

Water Indicators

Indicator	Value	Description	Source
Overall Basin Risk (score)	2.96	Overall Basin Risk (score)	
Overall Basin Risk (rank)	37	Overall Basin Risk (rank)	
Physical risk (score)	2.97	Physical risk (score)	
Physical risk (rank)	54	Physical risk (rank)	
Regulatory risk (score)	3.04	Regulatory risk (score)	
Regulatory risk (rank)	62	Regulatory risk (rank)	
Reputation risk (score)	2.83	Reputation risk (score)	
Reputation risk (rank)	70	Reputation risk (rank)	
1. Quantity - Scarcity (score)	3.59	1. Quantity - Scarcity (score)	
1. Quantity - Scarcity (rank)	26	1. Quantity - Scarcity (rank)	
2. Quantity - Flooding (score)	1.81	2. Quantity - Flooding (score)	
2. Quantity - Flooding (rank)	172	2. Quantity - Flooding (rank)	
3. Quality (score)	3.30	3. Quality (score)	
3. Quality (rank)	68	3. Quality (rank)	
4. Ecosystem Service Status (score)	2.08	4. Ecosystem Service Status (score)	
4. Ecosystem Service Status (rank)	122	4. Ecosystem Service Status (rank)	
5. Enabling Environment (Policy & Laws) (score)	3.65	5. Enabling Environment (Policy & Laws) (score)	
5. Enabling Environment (Policy & Laws) (rank)	22	5. Enabling Environment (Policy & Laws) (rank)	
6. Institutions and Governance (score)	4.00	6. Institutions and Governance (score)	
6. Institutions and Governance (rank)	26	6. Institutions and Governance (rank)	
7. Management Instruments (score)	2.27	7. Management Instruments (score)	
7. Management Instruments (rank)	134	7. Management Instruments (rank)	
8 - Infrastructure & Finance (score)	1.20	8 - Infrastructure & Finance (score)	
8 - Infrastructure & Finance (rank)	137	8 - Infrastructure & Finance (rank)	
9. Cultural Diversity (score)	1.00	9. Cultural importance (score)	
9. Cultural Diversity (rank)	134	9. Cultural importance (rank)	
10. Biodiversity Importance (score)	1.95	10. Biodiversity importance (score)	

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Indicator	Value	Description	Source
10. Biodiversity Importance (rank)	184	10. Biodiversity importance (rank)	
11. Media Scrutiny (score)	3.55	11. Media Scrutiny (score)	
11. Media Scrutiny (rank)	24	11. Media Scrutiny (rank)	
12. Conflict (score)	3.11	12. Conflict (score)	
12. Conflict (rank)	38	12. Conflict (rank)	
1.0 - Aridity (score)	3.73	The aridity risk indicator is based on the Global Aridity Index (Global-Aridity) and Global Potential Evapo-Transpiration (Global-PET) Geospatial data sets by Trabucco and Zomer (2009). These data sets provide information about the potential availability of water in regions with low water demand, thus they are used in the Water Risk Filter 5.0 to better account for deserts and other arid areas in the risk assessment.	Trabucco, A., & Zomer, R. J. (2009). Global potential evapo-transpiration (Global-PET) and global aridity index (Global-Aridity) geodatabase. CGIAR consortium for spatial information.
1.0 - Aridity (rank)	23	The aridity risk indicator is based on the Global Aridity Index (Global-Aridity) and Global Potential Evapo-Transpiration (Global-PET) Geospatial data sets by Trabucco and Zomer (2009). These data sets provide information about the potential availability of water in regions with low water demand, thus they are used in the Water Risk Filter 5.0 to better account for deserts and other arid areas in the risk assessment.	Trabucco, A., & Zomer, R. J. (2009). Global potential evapo-transpiration (Global-PET) and global aridity index (Global-Aridity) geodatabase. CGIAR consortium for spatial information.
1.1 - Water Depletion (score)	3.46	The water depletion risk indicator is based on annual average monthly net water depletion from Brauman et al. (2016). Their analysis is based on model outputs from the newest version of the integrated water resources model WaterGAP3 which measures water depletion as the ratio of water consumption-to-availability.	Brauman, K. A., Richter, B. D., Postel, S., Malsy, M., & Flörke, M. (2016). Water depletion: An improved metric for incorporating seasonal and dry-year water scarcity into water risk assessments. <i>Elem Sci Anth</i> , 4.
1.1 - Water Depletion (rank)	19	The water depletion risk indicator is based on annual average monthly net water depletion from Brauman et al. (2016). Their analysis is based on model outputs from the newest version of the integrated water resources model WaterGAP3 which measures water depletion as the ratio of water consumption-to-availability.	Brauman, K. A., Richter, B. D., Postel, S., Malsy, M., & Flörke, M. (2016). Water depletion: An improved metric for incorporating seasonal and dry-year water scarcity into water risk assessments. <i>Elem Sci Anth</i> , 4.
1.2 - Baseline Water Stress (score)	3.76	World Resources Institute's Baseline Water Stress measures the ratio of total annual water withdrawals to total available annual renewable supply, accounting for upstream consumptive use. A higher percentage indicates more competition among users.	Hofste, R., Kuzma, S., Walker, S., ... & Sutanudjaja, E.H. (2019). <i>Aqueduct 3.0: Updated decision relevant global water risk indicators</i> . Technical note. Washington, DC: World Resources Institute.

