0.00	0.00
2331	Khenti	Darkhan	0.00	0.00	0.00	6222	Uvurkhangai	Guchin-Us	0.00	0.00	0.00	8170	Zavkhan	Yaruu	0.00	0.00	0.00
2334	Khenti	Dergelkhaan	0.00	0.00	0.00	6225	Uvurkhangai	Yesunzuil	-0.64	0.00	-0.64	8201	Gove-Altai	Esunbulag	0.00	0.00	0.00
2337	Khenti	Jagaltkhaan	0.00	0.00	0.00	6228	Uvurkhangai	Zuunbayan-Ulaan	0.00	0.00	0.00	8204	Gove-Altai	Altai	0.00	0.00	0.00
2340	Khenti	Murun	0.00	0.00	0.00	6231	Uvurkhangai	Nariinteel	0.00	0.00	0.00	8207	Gove-Altai	Bayan-Uul	0.00	0.00	0.00
2343	Khenti	Norovlin	0.00	0.00	0.00	6234	Uvurkhangai	Ulziit	0.00	0.00	0.00	8210	Gove-Altai	Binger	0.00	0.00	0.00
2346	Khenti	Umnudelger	0.00	0.00	0.00	6237	Uvurkhangai	Sant	0.00	0.00	0.00	8213	Gove-Altai	Bugat	0.00	0.00	0.00
2349	Khenti	Tsenkhermandal	0.00	0.00	0.00	6240	Uvurkhangai	Taragt	0.00	0.00	0.00	8216	Gove-Altai	Darvi	0.00	0.00	0.00
4101	Tuv	Zuunmod	-3.20	-39.61	-42.81	6243	Uvurkhangai	Tugrug	0.00	0.00	0.00	8219	Gove-Altai	Delger	0.00	0.00	0.00
4103	Tuv	Altanbulag	0.00	0.00	0.00	6246	Uvurkhangai	Uyanga	-1.16	0.00	-1.16	8222	Gove-Altai	Jargalan	0.00	0.00	0.00
4107	Tuv	Argalant	0.00	0.00	0.00	6249	Uvurkhangai	Khairkhandulaan	0.00	0.00	0.00	8225	Gove-Altai	Taishir	0.00	0.00	0.00
4110	Tuv	Arkhust	0.00	0.00	0.00	6252	Uvurkhangai	Kharkhorin	0.00	0.00	0.00	8228	Gove-Altai	Tonkhil	0.00	0.00	0.00
4113	Tuv	Batsumber	0.00	0.00	0.00	6255	Uvurkhangai	Khujirt	0.00	0.00	0.00	8231	Gove-Altai	Tugrug	0.00	0.00	0.00
4116	Tuv	Bayan	0.00	0.00	0.00	6301	Bulgan	Bulgan	-7.33	-7.34	-14.67	8234	Gove-Altai	Kaliun	0.00	0.00	0.00
4119	Tuv	Bayandelger	0.00	0.00	0.00	6304	Bulgan	Bayan-Agt	0.00	0.00	0.00	8237	Gove-Altai	Khunkhmorit	0.00	0.00	0.00
4122	Tuv	Bayanjargalan	0.00	0.00	0.00	6307	Bulgan	Bayannuur	-1.15	0.00	-1.15	8240	Gove-Altai	Tsogt	0.00	0.00	0.00
4125	Tuv	Bayan-Unjuul	0.00	0.00	0.00	6310	Bulgan	Bugat	0.00	0.00	0.00	8243	Gove-Altai	Tseel	0.00	0.00	0.00
4128	Tuv	Bayankhangai	0.00	0.00	0.00	6313	Bulgan	Buregkhangai	-1.67	0.00	-1.67	8246	Gove-Altai	Chandmani	0.00	0.00	0.00
4131	Tuv	Bayantsagaan	0.00	0.00	0.00	6316	Bulgan	Gurvanbulag	-1.81	0.00	-1.81	8249	Gove-Altai	Sharga	0.00	0.00	0.00
4134	Tuv	Bayantsogt	0.00	0.00	0.00	6319	Bulgan	Dhashinchilen	-1.72	0.00	-1.72	8252	Gove-Altai	Erdene	0.00	0.00	0.00
4137	Tuv	Bayanchandmani	0.00	0.00	0.00	6322	Bulgan	Mogod	0.00	0.00	0.00	8301	Bayan-Ulgii	Ulgii	-1.60	-1.36	-2.95
4140	Tuv	Bornuur	0.00	0.00	0.00	6325	Bulgan	Orkhon	0.00	0.00	0.00	8304	Bayan-Ulgii	Altai	0.00	0.00	0.00
4143	Tuv	Buren	0.00	0.00	0.00	6328	Bulgan	Rashaant	-1.45	0.00	-1.45	8307	Bayan-Ulgii	Altantsugts	0.00	0.00	0.00
4146	Tuv	Delgerkhaan	0.00	0.00	0.00	6331	Bulgan	Saikhan	0.00	0.00	0.00	8310	Bayan-Ulgii	Bayannuur	0.00	0.00	0.00
4149	Tuv	Jargalant	0.00	0.00	0.00	6334	Bulgan	Selenge	0.00	0.00	0.00	8313	Bayan-Ulgii	Bugat	0.00	0.00	0.00
4152	Tuv	Zaamar	-1.08	0.00	-1.08	6337	Bulgan	Teshig	0.00	0.00	0.00	8316	Bayan-Ulgii	Bulgan	0.00	0.00	0.00
4155	Tuv	Lun	-0.51	0.00	-0.51	6340	Bulgan	Khangal	0.00	0.00	0.00	8319	Bayan-Ulgii	Buyant	0.00	0.00	0.00
4158	Tuv	Mungunmorit	0.00	0.00	0.00	6343	Bulgan	Khishing-Undur	0.00	0.00	0.00	8322	Bayan-Ulgii	Deluum	0.00	0.00	0.00
4161	Tuv	Undurshireet	-0.38	0.00	-0.38	6346	Bulgan	Khutag-Unduur	0.00	0.00	0.00	8325	Bayan-Ulgii	Nogoonnuur	0.00	0.00	0.00
4164	Tuv	Sumber	0.00	0.00	0.00	6401	Bayankhongor	Bayankhongor	-4.75	-8.62	-13.37	8328	Bayan-Ulgii	Sagsai	0.00	0.00	0.00
4167	Tuv	Sergelen	0.00	0.00	0.00	6404	Bayankhongor	Baatsagaan	0.00	0.00	0.00	8331	Bayan-Ulgii	Tolbo	0.00	0.00	0.00
4170	Tuv	Ugtaaltsaidam	-0.52	0.00	-0.52	6407	Bayankhongor	Bayanbulag	0.00	0.00	0.00	8334	Bayan-Ulgii	Ulaankhus	0.00	0.00	0.00
4173	Tuv	Tseel	0.00	0.00	0.00	6410	Bayankhongor	Bayangobi	0.00	0.00	0.00	8340	Bayan-Ulgii	Tsengel	0.00	0.00	0.00
4176	Tuv	Erdene	0.00	0.00	0.00	6413	Bayankhongor	Bayanlig	0.00	0.00	0.00	8401	Khovd	Jargalant	-2.98	-4.39	-7.36
4179	Tuv	Erdensant	0.00	0.00	0.00	6416	Bayankhongor	Bayan-Ovoo	0.00	0.00	0.00	8404	Khovd	Altai	0.00	0.00	0.00
4201	Goveisumber	Sumber	0.00	0.00	0.00	6419	Bayankhongor	Bayan-Undur	0.00	0.00	0.00	8407	Khovd	Bulgan	0.00	0.00	0.00
4204	Goveisumber	Bayantal	0.00	0.00	0.00	6422	Bayankhongor	Bayantsagaan	0.00	0.00	0.00	8410	Khovd	Buyant	0.00	0.00	0.00
4207	Goveisumber	Shivee gobi	0.00	0.00	0.00	6425	Bayankhongor	Bogd	0.00	0.00	0.00	8413	Khovd	Darvi	0.00	0.00	0.00
4301	Selenge	Sukhbaatar	-70.84	0.00	-70.84	6428	Bayankhongor	Bumbugur	0.00	0.00	0.00	8416	Khovd	Durgun	0.00	0.00	0.00
4304	Selenge	Altanbulag	0.00	0.00	0.00	6431	Bayankhongor	Buutsagaan	0.00	0.00	0.00	8419	Khovd	Duut	0.00	0.00	0.00
4307	Selenge	Baruunburen	-3.56	0.00	-3.56	6434	Bayankhongor	Galuut	0.00	0.00	0.00	8422	Khovd	Zereg	0.00	0.00	0.00
4310	Selenge	Bayangol	-7.60	0.00	-7.60	6437	Bayankhongor	Gurvanbulag	0.00	0.00	0.00	8425	Khovd	Mankhan	0.00	0.00	0.00
4313	Selenge	Yeruu	0.00	0.00	0.00	6440	Bayankhongor	Jargalant	0.00	0.00	0.00	8428	Khovd	Munkhkhairkhan	0.00	0.00	0.00
4316	Selenge	Javkhlant	-5.85	0.00	-5.85	6443	Bayankhongor	Jinst	0.00	0.00	0.00	8431	Khovd	Must	0.00	0.00	0.00
4319	Selenge	Zuunburen	-8.18	0.00	-8.18	6446	Bayankhongor	Zag	0.00	0.00	0.00	8434	Khovd	Myangat	0.00	0.00	0.00
4322	Selenge	Mandal	-30.75	0.00	-30.75	6449	Bayankhongor	Ulziit	0.00	0.00	0.00	8437	Khovd	Uyench	0.00	0.00	0.00
4325	Selenge	Orkhon	-4.42	0.00	-4.42	6452	Bayankhongor	Khureemaral	0.00	0.00	0.00	8440	Khovd	Khovd	0.00	0.00	0.00
4328	Selenge	Orkhontuul	-4.90	0.00	-4.90	6455	Bayankhongor	Shinejinst	0.00	0.00	0.00	8443	Khovd	Tsetseg	0.00	0.00	0.00
4331	Selenge	Saikhan	-26.16	0.00	-26.16	6458	Bayankhongor	Erdenetsogt	0.00	0.00	0.00	8446	Khovd	Chandmani	0.00	0.00	0.00
4334	Selenge	Sant	-3.20	0.00	-3.20	6501	Arkhangai	Erdenbulgan	-20.69	-5.90	-26.58	8449	Khovd	Erdenburen	0.00	0.00	0.00
4337	Selenge	Tushig	0.00	0.00	0.00	6504	Arkhangai	Battsengel	0.00	0.00	0.00	8504	Uvs	Baruunturuun	0.00	0.00	0.00
4340	Selenge	Khuder	0.00	0.00	0.00	6507	Arkhangai	Bulgan	-1.69	0.00	-1.69	8507	Uvs	Bukhmurun	0.00	0.00	0.00
4343	Selenge	Khushaat	0.00	0.00	0.00	6510	Arkhangai	Jargalant	0.00	0.00	0.00	8510	Uvs	Davst	0.00	0.00	0.00
4346	Selenge	Tsagaannuur	0.00	0.00	0.00	6513	Arkhangai	Ikh Tamir	0.00	0.00	0.00	8513	Uvs	Zavkhan	0.00	0.00	0.00
4349	Selenge	Shaamar	-12.37	0.00	-12.37	6516	Arkhangai	Ugiinuur	0.00	0.00	0.00	8516	Uvs	Zuungobi	0.00	0.00	0.00
4352	Selenge	Shaamar	0.00	0.00	0.00	6519	Arkhangai	Ulziit	0.00	0.00	0.00	8519	Uvs	Zuunkhangai	0.00	0.00	0.00
4401	Dornogovi	Sainshand	0.00	-22.76	-22.76	6522	Arkhangai	Unduur-Ulaan	0.00	0.00	0.00	8522	Uvs	Malchin	0.00	0.00	0.00
4404	Dornogovi	Airag	0.00	0.00	0.00	6525	Arkhangai	Tariat	0.00	0.00	0.00	8525	Uvs	Naranbulag	0.00	0.00	0.00
4407	Dornogovi	Altanshiree	0.00	0.00	0.00	6528	Arkhangai	Tuvshruulekh	0.00	0.00	0.00	8528	Uvs	Ulgii	0.00	0.00	0.00
4410	Dornogovi	Dalanjargalan	0.00	0.00	0.00	6531	Arkhangai	Khairkhan	0.00	0.00	0.00	8531	Uvs	Umnugobi	0.00	0.00	0.00
4413	Dornogovi	Delgerekh	0.00	0.00	0.00	6534	Arkhangai	Khangai	0.00	0.00	0.00	8534	Uvs	Undurkhangai	0.00	0.00	0.00
4416	Dornogovi	Zamin-Uud	0.00	-10.30	-10.30	6537	Arkhangai	Khashaat	-2.96	0.00	-2.96	8537	Uvs	Sagil	0.00	0.00	0.00
4419	Dornogovi	Ikhkhet	0.00	0.00	0.00	6540	Arkhangai	Khotont	-1.99	0.00	-1.99	8540	Uvs	Tarialan	0.00	0.00	0.00
4422	Dornogovi	Mandakh	0.00	0.00	0.00	6543	Arkhangai	Tsakhir	0.00	0.00	0.00	8540	Uvs	Tarialan	0.00	0.00	0.00
4425	Dornogovi	Urgun	0.00	0.00	0.00	6546	Arkhangai	Tsenkher	-4.77	0.00	-4.77	8543	Uvs	Turgen	0.00	0.00	0.00
4428	Dornogovi	Saikhandulaan	0.00	0.00	0.00	6549	Arkhangai	Tsetserleg	0.00	0.00	0.00	8546	Uvs	Tes	0.00	0.00	0.00
4431	Dornogovi	Ulaanbadrakh	0.00	0.00	0.00	6552	Arkhangai	Chuluut	0.00	0.00	0.00	8549	Uvs	Khovd	0.00	0.00	0.00
4434	Dornogovi	Khatanbulag	0.00	0.00	0.00	6555	Arkhangai	Erdebmandal	0.00	0.00	0.00	8552	Uvs	Khyargas	0.00	0.00	0.00
4437	Dornogovi	Khuvsgul	0.00	0.00	0.00	6701	Khusvgul	Murun	-4.40	-5.29	-9.68	8555	Uvs	Tsagaankhairkhan	0.00	0.00	0.00

Source: JICA Project Team

Table 3.7.26 Water Balance in 2040 Demand by Soum (Dry Year, 2050 RCP8.5)

ID	Aimag	Soum Name	Water Deficit (Dry Year)			ID	Aimag	Soum Name	Water Deficit (Dry Year)			ID	Aimag	Soum Name	Water Deficit (Dry Year)		
			SW	GW	Total				SW	GW	Total				SW	GW	Total
1101	Ulaanbaatar	Baganuur	0.00	0.00	0.00	4440	Dornogovi	Erdene	0.00	0.00	0.00	6704	Khusvgul	Alag-Erdene	0.00	0.00	0.00
1104	Ulaanbaatar	Bagaxangai	0.00	0.00	0.00	4443	Dornogovi	Sainshand	0.00	-3.03	-3.03	6707	Khusvgul	Arbulag	0.00	0.00	0.00
1107	Ulaanbaatar	Bayangol	-5.45	-34.78	-40.23	4501	Darkhan-Uul	Darkhan	-33.87	-2.13	-36.00	6710	Khusvgul	Bayanzukh	0.00	0.00	0.00
1110	Ulaanbaatar	Bayanzu'rx	0.00	-33.04	-33.04	4504	Darkhan-Uul	Orkohn	-1.16	0.00	-1.16	6713	Khusvgul	Burentogtokh	0.00	0.00	0.00
1113	Ulaanbaatar	Nalaix	0.00	0.00	0.00	4507	Darkhan-Uul	Khongor	-1.69	0.00	-1.69	6716	Khusvgul	Galat	0.00	0.00	0.00
1116	Ulaanbaatar	Songinoxairxan	-5.54	-23.97	-29.52	4510	Darkhan-Uul	Sharingol	-3.37	0.00	-3.37	6719	Khusvgul	Jargalant	0.00	0.00	0.00
1119	Ulaanbaatar	Su'xbaatar	0.00	-20.62	-20.62	4601	Umnugovi	Dalanzadgad	-4.10	-8.33	-12.43	6722	Khusvgul	Ikh-Uul	0.00	0.00	0.00
1121	Ulaanbaatar	Xan-Uul	0.00	-19.65	-19.65	4604	Umnugovi	Bayandalai	0.00	0.00	0.00	6725	Khusvgul	Rashaant	0.00	-1.11	-1.11
1125	Ulaanbaatar	Chingeltei	-2.49	-24.55	-27.05	4607	Umnugovi	Bayan-Ovoo	0.00	0.00	0.00	6728	Khusvgul	Renchinlumbe	0.00	0.00	0.00
2104	Dornod	Bayandun	0.00	0.00	0.00	4610	Umnugovi	Bulgan	0.00	0.00	0.00	6731	Khusvgul	Taialan	0.00	0.00	0.00
2107	Dornod	Bayantumen	-11.90	0.00	-11.90	4613	Umnugovi	Gurvantes	0.00	0.00	0.00	6734	Khusvgul	Tosontsengel	0.00	0.00	0.00
2107	Dornod	Bayantumen	-11.90	0.00	-11.90	4616	Umnugovi	Mandal-Ovoo	0.00	0.00	0.00	6737	Khusvgul	Tumubulag	0.00	0.00	0.00
2110	Dornod	Bayan-Uul	-0.63	0.00	-0.63	4619	Umnugovi	Munlai	0.00	0.00	0.00	6740	Khusvgul	Tunel	0.00	0.00	0.00
2113	Dornod	Bulgan	0.00	0.00	0.00	4622	Umnugovi	Noyon	0.00	0.00	0.00	6743	Khusvgul	Ulaan-Uul	0.00	0.00	0.00
2116	Dornod	Gurvanzagal	0.00	0.00	0.00	4625	Umnugovi	Nomgon	0.00	0.00	0.00	6746	Khusvgul	Khankh	0.00	0.00	0.00
2119	Dornod	Dashbalbar	-0.92	0.00	-0.92	4628	Umnugovi	Sevrei	0.00	0.00	0.00	6749	Khusvgul	Tsagaannuur	0.00	0.00	0.00
2122	Dornod	Matad	0.00	0.00	0.00	4631	Umnugovi	Khanbogd	0.00	0.00	0.00	6752	Khusvgul	Tsagaan-Uul	0.00	0.00	0.00
2125	Dornod	Selgeren	0.00	0.00	0.00	4634	Umnugovi	Khankhongor	0.00	0.00	0.00	6755	Khusvgul	Tsagaan-Uur	0.00	0.00	0.00
2128	Dornod	Khalkhgol	0.00	0.00	0.00	4637	Umnugovi	Khurmen	0.00	0.00	0.00	6758	Khusvgul	Tsetserleg	0.00	0.00	0.00
2131	Dornod	Khulunbuir	0.00	0.00	0.00	4640	Umnugovi	Tsogt-Ovoo	0.00	0.00	0.00	6761	Khusvgul	Chandmani-Undur	0.00	0.00	0.00
2134	Dornod	Tsagaan-Ovoo	0.00	0.00	0.00	4643	Umnugovi	Tsogttsetsii	0.00	0.00	0.00	6764	Khusvgul	Shine-ider	0.00	0.00	0.00
2137	Dornod	Choibalsan	0.00	0.00	0.00	4801	Dundgovi	Saintsagaan	0.00	0.00	0.00	6767	Khusvgul	Erdenbulgan	0.00	0.00	0.00
2140	Dornod	Chuluunkhoroot	-0.06	0.00	-0.06	4804	Dundgovi	Adaatsag	0.00	0.00	0.00	8101	Zavkhan	Uliastai	-4.26	-2.10	-6.36
2201	Sukhbaatar	Baruun-Urt	0.00	0.00	0.00	4807	Dundgovi	Bayanjargalan	0.00	0.00	0.00	8104	Zavkhan	Ardarkhan	0.00	0.00	0.00
2204	Sukhbaatar	Asgat	0.00	0.00	0.00	4810	Dundgovi	Govi-Ugtaal	0.00	0.00	0.00	8107	Zavkhan	Asgat	0.00	0.00	0.00
2207	Sukhbaatar	Bayandelger	0.00	0.00	0.00	4813	Dundgovi	Gurvansaihan	0.00	0.00	0.00	8110	Zavkhan	Bayantes	0.00	0.00	0.00
2210	Sukhbaatar	Dariganga	0.00	0.00	0.00	4816	Dundgovi	Delgerkhangai	0.00	0.00	0.00	8113	Zavkhan	Bayankhairkhan	0.00	0.00	0.00
2213	Sukhbaatar	Munkhkhaan	0.00	0.00	0.00	4819	Dundgovi	Delgertsogt	0.00	0.00	0.00	8116	Zavkhan	Durvuligin	0.00	0.00	0.00
2216	Sukhbaatar	Naran	0.00	0.00	0.00	4822	Dundgovi	Deren	0.00	0.00	0.00	8119	Zavkhan	Zavkhanmandal	0.00	0.00	0.00
2219	Sukhbaatar	Ongon	0.00	0.00	0.00	4825	Dundgovi	Luus	0.00	0.00	0.00	8122	Zavkhan	Ider	0.00	0.00	0.00
2225	Sukhbaatar	Tuvshinshiree	0.00	0.00	0.00	4828	Dundgovi	Ulziit	0.00	0.00	0.00	8125	Zavkhan	Ikh-Uul	0.00	0.00	0.00
2228	Sukhbaatar	Tumentsogt	0.00	0.00	0.00	4831	Dundgovi	Undurshil	0.00	0.00	0.00	8128	Zavkhan	Numrug	0.00	0.00	0.00
2231	Sukhbaatar	Uubayan	0.00	0.00	0.00	4834	Dundgovi	Saikhan-Ovoo	0.00	0.00	0.00	8131	Zavkhan	Otgon	0.00	0.00	0.00
2234	Sukhbaatar	Khalzan	0.00	0.00	0.00	4837	Dundgovi	Khuld	0.00	0.00	0.00	8134	Zavkhan	Santmargats	0.00	0.00	0.00
2237	Sukhbaatar	Erdenetsagaan	0.00	0.00	0.00	4840	Dundgovi	Tsagaandelger	0.00	0.00	0.00	8137	Zavkhan	Songino	0.00	0.00	0.00
2301	Khenti	Kherlen	-11.50	0.00	-11.50	4843	Dundgovi	Erdendalai	0.00	0.00	0.00	8140	Zavkhan	Tosontsengel	0.00	0.00	0.00
2304	Khenti	Batnorov	0.00	0.00	0.00	6101	Orkhon	Bayan-Undur	-4.64	-6.62	-11.26	8143	Zavkhan	Tudevtei	0.00	0.00	0.00
2307	Khenti	Batshireet	0.00	0.00	0.00	6104	Orkhon	Jargalant	0.00	0.00	0.00	8146	Zavkhan	Telmen	0.00	0.00	0.00
2310	Khenti	Bayan-Adarga	0.00	0.00	0.00	6201	Uvurkhangai	Arvaikheer	-7.68	-7.69	-15.37	8149	Zavkhan	Tes	0.00	0.00	0.00
2313	Khenti	Bayanmunkh	0.00	0.00	0.00	6204	Uvurkhangai	Baruunbayan-Ulaan	0.00	0.00	0.00	8152	Zavkhan	Urgamal	0.00	0.00	0.00
2316	Khenti	Bayan-Ovoo	0.00	0.00	0.00	6207	Uvurkhangai	Bat-Ulzii	-0.24	0.00	-0.24	8155	Zavkhan	Tsagaankhairkhan	0.00	0.00	0.00
2319	Khenti	Bayankhutag	0.00	0.00	0.00	6210	Uvurkhangai	Bayangol	0.00	0.00	0.00	8158	Zavkhan	Tsagaanchuluut	0.00	0.00	0.00
2322	Khenti	Binder	0.00	0.00	0.00	6213	Uvurkhangai	Bayan-Undur	0.00	0.00	0.00	8161	Zavkhan	Tsetsen-Uul	0.00	0.00	0.00
2325	Khenti	Galshir	0.00	0.00	0.00	6216	Uvurkhangai	Bogd	0.00	0.00	0.00	8164	Zavkhan	Shiluustei	0.00	0.00	0.00
2328	Khenti	Dadal	0.00	0.00	0.00	6219	Uvurkhangai	Burd	-0.53	0.00	-0.53	8167	Zavkhan	Erdenekhairkhan	0.00	0.00	0.00
2331	Khenti	Darkhan	-0.33	0.00	-0.33	6222	Uvurkhangai	Guchin-Us	0.00	0.00	0.00	8170	Zavkhan	Yaruu	0.00	0.00	0.00
2334	Khenti	Dergelkhaan	0.00	0.00	0.00	6225	Uvurkhangai	Yesunzuil	-0.60	0.00	-0.60	8201	Gove-Altai	Esunbulag	0.00	0.00	0.00
2337	Khenti	Jagaltkhaan	0.00	0.00	0.00	6228	Uvurkhangai	Zuunbayan-Ulaan	-0.02	0.00	-0.02	8204	Gove-Altai	Altai	0.00	0.00	0.00
2340	Khenti	Murun	0.00	0.00	0.00	6231	Uvurkhangai	Nariinteel	0.00	0.00	0.00	8207	Gove-Altai	Bayan-Uul	0.00	0.00	0.00
2343	Khenti	Norovlin	0.00	0.00	0.00	6234	Uvurkhangai	Ulziit	0.00	0.00	0.00	8210	Gove-Altai	Binger	0.00	0.00	0.00
2346	Khenti	Umnudelger	0.00	0.00	0.00	6237	Uvurkhangai	Sant	0.00	0.00	0.00	8213	Gove-Altai	Bugat	0.00	0.00	0.00
2349	Khenti	Tsenkhermandal	0.00	0.00	0.00	6240	Uvurkhangai	Taragt	0.00	0.00	0.00	8216	Gove-Altai	Darvi	0.00	0.00	0.00
4101	Tuv	Zuunmod	-3.20	-39.63	-42.83	6243	Uvurkhangai	Tugrug	0.00	0.00	0.00	8219	Gove-Altai	Delger	0.00	0.00	0.00
4103	Tuv	Altanbulag	0.00	0.00	0.00	6246	Uvurkhangai	Uyanga	-1.20	0.00	-1.20	8222	Gove-Altai	Jargalan	0.00	0.00	0.00
4107	Tuv	Argalant	0.00	0.00	0.00	6249	Uvurkhangai	Khairkhandulaan	0.00	0.00	0.00	8225	Gove-Altai	Taishir	0.00	0.00	0.00
4110	Tuv	Arkhust	0.00	0.00	0.00	6252	Uvurkhangai	Kharkhorin	0.00	0.00	0.00	8228	Gove-Altai	Tonkhil	0.00	0.00	0.00
4113	Tuv	Batsumber	0.00	0.00	0.00	6255	Uvurkhangai	Khujirt	0.00	0.00	0.00	8231	Gove-Altai	Tugrug	0.00	0.00	0.00
4116	Tuv	Bayan	0.00	0.00	0.00	6301	Bulgan	Bulgan	-7.33	-7.32	-14.65	8234	Gove-Altai	Kaliun	0.00	0.00	0.00
4119	Tuv	Bayandelger	0.00	0.00	0.00	6304	Bulgan	Bayan-Agt	0.00	0.00	0.00	8237	Gove-Altai	Khunkhmorit	0.00	0.00	0.00
4122	Tuv	Bayanjargalan	0.00	0.00	0.00	6307	Bulgan	Bayannuur	-1.16	0.00	-1.16	8240	Gove-Altai	Tsogt	0.00	0.00	0.00
4125	Tuv	Bayan-Unjuul	0.00	0.00	0.00	6310	Bulgan	Bugat	0.00	0.00	0.00	8243	Gove-Altai	Tseel	0.00	0.00	0.00
4128	Tuv	Bayankhangai	0.00	0.00	0.00	6313	Bulgan	Buregkhangai	-1.68	0.00	-1.68	8246	Gove-Altai	Chandmani	0.00	0.00	0.00
4131	Tuv	Bayantsagaan	0.00	0.00	0.00	6316	Bulgan	Gurvanbulag	-1.75	0.00	-1.75	8249	Gove-Altai	Sharga	0.00	0.00	0.00
4134	Tuv	Bayantsogt	0.00	0.00	0.00	6319	Bulgan	Dhashinchilen	-1.73	0.00	-1.73	8252	Gove-Altai	Erdene	0.00	0.00	0.00
4137	Tuv	Bayanchandmani	0.00	0.00	0.00	6322	Bulgan	Mogod	0.00	0.00	0.00	8301	Bayan-Ulgii	Ulgii	-1.57	-1.37	-2.95
4140	Tuv	Bornuur	0.00	0.00	0.00	6325	Bulgan	Orkhon	0.00	0.00	0.00	8304	Bayan-Ulgii	Altai	0.00	0.00	0.00
4143	Tuv	Buren	0.00	0.00	0.00	6328	Bulgan	Rashaant	-1.47	0.00	-1.47	8307	Bayan-Ulgii	Altantsugts	0.00	0.00	0.00
4146	Tuv	Delgerkhaan	0.00	0.00	0.00	6331	Bulgan	Saikhan	0.00	0.00	0.00	8310	Bayan-Ulgii	Bayannuur	0.00	0.00	0.00
4149	Tuv	Jargalant	0.00	0.00	0.00	6334	Bulgan	Selenge	0.00	0.00	0.00	8313	Bayan-Ulgii	Bugat	0.00	0.00	0.00
4152	Tuv	Zaamar	-1.09	0.00	-1.09	6337	Bulgan	Teshig	0.00	0.00	0.00	8316	Bayan-Ulgii	Bulgan	0.00	0.00	0.00
4155	Tuv	Lun	-0.52	0.00	-0.52	6340	Bulgan	Khangal	0.00	0.00	0.00	8319	Bayan-Ulgii	Buyant	0.00	0.00	0.00
4158	Tuv	Mungunmorit	0.00	0.00	0.00	6343	Bulgan	Khishing-Undur	0.00	0.00	0.00	8322	Bayan-Ulgii	Deluum	0.00	0.00	0.00
4161	Tuv	Undurshireet	-0.38	0.00	-0.38	6346	Bulgan	Khutag-Unduur	0.00	0.00	0.00	8325	Bayan-Ulgii	Nogoonnuur	0.00	0.00	0.00
4164	Tuv	Sumber	0.00	0.00	0.00	6401	Bayankhongor	Bayankhongor	-4.76	-8.69	-13.45	8328	Bayan-Ulgii	Sagsai	0.00	0.00	0.00
4167	Tuv	Sergelen	0.00	0.00	0.00	6404	Bayankhongor	Baatsagaan	0.00	0.00	0.00	8331	Bayan-Ulgii	Tolbo	0.00	0.00	0.00
4170	Tuv	Ugtaaltsaidam	-0.53	0.00	-0.53	6407	Bayankhongor	Bayanbulag	0.00	0.00	0.00	8334	Bayan-Ulgii	Ulaankhus	0.00	0.00	0.00
4173	Tuv	Tseel	0.00	0.00	0.00	6410	Bayankhongor	Bayangobi	0.00	0.00	0.00	8340	Bayan-Ulgii	Tsengel	0.00	0.00	0.00
4176	Tuv	Erdene	0.00	0.00	0.00	6413	Bayankhongor	Bayanlig	0.00	0.00	0.00	8401	Khovd	Jargalant	-3.03	-4.45	-7.49
4179	Tuv	Erdensant	0.00	0.00	0.00	6416	Bayankhongor	Bayan-Ovoo	0.00	0.00	0.00	8404	Khovd	Altai	0.00	0.00	0.00
4201	Goveisumber	Sumber	0.00	0.00	0.00	6419	Bayankhongor	Bayan-Undur	0.00	0.00	0.00	8407	Khovd	Bulgan	0.00	0.00	0.00
4204	Goveisumber	Bayantal	0.00	0.00	0.00	6422	Bayankhongor	Bayantsagaan	0.00	0.00	0.00	8410	Khovd	Buyant	0.00	0.00	0.00
4207	Goveisumber	Shivee gobi	0.00	0.00	0.00	6425	Bayankhongor	Bogd	0.00	0.00	0.00	8413	Khovd	Darvi	0.00	0.00	0.00
4301	Selenge	Sukhbaatar	-70.84	-0.48	-71.31	6428	Bayankhongor	Bumbugur	0.00	0.00	0.00	8416	Khovd	Durgun	0.00	0.00	0.00
4304	Selenge	Altanbulag	0.00	0.00	0.00	6431	Bayankhongor	Buutsagaan	0.00	0.00	0.00	8419	Khovd	Duut	0.00	0.00	0.00
4307	Selenge	Baruunburen	-3.48	0.00	-3.48	6434	Bayankhongor	Galuut	0.00	0.00	0.00	8422	Khovd	Zereg	0.00	0.00	0.00
4310	Selenge	Bayangol	-8.50	0.00	-8.50	6437	Bayankhongor	Gurvanbulag	0.00	0.00	0.00	8425	Khovd	Mankhan	0.00	0.00	0.00
4313	Selenge	Yeruu	0.00	0.00	0.00	6440	Bayankhongor	Jargalant	0.00	0.00	0.00	8428	Khovd	Munkhkhairkhan	0.00	0.00	0.00
4316	Selenge	Javkhlant	-5.89	0.00	-5.89	6443	Bayankhongor	Jinst	0.00	0.00	0.00	8431	Khovd	Must	0.00	0.00	0.00
4319	Selenge	Zuunburen	-8.22	0.00	-8.22	6446	Bayankhongor	Zag	0.00	0.00	0.00	8434	Khovd	Myangat	0.00	0.00	0.00
4322	Selenge	Mandal	-33.97	0.00	-33.97	6449	Bayankhongor	Ulziit	0.00	0.00	0.00	8437	Khovd	Uyench	0.00	0.00	0.00
4325	Selenge	Orkhon	-4.39	0.00	-4.39	6452	Bayankhongor	Khureemaral	0.00	0.00	0.00	8440	Khovd	Khovd	0.00	0.00	0.00
4328	Selenge	Orkhontuul	-4.82	0.00	-4.82	6455	Bayankhongor	Shinejinst	0.00	0.00	0.00	8443	Khovd	Tsetseg	0.00	0.00	0.00
4331	Selenge	Saikhan	-26.13	0.00	-26.13	6458	Bayankhongor	Erdenetsogt	0.00	0.00	0.00	8446	Khovd	Chandmani	0.00	0.00	0.00
4334	Selenge	Sant	-3.17	0.00	-3.17	6501	Arkhangai	Erdenbulgan	-20.69	-5.91	-26.60	8449	Khovd	Erdenburen	0.00	0.00	0.00
4337	Selenge	Tushig	0.00	0.00	0.00	6504	Arkhangai	Battsengel	0.00	0.00	0.00	8504	Uvs	Baruunturuun	0.00	0.00	0.00
4340	Selenge	Khuder	0.00	0.00	0.00	6507	Arkhangai	Bulgan	-1.76	0.00	-1.76	8507	Uvs	Bukhmurun	0.00	0.00	0.00
4343	Selenge	Khushaat	-5.83	0.00	-5.83	6510	Arkhangai	Jargalant	0.00	0.00	0.00	8510	Uvs	Davst	0.00	0.00	0.00
4346	Selenge	Tsagaannuur	-14.93	0.00	-14.93	6513	Arkhangai	Ikh Tamir	0.00	0.00	0.00	8513	Uvs	Zavkhan	0.00	0.00	0.00
4349	Selenge	Shaamar	-12.39	0.00	-12.39	6516	Arkhangai	Ugiinuur	0.00	0.00	0.00	8516	Uvs	Zuungobi	0.00	0.00	0.00
4352	Selenge	Shaamar	0.00	0.00	0.00	6519	Arkhangai	Ulziit	0.00	0.00	0.00	8519	Uvs	Zuunkhangai	0.00	0.00	0.00
4401	Dornogovi	Sainshand	0.00	-22.76	-22.76	6522	Arkhangai	Unduur-Ulaan	0.00	0.00	0.00	8522	Uvs	Malchin	0.00	0.00	0.00
4404	Dornogovi	Airag	0.00	0.00	0.00	6525	Arkhangai	Tariat	0.00	0.00	0.00	8525	Uvs	Naranbulag	0.00	0.00	0.00
4407	Dornogovi	Altanshiree	0.00	0.00	0.00	6528	Arkhangai	Tuvshruulekh	0.00	0.00	0.00	8528	Uvs	Ulgii	0.00	0.00	0.00
4410	Dornogovi	Dalanjargalan	0.00	0.00	0.00	6531	Arkhangai	Khairkhan	0.00	0.00	0.00	8531	Uvs	Umnugobi	0.00	0.00	0.00
4413	Dornogovi	Delgerekh	0.00	0.00	0.00	6534	Arkhangai	Khangai	0.00	0.00	0.00	8534	Uvs	Undurkhangai	0.00	0.00	0.00
4416	Dornogovi	Zamin-Uud	0.00	-10.46	-10.46	6537	Arkhangai	Khashaat	-2.90	0.00	-2.90	8537	Uvs	Sagil	0.00	0.00	0.00
4419	Dornogovi	Ikhkhet	0.00	0.00	0.00	6540	Arkhangai	Khotont	-2.21	0.00	-2.21	8540	Uvs	Tarialan	0.00	0.00	0.00
4422	Dornogovi	Mandakh	0.00	0.00	0.00	6543	Arkhangai	Tsakhir	0.00	0.00	0.00	8540	Uvs	Tarialan	0.00	0.00	0.00
4425	Dornogovi	Urgun	0.00	0.00	0.00	6546	Arkhangai	Tsenkher	-4.84	0.00	-4.84	8543	Uvs	Turgen	0.00	0.00	0.00
4428	Dornogovi	Saikhandulaan	0.00	0.00	0.00	6549	Arkhangai	Tsetserleg	0.00	0.00	0.00	8546	Uvs	Tes	0.00	0.00	0.00
4431	Dornogovi	Ulaanbadrakh	0.00	0.00	0.00	6552	Arkhangai	Chuluut	0.00	0.00	0.00	8549	Uvs	Khovd	0.00	0.00	0.00
4434	Dornogovi	Khatanbulag	0.00	0.00	0.00	6555	Arkhangai	Erdebmandal	0.00	0.00	0.00	8552	Uvs	Khyargas	0.00	0.00	0.00
4437	Dornogovi	Khuvsgul	0.00	0.00	0.00	6701	Khusvgul	Murun	-4.47	-5.95	-10.42	8555	Uvs	Tsagaankhairkhan	0.00	0.00	0.00

Source: JICA Project Team

Table 3.7.27 Water Balance in 2040 Demand by Soum (Dry Year, 2100 RCP4.5)