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Indicator	Value	Description	Source
1.2 - Baseline Water Stress (rank)	24	World Resources Institute's Baseline Water Stress measures the ratio of total annual water withdrawals to total available annual renewable supply, accounting for upstream consumptive use. A higher percentage indicates more competition among users.	Hofste, R., Kuzma, S., Walker, S., ... & Sutanudjaja, E.H. (2019). Aqueduct 3.0: Updated decision relevant global water risk indicators. Technical note. Washington, DC: World Resources Institute.
1.3 - Blue Water Scarcity (score)	3.23	The blue water scarcity risk indicator is based on Mekonnen and Hoekstra (2016) global assessment of blue water scarcity on a monthly basis and at high spatial resolution (grid cells of 30 × 30 arc min resolution). Blue water scarcity is calculated as the ratio of the blue water footprint in a grid cell to the total blue water availability in the cell. The time period analyzed in this study ranges from 1996 to 2005.	Mekonnen, M. M., & Hoekstra, A. Y. (2016). Four billion people facing severe water scarcity. <i>Science advances</i> , 2(2), e1500323.
1.3 - Blue Water Scarcity (rank)	65	The blue water scarcity risk indicator is based on Mekonnen and Hoekstra (2016) global assessment of blue water scarcity on a monthly basis and at high spatial resolution (grid cells of 30 × 30 arc min resolution). Blue water scarcity is calculated as the ratio of the blue water footprint in a grid cell to the total blue water availability in the cell. The time period analyzed in this study ranges from 1996 to 2005.	Mekonnen, M. M., & Hoekstra, A. Y. (2016). Four billion people facing severe water scarcity. <i>Science advances</i> , 2(2), e1500323.
1.4 - Projected Change in Water Discharge (by ~2050) (score)	2.39	This risk indicator is based on multi-model simulation that applies both global climate and hydrological models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). To estimate the change at 2°C of global warming above 1980-2010 levels, simulated annual water discharge was averaged over a 31-year period with 2°C mean warming. Results are expressed in terms of relative change (%) in probability between present day (1980-2010) conditions and 2°C scenarios by 2050.	Schewe, J., Heinke, J., Gerten, D., Haddeland, I., Arnell, N. W., Clark, D. B., ... & Gosling, S. N. (2014). Multimodel assessment of water scarcity under climate change. <i>Proceedings of the National Academy of Sciences</i> , 111(9), 3245-3250.
1.4 - Projected Change in Water Discharge (by ~2050) (rank)	48	This risk indicator is based on multi-model simulation that applies both global climate and hydrological models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). To estimate the change at 2°C of global warming above 1980-2010 levels, simulated annual water discharge was averaged over a 31-year period with 2°C mean warming. Results are expressed in terms of relative change (%) in probability between present day (1980-2010) conditions and 2°C scenarios by 2050.	Schewe, J., Heinke, J., Gerten, D., Haddeland, I., Arnell, N. W., Clark, D. B., ... & Gosling, S. N. (2014). Multimodel assessment of water scarcity under climate change. <i>Proceedings of the National Academy of Sciences</i> , 111(9), 3245-3250.