ID	Aimag	Soum Name	Water Deficit (Dry Year)			ID	Aimag	Soum Name	Water Deficit (Dry Year)			ID	Aimag	Soum Name	Water Deficit (Dry Year)		
			SW	GW	Total				SW	GW	Total				SW	GW	Total
1101	Ulaanbaatar	Baganuur	0.00	0.00	0.00	4440	Dornogovi	Erdene	0.00	0.00	0.00	6704	Khusvgul	Alag-Erdene	0.00	0.00	0.00
1104	Ulaanbaatar	Bagaxangai	0.00	0.00	0.00	4443	Dornogovi	Sainshand	0.00	-3.03	-3.03	6707	Khusvgul	Arbulag	0.00	0.00	0.00
1107	Ulaanbaatar	Bayangol	-5.44	-34.78	-40.23	4501	Darkhan-Uul	Darkhan	-33.87	-2.00	-35.87	6710	Khusvgul	Bayanzukh	0.00	0.00	0.00
1110	Ulaanbaatar	Bayanzu'rx	0.00	-32.81	-32.81	4504	Darkhan-Uul	Orkohn	-1.17	0.00	-1.17	6713	Khusvgul	Burentogtokh	0.00	0.00	0.00
1113	Ulaanbaatar	Nalaix	0.00	0.00	0.00	4507	Darkhan-Uul	Khongor	-1.73	0.00	-1.73	6716	Khusvgul	Galat	0.00	0.00	0.00
1116	Ulaanbaatar	Songinoxairxan	-5.34	-22.71	-28.05	4510	Darkhan-Uul	Sharingol	-3.37	0.00	-3.37	6719	Khusvgul	Jargalant	0.00	0.00	0.00
1119	Ulaanbaatar	Su'xbaatar	0.00	-20.62	-20.62	4601	Umnugovi	Dalanzadgad	-4.09	-8.32	-12.41	6722	Khusvgul	Ikh-Uul	0.00	0.00	0.00
1121	Ulaanbaatar	Xan-Uul	0.00	-19.65	-19.65	4604	Umnugovi	Bayandalai	0.00	0.00	0.00	6725	Khusvgul	Rashaant	0.00	-1.07	-1.07
1125	Ulaanbaatar	Chingeltei	-2.48	-24.55	-27.03	4607	Umnugovi	Bayan-Ovoo	0.00	0.00	0.00	6728	Khusvgul	Renchinlumbe	0.00	0.00	0.00
2104	Dornod	Bayandun	0.00	0.00	0.00	4610	Umnugovi	Bulgan	0.00	0.00	0.00	6731	Khusvgul	Taialan	0.00	0.00	0.00
2107	Dornod	Bayantumen	-12.32	0.00	-12.32	4613	Umnugovi	Gurvantes	0.00	0.00	0.00	6734	Khusvgul	Tosontsengel	0.00	0.00	0.00
2107	Dornod	Bayantumen	-12.32	0.00	-12.32	4616	Umnugovi	Mandal-Ovoo	0.00	0.00	0.00	6737	Khusvgul	Tumubulag	0.00	0.00	0.00
2110	Dornod	Bayan-Uul	-0.63	0.00	-0.63	4619	Umnugovi	Munlai	0.00	0.00	0.00	6740	Khusvgul	Tunel	0.00	0.00	0.00
2113	Dornod	Bulgan	0.00	0.00	0.00	4622	Umnugovi	Noyon	0.00	0.00	0.00	6743	Khusvgul	Ulaan-Uul	0.00	0.00	0.00
2116	Dornod	Gurvanzagal	0.00	0.00	0.00	4625	Umnugovi	Nomgon	0.00	0.00	0.00	6746	Khusvgul	Khankh	0.00	0.00	0.00
2119	Dornod	Dashbalbar	-0.93	0.00	-0.93	4628	Umnugovi	Sevrei	0.00	0.00	0.00	6749	Khusvgul	Tsagaannuur	0.00	0.00	0.00
2122	Dornod	Matad	0.00	0.00	0.00	4631	Umnugovi	Khanbogd	0.00	0.00	0.00	6752	Khusvgul	Tsagaan-Uul	0.00	0.00	0.00
2125	Dornod	Selgeren	0.00	0.00	0.00	4634	Umnugovi	Khankhongor	0.00	0.00	0.00	6755	Khusvgul	Tsagaan-Uur	0.00	0.00	0.00
2128	Dornod	Khalkhgol	0.00	0.00	0.00	4637	Umnugovi	Khurmen	0.00	0.00	0.00	6758	Khusvgul	Tsetserleg	0.00	0.00	0.00
2131	Dornod	Khulunbuir	0.00	0.00	0.00	4640	Umnugovi	Tsogt-Ovoo	0.00	0.00	0.00	6761	Khusvgul	Chandmani-Undur	0.00	0.00	0.00
2134	Dornod	Tsagaan-Ovoo	0.00	0.00	0.00	4643	Umnugovi	Tsogttsetsii	0.00	0.00	0.00	6764	Khusvgul	Shine-ider	0.00	0.00	0.00
2137	Dornod	Choibalsan	0.00	0.00	0.00	4801	Dundgovi	Saintsagaan	0.00	0.00	0.00	6767	Khusvgul	Erdenbulgan	0.00	0.00	0.00
2140	Dornod	Chuluunkhoroot	-0.07	0.00	-0.07	4804	Dundgovi	Adaatsag	0.00	0.00	0.00	8101	Zavkhan	Uliastai	-4.26	-2.10	-6.36
2201	Sukhbaatar	Baruun-Urt	0.00	0.00	0.00	4807	Dundgovi	Bayanjargalan	0.00	0.00	0.00	8104	Zavkhan	Ardarkhan	0.00	0.00	0.00
2204	Sukhbaatar	Asgat	0.00	0.00	0.00	4810	Dundgovi	Govi-Ugtaal	0.00	0.00	0.00	8107	Zavkhan	Asgat	0.00	0.00	0.00
2207	Sukhbaatar	Bayandelger	0.00	0.00	0.00	4813	Dundgovi	Gurvansaihan	0.00	0.00	0.00	8110	Zavkhan	Bayantes	0.00	0.00	0.00
2210	Sukhbaatar	Dariganga	0.00	0.00	0.00	4816	Dundgovi	Delgerkhangai	0.00	0.00	0.00	8113	Zavkhan	Bayankhairkhan	0.00	0.00	0.00
2213	Sukhbaatar	Munkhkhaan	0.00	0.00	0.00	4819	Dundgovi	Delgertsogt	0.00	0.00	0.00	8116	Zavkhan	Durvuligin	0.00	0.00	0.00
2216	Sukhbaatar	Naran	0.00	0.00	0.00	4822	Dundgovi	Deren	0.00	0.00	0.00	8119	Zavkhan	Zavkhanmandal	0.00	0.00	0.00
2219	Sukhbaatar	Ongon	0.00	0.00	0.00	4825	Dundgovi	Luus	0.00	0.00	0.00	8122	Zavkhan	Ider	0.00	0.00	0.00
2225	Sukhbaatar	Tuvshinshiree	0.00	0.00	0.00	4828	Dundgovi	Ulziit	0.00	0.00	0.00	8125	Zavkhan	Ikh-Uul	0.00	0.00	0.00
2228	Sukhbaatar	Tumentsogt	0.00	0.00	0.00	4831	Dundgovi	Undurshil	0.00	0.00	0.00	8128	Zavkhan	Numrug	0.00	0.00	0.00
2231	Sukhbaatar	Uubayan	0.00	0.00	0.00	4834	Dundgovi	Saikhan-Ovoo	0.00	0.00	0.00	8131	Zavkhan	Otgon	0.00	0.00	0.00
2234	Sukhbaatar	Khalzan	0.00	0.00	0.00	4837	Dundgovi	Khuld	0.00	0.00	0.00	8134	Zavkhan	Santmargats	0.00	0.00	0.00
2237	Sukhbaatar	Erdenetsagaan	0.00	0.00	0.00	4840	Dundgovi	Tsagaandelger	0.00	0.00	0.00	8137	Zavkhan	Songino	0.00	0.00	0.00
2301	Khenti	Kherlen	-10.82	0.00	-10.82	4843	Dundgovi	Erdendalai	0.00	0.00	0.00	8140	Zavkhan	Tosontsengel	0.00	0.00	0.00
2304	Khenti	Batnorov	0.00	0.00	0.00	6101	Orkhon	Bayan-Undur	-4.67	-6.68	-11.35	8143	Zavkhan	Tudevtei	0.00	0.00	0.00
2307	Khenti	Batshireet	0.00	0.00	0.00	6104	Orkhon	Jargalant	0.00	0.00	0.00	8146	Zavkhan	Telmen	0.00	0.00	0.00
2310	Khenti	Bayan-Adarga	0.00	0.00	0.00	6201	Uvurkhangai	Arvaikheer	-7.68	-7.68	-15.35	8149	Zavkhan	Tes	0.00	0.00	0.00
2313	Khenti	Bayanmunkh	0.00	0.00	0.00	6204	Uvurkhangai	Baruunbayan-Ulaan	0.00	0.00	0.00	8152	Zavkhan	Urgamal	0.00	0.00	0.00
2316	Khenti	Bayan-Ovoo	0.00	0.00	0.00	6207	Uvurkhangai	Bat-Ulzii	-0.16	0.00	-0.16	8155	Zavkhan	Tsagaankhairkhan	0.00	0.00	0.00
2319	Khenti	Bayankhutag	0.00	0.00	0.00	6210	Uvurkhangai	Bayangol	0.00	0.00	0.00	8158	Zavkhan	Tsagaanchuluut	0.00	0.00	0.00
2322	Khenti	Binder	0.00	0.00	0.00	6213	Uvurkhangai	Bayan-Undur	0.00	0.00	0.00	8161	Zavkhan	Tsetsen-Uul	0.00	0.00	0.00
2325	Khenti	Galshir	0.00	0.00	0.00	6216	Uvurkhangai	Bogd	0.00	0.00	0.00	8164	Zavkhan	Shiluustei	0.00	0.00	0.00
2328	Khenti	Dadal	0.00	0.00	0.00	6219	Uvurkhangai	Burd	-0.58	0.00	-0.58	8167	Zavkhan	Erdenekhairkhan	0.00	0.00	0.00
2331	Khenti	Darkhan	0.00	0.00	0.00	6222	Uvurkhangai	Guchin-Us	0.00	0.00	0.00	8170	Zavkhan	Yaruu	0.00	0.00	0.00
2334	Khenti	Dergelkhaan	0.00	0.00	0.00	6225	Uvurkhangai	Yesunzuil	-0.64	0.00	-0.64	8201	Gove-Altai	Esunbulag	0.00	0.00	0.00
2337	Khenti	Jagaltkhaan	0.00	0.00	0.00	6228	Uvurkhangai	Zuunbayan-Ulaan	0.00	0.00	0.00	8204	Gove-Altai	Altai	0.00	0.00	0.00
2340	Khenti	Murun	0.00	0.00	0.00	6231	Uvurkhangai	Nariinteel	0.00	0.00	0.00	8207	Gove-Altai	Bayan-Uul	0.00	0.00	0.00
2343	Khenti	Norovlin	0.00	0.00	0.00	6234	Uvurkhangai	Ulziit	0.00	0.00	0.00	8210	Gove-Altai	Binger	0.00	0.00	0.00
2346	Khenti	Umnudelger	0.00	0.00	0.00	6237	Uvurkhangai	Sant	0.00	0.00	0.00	8213	Gove-Altai	Bugat	0.00	0.00	0.00
2349	Khenti	Tsenkhermandal	0.00	0.00	0.00	6240	Uvurkhangai	Taragt	0.00	0.00	0.00	8216	Gove-Altai	Darvi	0.00	0.00	0.00
4101	Tuv	Zuunmod	-3.19	-39.61	-42.80	6243	Uvurkhangai	Tugrug	0.00	0.00	0.00	8219	Gove-Altai	Delger	0.00	0.00	0.00
4103	Tuv	Altanbulag	-0.07	0.00	-0.07	6246	Uvurkhangai	Uyanga	-1.01	0.00	-1.01	8222	Gove-Altai	Jargalan	0.00	0.00	0.00
4107	Tuv	Argalant	0.00	0.00	0.00	6249	Uvurkhangai	Khairkhandulaan	0.00	0.00	0.00	8225	Gove-Altai	Taishir	0.00	0.00	0.00
4110	Tuv	Arkhust	0.00	0.00	0.00	6252	Uvurkhangai	Kharkhorin	0.00	0.00	0.00	8228	Gove-Altai	Tonkhil	0.00	0.00	0.00
4113	Tuv	Batsumber	0.00	0.00	0.00	6255	Uvurkhangai	Khujirt	0.00	0.00	0.00	8231	Gove-Altai	Tugrug	0.00	0.00	0.00
4116	Tuv	Bayan	0.00	0.00	0.00	6301	Bulgan	Bulgan	-7.34	-7.35	-14.68	8234	Gove-Altai	Kaliun	0.00	0.00	0.00
4119	Tuv	Bayandelger	0.00	0.00	0.00	6304	Bulgan	Bayan-Agt	0.00	0.00	0.00	8237	Gove-Altai	Khunkhmorit	0.00	0.00	0.00
4122	Tuv	Bayanjargalan	0.00	0.00	0.00	6307	Bulgan	Bayannuur	-1.16	0.00	-1.16	8240	Gove-Altai	Tsogt	0.00	0.00	0.00
4125	Tuv	Bayan-Unjuul	0.00	0.00	0.00	6310	Bulgan	Bugat	0.00	0.00	0.00	8243	Gove-Altai	Tseel	0.00	0.00	0.00
4128	Tuv	Bayankhangai	0.00	0.00	0.00	6313	Bulgan	Buregkhangai	-1.68	0.00	-1.68	8246	Gove-Altai	Chandmani	0.00	0.00	0.00
4131	Tuv	Bayantsagaan	0.00	0.00	0.00	6316	Bulgan	Gurvanbulag	-1.81	0.00	-1.81	8249	Gove-Altai	Sharga	0.00	0.00	0.00
4134	Tuv	Bayantsogt	0.00	0.00	0.00	6319	Bulgan	Dhashinchilen	-1.73	0.00	-1.73	8252	Gove-Altai	Erdene	0.00	0.00	0.00
4137	Tuv	Bayanchandmani	0.00	0.00	0.00	6322	Bulgan	Mogod	0.00	0.00	0.00	8301	Bayan-Ulgii	Ulgii	-1.42	-1.14	-2.56
4140	Tuv	Bornuur	0.00	0.00	0.00	6325	Bulgan	Orkhon	0.00	0.00	0.00	8304	Bayan-Ulgii	Altai	0.00	0.00	0.00
4143	Tuv	Buren	0.00	0.00	0.00	6328	Bulgan	Rashaant	-1.45	0.00	-1.45	8307	Bayan-Ulgii	Altantsugts	0.00	0.00	0.00
4146	Tuv	Delgerkhaan	0.00	0.00	0.00	6331	Bulgan	Saikhan	0.00	0.00	0.00	8310	Bayan-Ulgii	Bayannuur	0.00	0.00	0.00
4149	Tuv	Jargalant	0.00	0.00	0.00	6334	Bulgan	Selenge	0.00	0.00	0.00	8313	Bayan-Ulgii	Bugat	0.00	0.00	0.00
4152	Tuv	Zaamar	-1.09	0.00	-1.09	6337	Bulgan	Teshig	0.00	0.00	0.00	8316	Bayan-Ulgii	Bulgan	0.00	0.00	0.00
4155	Tuv	Lun	-0.52	0.00	-0.52	6340	Bulgan	Khangal	0.00	0.00	0.00	8319	Bayan-Ulgii	Buyant	0.00	0.00	0.00
4158	Tuv	Mungunmorit	0.00	0.00	0.00	6343	Bulgan	Khishing-Undur	0.00	0.00	0.00	8322	Bayan-Ulgii	Deluum	0.00	0.00	0.00
4161	Tuv	Undurshireet	-0.38	0.00	-0.38	6346	Bulgan	Khutag-Unduur	0.00	0.00	0.00	8325	Bayan-Ulgii	Nogoonnuur	0.00	0.00	0.00
4164	Tuv	Sumber	0.00	0.00	0.00	6401	Bayankhongor	Bayankhongor	-4.75	-8.67	-13.42	8328	Bayan-Ulgii	Sagsai	0.00	0.00	0.00
4167	Tuv	Sergelen	0.00	0.00	0.00	6404	Bayankhongor	Baatsagaan	0.00	0.00	0.00	8331	Bayan-Ulgii	Tolbo	0.00	0.00	0.00
4170	Tuv	Ugtaaltsaidam	-0.52	0.00	-0.52	6407	Bayankhongor	Bayanbulag	0.00	0.00	0.00	8334	Bayan-Ulgii	Ulaankhus	0.00	0.00	0.00
4173	Tuv	Tseel	0.00	0.00	0.00	6410	Bayankhongor	Bayangobi	0.00	0.00	0.00	8340	Bayan-Ulgii	Tsengel	0.00	0.00	0.00
4176	Tuv	Erdene	0.00	0.00	0.00	6413	Bayankhongor	Bayanlig	0.00	0.00	0.00	8401	Khovd	Jargalant	-3.03	-4.45	-7.48
4179	Tuv	Erdensant	0.00	0.00	0.00	6416	Bayankhongor	Bayan-Ovoo	0.00	0.00	0.00	8404	Khovd	Altai	0.00	0.00	0.00
4201	Goveisumber	Sumber	0.00	0.00	0.00	6419	Bayankhongor	Bayan-Undur	0.00	0.00	0.00	8407	Khovd	Bulgan	0.00	0.00	0.00
4204	Goveisumber	Bayantal	0.00	0.00	0.00	6422	Bayankhongor	Bayantsagaan	0.00	0.00	0.00	8410	Khovd	Buyant	0.00	0.00	0.00
4207	Goveisumber	Shivee gobi	0.00	0.00	0.00	6425	Bayankhongor	Bogd	0.00	0.00	0.00	8413	Khovd	Darvi	0.00	0.00	0.00
4301	Selenge	Sukhbaatar	-70.84	-0.55	-71.39	6428	Bayankhongor	Bumbugur	0.00	0.00	0.00	8416	Khovd	Durgun	0.00	0.00	0.00
4304	Selenge	Altanbulag	0.00	0.00	0.00	6431	Bayankhongor	Buutsagaan	0.00	0.00	0.00	8419	Khovd	Duut	0.00	0.00	0.00
4307	Selenge	Baruunburen	-3.75	0.00	-3.75	6434	Bayankhongor	Galuut	0.00	0.00	0.00	8422	Khovd	Zereg	0.00	0.00	0.00
4310	Selenge	Bayangol	-8.48	0.00	-8.48	6437	Bayankhongor	Gurvanbulag	0.00	0.00	0.00	8425	Khovd	Mankhan	0.00	0.00	0.00
4313	Selenge	Yeruu	0.00	0.00	0.00	6440	Bayankhongor	Jargalant	0.00	0.00	0.00	8428	Khovd	Munkhkhairkhan	0.00	0.00	0.00
4316	Selenge	Javkhlant	-5.92	0.00	-5.92	6443	Bayankhongor	Jinst	0.00	0.00	0.00	8431	Khovd	Must	0.00	0.00	0.00
4319	Selenge	Zuunburen	-8.24	0.00	-8.24	6446	Bayankhongor	Zag	0.00	0.00	0.00	8434	Khovd	Myangat	0.00	0.00	0.00
4322	Selenge	Mandal	-33.16	0.00	-33.16	6449	Bayankhongor	Ulziit	0.00	0.00	0.00	8437	Khovd	Uyench	0.00	0.00	0.00
4325	Selenge	Orkhon	-4.51	0.00	-4.51	6452	Bayankhongor	Khureemaral	0.00	0.00	0.00	8440	Khovd	Khovd	0.00	0.00	0.00
4328	Selenge	Orkhontuul	-5.10	0.00	-5.10	6455	Bayankhongor	Shinejinst	0.00	0.00	0.00	8443	Khovd	Tsetseg	0.00	0.00	0.00
4331	Selenge	Saikhan	-26.25	0.00	-26.25	6458	Bayankhongor	Erdenetsogt	0.00	0.00	0.00	8446	Khovd	Chandmani	0.00	0.00	0.00
4334	Selenge	Sant	-3.30	0.00	-3.30	6501	Arkhangai	Erdenbulgan	-20.69	-5.89	-26.58	8449	Khovd	Erdenburen	0.00	0.00	0.00
4337	Selenge	Tushig	0.00	0.00	0.00	6504	Arkhangai	Battsengel	0.00	0.00	0.00	8504	Uvs	Baruunturuun	0.00	0.00	0.00
4340	Selenge	Khuder	0.00	0.00	0.00	6507	Arkhangai	Bulgan	-1.69	0.00	-1.69	8507	Uvs	Bukhmurun	0.00	0.00	0.00
4343	Selenge	Khushaat	-5.83	0.00	-5.83	6510	Arkhangai	Jargalant	0.00	0.00	0.00	8510	Uvs	Davst	0.00	0.00	0.00
4346	Selenge	Tsagaannuur	-14.93	0.00	-14.93	6513	Arkhangai	Ikh Tamir	0.00	0.00	0.00	8513	Uvs	Zavkhan	0.00	0.00	0.00
4349	Selenge	Shaamar	-12.41	0.00	-12.41	6516	Arkhangai	Ugiinuur	0.00	0.00	0.00	8516	Uvs	Zuungobi	0.00	0.00	0.00
4352	Selenge	Shaamar	0.00	0.00	0.00	6519	Arkhangai	Ulziit	0.00	0.00	0.00	8519	Uvs	Zuunkhangai	0.00	0.00	0.00
4401	Dornogovi	Sainshand	0.00	-22.77	-22.77	6522	Arkhangai	Unduur-Ulaan	0.00	0.00	0.00	8522	Uvs	Malchin	0.00	0.00	0.00
4404	Dornogovi	Airag	0.00	0.00	0.00	6525	Arkhangai	Tariat	0.00	0.00	0.00	8525	Uvs	Naranbulag	0.00	0.00	0.00
4407	Dornogovi	Altanshiree	0.00	0.00	0.00	6528	Arkhangai	Tuvshruulekh	0.00	0.00	0.00	8528	Uvs	Ulgii	0.00	0.00	0.00
4410	Dornogovi	Dalanjargalan	0.00	0.00	0.00	6531	Arkhangai	Khairkhan	0.00	0.00	0.00	8531	Uvs	Umnugobi	0.00	0.00	0.00
4413	Dornogovi	Delgerekh	0.00	0.00	0.00	6534	Arkhangai	Khangai	0.00	0.00	0.00	8534	Uvs	Undurkhangai	0.00	0.00	0.00
4416	Dornogovi	Zamin-Uud	0.00	-10.14	-10.14	6537	Arkhangai	Khashaat	-2.96	0.00	-2.96	8537	Uvs	Sagil	0.00	0.00	0.00
4419	Dornogovi	Ikhkhet	0.00	0.00	0.00	6540	Arkhangai	Khotont	-2.15	0.00	-2.15	8540	Uvs	Tarialan	0.00	0.00	0.00
4422	Dornogovi	Mandakh	0.00	0.00	0.00	6543	Arkhangai	Tsakhir	0.00	0.00	0.00	8540	Uvs	Tarialan	0.00	0.00	0.00
4425	Dornogovi	Urgun	0.00	0.00	0.00	6546	Arkhangai	Tsenkher	-4.77	0.00	-4.77	8543	Uvs	Turgen	0.00	0.00	0.00
4428	Dornogovi	Saikhandulaan	0.00	0.00	0.00	6549	Arkhangai	Tsetserleg	0.00	0.00	0.00	8546	Uvs	Tes	0.00	0.00	0.00
4431	Dornogovi	Ulaanbadrakh	0.00	0.00	0.00	6552	Arkhangai	Chuluut	0.00	0.00	0.00	8549	Uvs	Khovd	0.00	0.00	0.00
4434	Dornogovi	Khatanbulag	0.00	0.00	0.00	6555	Arkhangai	Erdebmandal	0.00	0.00	0.00	8552	Uvs	Khyargas	0.00	0.00	0.00
4437	Dornogovi	Khuvsgul	0.00	0.00	0.00	6701	Khusvgul	Murun	-4.47	-5.85	-10.32	8555	Uvs	Tsagaankhairkhan	0.00	0.00	0.00

Source: JICA Project Team

Table 3.7.28 Water Balance in 2040 Demand by Soum (Dry Year, 2100 RCP8.5)

ID	Aimag	Soum Name	Water Deficit (Dry Year)			ID	Aimag	Soum Name	Water Deficit (Dry Year)			ID	Aimag	Soum Name	Water Deficit (Dry Year)		
			SW	GW	Total				SW	GW	Total				SW	GW	Total
1101	Ulaanbaatar	Baganuur	0.00	0.00	0.00	4440	Dornogovi	Erdene	0.00	0.00	0.00	6704	Khusvgul	Alag-Erdene	0.00	0.00	0.00
1104	Ulaanbaatar	Bagaxangai	0.00	0.00	0.00	4443	Dornogovi	Sainshand	0.00	-3.03	-3.03	6707	Khusvgul	Arbulag	0.00	0.00	0.00
1107	Ulaanbaatar	Bayangol	-5.37	-34.75	-40.12	4501	Darkhan-Uul	Darkhan	-33.82	-1.88	-35.70	6710	Khusvgul	Bayanzukh	0.00	0.00	0.00
1110	Ulaanbaatar	Bayanzu'rx	0.00	-32.54	-32.54	4504	Darkhan-Uul	Orkohn	-1.16	0.00	-1.16	6713	Khusvgul	Burentogtokh	0.00	0.00	0.00
1113	Ulaanbaatar	Nalaix	0.00	0.00	0.00	4507	Darkhan-Uul	Khongor	-1.68	0.00	-1.68	6716	Khusvgul	Galat	0.00	0.00	0.00
1116	Ulaanbaatar	Songinoxairxan	-5.29	-21.65	-26.94	4510	Darkhan-Uul	Sharingol	-3.37	0.00	-3.37	6719	Khusvgul	Jargalant	0.00	0.00	0.00
1119	Ulaanbaatar	Su'xbaatar	0.00	-20.30	-20.30	4601	Umnugovi	Dalanzadgad	-4.10	-8.32	-12.42	6722	Khusvgul	Ikh-Uul	0.00	0.00	0.00
1121	Ulaanbaatar	Xan-Uul	0.00	-18.91	-18.91	4604	Umnugovi	Bayandalai	0.00	0.00	0.00	6725	Khusvgul	Rashaant	0.00	-1.12	-1.12
1125	Ulaanbaatar	Chingeltei	-2.19	-24.42	-26.61	4607	Umnugovi	Bayan-Ovoo	0.00	0.00	0.00	6728	Khusvgul	Renchinlumbe	0.00	0.00	0.00
2104	Dornod	Bayandun	0.00	0.00	0.00	4610	Umnugovi	Bulgan	0.00	0.00	0.00	6731	Khusvgul	Taialan	0.00	0.00	0.00
2107	Dornod	Bayantumen	-13.22	0.00	-13.22	4613	Umnugovi	Gurvantes	0.00	0.00	0.00	6734	Khusvgul	Tosontsengel	0.00	0.00	0.00
2107	Dornod	Bayantumen	-13.22	0.00	-13.22	4616	Umnugovi	Mandal-Ovoo	0.00	0.00	0.00	6737	Khusvgul	Tumubulag	0.00	0.00	0.00
2110	Dornod	Bayan-Uul	-0.54	0.00	-0.54	4619	Umnugovi	Munlai	0.00	0.00	0.00	6740	Khusvgul	Tunel	0.00	0.00	0.00
2113	Dornod	Bulgan	0.00	0.00	0.00	4622	Umnugovi	Noyon	0.00	0.00	0.00	6743	Khusvgul	Ulaan-Uul	0.00	0.00	0.00
2116	Dornod	Gurvanzagal	0.00	0.00	0.00	4625	Umnugovi	Nomgon	0.00	0.00	0.00	6746	Khusvgul	Khankh	0.00	0.00	0.00
2119	Dornod	Dashbalbar	-0.92	0.00	-0.92	4628	Umnugovi	Sevrei	0.00	0.00	0.00	6749	Khusvgul	Tsagaannuur	0.00	0.00	0.00
2122	Dornod	Matad	0.00	0.00	0.00	4631	Umnugovi	Khanbogd	0.00	0.00	0.00	6752	Khusvgul	Tsagaan-Uul	0.00	0.00	0.00
2125	Dornod	Selgeren	0.00	0.00	0.00	4634	Umnugovi	Khankhongor	0.00	0.00	0.00	6755	Khusvgul	Tsagaan-Uur	0.00	0.00	0.00
2128	Dornod	Khalkhgol	0.00	0.00	0.00	4637	Umnugovi	Khurmen	0.00	0.00	0.00	6758	Khusvgul	Tsetserleg	0.00	0.00	0.00
2131	Dornod	Khulunbuir	0.00	0.00	0.00	4640	Umnugovi	Tsogt-Ovoo	0.00	0.00	0.00	6761	Khusvgul	Chandmani-Undur	0.00	0.00	0.00
2134	Dornod	Tsagaan-Ovoo	0.00	0.00	0.00	4643	Umnugovi	Tsogttsetsii	0.00	0.00	0.00	6764	Khusvgul	Shine-ider	0.00	0.00	0.00
2137	Dornod	Choibalsan	0.00	0.00	0.00	4801	Dundgovi	Saintsagaan	0.00	0.00	0.00	6767	Khusvgul	Erdenbulgan	0.00	0.00	0.00
2140	Dornod	Chuluunkhoroot	-0.05	0.00	-0.05	4804	Dundgovi	Adaatsag	0.00	0.00	0.00	8101	Zavkhan	Uliastai	-4.25	-2.09	-6.34
2201	Sukhbaatar	Baruun-Urt	0.00	0.00	0.00	4807	Dundgovi	Bayanjargalan	0.00	0.00	0.00	8104	Zavkhan	Ardarkhan	0.00	0.00	0.00
2204	Sukhbaatar	Asgat	0.00	0.00	0.00	4810	Dundgovi	Govi-Ugtaal	0.00	0.00	0.00	8107	Zavkhan	Asgat	0.00	0.00	0.00
2207	Sukhbaatar	Bayandelger	0.00	0.00	0.00	4813	Dundgovi	Gurvansaihan	0.00	0.00	0.00	8110	Zavkhan	Bayantes	0.00	0.00	0.00
2210	Sukhbaatar	Dariganga	0.00	0.00	0.00	4816	Dundgovi	Delgerkhangai	0.00	0.00	0.00	8113	Zavkhan	Bayankhairkhan	0.00	0.00	0.00
2213	Sukhbaatar	Munkhkhaan	0.00	0.00	0.00	4819	Dundgovi	Delgertsogt	0.00	0.00	0.00	8116	Zavkhan	Durvuligin	0.00	0.00	0.00
2216	Sukhbaatar	Naran	0.00	0.00	0.00	4822	Dundgovi	Deren	0.00	0.00	0.00	8119	Zavkhan	Zavkhanmandal	0.00	0.00	0.00
2219	Sukhbaatar	Ongon	0.00	0.00	0.00	4825	Dundgovi	Luus	0.00	0.00	0.00	8122	Zavkhan	Ider	0.00	0.00	0.00
2225	Sukhbaatar	Tuvshinshiree	0.00	0.00	0.00	4828	Dundgovi	Ulziit	0.00	0.00	0.00	8125	Zavkhan	Ikh-Uul	0.00	0.00	0.00
2228	Sukhbaatar	Tumentsogt	0.00	0.00	0.00	4831	Dundgovi	Undurshil	0.00	0.00	0.00	8128	Zavkhan	Numrug	0.00	0.00	0.00
2231	Sukhbaatar	Uubayan	0.00	0.00	0.00	4834	Dundgovi	Saikhan-Ovoo	0.00	0.00	0.00	8131	Zavkhan	Otgon	0.00	0.00	0.00
2234	Sukhbaatar	Khalzan	0.00	0.00	0.00	4837	Dundgovi	Khuld	0.00	0.00	0.00	8134	Zavkhan	Santmargats	0.00	0.00	0.00
2237	Sukhbaatar	Erdenetsagaan	0.00	0.00	0.00	4840	Dundgovi	Tsagaandelger	0.00	0.00	0.00	8137	Zavkhan	Songino	0.00	0.00	0.00
2301	Khenti	Kherlen	-11.56	0.00	-11.56	4843	Dundgovi	Erdendalai	0.00	0.00	0.00	8140	Zavkhan	Tosontsengel	-0.10	0.00	-0.10
2304	Khenti	Batnorov	-0.03	0.00	-0.03	6101	Orkhon	Bayan-Undur	-4.63	-6.49	-11.12	8143	Zavkhan	Tudevtei	0.00	0.00	0.00
2307	Khenti	Batshireet	0.00	0.00	0.00	6104	Orkhon	Jargalant	0.00	0.00	0.00	8146	Zavkhan	Telmen	0.00	0.00	0.00
2310	Khenti	Bayan-Adarga	0.00	0.00	0.00	6201	Uvurkhangai	Arvaikheer	-7.68	-7.69	-15.37	8149	Zavkhan	Tes	0.00	0.00	0.00
2313	Khenti	Bayanmunkh	0.00	0.00	0.00	6204	Uvurkhangai	Baruunbayan-Ulaan	0.00	0.00	0.00	8152	Zavkhan	Urgamal	0.00	0.00	0.00
2316	Khenti	Bayan-Ovoo	0.00	0.00	0.00	6207	Uvurkhangai	Bat-Ulzii	-0.27	0.00	-0.27	8155	Zavkhan	Tsagaankhairkhan	0.00	0.00	0.00
2319	Khenti	Bayankhutag	0.00	0.00	0.00	6210	Uvurkhangai	Bayangol	0.00	0.00	0.00	8158	Zavkhan	Tsagaanchuluut	0.00	0.00	0.00
2322	Khenti	Binder	0.00	0.00	0.00	6213	Uvurkhangai	Bayan-Undur	0.00	0.00	0.00	8161	Zavkhan	Tsetsen-Uul	0.00	0.00	0.00
2325	Khenti	Galshir	0.00	0.00	0.00	6216	Uvurkhangai	Bogd	0.00	0.00	0.00	8164	Zavkhan	Shiluustei	0.00	0.00	0.00
2328	Khenti	Dadal	0.00	0.00	0.00	6219	Uvurkhangai	Burd	-0.54	0.00	-0.54	8167	Zavkhan	Erdenekhairkhan	0.00	0.00	0.00
2331	Khenti	Darkhan	-0.47	0.00	-0.47	6222	Uvurkhangai	Guchin-Us	0.00	0.00	0.00	8170	Zavkhan	Yaruu	0.00	0.00	0.00
2334	Khenti	Dergelkhaan	0.00	0.00	0.00	6225	Uvurkhangai	Yesunzuil	-0.61	0.00	-0.61	8201	Gove-Altai	Esunbulag	0.00	0.00	0.00
2337	Khenti	Jagaltkhaan	0.00	0.00	0.00	6228	Uvurkhangai	Zuunbayan-Ulaan	-0.06	0.00	-0.06	8204	Gove-Altai	Altai	0.00	0.00	0.00
2340	Khenti	Murun	0.00	0.00	0.00	6231	Uvurkhangai	Nariinteel	0.00	0.00	0.00	8207	Gove-Altai	Bayan-Uul	0.00	0.00	0.00
2343	Khenti	Norovlin	0.00	0.00	0.00	6234	Uvurkhangai	Ulziit	0.00	0.00	0.00	8210	Gove-Altai	Binger	0.00	0.00	0.00
2346	Khenti	Umnudelger	0.00	0.00	0.00	6237	Uvurkhangai	Sant	0.00	0.00	0.00	8213	Gove-Altai	Bugat	0.00	0.00	0.00
2349	Khenti	Tsenkhermandal	0.00	0.00	0.00	6240	Uvurkhangai	Taragt	0.00	0.00	0.00	8216	Gove-Altai	Darvi	0.00	0.00	0.00
4101	Tuv	Zuunmod	-3.19	-39.61	-42.80	6243	Uvurkhangai	Tugrug	0.00	0.00	0.00	8219	Gove-Altai	Delger	0.00	0.00	0.00
4103	Tuv	Altanbulag	0.00	0.00	0.00	6246	Uvurkhangai	Uyanga	-1.25	0.00	-1.25	8222	Gove-Altai	Jargalan	0.00	0.00	0.00
4107	Tuv	Argalant	0.00	0.00	0.00	6249	Uvurkhangai	Khairkhandulaan	0.00	0.00	0.00	8225	Gove-Altai	Taishir	0.00	0.00	0.00
4110	Tuv	Arkhust	0.00	0.00	0.00	6252	Uvurkhangai	Kharkhorin	0.00	0.00	0.00	8228	Gove-Altai	Tonkhil	0.00	0.00	0.00
4113	Tuv	Batsumber	0.00	0.00	0.00	6255	Uvurkhangai	Khujirt	0.00	0.00	0.00	8231	Gove-Altai	Tugrug	0.00	0.00	0.00
4116	Tuv	Bayan	0.00	0.00	0.00	6301	Bulgan	Bulgan	-7.33	-7.28	-14.61	8234	Gove-Altai	Kaliun	0.00	0.00	0.00
4119	Tuv	Bayandelger	0.00	0.00	0.00	6304	Bulgan	Bayan-Agt	0.00	0.00	0.00	8237	Gove-Altai	Khunkhmorit	0.00	0.00	0.00
4122	Tuv	Bayanjargalan	0.00	0.00	0.00	6307	Bulgan	Bayannuur	-1.14	0.00	-1.14	8240	Gove-Altai	Tsogt	0.00	0.00	0.00
4125	Tuv	Bayan-Unjuul	0.00	0.00	0.00	6310	Bulgan	Bugat	0.00	0.00	0.00	8243	Gove-Altai	Tseel	0.00	0.00	0.00
4128	Tuv	Bayankhangai	0.00	0.00	0.00	6313	Bulgan	Buregkhangai	-1.64	0.00	-1.64	8246	Gove-Altai	Chandmani	0.00	0.00	0.00
4131	Tuv	Bayantsagaan	0.00	0.00	0.00	6316	Bulgan	Gurvanbulag	-1.77	0.00	-1.77	8249	Gove-Altai	Sharga	0.00	0.00	0.00
4134	Tuv	Bayantsogt	0.00	0.00	0.00	6319	Bulgan	Dhashinchilen	-1.70	0.00	-1.70	8252	Gove-Altai	Erdene	0.00	0.00	0.00
4137	Tuv	Bayanchandmani	0.00	0.00	0.00	6322	Bulgan	Mogod	0.00	0.00	0.00	8301	Bayan-Ulgii	Ulgii	-1.02	-0.81	-1.83
4140	Tuv	Bornuur	0.00	0.00	0.00	6325	Bulgan	Orkhon	0.00	0.00	0.00	8304	Bayan-Ulgii	Altai	0.00	0.00	0.00
4143	Tuv	Buren	0.00	0.00	0.00	6328	Bulgan	Rashaant	-1.47	0.00	-1.47	8307	Bayan-Ulgii	Altantsugts	0.00	0.00	0.00
4146	Tuv	Delgerkhaan	0.00	0.00	0.00	6331	Bulgan	Saikhan	0.00	0.00	0.00	8310	Bayan-Ulgii	Bayannuur	0.00	0.00	0.00
4149	Tuv	Jargalant	0.00	0.00	0.00	6334	Bulgan	Selenge	0.00	0.00	0.00	8313	Bayan-Ulgii	Bugat	0.00	0.00	0.00
4152	Tuv	Zaamar	-1.06	0.00	-1.06	6337	Bulgan	Teshig	0.00	0.00	0.00	8316	Bayan-Ulgii	Bulgan	0.00	0.00	0.00
4155	Tuv	Lun	-0.50	0.00	-0.50	6340	Bulgan	Khangal	0.00	0.00	0.00	8319	Bayan-Ulgii	Buyant	0.00	0.00	0.00
4158	Tuv	Mungunmorit	0.00	0.00	0.00	6343	Bulgan	Khishing-Undur	0.00	0.00	0.00	8322	Bayan-Ulgii	Deluum	0.00	0.00	0.00
4161	Tuv	Undurshireet	-0.37	0.00	-0.37	6346	Bulgan	Khutag-Unduur	0.00	0.00	0.00	8325	Bayan-Ulgii	Nogoonnuur	0.00	0.00	0.00
4164	Tuv	Sumber	0.00	0.00	0.00	6401	Bayankhongor	Bayankhongor	-4.76	-8.66	-13.42	8328	Bayan-Ulgii	Sagsai	0.00	0.00	0.00
4167	Tuv	Sergelen	0.00	0.00	0.00	6404	Bayankhongor	Baatsagaan	0.00	0.00	0.00	8331	Bayan-Ulgii	Tolbo	0.00	0.00	0.00
4170	Tuv	Ugtaaltsaidam	-0.51	0.00	-0.51	6407	Bayankhongor	Bayanbulag	0.00	0.00	0.00	8334	Bayan-Ulgii	Ulaankhus	0.00	0.00	0.00
4173	Tuv	Tseel	0.00	0.00	0.00	6410	Bayankhongor	Bayangobi	0.00	0.00	0.00	8340	Bayan-Ulgii	Tsengel	0.00	0.00	0.00
4176	Tuv	Erdene	0.00	0.00	0.00	6413	Bayankhongor	Bayanlig	0.00	0.00	0.00	8401	Khovd	Jargalant	-3.01	-4.48	-7.49
4179	Tuv	Erdensant	0.00	0.00	0.00	6416	Bayankhongor	Bayan-Ovoo	0.00	0.00	0.00	8404	Khovd	Altai	0.00	0.00	0.00
4201	Goveisumber	Sumber	0.00	0.00	0.00	6419	Bayankhongor	Bayan-Undur	0.00	0.00	0.00	8407	Khovd	Bulgan	0.00	0.00	0.00
4204	Goveisumber	Bayantal	0.00	0.00	0.00	6422	Bayankhongor	Bayantsagaan	0.00	0.00	0.00	8410	Khovd	Buyant	0.00	0.00	0.00
4207	Goveisumber	Shivee gobi	0.00	0.00	0.00	6425	Bayankhongor	Bogd	0.00	0.00	0.00	8413	Khovd	Darvi	0.00	0.00	0.00
4301	Selenge	Sukhbaatar	-70.84	-0.46	-71.29	6428	Bayankhongor	Bumbugur	0.00	0.00	0.00	8416	Khovd	Durgun	0.00	0.00	0.00
4304	Selenge	Altanbulag	0.00	0.00	0.00	6431	Bayankhongor	Buutsagaan	0.00	0.00	0.00	8419	Khovd	Duut	0.00	0.00	0.00
4307	Selenge	Baruunburen	-3.36	0.00	-3.36	6434	Bayankhongor	Galuut	0.00	0.00	0.00	8422	Khovd	Zereg	0.00	0.00	0.00
4310	Selenge	Bayangol	-7.49	0.00	-7.49	6437	Bayankhongor	Gurvanbulag	0.00	0.00	0.00	8425	Khovd	Mankhan	0.00	0.00	0.00
4313	Selenge	Yeruu	0.00	0.00	0.00	6440	Bayankhongor	Jargalant	0.00	0.00	0.00	8428	Khovd	Munkhkhairkhan	0.00	0.00	0.00
4316	Selenge	Javkhlant	-5.89	0.00	-5.89	6443	Bayankhongor	Jinst	0.00	0.00	0.00	8431	Khovd	Must	0.00	0.00	0.00
4319	Selenge	Zuunburen	-8.22	0.00	-8.22	6446	Bayankhongor	Zag	0.00	0.00	0.00	8434	Khovd	Myangat	0.00	0.00	0.00
4322	Selenge	Mandal	-42.38	0.00	-42.38	6449	Bayankhongor	Ulziit	0.00	0.00	0.00	8437	Khovd	Uyench	0.00	0.00	0.00
4325	Selenge	Orkhon	-4.33	0.00	-4.33	6452	Bayankhongor	Khureemaral	0.00	0.00	0.00	8440	Khovd	Khovd	0.00	0.00	0.00
4328	Selenge	Orkhontuul	-4.69	0.00	-4.69	6455	Bayankhongor	Shinejinst	0.00	0.00	0.00	8443	Khovd	Tsetseg	0.00	0.00	0.00
4331	Selenge	Saikhan	-26.07	0.00	-26.07	6458	Bayankhongor	Erdenetsogt	0.00	0.00	0.00	8446	Khovd	Chandmani	0.00	0.00	0.00
4334	Selenge	Sant	-3.11	0.00	-3.11	6501	Arkhangai	Erdenbulgan	-20.69	-5.89	-26.57	8449	Khovd	Erdenburen	0.00	0.00	0.00
4337	Selenge	Tushig	0.00	0.00	0.00	6504	Arkhangai	Battsengel	0.00	0.00	0.00	8504	Uvs	Baruunturuun	0.00	0.00	0.00
4340	Selenge	Khuder	0.00	0.00	0.00	6507	Arkhangai	Bulgan	-1.65	0.00	-1.65	8507	Uvs	Bukhmurun	0.00	0.00	0.00
4343	Selenge	Khushaat	-5.83	0.00	-5.83	6510	Arkhangai	Jargalant	0.00	0.00	0.00	8510	Uvs	Davst	0.00	0.00	0.00
4346	Selenge	Tsagaannuur	-14.93	0.00	-14.93	6513	Arkhangai	Ikh Tamir	0.00	0.00	0.00	8513	Uvs	Zavkhan	0.00	0.00	0.00
4349	Selenge	Shaamar	-12.39	0.00	-12.39	6516	Arkhangai	Ugiinuur	0.00	0.00	0.00	8516	Uvs	Zuungobi	0.00	0.00	0.00
4352	Selenge	Shaamar	0.00	0.00	0.00	6519	Arkhangai	Ulziit	0.00	0.00	0.00	8519	Uvs	Zuunkhangai	0.00	0.00	0.00
4401	Dornogovi	Sainshand	0.00	-22.77	-22.77	6522	Arkhangai	Unduur-Ulaan	0.00	0.00	0.00	8522	Uvs	Malchin	0.00	0.00	0.00
4404	Dornogovi	Airag	0.00	0.00	0.00	6525	Arkhangai	Tariat	0.00	0.00	0.00	8525	Uvs	Naranbulag	0.00	0.00	0.00
4407	Dornogovi	Altanshiree	0.00	0.00	0.00	6528	Arkhangai	Tuvshruulekh	0.00	0.00	0.00	8528	Uvs	Ulgii	0.00	0.00	0.00
4410	Dornogovi	Dalanjargalan	0.00	0.00	0.00	6531	Arkhangai	Khairkhan	0.00	0.00	0.00	8531	Uvs	Umnugobi	0.00	0.00	0.00
4413	Dornogovi	Delgerekh	0.00	0.00	0.00	6534	Arkhangai	Khangai	0.00	0.00	0.00	8534	Uvs	Undurkhangai	0.00	0.00	0.00
4416	Dornogovi	Zamin-Uud	0.00	-9.93	-9.93	6537	Arkhangai	Khashaat	-2.92	0.00	-2.92	8537	Uvs	Sagil	0.00	0.00	0.00
4419	Dornogovi	Ikhkhet	0.00	0.00	0.00	6540	Arkhangai	Khotont	-2.09	0.00	-2.09	8540	Uvs	Tarialan	0.00	0.00	0.00
4422	Dornogovi	Mandakh	0.00	0.00	0.00	6543	Arkhangai	Tsakhir	0.00	0.00	0.00	8540	Uvs	Tarialan	0.00	0.00	0.00
4425	Dornogovi	Urgun	0.00	0.00	0.00	6546	Arkhangai	Tsenkher	-4.73	0.00	-4.73	8543	Uvs	Turgen	0.00	0.00	0.00
4428	Dornogovi	Saikhandulaan	0.00	0.00	0.00	6549	Arkhangai	Tsetserleg	0.00	0.00	0.00	8546	Uvs	Tes	0.00	0.00	0.00
4431	Dornogovi	Ulaanbadrakh	0.00	0.00	0.00	6552	Arkhangai	Chuluut	0.00	0.00	0.00	8549	Uvs	Khovd	0.00	0.00	0.00
4434	Dornogovi	Khatanbulag	0.00	0.00	0.00	6555	Arkhangai	Erdebmandal	0.00	0.00	0.00	8552	Uvs	Khyargas	0.00	0.00	0.00
4437	Dornogovi	Khuvsgul	0.00	0.00	0.00	6701	Khusvgul	Murun	-4.54	-6.45	-10.98	8555	Uvs	Tsagaankhairkhan	0.00	0.00	0.00

Source: JICA Project Team

Table 3.7.29 Water Balance in 2040 Demand by Aimag (Dry Year, Present Weather)