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Indicator	Value	Description	Source
1.5 - Drought Frequency Probability (score)	4.31	This risk indicator is based on the Standardized Precipitation and Evaporation Index (SPEI). Vicente-Serrano et al. (2010) developed this multi-scalar drought index applying both precipitation and temperature data to detect, monitor and analyze different drought types and impacts in the context of global warming. The mathematical calculations used for SPEI are similar to the Standard Precipitation Index (SPI), but it has the advantage to include the role of evapotranspiration.	Vicente-Serrano, S. M., Beguería, S., & López-Moreno, J. I. (2010). A multiscale drought index sensitive to global warming: the standardized precipitation evapotranspiration index. <i>Journal of climate</i> , 23(7), 1696-1718.
1.5 - Drought Frequency Probability (rank)	24	This risk indicator is based on the Standardized Precipitation and Evaporation Index (SPEI). Vicente-Serrano et al. (2010) developed this multi-scalar drought index applying both precipitation and temperature data to detect, monitor and analyze different drought types and impacts in the context of global warming. The mathematical calculations used for SPEI are similar to the Standard Precipitation Index (SPI), but it has the advantage to include the role of evapotranspiration.	Vicente-Serrano, S. M., Beguería, S., & López-Moreno, J. I. (2010). A multiscale drought index sensitive to global warming: the standardized precipitation evapotranspiration index. <i>Journal of climate</i> , 23(7), 1696-1718.
1.6 - Projected Change in Drought Occurrence (by ~2050) (score)	3.00	This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) . A drought threshold for pre-industrial conditions was calculated based on time-series averages. Results are expressed in terms of relative change (%) in probability between pre-industrial and 2°C scenarios.	Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming-simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development.
1.6 - Projected Change in Drought Occurrence (by ~2050) (rank)	78	This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) . A drought threshold for pre-industrial conditions was calculated based on time-series averages. Results are expressed in terms of relative change (%) in probability between pre-industrial and 2°C scenarios.	Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming-simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development.
2.1 - Estimated Flood Occurrence (score)	1.79	This risk indicator is based on the recurrence of floods within the 34-year time frame period of 1985 to 2019. The occurrence of floods within a given location was estimated using data from Flood Observatory, University of Colorado. The Flood Observatory use data derived from a wide variety of news, governmental, instrumental, and remote sensing source.	Brakenridge, G. R. (2019). Global active archive of large flood events. Dartmouth Flood Observatory, University of Colorado.
2.1 - Estimated Flood Occurrence (rank)	171	This risk indicator is based on the recurrence of floods within the 34-year time frame period of 1985 to 2019. The occurrence of floods within a given location was estimated using data from Flood Observatory, University of Colorado. The Flood Observatory use data derived from a wide variety of news, governmental, instrumental, and remote sensing source.	Brakenridge, G. R. (2019). Global active archive of large flood events. Dartmouth Flood Observatory, University of Colorado.

Indicator	Value	Description	Source
2.2 - Projected Change in Flood Occurrence (by ~2050) (score)	2.20	This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). The magnitude of the flood event was defined based on 100-year return period for pre-industrial conditions. Results are expressed in terms of change (%) in probability between pre-industrial and 2°C scenarios.	Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming-simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development.
2.2 - Projected Change in Flood Occurrence (by ~2050) (rank)	101	This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). The magnitude of the flood event was defined based on 100-year return period for pre-industrial conditions. Results are expressed in terms of change (%) in probability between pre-industrial and 2°C scenarios.	Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming-simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development.
3.1 - Surface Water Contamination Index (score)	3.30	<p>The underlying data for this risk indicator is based on a broad suite of pollutants with well-documented direct or indirect negative effects on water security for both humans and freshwater biodiversity, compiled by Vörösmarty et al. (2010). The negative effects are specific to individual pollutants, ranging from impacts mediated by eutrophication such as algal blooms and oxygen depletion (e.g., caused by phosphorus and organic loading) to direct toxic effects (e.g., caused by pesticides, mercury).</p> <p>The overall Surface Water Contamination Index is calculated based on a range of key pollutants with different weightings according to the level of their negative effects on water security for both humans and freshwater biodiversity: soil salinization (8%), nitrogen (12%) and phosphorus (P, 13%) loading, mercury deposition (5%), pesticide loading (10%), sediment loading (17%), organic loading (as Biological Oxygen Demand, BOD; 15%), potential acidification (9%), and thermal alteration (11%).</p>	Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., ... & Davies, P. M. (2010). Global threats to human water security and river biodiversity. <i>Nature</i> , 467(7315), 555.