Unit: million m^3/year

Aimag Name	Water Availability (Dry Year)			Water Demand in 2018			Gap	Water Demand in 2030			Gap	Water Demand in 2040			Gap
	SW	GW	Total	SW	GW	Total	2018	SW	GW	Total	2030	SW	GW	Total	2040
	a	b	c=a+b	d	e	f=d+e	g=c-f	d	e	f=d+e	g=c-f	d	e	f=d+e	g=c-f
Mongolia	**13,689.7**	**25,668.8**	**39,358.5**	**352.7**	**505.0**	**857.7**	**38,500.8**	**596.7**	**779.9**	**1,376.6**	**37,124.2**	**811.4**	**1,051.4**	**1,862.8**	**35,261.4**
Western Region	*4,072.6*	*4,204.0*	*8,276.6*	*42.4*	*38.2*	*80.5*	*8,196.0*	*66.6*	*59.5*	*126.1*	*8,069.9*	*88.5*	*75.6*	*164.2*	*7,905.8*
Bayan-Ulgii	1,316.4	709.4	2,025.9	7.7	4.5	12.3	2,013.6	12.5	7.5	19.9	1,993.6	16.5	10.1	26.5	1,967.1
Gove-Altai	822.4	1,144.3	1,966.8	1.8	12.1	13.9	1,952.9	3.0	18.6	21.6	1,931.3	4.1	23.3	27.4	1,903.9
Zavkhan	315.9	274.3	590.3	9.7	5.7	15.3	574.9	14.6	8.7	23.3	551.6	18.9	11.0	29.9	521.7
Uvs	805.6	1,202.1	2,007.7	18.0	6.9	24.8	1,982.8	26.8	10.6	37.3	1,945.5	35.8	13.5	49.4	1,896.1
Khovd	812.2	873.8	1,686.0	5.2	9.0	14.2	1,671.8	9.8	14.2	24.0	1,647.8	13.2	17.7	30.9	1,616.9
Khangai Region	*4,097.4*	*5,330.9*	*9,428.3*	*80.6*	*85.2*	*165.8*	*9,262.4*	*140.9*	*138.5*	*279.4*	*8,983.0*	*191.8*	*182.6*	*374.4*	*8,608.7*
Arkhangai	1,096.0	1,462.9	2,558.9	32.6	12.9	45.4	2,513.5	64.0	20.5	84.5	2,429.0	89.6	27.6	117.2	2,311.8
Bayankhongor	210.6	348.0	558.6	6.1	11.4	17.6	541.0	10.5	19.8	30.2	510.8	13.8	26.3	40.1	470.7
Bulgan	892.7	1,263.6	2,156.3	17.7	19.2	36.9	2,119.4	27.8	30.1	58.0	2,061.5	37.2	39.9	77.2	1,984.3
Orkhon	1.9	3.7	5.6	2.6	3.4	6.0	-0.4	4.1	7.7	11.8	-12.2	5.5	9.3	14.7	-26.9
Uvurkhangai	98.8	377.4	476.2	12.9	14.1	27.0	449.2	21.3	22.7	44.0	405.3	28.4	29.6	58.0	347.3
Khusvgul	1,797.4	1,875.3	3,672.7	8.7	24.3	33.0	3,639.7	13.3	37.7	51.0	3,588.7	17.3	49.9	67.2	3,521.5
Central Region	*2,988.6*	*6,925.0*	*9,913.6*	*176.4*	*165.0*	*341.4*	*9,572.2*	*296.2*	*286.3*	*582.5*	*8,989.7*	*404.5*	*390.4*	*794.9*	*8,194.8*
Goveisumber	21.9	55.3	77.2	0.0	1.9	1.9	75.4	0.0	3.1	3.1	72.3	0.0	4.1	4.1	68.2
Darkhan-Uul	1.5	19.3	20.9	16.3	2.6	18.9	2.0	30.5	5.4	35.9	-33.9	41.6	6.3	47.9	-81.7
Dornogovi	1,279.9	2,934.0	4,213.8	0.0	28.8	28.8	4,185.1	0.0	60.0	60.0	4,125.1	0.0	85.0	85.0	4,040.1
Dundgovi	169.8	569.4	739.2	0.0	16.8	16.8	722.3	0.0	26.2	26.2	696.2	0.0	34.8	34.8	661.4
Umnugovi	783.1	1,816.1	2,599.2	4.7	9.8	14.5	2,584.8	8.3	16.8	25.1	2,559.7	11.1	22.7	33.9	2,525.8
Selenge	240.6	415.3	655.9	147.2	4.9	152.1	503.8	243.7	9.9	253.6	250.3	333.7	13.0	346.7	-96.4
Tuv	491.7	1,115.6	1,607.3	8.2	100.3	108.5	1,498.8	13.8	164.9	178.7	1,320.1	18.2	224.6	242.7	1,077.4
Eastern Region	*2,439.7*	*9,113.4*	*11,553.0*	*39.4*	*72.3*	*111.6*	*11,441.4*	*64.2*	*126.2*	*190.4*	*11,251.0*	*87.7*	*173.1*	*260.8*	*10,990.3*
Dornod	1,359.5	5,832.0	7,191.5	17.4	25.9	43.3	7,148.1	28.8	48.9	77.7	7,070.5	39.7	68.5	108.2	6,962.2
Sukhbaatar	88.0	979.7	1,067.7	0.0	19.9	19.9	1,047.8	0.0	30.2	30.2	1,017.6	0.0	39.7	39.7	977.9
Khenti	992.2	2,301.7	3,293.8	22.0	26.4	48.4	3,245.4	35.5	47.0	82.5	3,162.9	47.9	64.9	112.8	3,050.1
Ulaanbaatar	*91.5*	*95.5*	*187.0*	*14.0*	*144.3*	*158.3*	*28.7*	*28.8*	*169.4*	*198.2*	*-169.5*	*38.9*	*229.7*	*268.5*	*-438.0*

Source: JICA Project Team

Table 3.7.30 Water Balance in 2040 Demand by Aimag (Dry Year, 2050 RCP4.5)

Unit: million m^3/year

Aimag Name	Water Availability (Dry Year)			Water Demand in 2018			Gap	Water Demand in 2030			Gap	Water Demand in 2040			Gap
	SW	GW	Total	SW	GW	Total	2018	SW	GW	Total	2030	SW	GW	Total	2040
	a	b	c=a+b	d	e	f=d+e	g=c-f	d	e	f=d+e	g=c-f	d	e	f=d+e	g=c-f
Mongolia	**17,961.6**	**38,906.5**	**56,868.1**	**352.7**	**505.0**	**857.7**	**56,010.4**	**596.7**	**779.9**	**1,376.6**	**54,633.8**	**811.4**	**1,051.4**	**1,862.8**	**52,771.0**
Western Region	*4,842.2*	*6,987.6*	*11,829.7*	*42.4*	*38.2*	*80.5*	*11,749.2*	*66.6*	*59.5*	*126.1*	*11,623.1*	*88.5*	*75.6*	*164.2*	*11,458.9*
Bayan-Ulgii	1,429.5	802.9	2,232.3	7.7	4.5	12.3	2,220.1	12.5	7.5	19.9	2,200.1	16.5	10.1	26.5	2,173.6
Gove-Altai	1,058.3	1,975.3	3,033.6	1.8	12.1	13.9	3,019.7	3.0	18.6	21.6	2,998.1	4.1	23.3	27.4	2,970.7
Zavkhan	353.6	633.5	987.1	9.7	5.7	15.3	971.7	14.6	8.7	23.3	948.4	18.9	11.0	29.9	918.5
Uvs	1,127.8	2,481.5	3,609.3	18.0	6.9	24.8	3,584.5	26.8	10.6	37.3	3,547.2	35.8	13.5	49.4	3,497.8
Khovd	873.0	1,094.4	1,967.4	5.2	9.0	14.2	1,953.2	9.8	14.2	24.0	1,929.2	13.2	17.7	30.9	1,898.3
Khangai Region	*4,589.3*	*15,225.6*	*19,814.9*	*80.6*	*85.2*	*165.8*	*19,649.1*	*140.9*	*138.5*	*279.4*	*19,369.7*	*191.8*	*182.6*	*374.4*	*18,995.3*
Arkhangai	1,108.9	2,366.7	3,475.6	32.6	12.9	45.4	3,430.2	64.0	20.5	84.5	3,345.7	89.6	27.6	117.2	3,228.5
Bayankhongor	269.7	798.1	1,067.8	6.1	11.4	17.6	1,050.2	10.5	19.8	30.2	1,019.9	13.8	26.3	40.1	979.8
Bulgan	1,326.1	6,121.1	7,447.1	17.7	19.2	36.9	7,410.2	27.8	30.1	58.0	7,352.3	37.2	39.9	77.2	7,275.1
Orkhon	1.9	6.9	8.8	2.6	3.4	6.0	2.8	4.1	7.7	11.8	-8.9	5.5	9.3	14.7	-23.7
Uvurkhangai	97.3	568.7	665.9	12.9	14.1	27.0	639.0	21.3	22.7	44.0	595.0	28.4	29.6	58.0	537.0
Khusvgul	1,785.5	5,364.2	7,149.8	8.7	24.3	33.0	7,116.7	13.3	37.7	51.0	7,065.7	17.3	49.9	67.2	6,998.5
Central Region	*5,884.3*	*7,343.5*	*13,227.8*	*176.4*	*165.0*	*341.4*	*12,886.4*	*296.2*	*286.3*	*582.5*	*12,303.9*	*404.5*	*390.4*	*794.9*	*11,508.9*
Goveisumber	24.0	57.2	81.2	0.0	1.9	1.9	79.3	0.0	3.1	3.1	76.2	0.0	4.1	4.1	72.2
Darkhan-Uul	1.6	84.4	86.0	16.3	2.6	18.9	67.2	30.5	5.4	35.9	31.3	41.6	6.3	47.9	-16.6
Dornogovi	696.7	658.4	1,355.1	0.0	28.8	28.8	1,326.3	0.0	60.0	60.0	1,266.3	0.0	85.0	85.0	1,181.3
Dundgovi	183.7	590.1	773.8	0.0	16.8	16.8	757.0	0.0	26.2	26.2	730.8	0.0	34.8	34.8	696.1
Umnugovi	4,161.3	1,860.0	6,021.3	4.7	9.8	14.5	6,006.8	8.3	16.8	25.1	5,981.8	11.1	22.7	33.9	5,947.9
Selenge	281.1	2,610.6	2,891.6	147.2	4.9	152.1	2,739.6	243.7	9.9	253.6	2,486.0	333.7	13.0	346.7	2,139.3
Tuv	536.0	1,482.7	2,018.7	8.2	100.3	108.5	1,910.2	13.8	164.9	178.7	1,731.5	18.2	224.6	242.7	1,488.8
Eastern Region	*2,527.1*	*9,222.3*	*11,749.4*	*39.4*	*72.3*	*111.6*	*11,637.8*	*64.2*	*126.2*	*190.4*	*11,447.4*	*87.7*	*173.1*	*260.8*	*11,186.7*
Dornod	1,425.9	5,651.7	7,077.6	17.4	25.9	43.3	7,034.3	28.8	48.9	77.7	6,956.6	39.7	68.5	108.2	6,848.4
Sukhbaatar	87.7	1,134.4	1,222.1	0.0	19.9	19.9	1,202.2	0.0	30.2	30.2	1,172.0	0.0	39.7	39.7	1,132.3
Khenti	1,013.5	2,436.2	3,449.7	22.0	26.4	48.4	3,401.3	35.5	47.0	82.5	3,318.8	47.9	64.9	112.8	3,206.0
Ulaanbaatar	*118.7*	*127.5*	*246.2*	*14.0*	*144.3*	*158.3*	*87.9*	*28.8*	*169.4*	*198.2*	*-110.3*	*38.9*	*229.7*	*268.5*	*-378.8*

Source: JICA Project Team

Table 3.7.31 Water Balance in 2040 Demand by Aimag (Dry Year, 2050 RCP8.5)

Unit: million m^3/year

Aimag Name	Water Availability (Dry Year)			Water Demand in 2018			Gap	Water Demand in 2030			Gap	Water Demand in 2040			Gap
	SW	GW	Total	SW	GW	Total	2018	SW	GW	Total	2030	SW	GW	Total	2040
	a	b	c=a+b	d	e	f=d+e	g=c-f	d	e	f=d+e	g=c-f	d	e	f=d+e	g=c-f
Mongolia	**14,589.1**	**34,360.1**	**48,949.1**	**352.7**	**505.0**	**857.7**	**48,091.4**	**596.7**	**779.9**	**1,376.6**	**46,714.8**	**811.4**	**1,051.4**	**1,862.8**	**44,852.1**
Western Region	*4,677.2*	*6,413.7*	*11,090.9*	*42.4*	*38.2*	*80.5*	*11,010.3*	*66.6*	*59.5*	*126.1*	*10,884.2*	*88.5*	*75.6*	*164.2*	*10,720.1*
Bayan-Ulgii	1,401.4	782.8	2,184.2	7.7	4.5	12.3	2,171.9	12.5	7.5	19.9	2,152.0	16.5	10.1	26.5	2,125.5
Gove-Altai	994.3	1,905.1	2,899.5	1.8	12.1	13.9	2,885.6	3.0	18.6	21.6	2,864.0	4.1	23.3	27.4	2,836.6
Zavkhan	389.1	535.9	925.0	9.7	5.7	15.3	909.7	14.6	8.7	23.3	886.4	18.9	11.0	29.9	856.5
Uvs	1,093.1	2,176.3	3,269.4	18.0	6.9	24.8	3,244.6	26.8	10.6	37.3	3,207.2	35.8	13.5	49.4	3,157.8
Khovd	799.2	1,013.5	1,812.8	5.2	9.0	14.2	1,798.6	9.8	14.2	24.0	1,774.6	13.2	17.7	30.9	1,743.7
Khangai Region	*4,092.4*	*13,196.9*	*17,289.3*	*80.6*	*85.2*	*165.8*	*17,123.4*	*140.9*	*138.5*	*279.4*	*16,844.0*	*191.8*	*182.6*	*374.4*	*16,469.6*
Arkhangai	1,092.6	1,533.2	2,625.8	32.6	12.9	45.4	2,580.4	64.0	20.5	84.5	2,495.9	89.6	27.6	117.2	2,378.7
Bayankhongor	269.3	784.6	1,053.9	6.1	11.4	17.6	1,036.3	10.5	19.8	30.2	1,006.0	13.8	26.3	40.1	965.9
Bulgan	868.0	5,391.0	6,258.9	17.7	19.2	36.9	6,222.1	27.8	30.1	58.0	6,164.1	37.2	39.9	77.2	6,086.9
Orkhon	1.9	7.0	8.9	2.6	3.4	6.0	3.0	4.1	7.7	11.8	-8.8	5.5	9.3	14.7	-23.6
Uvurkhangai	95.0	543.6	638.6	12.9	14.1	27.0	611.6	21.3	22.7	44.0	567.7	28.4	29.6	58.0	509.7
Khusvgul	1,765.6	4,937.6	6,703.1	8.7	24.3	33.0	6,670.1	13.3	37.7	51.0	6,619.1	17.3	49.9	67.2	6,551.9
Central Region	*3,395.1*	*6,114.6*	*9,509.6*	*176.4*	*165.0*	*341.4*	*9,168.3*	*296.2*	*286.3*	*582.5*	*8,585.7*	*404.5*	*390.4*	*794.9*	*7,790.8*
Goveisumber	21.8	55.1	76.9	0.0	1.9	1.9	75.0	0.0	3.1	3.1	71.9	0.0	4.1	4.1	67.9
Darkhan-Uul	1.5	43.7	45.1	16.3	2.6	18.9	26.3	30.5	5.4	35.9	-9.6	41.6	6.3	47.9	-57.5
Dornogovi	1,542.0	699.0	2,241.0	0.0	28.8	28.8	2,212.3	0.0	60.0	60.0	2,152.2	0.0	85.0	85.0	2,067.3
Dundgovi	169.3	574.3	743.6	0.0	16.8	16.8	726.8	0.0	26.2	26.2	700.6	0.0	34.8	34.8	665.9
Umnugovi	942.0	1,791.7	2,733.7	4.7	9.8	14.5	2,719.2	8.3	16.8	25.1	2,694.1	11.1	22.7	33.9	2,660.3
Selenge	234.5	1,743.2	1,977.7	147.2	4.9	152.1	1,825.6	243.7	9.9	253.6	1,572.1	333.7	13.0	346.7	1,225.4
Tuv	484.1	1,207.5	1,691.6	8.2	100.3	108.5	1,583.1	13.8	164.9	178.7	1,404.4	18.2	224.6	242.7	1,161.6
Eastern Region	*2,320.5*	*8,537.4*	*10,857.9*	*39.4*	*72.3*	*111.6*	*10,746.2*	*64.2*	*126.2*	*190.4*	*10,555.9*	*87.7*	*173.1*	*260.8*	*10,295.1*
Dornod	1,273.6	5,156.0	6,429.6	17.4	25.9	43.3	6,386.3	28.8	48.9	77.7	6,308.6	39.7	68.5	108.2	6,200.4
Sukhbaatar	76.1	1,070.5	1,146.6	0.0	19.9	19.9	1,126.7	0.0	30.2	30.2	1,096.5	0.0	39.7	39.7	1,056.8
Khenti	970.8	2,310.9	3,281.6	22.0	26.4	48.4	3,233.2	35.5	47.0	82.5	3,150.7	47.9	64.9	112.8	3,037.9
Ulaanbaatar	*103.9*	*97.6*	*201.5*	*14.0*	*144.3*	*158.3*	*43.2*	*28.8*	*169.4*	*198.2*	*-155.0*	*38.9*	*229.7*	*268.5*	*-423.6*

Source: JICA Project Team

Table 3.7.32 Water Balance in 2040 Demand by Aimag (Dry Year, 2100 RCP4.5)

Unit: million m^3/year

Aimag Name	Water Availability (Dry Year)			Water Demand in 2018			Gap	Water Demand in 2030			Gap	Water Demand in 2040			Gap
	SW	GW	Total	SW	GW	Total	2018	SW	GW	Total	2030	SW	GW	Total	2040
	a	b	c=a+b	d	e	f=d+e	g=c-f	d	e	f=d+e	g=c-f	d	e	f=d+e	g=c-f
Mongolia	**15,063.4**	**34,959.5**	**50,023.0**	**352.7**	**505.0**	**857.7**	**49,165.3**	**596.7**	**779.9**	**1,376.6**	**47,788.7**	**811.4**	**1,051.4**	**1,862.8**	**45,925.9**
Western Region	*4,914.9*	*6,674.2*	*11,589.1*	*42.4*	*38.2*	*80.5*	*11,508.6*	*66.6*	*59.5*	*126.1*	*11,382.5*	*88.5*	*75.6*	*164.2*	*11,218.3*
Bayan-Ulgii	1,468.2	818.7	2,287.0	7.7	4.5	12.3	2,274.7	12.5	7.5	19.9	2,254.7	16.5	10.1	26.5	2,228.2
Gove-Altai	1,078.6	2,012.5	3,091.1	1.8	12.1	13.9	3,077.2	3.0	18.6	21.6	3,055.7	4.1	23.3	27.4	3,028.2
Zavkhan	360.2	531.1	891.3	9.7	5.7	15.3	876.0	14.6	8.7	23.3	852.7	18.9	11.0	29.9	822.8
Uvs	1,108.2	2,192.7	3,300.9	18.0	6.9	24.8	3,276.0	26.8	10.6	37.3	3,238.7	35.8	13.5	49.4	3,189.3
Khovd	899.7	1,119.2	2,018.9	5.2	9.0	14.2	2,004.7	9.8	14.2	24.0	1,980.7	13.2	17.7	30.9	1,949.8
Khangai Region	*4,096.9*	*13,114.3*	*17,211.2*	*80.6*	*85.2*	*165.8*	*17,045.3*	*140.9*	*138.5*	*279.4*	*16,765.9*	*191.8*	*182.6*	*374.4*	*16,391.5*
Arkhangai	1,076.8	1,486.2	2,562.9	32.6	12.9	45.4	2,517.5	64.0	20.5	84.5	2,433.0	89.6	27.6	117.2	2,315.9
Bayankhongor	270.0	794.4	1,064.4	6.1	11.4	17.6	1,046.8	10.5	19.8	30.2	1,016.6	13.8	26.3	40.1	976.5
Bulgan	849.7	5,292.9	6,142.5	17.7	19.2	36.9	6,105.6	27.8	30.1	58.0	6,047.7	37.2	39.9	77.2	5,970.5
Orkhon	1.8	6.8	8.7	2.6	3.4	6.0	2.7	4.1	7.7	11.8	-9.1	5.5	9.3	14.7	-23.8
Uvurkhangai	99.8	558.8	658.6	12.9	14.1	27.0	631.6	21.3	22.7	44.0	587.7	28.4	29.6	58.0	529.7
Khusvgul	1,798.8	4,975.2	6,774.0	8.7	24.3	33.0	6,741.0	13.3	37.7	51.0	6,690.0	17.3	49.9	67.2	6,622.8
Central Region	*3,482.6*	*6,207.4*	*9,690.1*	*176.4*	*165.0*	*341.4*	*9,348.7*	*296.2*	*286.3*	*582.5*	*8,766.2*	*404.5*	*390.4*	*794.9*	*7,971.2*
Goveisumber	23.8	57.7	81.5	0.0	1.9	1.9	79.7	0.0	3.1	3.1	76.6	0.0	4.1	4.1	72.5
Darkhan-Uul	1.4	42.7	44.2	16.3	2.6	18.9	25.3	30.5	5.4	35.9	-10.6	41.6	6.3	47.9	-58.5
Dornogovi	1,595.1	726.3	2,321.4	0.0	28.8	28.8	2,292.7	0.0	60.0	60.0	2,232.7	0.0	85.0	85.0	2,147.7
Dundgovi	184.3	607.1	791.4	0.0	16.8	16.8	774.5	0.0	26.2	26.2	748.4	0.0	34.8	34.8	713.6
Umnugovi	950.4	1,816.1	2,766.5	4.7	9.8	14.5	2,752.0	8.3	16.8	25.1	2,726.9	11.1	22.7	33.9	2,693.0
Selenge	234.8	1,714.9	1,949.7	147.2	4.9	152.1	1,797.7	243.7	9.9	253.6	1,544.1	333.7	13.0	346.7	1,197.4
Tuv	492.9	1,242.5	1,735.3	8.2	100.3	108.5	1,626.8	13.8	164.9	178.7	1,448.1	18.2	224.6	242.7	1,205.4
Eastern Region	*2,463.7*	*8,862.8*	*11,326.5*	*39.4*	*72.3*	*111.6*	*11,214.9*	*64.2*	*126.2*	*190.4*	*11,024.5*	*87.7*	*173.1*	*260.8*	*10,763.8*
Dornod	1,361.3	5,321.5	6,682.9	17.4	25.9	43.3	6,639.5	28.8	48.9	77.7	6,561.8	39.7	68.5	108.2	6,453.6
Sukhbaatar	88.7	1,154.6	1,243.3	0.0	19.9	19.9	1,223.4	0.0	30.2	30.2	1,193.2	0.0	39.7	39.7	1,153.5
Khenti	1,013.6	2,386.7	3,400.3	22.0	26.4	48.4	3,351.9	35.5	47.0	82.5	3,269.4	47.9	64.9	112.8	3,156.6
Ulaanbaatar	*105.3*	*100.8*	*206.1*	*14.0*	*144.3*	*158.3*	*47.8*	*28.8*	*169.4*	*198.2*	*-150.4*	*38.9*	*229.7*	*268.5*	*-418.9*

Source: JICA Project Team

Table 3.7.33 Water Balance in 2040 Demand by Aimag (Dry Year, 2100 RCP8.5)