Indicator	Value	Description	Source
3.1 - Surface Water Contamination Index (rank)	68	<p>The underlying data for this risk indicator is based on a broad suite of pollutants with well-documented direct or indirect negative effects on water security for both humans and freshwater biodiversity, compiled by Vörösmarty et al. (2010). The negative effects are specific to individual pollutants, ranging from impacts mediated by eutrophication such as algal blooms and oxygen depletion (e.g., caused by phosphorus and organic loading) to direct toxic effects (e.g., caused by pesticides, mercury).</p> <p>The overall Surface Water Contamination Index is calculated based on a range of key pollutants with different weightings according to the level of their negative effects on water security for both humans and freshwater biodiversity: soil salinization (8%), nitrogen (12%) and phosphorus (P, 13%) loading, mercury deposition (5%), pesticide loading (10%), sediment loading (17%), organic loading (as Biological Oxygen Demand, BOD; 15%), potential acidification (9%), and thermal alteration (11%).</p>	Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., ... & Davies, P. M. (2010). Global threats to human water security and river biodiversity. <i>Nature</i> , 467(7315), 555.
4.1 - Fragmentation Status of Rivers (score)	2.37	<p>This risk indicator is based on the data set by Grill et al. (2019) mapping the world's free-flowing rivers. Grill et al. (2019) compiled a geometric network of the global river system and associated attributes, such as hydro-geometric properties, as well as pressure indicators to calculate an integrated connectivity status index (CSI). While only rivers with high levels of connectivity in their entire length are classified as free-flowing, rivers of CSI < 95% are considered as fragmented at a certain degree.</p>	Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., ... & Macedo, H. E. (2019). Mapping the world's free-flowing rivers. <i>Nature</i> , 569(7755), 215.
4.1 - Fragmentation Status of Rivers (rank)	97	<p>This risk indicator is based on the data set by Grill et al. (2019) mapping the world's free-flowing rivers. Grill et al. (2019) compiled a geometric network of the global river system and associated attributes, such as hydro-geometric properties, as well as pressure indicators to calculate an integrated connectivity status index (CSI). While only rivers with high levels of connectivity in their entire length are classified as free-flowing, rivers of CSI < 95% are considered as fragmented at a certain degree.</p>	Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., ... & Macedo, H. E. (2019). Mapping the world's free-flowing rivers. <i>Nature</i> , 569(7755), 215.
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (score)	1.00	<p>For this risk indicator, tree cover loss was applied as a proxy to represent catchment ecosystem services degradation since forests play an important role in terms of water regulation, supply and pollution control. The forest cover data is based on Hansen et al.'s global Landsat data at a 30-meter spatial resolution to characterize forest cover and change. The authors defined trees as vegetation taller than 5 meters in height, and forest cover loss as a stand-replacement disturbance, or a change from a forest to non-forest state, during the period 2000 – 2018.</p>	Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A. A., Tyukavina, A., ... & Kommareddy, A. (2013). High-resolution global maps of 21st-century forest cover change. <i>science</i> , 342(6160), 850-853.

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Indicator	Value	Description	Source
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (rank)	161	<p>For this risk indicator, tree cover loss was applied as a proxy to represent catchment ecosystem services degradation since forests play an important role in terms of water regulation, supply and pollution control.</p> <p>The forest cover data is based on Hansen et al.'s global Landsat data at a 30-meter spatial resolution to characterize forest cover and change. The authors defined trees as vegetation taller than 5 meters in height, and forest cover loss as a stand-replacement disturbance, or a change from a forest to non-forest state, during the period 2000 – 2018.</p>	Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A. A., Tyukavina, A., ... & Kommareddy, A. (2013). High-resolution global maps of 21st-century forest cover change. <i>science</i> , 342(6160), 850-853.
4.3 - Projected Impacts on Freshwater Biodiversity (score)	3.51	The study by Tedesco et al. (2013) to project changes [% increase or decrease] in extinction rate by ~2090 of freshwater fish due to water availability loss from climate change is used as a proxy to estimate the projected impacts on freshwater biodiversity.	Tedesco, P. A., Oberdorff, T., Cornu, J. F., Beauchard, O., Brosse, S., Dürr, H. H., ... & Hugueny, B. (2013). A scenario for impacts of water availability loss due to climate change on riverine fish extinction rates. <i>Journal of Applied Ecology</i> , 50(5), 1105-1115.
4.3 - Projected Impacts on Freshwater Biodiversity (rank)	54	The study by Tedesco et al. (2013) to project changes [% increase or decrease] in extinction rate by ~2090 of freshwater fish due to water availability loss from climate change is used as a proxy to estimate the projected impacts on freshwater biodiversity.	Tedesco, P. A., Oberdorff, T., Cornu, J. F., Beauchard, O., Brosse, S., Dürr, H. H., ... & Hugueny, B. (2013). A scenario for impacts of water availability loss due to climate change on riverine fish extinction rates. <i>Journal of Applied Ecology</i> , 50(5), 1105-1115.
5.1 - Freshwater Policy Status (SDG 6.5.1) (score)	3.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Policy" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.1 - Freshwater Policy Status (SDG 6.5.1) (rank)	49	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Policy" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.2 - Freshwater Law Status (SDG 6.5.1) (score)	4.00	<p>This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Law(s)" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.</p> <p>For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.</p>	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.