Unit: million m^3/year

Aimag Name	Water Availability (Dry Year)			Water Demand in 2018			Gap	Water Demand in 2030			Gap	Water Demand in 2040			Gap
	SW	GW	Total	SW	GW	Total	2018	SW	GW	Total	2030	SW	GW	Total	2040
	a	b	c=a+b	d	e	f=d+e	g=c-f	d	e	f=d+e	g=c-f	d	e	f=d+e	g=c-f
Mongolia	**15,148.7**	**34,071.1**	**49,219.8**	**352.7**	**505.0**	**857.7**	**48,362.1**	**596.7**	**779.9**	**1,376.6**	**46,985.5**	**811.4**	**1,051.4**	**1,862.8**	**45,122.8**
Western Region	*5,006.2*	*6,375.6*	*11,381.8*	*42.4*	*38.2*	*80.5*	*11,301.2*	*66.6*	*59.5*	*126.1*	*11,175.1*	*88.5*	*75.6*	*164.2*	*11,011.0*
Bayan-Ulgii	1,567.2	859.0	2,426.2	7.7	4.5	12.3	2,413.9	12.5	7.5	19.9	2,394.0	16.5	10.1	26.5	2,367.5
Gove-Altai	1,091.3	1,879.7	2,971.1	1.8	12.1	13.9	2,957.2	3.0	18.6	21.6	2,935.6	4.1	23.3	27.4	2,908.2
Zavkhan	391.5	537.8	929.4	9.7	5.7	15.3	914.0	14.6	8.7	23.3	890.7	18.9	11.0	29.9	860.8
Uvs	1,173.6	2,117.7	3,291.3	18.0	6.9	24.8	3,266.5	26.8	10.6	37.3	3,229.1	35.8	13.5	49.4	3,179.7
Khovd	782.4	981.4	1,763.9	5.2	9.0	14.2	1,749.6	9.8	14.2	24.0	1,725.7	13.2	17.7	30.9	1,694.8
Khangai Region	*4,022.5*	*12,849.6*	*16,872.1*	*80.6*	*85.2*	*165.8*	*16,706.3*	*140.9*	*138.5*	*279.4*	*16,426.9*	*191.8*	*182.6*	*374.4*	*16,052.5*
Arkhangai	1,040.9	1,456.1	2,497.0	32.6	12.9	45.4	2,451.6	64.0	20.5	84.5	2,367.1	89.6	27.6	117.2	2,249.9
Bayankhongor	269.9	773.7	1,043.6	6.1	11.4	17.6	1,026.0	10.5	19.8	30.2	995.8	13.8	26.3	40.1	955.7
Bulgan	888.6	5,159.6	6,048.2	17.7	19.2	36.9	6,011.3	27.8	30.1	58.0	5,953.3	37.2	39.9	77.2	5,876.2
Orkhon	1.9	7.4	9.4	2.6	3.4	6.0	3.4	4.1	7.7	11.8	-8.4	5.5	9.3	14.7	-23.1
Uvurkhangai	95.2	555.5	650.8	12.9	14.1	27.0	623.8	21.3	22.7	44.0	579.8	28.4	29.6	58.0	521.9
Khusvgul	1,726.0	4,897.3	6,623.2	8.7	24.3	33.0	6,590.2	13.3	37.7	51.0	6,539.2	17.3	49.9	67.2	6,472.0
Central Region	*3,584.3*	*6,163.9*	*9,748.3*	*176.4*	*165.0*	*341.4*	*9,406.9*	*296.2*	*286.3*	*582.5*	*8,824.4*	*404.5*	*390.4*	*794.9*	*8,029.4*
Goveisumber	20.8	52.0	72.9	0.0	1.9	1.9	71.0	0.0	3.1	3.1	67.9	0.0	4.1	4.1	63.8
Darkhan-Uul	1.5	46.4	48.0	16.3	2.6	18.9	29.1	30.5	5.4	35.9	-6.8	41.6	6.3	47.9	-54.7
Dornogovi	1,689.7	722.9	2,412.6	0.0	28.8	28.8	2,383.8	0.0	60.0	60.0	2,323.8	0.0	85.0	85.0	2,238.8
Dundgovi	163.6	572.3	735.9	0.0	16.8	16.8	719.1	0.0	26.2	26.2	692.9	0.0	34.8	34.8	658.1
Umnugovi	981.3	1,832.1	2,813.5	4.7	9.8	14.5	2,799.0	8.3	16.8	25.1	2,773.9	11.1	22.7	33.9	2,740.0
Selenge	210.9	1,724.5	1,935.4	147.2	4.9	152.1	1,783.3	243.7	9.9	253.6	1,529.7	333.7	13.0	346.7	1,183.1
Tuv	516.5	1,213.7	1,730.2	8.2	100.3	108.5	1,621.7	13.8	164.9	178.7	1,443.0	18.2	224.6	242.7	1,200.2
Eastern Region	*2,416.7*	*8,578.0*	*10,994.7*	*39.4*	*72.3*	*111.6*	*10,883.1*	*64.2*	*126.2*	*190.4*	*10,692.7*	*87.7*	*173.1*	*260.8*	*10,431.9*
Dornod	1,336.3	5,175.2	6,511.5	17.4	25.9	43.3	6,468.2	28.8	48.9	77.7	6,390.5	39.7	68.5	108.2	6,282.3
Sukhbaatar	78.5	1,076.8	1,155.3	0.0	19.9	19.9	1,135.4	0.0	30.2	30.2	1,105.2	0.0	39.7	39.7	1,065.5
Khenti	1,001.8	2,326.0	3,327.9	22.0	26.4	48.4	3,279.4	35.5	47.0	82.5	3,197.0	47.9	64.9	112.8	3,084.2
Ulaanbaatar	*119.0*	*104.0*	*223.0*	*14.0*	*144.3*	*158.3*	*64.7*	*28.8*	*169.4*	*198.2*	*-133.5*	*38.9*	*229.7*	*268.5*	*-402.1*

Source: JICA Project Team

3.7.8 Preliminary Assessment of Climate Risks for Water Resources in Mongolia

JICA has developed "Climate Finance Impact Tool for Adaptation" (Climate-FIT) for climate risk assessment and adaptation for water resources and related sectors (JICA Global Environment Department, 2019). Based on it, preliminary assessment of the matrix of JICA Climate-Fit (Adaptation) for water resources in Mongolia has been undertaken as shown in Figure 3.7.54. Also, the climate risk tree for water resources in Mongolia has been constructed as shown in Figure 3.7.55.

Exposure			Climate Hazard H1 Mean Annual Tempera-ture	H2 Heat Extreme	H3 Cold Spells	H4 Annual Rainfall	H5 Changes in Rainfall Patterns	H6 Heavy Rain/ Floods	H7 Drought	H8 Evapo-ration	H9 Storm	Vulnerability	Count of "3"	Climate Risk	Potential Adaptation Options	Correspon-ding SDGs items
		Current Frequency	++	++	++	+	+	++	++	++	+					
		Future	↗	↗	↘	→	↗	↗	↗	↗	→					
Exposure	E1	Percentage of area susceptible to floods/droughts	2↗ Percentage of area susceptible to floods/droughts is high	3↗ Percentage of area susceptible to floods/droughts is high	3↘ Percentage of area susceptible to floods/droughts is high	2→ Percentage of area susceptible to floods/droughts is high	2↗ Percentage of area susceptible to floods/droughts is high	3↗ Percentage of area susceptible to floods/droughts is high	3↗ Percentage of area susceptible to floods/droughts is high	3↗ Percentage of area susceptible to floods/droughts is high	3→ Percentage of area susceptible to floods/droughts is high	* Current Percentage of farmers working to improve water management is low. * Integration of Climate Risk Mitigation into National and Local Development Plans	6	(Risk) * Floods / droughts can increase the area of farmland damaged.	(Dealing with risks) * Diversification of livelihoods * Agricultural insurance to avoid and compensate for agricultural risks	13 CLIMATE ACTION
Exposure	E2	Soil fertility and soil organic matter content	1↗ In southern area, soil fertility and soil organic matter content is low	2↗ In southern area, soil fertility and soil organic matter content is low	2↘ In southern area, soil fertility and soil organic matter content is low	2→ In southern area, soil fertility and soil organic matter content is low	2↗ In southern area, soil fertility and soil organic matter content is low	2↗ In southern area, soil fertility and soil organic matter content is low	2↗ In southern area, soil fertility and soil organic matter content is low	2↗ In southern area, soil fertility and soil organic matter content is low	3→ In southern area, soil fertility and soil organic matter content is low	* % of farmers practicing soil management (e.g., organic agriculture soil management technology) is low. * Introducing of practicing soil management is required.	1	(Risk) * Changes in soil moisture (amount, salinity) in the field may increase due to an increase in evapotranspiration.	(Dealing with risks) * Use of organic fertilizer and residual organic matter in crops * Crop diversification and intercropping	2 ZERO HUNGER
Exposure	E3	Conservation area of important places in the basin of a water source	1↗ Conservation area in the basin of a water source is maintained	2↗ Conservation area in the basin of a water source is maintained	1↘ Conservation area in the basin of a water source is maintained	1→ Conservation area in the basin of a water source is maintained	1↗ Conservation area in the basin of a water source is maintained	2↗ Conservation area in the basin of a water source is maintained	2↗ Conservation area in the basin of a water source is maintained	1↗ Conservation area in the basin of a water source is maintained	1→ Conservation area in the basin of a water source is maintained	* Protection of water sources efforts are being made. * Efforts to protect water sources will continue. * Integration of Climate Risk Mitigation into National Development Plans.	0	(Risk) * Increase or decrease in annual water resources available for water supply.	(Dealing with risks) * Diversification of water supply sources/sources (e.g., investigation of alternative water supply possibilities from watersheds expected to pose less climate risk, interconnection with neighboring facilities with additional water supply/treatment capacity, etc.)	15 LIFE ON LAND
Exposure	E4	Annual deforestation area (deforestation rate) in the water source basin	1↗ Deforestation rate in the water source basin is increasing	2↗ Deforestation rate in the water source basin is increasing	2↘ Deforestation rate in the water source basin is increasing	1→ Deforestation rate in the water source basin is increasing	2↗ Deforestation rate in the water source basin is increasing	2↗ Deforestation rate in the water source basin is increasing	2↗ Deforestation rate in the water source basin is increasing	2↗ Deforestation rate in the water source basin is increasing	1→ Deforestation rate in the water source basin is increasing	* Protection of water sources efforts are being made. * Efforts to protect water sources will continue. * Integration of Climate Risk Mitigation into National Development Plans.	0	(Risk) * Changes in the number of months in which there was no shortage of water supply annually, and the reduction and improvement of reliability associated therewith.	(Dealing with risks) * Afforestation and forest conservation in catchment areas and associated improvement of microclimate	15 LIFE ON LAND
Exposure	E5	Overgrazing in watersheds	1↗ Overgrazing in the watershed basin is a problem	3↗ Overgrazing in the watershed basin is a problem	2↘ Overgrazing in the watershed basin is a problem	2→ Overgrazing in the watershed basin is a problem	2↗ Overgrazing in the watershed basin is a problem	2↗ Overgrazing in the watershed basin is a problem	3↗ Overgrazing in the watershed basin is a problem	2↗ Overgrazing in the watershed basin is a problem	1→ Overgrazing in the watershed basin is a problem	* Protection of water sources efforts are being made. * Efforts to protect water sources will continue. * Integration of Climate Risk Mitigation into National Development Plans.	2	(Risk) * Changes in the number of months in which there was no shortage of water supply annually, and the reduction and improvement of reliability associated therewith.	(Dealing with risks) * Restrict the use of pastures for a certain period of time to prevent excessive use of land	15 LIFE ON LAND
Exposure	E6	Crop water demand	2↗ Crop water demand is high	2↗ Crop water demand is high	2↘ Crop water demand is high	2→ Crop water demand is high	2↗ Crop water demand is high	2↗ Crop water demand is high	3↗ Crop water demand is high	3↗ Crop water demand is high	2→ Crop water demand is high	* Percentage of farmers working to improve water management is low. * Integration of Climate Risk Mitigation into National and Local Development Plans.	2	(Risk) * Decrease in agricultural land productivity, crop productivity (or output) (annual output per ha).	(Dealing with risks) * Introduction of water-saving agricultural technology * Choose the appropriate crop type based on the average amount of water required per day of crop	2 ZERO HUNGER
Exposure	E7	Physiological Susceptibility of Crops to Climate Change	2↗ Physiological Susceptibility of Crops to Climate Change is low	2↗ Physiological Susceptibility of Crops to Climate Change is low	2↘ Physiological Susceptibility of Crops to Climate Change is low	2→ Physiological Susceptibility of Crops to Climate Change is low	2↗ Physiological Susceptibility of Crops to Climate Change is low	2↗ Physiological Susceptibility of Crops to Climate Change is low	3↗ Physiological Susceptibility of Crops to Climate Change is low	2↗ Physiological Susceptibility of Crops to Climate Change is low	2→ Physiological Susceptibility of Crops to Climate Change is low	* Percentage of farmers working to change to alternative crops or select optimal lines is low. * Integration of Climate Risk Mitigation into National and Local Development Plans.	1	(Risk) * Decrease in agricultural land productivity, crop productivity (or output) (annual output per ha).	(Dealing with risks) * Crop diversification and intercropping * Choose the appropriate crop type based on the average amount of water required per day of crop	13 CLIMATE ACTION
Exposure	E8	Percentage of the population engaged in agricultural production	1↗ Percentage of the population engaged in agricultural production is high	2↗ Percentage of the population engaged in agricultural production is high	3↘ Percentage of the population engaged in agricultural production is high	2→ Percentage of the population engaged in agricultural production is high	2↗ Percentage of the population engaged in agricultural production is high	2↗ Percentage of the population engaged in agricultural production is high	3↗ Percentage of the population engaged in agricultural production is high	2↗ Percentage of the population engaged in agricultural production is high	3→ Percentage of the population engaged in agricultural production is high	* Percentage of farmers with secondary income (non-farm income) (income from income generating activities to reduce the risk of crop failure) is low. * Integration of Climate Risk Mitigation into National and Local Development Plans should be made.	3	(Risk) * Increase of percentage of farmers who lost or decreased crop production.	(Dealing with risks) * Agricultural insurance to avoid and compensate for agricultural risks	1 NO POVERTY
Exposure	E9	Water consumption per capita [demand]	1↗ Water consumption per capita [demand] is increasing	2↗ Water consumption per capita [demand] is increasing	2↘ Water consumption per capita [demand] is increasing	2→ Water consumption per capita [demand] is increasing	2↗ Water consumption per capita [demand] is increasing	1↗ Water consumption per capita [demand] is increasing	2↗ Water consumption per capita [demand] is increasing	2↗ Water consumption per capita [demand] is increasing	1→ Water consumption per capita [demand] is increasing	* Use of water-efficient technology (technology for reducing water leakage, technology for reusing wastewater, etc.) is low. * Use of water-efficient technology will be increased.	0	(Risk) * Increase/decrease in water supply-demand balance ([vulnerability] = [annual supply]/[annual demand])	(Dealing with risks) * Formulation of plans and mechanisms for promoting the improvement of water utilization efficiency in areas subject to water supply	6 CLEAN WATER AND SANITATION
Exposure	E10	Percentage of households whose main source of income is agriculture	1↗ % of households whose main source of income is agriculture is still high	2↗ % of households whose main source of income is agriculture is still high	3↘ % of households whose main source of income is agriculture is still high	2→ % of households whose main source of income is agriculture is still high	2↗ % of households whose main source of income is agriculture is still high	2↗ % of households whose main source of income is agriculture is still high	3↗ % of households whose main source of income is agriculture is still high	2↗ % of households whose main source of income is agriculture is still high	2→ % of households whose main source of income is agriculture is still high	* Percentage of farmers with secondary income (non-farm income) (income from income generating activities to reduce the risk of crop failure) is low. * Integration of Climate Risk Mitigation into National and Local Development Plans should be made.	2	(Risk) * Decrease of household income from agricultural production [agricultural income]	(Dealing with risks) * Agricultural insurance to avoid and compensate for agricultural risks	1 NO POVERTY
Exposure	E11	Per capita GDP (Economic Development Level) [Factors Affecting Water Demand]	1↗ Per capita GDP is increasing	2↗ Per capita GDP is increasing	2↘ Per capita GDP is increasing	2→ Per capita GDP is increasing	2↗ Per capita GDP is increasing	2↗ Per capita GDP is increasing	2↗ Per capita GDP is increasing	2↗ Per capita GDP is increasing	2→ Per capita GDP is increasing	* Integration of Climate Risk Mitigation into National and Local Development Plans is making. * Integration of Climate Risk Mitigation into National and Local Development Plans will be made.	0	(Risk) * Decrease of household income from agricultural production [agricultural income]	(Dealing with risks) * Diversification of water supply sources/sources (e.g., investigation of alternative water supply possibilities from watersheds expected to pose less climate risk, interconnection with neighboring facilities with additional water supply/treatment capacity, etc.)	1 NO POVERTY
		Count of "3"	0	2	3	0	0	1	6	2	3					

Note 1) Hazard frequency assessment: ++ Frequently occurring thus far or at present, + Sometimes occurring thus far or at present, - Has hardly occurred thus far or at present
Note 2) Evaluation Scale for current impact levels:
3 Events and impacts that have occurred thus far have been so difficult that they cannot beaddressed and handled.
2 Events and impacts that have occurred to date have been moderately difficult to manage anddeal with.
1 It has not been so difficult to manage the events and impacts that have occurred thus far. Theresulting impact was minor and was managed to some extent.
0 The impacts of events that have occurred to date have been negligible.

Source: JICA Project Team based on JICA Climate-Fit

Figure 3.7.54 Preliminary Assessment of Matrix of JICA Climate-Fit (Adaptation) for Water Resources in Mongolia

Climate Hazard

H1	Heat Extreme
H2	Cold Spells
H3	Heavy Rain/ Floods
H4	Drought
H5	Evaporation
H6	Storm

Exposure

E1	Percentage of area susceptible to floods/droughts
E2	Soil fertility and soil organic matter content
E3	Overgrazing in watersheds
E4	Crop water demand
E5	Physiological Susceptibility of Crops to Climate Change
E6	Percentage of the population engaged in agricultural production
E7	Percentage of households whose main source of income is agriculture

Climate Risk

R1	Floods / droughts can increase the area of farmland damaged.
R2	Changes in soil moisture (amount, salinity) in the field may increase due to an increase in evapotranspiration.
R3	Changes in the number of months in which there was no shortage of water supply annually, and the reduction and improvement of reliability associated therewith.
R4	Decrease in agricultural land productivity, crop productivity (or output) (annual output per ha).
R5	Decrease in agricultural land productivity, crop productivity (or output) (annual output per ha).
R6	Increase of percentage of farmers who lost or decreased crop production.
R7	Decrease of household income from agricultural production [agricultural income]

Vulnerability

V1	* Current Percentage of farmers working to improve water management is low. * Integration of Climate Risk Mitigation into National and Local Development Plans
V2	* % of farmers practicing soil management (e.g., organic agriculture soil management technology) is low. * Introducing of practicing soil management is required.
V3	* Protection of water sources efforts are being made. * Efforts to protect water sources will continue. * Integration of Climate Risk Mitigation into National Development Plans.
V4	* Percentage of farmers working to improve water management is low. * Integration of Climate Risk Mitigation into National and Local Development Plans.
V5	* Percentage of farmers working to change to alternative crops or select optimal lines is low. * Integration of Climate Risk Mitigation into National and Local Development Plans.
V6	* Percentage of farmers with secondary income (non-farm income) (income from income generating activities to reduce the risk of crop failure) is low. * Integration of Climate Risk Mitigation into National and Local Development Plans should be made.
V7	* Percentage of farmers with secondary income (non-farm income) (income from income generating activities to reduce the risk of crop failure) is low. * Integration of Climate Risk Mitigation into National and Local Development Plans should be made.

Impact

Adaptation Options

A1	* Diversification of livelihoods * Agricultural insurance to avoid and compensate for agricultural risks
A2	* Use of organic fertilizer and residual organic matter in crops * Crop diversification and intercropping
A3	* Restrict the use of pastures for a certain period of time to prevent excessive use of land
A4	* Introduction of water-saving agricultural technology * Choose the appropriate crop type based on the average amount of water required per day of crop
A5	* Crop diversification and intercropping * Choose the appropriate crop type based on the average amount of water required per day of crop
A6	* Agricultural insurance to avoid and compensate for agricultural risks
A7	* Agricultural insurance to avoid and compensate for agricultural risks

Source: JICA Project Team based on JICA Climate-Fit

Figure 3.7.55 Preliminary Assessment of Climate Risk Tree for Water Resources in Mongolia

Annex to Chapter 3: Analysis on water balance for Ulaanbaatar

(1) Background

The water source of Ulaanbaatar City depends on groundwater (underground water of the Tuul River). It is predicted that Ulaanbaatar's water resources will become scarce, especially during the dry season (winter), when groundwater potential is low.

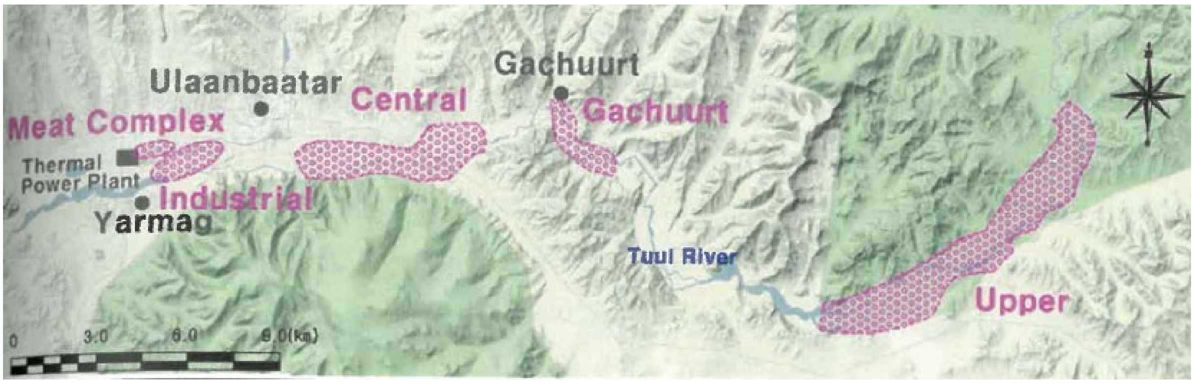
(2) Groundwater development status in Ulaanbaatar

Total yield of public wells in Ulaanbaatar city after 2026 will be 193.5 MCM/year as shown in Table A3.1. This yield is included new groundwater resources development in the west (lower) part of Ulaanbaatar city by the project of MCC (Millennium Challenge Corporation), which is an independent U.S. Government foreign aid agency at 140,000 m^3/day (51.1 MCM/year). The MCC project consists of the following three components: 1) Drill 32 new wells (16 wells x 2 places), 2) Construction of new advanced treatment water treatment plant (reverse osmosis technology), and 3) Construction of water distribution pipelines. Since a new well field for a pumping well by MCC project will be constructed downstream of Ulaanbaatar City, an advanced treatment plant will be required for soil and groundwater pollution control.

Table A3.1 Groundwater Development Status in Ulaanbaatar (Public Wells)

Water Source		Potential Resources (m3/day)	Number of Wells after 2026 (nos.)	Current Yield as of 2020 (m3/day)	Developable Yield after 2026 (m3/day)	Total Yield after 2026 (m3/day)	Total Yield after 2026 (MCM/year)
Total of Central Water Supply	Upper	72,000	55	72,000		72,000	26.3
	Central	114,000	93	114,000		114,000	41.6
	Industrial	36,000	16	36,000		36,000	13.1
	Meat-Complex	15,000	11	15,000		15,000	5.5
	Gachurt	25,700	25	25,700		25,700	9.4
	West (Lower) by MCC Project	140,000	32	-	140,000	140,000	51.1
Sub-Total		402,700	232	262,700	140,000	402,700	147.0
Power Plant		83,500	30	83,500		83,500	30.5
Yarmag		20,000	2	20,000		20,000	7.3
Nisekh and Biokombinat		23,800	4	23,800		23,800	8.7
TOTAL		530,000	268	390,000	140,000	530,000	193.5

Source: USUG and MCC



Source: USUG/KOICA, 2012

Figure A3.1 Groundwater Sources for Ulaanbaatar

(3) Water demand estimation by 2040 in Ulaanbaatar

AS described in section 3.5.6, the estimated water demand by 2040 in Ulaanbaatar will be at 268.5 MCM/year as shown in Table A3.2. A water shortage will be occurred in 2040 at 75 MCM/year (268.5 MCM-193.5 MCM=75 MCM).