Indicator	Value	Description	Source
5.2 - Freshwater Law Status (SDG 6.5.1) (rank)	10	<p>This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation “National Water Resources Law(s)” indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.</p> <p>For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.</p>	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.3 - Implementation Status of Water Management Plans (SDG 6.5.1) (score)	4.00	<p>This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation “National IWRM plans” indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.</p> <p>For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.</p>	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.3 - Implementation Status of Water Management Plans (SDG 6.5.1) (rank)	23	<p>This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation “National IWRM plans” indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.</p> <p>For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.</p>	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
6.1 - Corruption Perceptions Index (score)	4.00	<p>This risk Indicator is based on the latest Transparency International's data: the Corruption Perceptions Index 2018. This index aggregates data from a number of different sources that provide perceptions of business people and country experts on the level of corruption in the public sector.</p>	Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International.
6.1 - Corruption Perceptions Index (rank)	36	<p>This risk Indicator is based on the latest Transparency International's data: the Corruption Perceptions Index 2018. This index aggregates data from a number of different sources that provide perceptions of business people and country experts on the level of corruption in the public sector.</p>	Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International.
6.2 - Freedom in the World Index (score)	5.00	<p>This risk indicator is based on Freedom House (2019), an annual global report on political rights and civil liberties, composed of numerical ratings and descriptive texts for each country and a select group of territories. The 2019 edition involved more than 100 analysts and more than 30 advisers with global, regional, and issue-based expertise to covers developments in 195 countries and 14 territories from January 1, 2018, through December 31, 2018.</p>	Freedom House (2019). Freedom in the world 2019. Washington, DC: Freedom House.

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Indicator	Value	Description	Source
6.2 - Freedom in the World Index (rank)	15	This risk indicator is based on Freedom House (2019), an annual global report on political rights and civil liberties, composed of numerical ratings and descriptive texts for each country and a select group of territories. The 2019 edition involved more than 100 analysts and more than 30 advisers with global, regional, and issue-based expertise to covers developments in 195 countries and 14 territories from January 1, 2018, through December 31, 2018.	Freedom House (2019). Freedom in the world 2019. Washington, DC: Freedom House.
6.3 - Business Participation in Water Management (SDG 6.5.1) (score)	3.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Business Participation in Water Resources Development, Management and Use" indicator, which corresponds to one of the six national level indicators under the Institutions and Participation category.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
6.3 - Business Participation in Water Management (SDG 6.5.1) (rank)	59	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Business Participation in Water Resources Development, Management and Use" indicator, which corresponds to one of the six national level indicators under the Institutions and Participation category.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
7.1 - Management Instruments for Water Management (SDG 6.5.1) (score)	2.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Sustainable and efficient water use management" indicator, which corresponds to one of the five national level indicators under the Management Instruments category. For SDG 6.5.1, management instruments refer to the tools and activities that enable decision-makers and users to make rational and informed choices between alternative actions.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
7.1 - Management Instruments for Water Management (SDG 6.5.1) (rank)	124	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Sustainable and efficient water use management" indicator, which corresponds to one of the five national level indicators under the Management Instruments category. For SDG 6.5.1, management instruments refer to the tools and activities that enable decision-makers and users to make rational and informed choices between alternative actions.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.