Table A3.2 Water Demand Estimation by 2040 in Ulaanbaatar

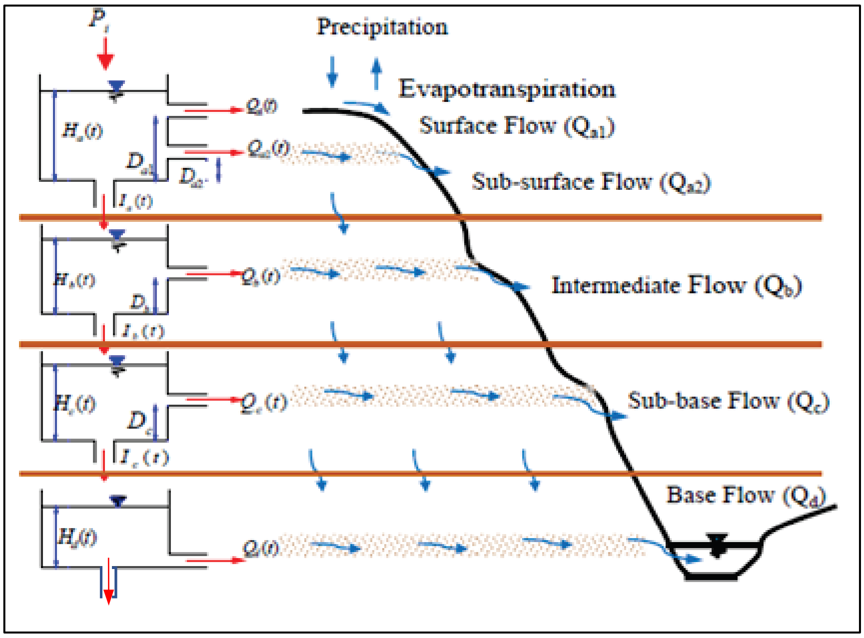
Aimag / City	Water demand for 2040 (million m3 / year)								
	Household drinking water	Public utilities & Tourism	Industrialization	Other industries, energy, construction and road transport	Industrialization and mining (mining and processing)	Sub-Total	Agriculture (pasture farming)	Irrigated area	Total
Ulaanbaatar	122.8	37.31	15.79	76.25	11.27	263.42	2.3	2.83	268.5

Source: JICA Project Team

(4) Evaluation of surface water potential

1) Tank model

The tank model (Masami Sugawara, 1972) is used to examine rainfall-runoff relation and temperature. This model allows to estimate snowfall and snowmelt. The schematic figure of the tank model is shown in Figure A3.2.



Source: Nugroho Suryoputro, et. al., (2017)

Figure A3.2 Schematic of the Tank Model

The tank model is a conceptual representation of hydrological processes in the unit area of the basin, and it simulates wetness of several soil layers using tanks arranged vertically in a series.

This kind of model typically consists of three or four storage tanks. Precipitation is the input of the model, and it enters into the top tank. Some of the accumulated water flows through the side outlet of a tank and some of it infiltrates down into the second lower tank. The process repeats for every lower tank. Evapotranspiration is incorporated via subtraction from the tank. The runoff from the side outlet of a storage tank (q) is proportional to the water head over that outlet, and the infiltration (p) is proportional to the water depth. These relations can be expressed as:

$$q = a(h - z),\ p = bh, \qquad (1)$$

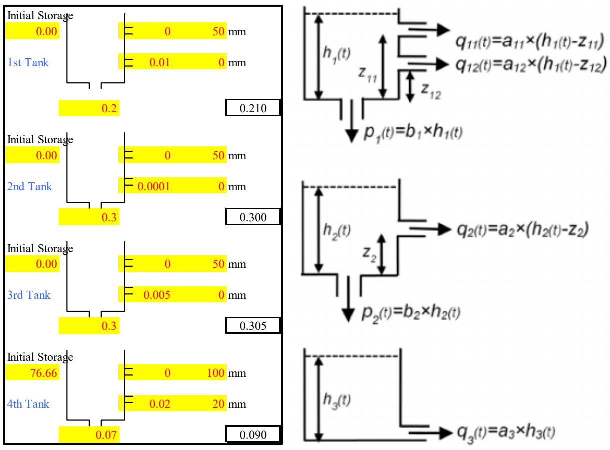
where h is the tank depth, z is the height of the discharge outlet from the base of each tank, a is the runoff coefficient and b is the infiltration coefficient.

In this study, the tank model is applied with four storage tanks consisting of a surface tank, an intermediate tank, and a base tank (Figure A3.3). The two side outflows from the surface tank are regarded as the surface runoff (q11) and the sub-surface runoff (q12), the side outflow from the intermediate tank is regarded as the intermediate runoff (q2) and the outflow from the third tank is regarded as the base runoff (q3). The total outflow from the side outlet (Q) from each tank is regarded as the accumulation of the outflows from a system in the watershed, as given by the following equation:

$$Q/A = q11 + q12 + q2 + q3 + q4, \qquad (2)$$

where A is the watershed area.

The tank model introduced by Sugawara for humid regions includes four tanks used to analyse daily discharge from daily precipitation and evaporation input (Sugawara et.al., 1995)



Source: JICA Project Team

Figure A3.3 Structure of Tank Model

Normally, a tank model combining several tanks in a series produces a better simulation results. In Japan, the tank model consisting of four tanks in a series successfully analyzes a number of river basins. In such a model, each tank interacts in the manner described in the above equation (1). The top tank receives the rainfall as inflow to the tank, while the tanks below get the supply from the bottom holes of the tank directory above. The aggregated outflow from all the side holes of the tanks constitutes the inflow into the river course.

2) Snow and snowmelt modelling

In Mongolia, it is important to construct a model that considers snowfall and snowmelt, because it will be below freezing below 30 degrees Celsius in winter. When evaluating water availability analysis at the site, a model that takes into account the snowfall and snow melting process is required. For this reason, in this study, the model of snowmelt and snow water volume based on the simplified heat balance method was incorporated into the tank model.

A snowmelt model based on a heat balance method has been developed by Dr. Suizu. The input data for this model comprises only daily precipitation amount, sunshine duration and air temperature.

- Snowfall amount is calculated by using precipitation and air temperature.
- Short wave radiation balance is calculated by using snowfall amount, sunshine duration and air temperature.
- An expression to calculate long wave radiation balance by using sunshine duration has been developed.

- Introducing *SL* factor K_{SL}, a method to calculate the sensible and latent heat fluxes by using air temperature has been developed.

The model is capable of calculating daily snowmelt and water equivalent of snow from the first snowfall of the season through to the disappearance of snow cover. K_{SL} shows the following:

- K_{SL} depends on daily mean wind speed and the patterns of diurnal wind fluctuation;
- K_{SL} is related to geographical location.

This model requires as input precipitation, sunshine duration and air temperature. As the distribution of those factors can be estimated by using meteorological data, the model can be applied to an extensive area.

3) Elevation correction of precipitation

In general, it is known that precipitation increases in high altitudes than in lowland areas. In this model, the precipitation at the rainfall observation station was corrected by using the average elevation of the sub-basin block according to the following formula.

$$P_{sub\text{-}basin} = P_{station} * (0.1955 \times H_{sub\text{-}basin} - 50.613) / (0.1955 \times H_{station} - 50.613),$$

where, $P_{sub\text{-}basin}$ is precipitation at sub-basin block, $P_{station}$ is precipitation at rainfall observation station, $H_{sub\text{-}basin}$ is average altitude of sub-basin block and $H_{station}$ is altitude at rainfall observation station.

4) Elevation correction of temperature

In general, it is known that temperature decreases in high altitudes than in lowland areas. In this model, the temperature at the meteorological observation station was corrected by using the average elevation of the sub-basin block according to the following formula.

$$T_{sub\text{-}basin} = T_{station} - 0.0065 \times (H_{sub\text{-}basin} - H_{station}),$$

where, $T_{sub\text{-}basin}$ is temperature at sub-basin block, $T_{station}$ is temperature at rainfall observation station, $H_{sub\text{-}basin}$ is average altitude of sub-basin block and $H_{station}$ is altitude at rainfall observation station.

5) Snowfall

Snowfall is estimated based on precipitation and temperature. The ratio of snow and rain is given by the average daily temperature. It is known that 100% snowfall at 1 degree Celsius and rain at 4 degrees Celsius. For this reason, in this model, it was made to snow on a day with a daily average temperature of 2 degrees Celsius.

6) Instrument correction for snowfall

When snowfall is measured with a precipitation meter, the airflow is disturbed by the precipitation meter, snowfall is not captured, and a value smaller than the true value is measured. Ohno et.al., (1998) clarified the relationship between the wind speed and the supplement rate of precipitation gauges used in the Japanese weather station. The relationship between the true precipitation *Pt* (mm), measured precipitation Pm (mm), wind speed *Ui* (m/s) at the receiving port height, and correction coefficient γ is shown in the following equation. Thus, the true snowfall is calculated. The correction factor is 0.17 for RT-1 type, 0.24 for RT-3 type, and 0.14 for RT-4 type, depending on the type of precipitation meter. The wind speed follows the logarithmic distribution and is converted to the height of the receiving port. For the snow particle size required for conversion, 0.5 mm is used as an average value of $(0.5\sim10) \times 10^{-4}$ m shown in Takeuchi and Kondo (1981). In this model, the rain-gauge instrument correction factor of γ at 0.17 and Ui at 1.0 m/s are applied, respectively.

$$Pt = Pm \times (1-\gamma Ui)$$

7) Snow melting by heat conduction from the ground

The heat conduction from the ground causes the snow melting at the bottom of the snow cover and heat conduction to the snow cover. According to Ishikawa (1994), even in snowy areas where the winter temperature is -30 ºC or below, there is snowmelt on the bottom of the snowfall of 0.1 to 0.5 mm/day, and it can reach 1.25 mm/day in warm winter years. Therefore, in this model, it is assumed that there is snow melting at the bottom of 0.1 mm/day.

8) Sensible heat and latent heat transfer

The amount of heat transport by sensible heat *H* and latent heat *lE* can be written by the bulk method as follows:

$$H=C_p\ C_H\ U(T_a-T_S), \text{ and}$$

$$lE=l\rho C_E\ U(Q-Qs\ (Ts)),$$

where C_p and ρ are constant pressure specific heat and density of air, *U*, *Ta* and *Q* are wind speed, temperature and specific humidity, *Ts* is the temperature of the snow cover, *Qs(Ts)* is saturation specific humidity at temperature *Ts,* and C_H and C_E are the bulk coefficient for sensible heat and latent heat, respectively. C_H and C_E have been shown to be approximately equal for flat snow surfaces regardless of wind speed (Kondo and Yamazawa, 1986).

Snow melting due to sensible heat transport occurs at temperatures above 0 ºC, and snow surface temperature is 0 ºC. When $C_H = C_E$ and the specific humidity is converted into the water vapor pressure *e* (hPa), the following equation is obtained. K_{SL} is a coefficient introduced to simplify sensible heat and latent heat transport and is called *SL* factor. *H* and *lE* are converted into the amount of snow melt, the unit is mm/day, P is atmospheric pressure (hPa), and the unit of *Ta* is ºC. It is not necessary to consider daily atmospheric pressure changes, and the standard atmospheric pressure obtained from the altitude of the point is enough (Suizu, 2001).

$$H=K_{SL}\ P_T\_a/1013, \text{ and}$$

$$lE=1.53K_{SL}\ (e-6.11).$$

Saturated vapor pressure relative to daily mean temperature e is calculated by following equation.

$$e=6.1078*10^\wedge(7.5*Ta/(Ta+237.3)).$$

According to Suizu (2001), K_{SL} values in Japan range from 0.7 to 5.4. In the model of this study, K_{SL} was set to 0.4 from the result of tank model calibration. Mean monthly sunshine duration is shown in Table A3.3.

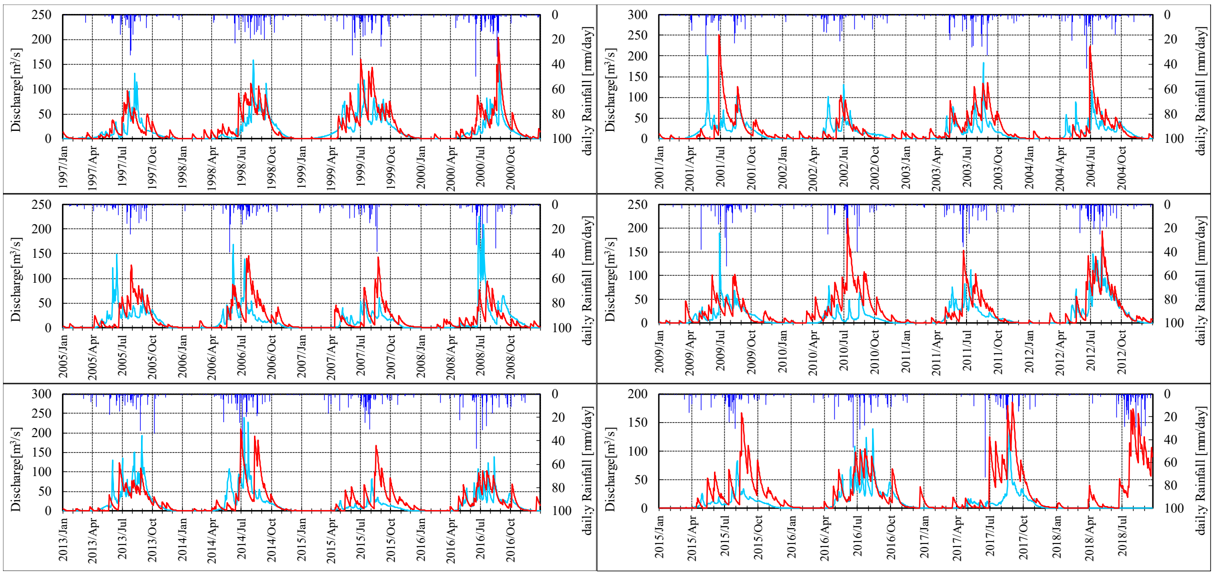
Table A3.3 Mean Monthly Sunshine Duration

Month	Monthly Mean Sunshine Duration (hours)	Monthly Mean Sunshine Duration (hrs/12hr)
1	5.806	0.484
2	7.143	0.595
3	8.226	0.685
4	8.333	0.694
5	9.677	0.806
6	8.667	0.722
7	8.065	0.672
8	8.226	0.685
9	8.333	0.694
10	7.581	0.632
11	5.667	0.472
12	4.839	0.403
Average	7.547	0.629

Source: JICA Project Team

9) Results of calibration of tank model

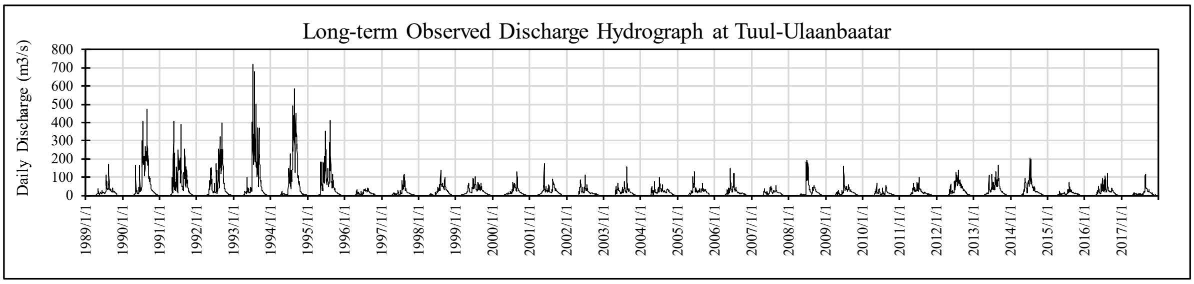
The results of tank model parameters estimation at Tuul Ulaanbaatar of Tuul River were shown in Figure A3.4. The simulated discharge by the tank model are well fitted to observed discharge.



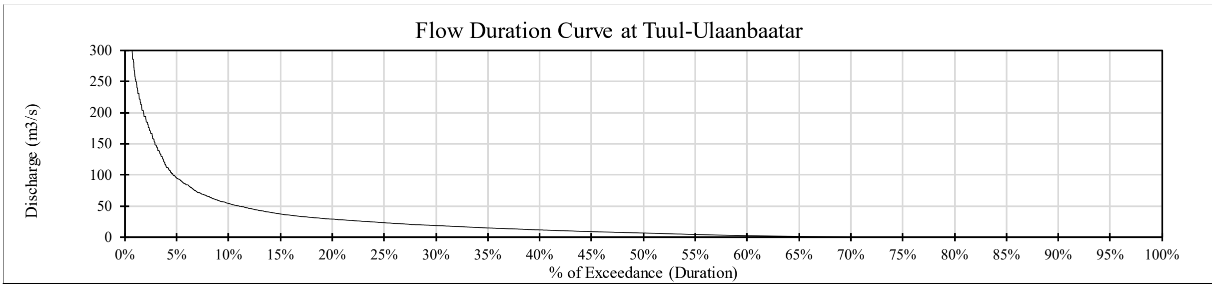
Source: JICA Project Team

Figure A3.4 Observed and Simulated Daily Discharge Hydrograph at Tuul-Ulaanbaatar

Figure A3.5 shows hydrograph of daily observed discharge and the flow duration curve at Tuul-Ulaanbaatar station. As shown, the river flow of 15% of year in winter (dry) season is at zero. The groundwater recharge in winter will also very limited. Thus, flow regulation facility such as dam/reservoir is required in future for Ulaanbaatar city water supply.



Source: JPT based on NAMEM data.

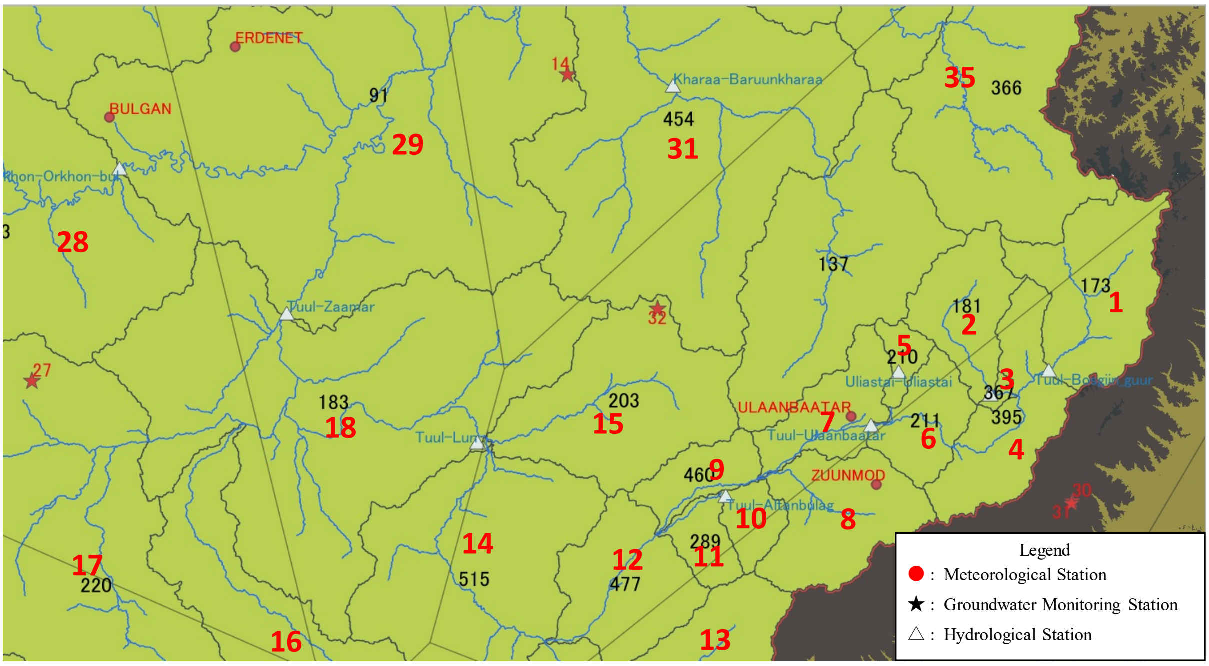


Duration (%)	Discharge (m^3/s)	Duration (%)	Discharge (m^3/s)	Duration (%)	Discharge (m^3/s)	Duration (%)	Discharge (m^3/s)	Duration (%)	Discharge (m^3/s)	Duration (%)	Discharge (m^3/s)	Duration (%)	Discharge (m^3/s)
Max	721.00	15%	37.30	30%	18.60	45%	8.87	60%	2.35	75%	0.20	90%	0.00
5%	95.10	20%	29.00	35%	14.70	50%	6.61	65%	1.22	80%	0.03	95%	0.00
10%	54.20	25%	23.40	40%	11.60	55%	4.25	70%	0.54	85%	0.00	100%	0.00

Source: JICA Project Team based on NAMEM data.

Figure A3.5 Flow Duration Curve at Tuul-Ulaanbaatar

Figure A3.6 shows the sub-basin map of Tuul River and Selenge River for evaluation of surface water and groundwater potential.



Source: JICA Project Team

Figure A3.6 Sub-Basin Map of Tuul River and Selenge River

(5) Evaluation of groundwater potential

1) Groundwater analysis model (Darcy's law model)

Using recharge results from top soil to groundwater aquifer by tank model, the Darcy's Law model for groundwater was constructed for evaluation of groundwater potentials.

The parameters of the groundwater model were decided with reference to the topographic map, geological map, hydrogeological map, borehole log data and observed groundwater level data, etc. The model was built by sub-basin block based on the Darcy's law;

Darcy's Law

$Q = A \times v$

$v = -K \times i$

$i = \Delta h / L$

$\Delta \mathrm{h} = h_a - h_b$

where: Q: groundwater flow [m^3/s]

A: sectional area [m^2] $A = W \times \{(h_a - h_b)/2\} - \mathrm{El\_base}\}$

v: velocity [m/s]

K: hydraulic conductivity [m/sec] or [cm/sec]

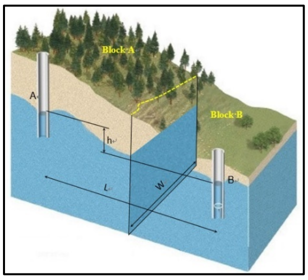
i: hydraulic gradient [m/m]

L: distance to downstream block [m]

W: width of groundwater contact line to downstream [m]

h_a: groundwater level at this block [El. m]

h_b: groundwater level at downstream block [El.m]



Source: JICA Project Team

Diagram of Groundwater Flow

El_base: elevation of basement lock [El.m]

[Safety Groundwater Potential]

$$SGWP_{today} = (GWFlow_{today} - GWFlow_{\min}) \times Safety\_Factor$$

$$GW\ FLow\_today = \{(h\_(a\_today\ ) - h\_b)/2 - El\_base\} \times W \times K \times i$$

$$GW\ FLow\_min = \{(h\_(a\_min) - h\_b)/2 - El\_base\} \times W \times K \times i$$

$$i = \Delta h/L$$

$$\Delta \mathrm{h} = h_a - h_b$$

where:

$SGWP_{today}$: safety groundwater potential of today [m³/s]

$GWFlow_{today}$: groundwater flow AToday [m³/sec]

$GWFlow_{min}$: minimum groundwater flow at most draught year [m³/sec]

$Safety\_Factor$: safety factor for groundwater usage at 0.5

h_{a_today} : groundwater level of this block today [El. m]

h_{a_min} : minimum groundwater level of this block at most drought year [El.m]

h_b : groundwater level of downstream block [El.m]

El_base : elevation of basement lock [El.m]

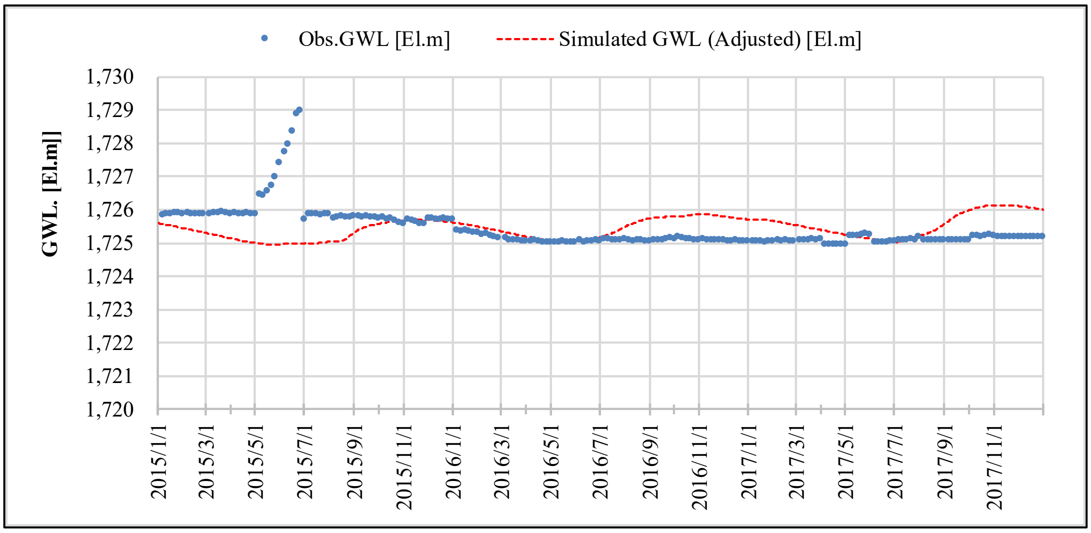
K : hydraulic conductivity [m/sec] or [cm/sec]

i : hydraulic gradient [m/m]

L : distance to downstream block [m]

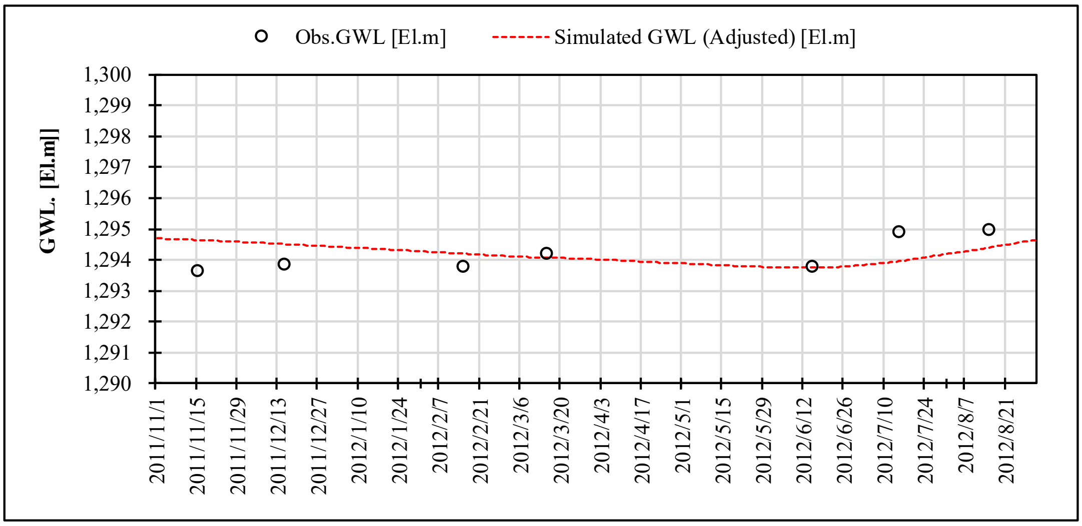
W : width of groundwater contact line to downstream block [m]

Observed groundwater levels from 2006 to 2016 (11 years) were simulated by the groundwater model (Figure A3.7). The simulated groundwater level and observed groundwater level at observation wells are fitted as shown Figure A3.8.



Source: JICA Project Team based on groundwater monitoring data of NAMEM

Figure A3.7 Observed GWL at Bayan and Simulated GWL at [Block-7]

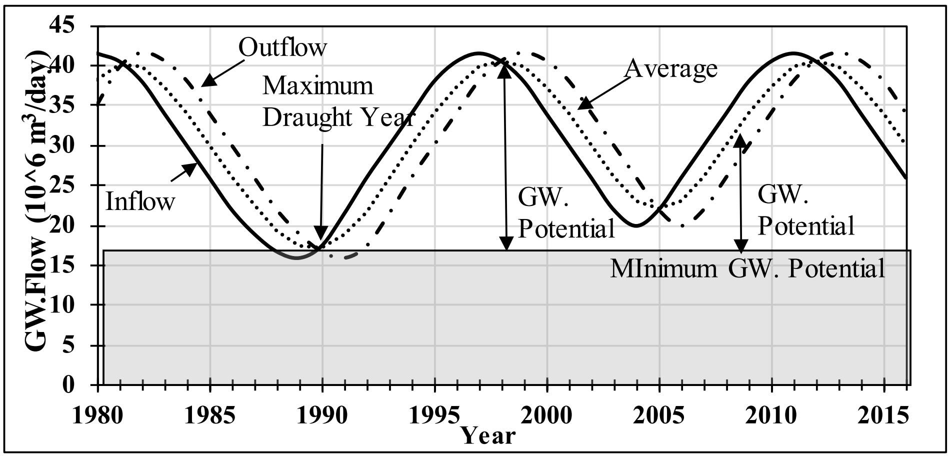


Source: JICA Project Team based on groundwater monitoring data of USUG/KOICA (2012)

Figure A3.8 Observed GWL at Central Source W-9 in Ulaanbaatar and Simulated GWL at Selenge River Basin [Block-7]

2) Groundwater potential in Tuul River basin (Ulaanbaatar)

In this study, the safety groundwater availability was defined as the figure shown in Figure A3.9. The safety factor of 0.6 was decided based on the consideration of aquifer characteristics, status of groundwater exploitation, and requirement of groundwater management of the area. After calibration of the model with estimated parameters, naturalized safety groundwater availability was estimated by not considering artificial groundwater intake.



Source: JICA Project Team

Figure A3.9 Conceptual Diagram of Groundwater Potential

(6) Groundwater development potential for Ulaanbaatar

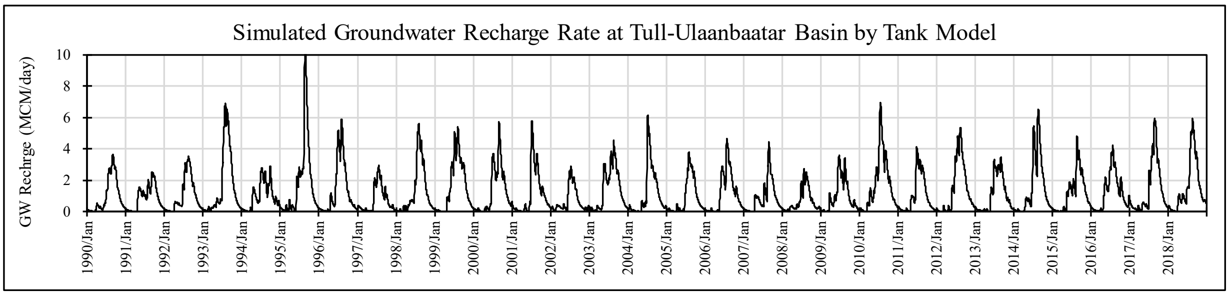
According to the "Master Plan (M/P) for Water Resources Development in Ulaanbaatar" by KOICA/USUG (2012), a substantive estimate of groundwater recharge volume at the Ulaanbaatar city catchment (7,514 km^2) would be 238.5 MCM/year by using the recession curve method. Based on limited experience, sustainable yield (safe yield) is about up to 40% of groundwater recharge and can be up to 70% of groundwater recharge (Miles and Chamber, 1995; Hahn et al., 1997). If the 60% of groundwater recharge is applied, the sustainable yield (groundwater development potential) would be 143.1 MCM/year only (Table A3.4).

Table A3.4 Groundwater Development Potential for Ulaanbaatar

Goundwater Resource Potential	Groundwater Recharge	Sustainable Yield Coefficient	Groundwater Development Potential
2,348 MCM/year	238.5 MCM/year	60%	143.1 MCM/year

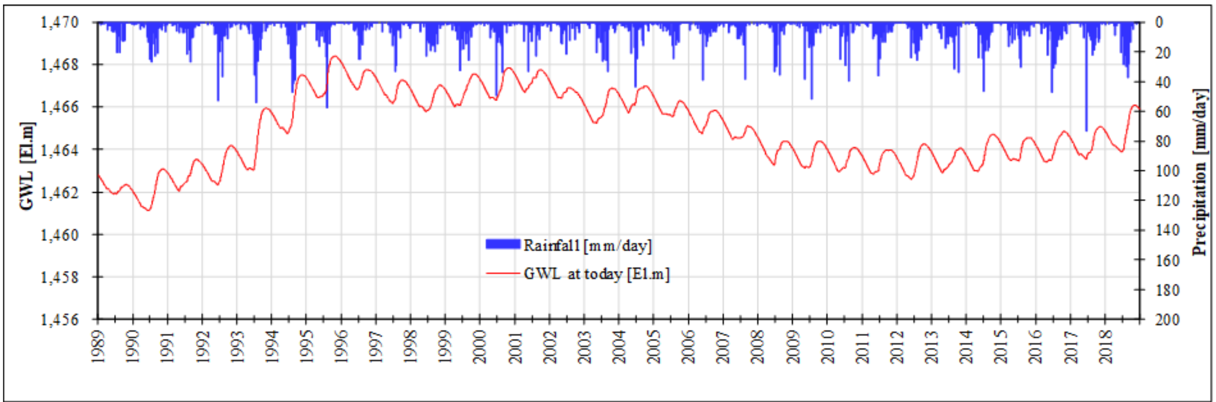
Source: USUG/KOICA, 2012

The JICA Project Team also evaluated groundwater potential in Ulaanbaatar catchment from 1989 to 2018 (30-years) by using the tank model results and the Darcy's law model as shown in Figures A3.10, A3.11 and A3.12.



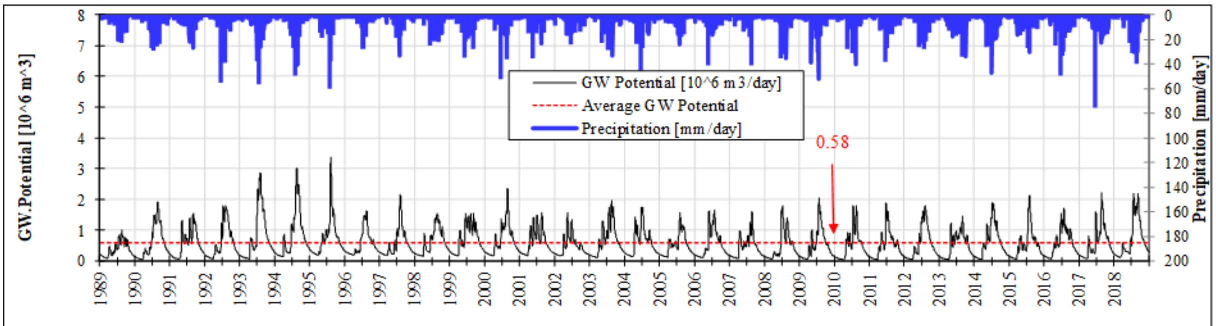
Source: JICA Project Team based on NAMEM data.

Figure A3.10 Simulated Groundwater Recharge at Tull-Ulaanbaatar Basin by Tank Model



Source: JICA Project Team

Figure A3.11 Daily Groundwater Level at Ulaanbaatar, Tuul River Basin



Source: JICA Project Team

Figure A3.12 Simulated Daily Groundwater Potential at Ulaanbaatar, Tuul River Basin

Summary of simulated groundwater potential is shown in Table A3.5. Average annual groundwater potential at Ulaanbaatar is estimated at 213.32 MCM/year. This value is slightly smaller compared with 238.5 MCM/year by using the recession curve method by USUG/KOICA study.

Table A3.5 Simulated Groundwater Potential at Ulaanbaatar, Tuul River Basin

No.	Year	Precipitation [mm/year]	Groundwater Potential Annual [10^6 m^3/year]	Daily Max. [m^3/day]	Daily Ave. [m^3/day]	Daily Min. [m^3/day]
1	1989	210.72	136.17	1,003,617	373,072	75,986
2	1990	361.94	213.74	1,911,364	585,595	40,206
3	1991	280.93	199.67	1,554,325	547,053	59,542
4	1992	350.66	215.93	1,796,547	589,965	65,659
5	1993	443.42	289.96	2,864,081	794,404	63,844
6	1994	460.04	301.07	3,015,125	824,858	132,351
7	1995	370.08	276.52	3,370,963	757,595	191,508
8	1996	251.17	205.14	1,629,376	560,502	190,332
9	1997	245.94	205.78	2,158,722	563,767	182,029
10	1998	310.91	226.28	1,541,727	619,933	150,001
11	1999	346.60	255.69	1,553,747	700,529	157,279
12	2000	382.98	248.12	2,350,718	677,916	171,164
13	2001	232.81	222.89	1,564,158	610,667	171,701
14	2002	221.65	176.51	1,583,963	483,598	161,845
15	2003	334.16	244.88	1,968,075	670,900	111,066
16	2004	303.01	224.08	1,753,644	612,233	134,659
17	2005	224.67	188.05	1,566,123	515,198	124,633
18	2006	299.64	191.35	1,651,861	524,247	105,524
19	2007	215.84	167.52	1,594,342	458,959	88,005
20	2008	265.58	171.31	1,790,034	468,060	63,590
21	2009	319.28	190.79	2,046,165	522,723	50,363
22	2010	277.91	176.06	1,808,055	482,359	33,717
23	2011	302.20	185.95	1,880,174	509,456	38,864
24	2012	334.04	201.86	1,805,767	551,542	38,017
25	2013	301.62	182.98	1,474,846	501,311	34,539
26	2014	341.95	221.43	1,882,055	606,661	47,199
27	2015	314.52	193.15	2,128,034	529,171	59,939
28	2016	350.32	213.36	1,725,204	582,941	64,726
29	2017	333.46	216.31	2,234,228	592,631	72,426
30	2018	405.41	256.95	2,198,700	703,968	108,464
	Maximum	460.04	301.07	3,370,963	824,858	191,508
	Average	313.11	213.32	1,913,525	584,060	99,639
	Minimum	210.72	136.17	1,003,617	373,072	33,717

Source: JICA Project Team

(7) Future water balance in Ulaanbaatar

Groundwater potential, water demand and water shortage in Ulaanbaatar are shown in Table A3.6. In the year 2040, the water demand will be increased and the water shortage (deficit) will occur many of years even in average annual potential. In particular, at the moment in dry season, the groundwater will be limited, and the water shortages will occur even in year of 2018 and the groundwater potential will not reach water demand in 2040. The water shortage will be at -151.556 m^3/day (= -1.75 m^3/s) in 2040 under annual average. In the dry season, the water shortage will be at -635,977 m^3/day (= -7.36 m^3/s) in 2040 on average. This value corresponds to the annual average water demand forecast of 2040, i.e. 735,616 m^3/day (268.5 MCM/year = 8.51 m^3/s), which is larger than the estimated dry season's groundwater potential of 30-years average i.e. 99,639 m^3/day (36.4 MCM/year).

These water shortages shall be solved by development of surface water such as dam/reservoir.

Table A3.6 Groundwater Potential, Water Demand and Water Shortage in Ulaanbaatar

No.	Year	Precipitation	Groundwater Potential				Water Demand			Water Shortage (Average)			Water Shortage (Dry Season)		
			Annual	Daily Max.	Daily Ave.	Daily Min.	2018	2030	2040	2018	2030	2040	2018	2030	2040
		[mm/year]	[10^6 m³/year]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]
1	1989	210.72	136.17	1,003,617	373,072	75,986	433,699	543,014	735,616	-60,627	-169,942	-362,545	-357,713	-467,028	-659,630
2	1990	361.94	213.74	1,911,364	585,595	40,206	433,699	543,014	735,616	151,896	42,581	-150,021	-393,493	-502,808	-695,411
3	1991	280.93	199.67	1,554,325	547,053	59,542	433,699	543,014	735,616	113,354	4,039	-188,564	-374,156	-483,471	-676,074
4	1992	350.66	215.93	1,796,547	589,965	65,659	433,699	543,014	735,616	156,267	46,951	-145,651	-368,040	-477,355	-669,958
5	1993	443.42	289.96	2,864,081	794,404	63,844	433,699	543,014	735,616	360,706	251,390	58,788	-369,854	-479,169	-671,772
6	1994	460.04	301.07	3,015,125	824,858	132,351	433,699	543,014	735,616	391,160	281,844	89,242	-301,348	-410,663	-603,265
7	1995	370.08	276.52	3,370,963	757,595	191,508	433,699	543,014	735,616	323,897	214,581	21,979	-242,190	-351,505	-544,108
8	1996	251.17	205.14	1,629,376	560,502	190,332	433,699	543,014	735,616	126,804	17,489	-175,114	-243,367	-352,682	-545,285
9	1997	245.94	205.78	2,158,722	563,767	182,029	433,699	543,014	735,616	130,069	20,754	-171,849	-251,670	-360,985	-553,588
10	1998	310.91	226.28	1,541,727	619,933	150,001	433,699	543,014	735,616	186,235	76,920	-115,683	-283,698	-393,013	-585,615
11	1999	346.60	255.69	1,553,747	700,529	157,279	433,699	543,014	735,616	266,831	157,516	-35,087	-276,419	-385,734	-578,337
12	2000	382.98	248.12	2,350,718	677,916	171,164	433,699	543,014	735,616	244,217	134,902	-57,701	-262,534	-371,849	-564,452
13	2001	232.81	222.89	1,564,158	610,667	171,701	433,699	543,014	735,616	176,969	67,654	-124,949	-261,997	-371,312	-563,915
14	2002	221.65	176.51	1,583,963	483,598	161,845	433,699	543,014	735,616	49,899	-59,416	-252,019	-271,853	-381,168	-573,771
15	2003	334.16	244.88	1,968,075	670,900	111,066	433,699	543,014	735,616	237,201	127,886	-64,717	-322,633	-431,948	-624,551
16	2004	303.01	224.08	1,753,644	612,233	134,659	433,699	543,014	735,616	178,535	69,220	-123,383	-299,039	-408,355	-600,957
17	2005	224.67	188.05	1,566,123	515,198	124,633	433,699	543,014	735,616	81,499	-27,816	-220,419	-309,065	-418,381	-610,983
18	2006	299.64	191.35	1,651,861	524,247	105,524	433,699	543,014	735,616	90,548	-18,767	-211,369	-328,175	-437,490	-630,093
19	2007	215.84	167.52	1,594,342	458,959	88,005	433,699	543,014	735,616	25,260	-84,055	-276,657	-345,693	-455,008	-647,611
20	2008	265.58	171.31	1,790,034	468,060	63,590	433,699	543,014	735,616	34,362	-74,953	-267,556	-370,108	-479,423	-672,026
21	2009	319.28	190.79	2,046,165	522,723	50,363	433,699	543,014	735,616	89,024	-20,291	-212,894	-383,335	-492,650	-685,253
22	2010	277.91	176.06	1,808,055	482,359	33,717	433,699	543,014	735,616	48,660	-60,655	-253,258	-399,982	-509,297	-701,900
23	2011	302.20	185.95	1,880,174	509,456	38,864	433,699	543,014	735,616	75,757	-33,558	-226,160	-394,835	-504,150	-696,752
24	2012	334.04	201.86	1,805,767	551,542	38,017	433,699	543,014	735,616	117,844	8,528	-184,074	-395,682	-504,997	-697,600
25	2013	301.62	182.98	1,474,846	501,311	34,539	433,699	543,014	735,616	67,612	-41,703	-234,306	-399,159	-508,475	-701,077
26	2014	341.95	221.43	1,882,055	606,661	47,199	433,699	543,014	735,616	172,963	63,648	-128,955	-386,500	-495,815	-688,418
27	2015	314.52	193.15	2,128,034	529,171	59,939	433,699	543,014	735,616	95,472	-13,843	-206,445	-373,760	-483,075	-675,677
28	2016	350.32	213.36	1,725,204	582,941	64,726	433,699	543,014	735,616	149,242	39,927	-152,676	-368,972	-478,287	-670,890
29	2017	333.46	216.31	2,234,228	592,631	72,426	433,699	543,014	735,616	158,933	49,618	-142,985	-361,273	-470,588	-663,191
30	2018	405.41	256.95	2,198,700	703,968	108,464	433,699	543,014	735,616	270,269	160,954	-31,649	-325,235	-434,550	-627,153
Maximum		460.04	301.07	3,370,963	824,858	191,508	433,699	543,014	735,616	391,160	281,844	89,242	-242,190	-351,505	-544,108
Average		313.11	213.32	1,913,525	584,060	99,639	433,699	543,014	735,616	150,362	41,047	-151,556	-334,059	-443,374	-635,977
Minimum		210.72	136.17	1,003,617	373,072	33,717	433,699	543,014	735,616	-60,627	-169,942	-362,545	-399,982	-509,297	-701,900

Source: JICA Project Team