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Indicator	Value	Description	Source
7.2 - Groundwater Monitoring Data Availability and Management (score)	3.00	This risk indicator is based on the data set by UN IGRAC (2019) to determine the level of availability of groundwater monitoring data at country level as groundwater management decisions rely strongly on data availability. The level of groundwater monitoring data availability for groundwater management is determined according to a combination of three criteria developed by WWF and IGRAC: 1) Status of country groundwater monitoring programme, 2) groundwater data availability for NGOs and 3) Public access to processed groundwater monitoring data.	UN IGRAC (2019). Global Groundwater Monitoring Network GGMM Portal. UN International Groundwater Resources Assessment Centre (IGRAC).
7.2 - Groundwater Monitoring Data Availability and Management (rank)	49	This risk indicator is based on the data set by UN IGRAC (2019) to determine the level of availability of groundwater monitoring data at country level as groundwater management decisions rely strongly on data availability. The level of groundwater monitoring data availability for groundwater management is determined according to a combination of three criteria developed by WWF and IGRAC: 1) Status of country groundwater monitoring programme, 2) groundwater data availability for NGOs and 3) Public access to processed groundwater monitoring data.	UN IGRAC (2019). Global Groundwater Monitoring Network GGMM Portal. UN International Groundwater Resources Assessment Centre (IGRAC).
7.3 - Density of Runoff Monitoring Stations (score)	2.83	The density of monitoring stations for water quantity was applied as proxy to develop this risk indicator. The Global Runoff Data Base was used to estimate the number of monitoring stations per 1000km ² of the main river system (data base access date: May 2018).	BfG (2019). Global Runoff Data Base. German Federal Institute of Hydrology (BfG).
7.3 - Density of Runoff Monitoring Stations (rank)	126	The density of monitoring stations for water quantity was applied as proxy to develop this risk indicator. The Global Runoff Data Base was used to estimate the number of monitoring stations per 1000km ² of the main river system (data base access date: May 2018).	BfG (2019). Global Runoff Data Base. German Federal Institute of Hydrology (BfG).
8.1 - Access to Safe Drinking Water (score)	1.00	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017.	WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.
8.1 - Access to Safe Drinking Water (rank)	106	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017.	WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.
8.2 - Access to Sanitation (score)	1.00	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017.	WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.

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Indicator	Value	Description	Source
8.2 - Access to Sanitation (rank)	125	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017.	WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.
8.3 - Financing for Water Resource Development and Management (SDG 6.5.1) (score)	3.00	This risk indicator is based on the average 'Financing' score of UN SDG 6.5.1. Degree of IWRM Implementation database. UN SDG 6.5.1 database contains a category on financing which assesses different aspects related to budgeting and financing made available and used for water resources development and management from various sources.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
8.3 - Financing for Water Resource Development and Management (SDG 6.5.1) (rank)	79	This risk indicator is based on the average 'Financing' score of UN SDG 6.5.1. Degree of IWRM Implementation database. UN SDG 6.5.1 database contains a category on financing which assesses different aspects related to budgeting and financing made available and used for water resources development and management from various sources.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
9.1 - Cultural Diversity (score)	1.00	Water is a social and cultural good. The cultural diversity risk indicator was included in order to acknowledge that businesses face reputational risk due to the importance of freshwater for indigenous and traditional people in their daily life, religion and culture. This risk indicator is based on Oviedo and Larsen (2000) data set, which mapped the world's ethnolinguistic groups onto the WWF map of the world's ecoregions. This cross-mapping showed for the very first time the significant overlap that exists between the global geographic distribution of biodiversity and that of linguistic diversity.	Oviedo, G., Maffi, L., & Larsen, P. B. (2000). Indigenous and traditional peoples of the world and ecoregion conservation: An integrated approach to conserving the world's biological and cultural diversity. Gland: WWF (World Wide Fund for Nature) International.
9.1 - Cultural Diversity (rank)	134	Water is a social and cultural good. The cultural diversity risk indicator was included in order to acknowledge that businesses face reputational risk due to the importance of freshwater for indigenous and traditional people in their daily life, religion and culture. This risk indicator is based on Oviedo and Larsen (2000) data set, which mapped the world's ethnolinguistic groups onto the WWF map of the world's ecoregions. This cross-mapping showed for the very first time the significant overlap that exists between the global geographic distribution of biodiversity and that of linguistic diversity.	Oviedo, G., Maffi, L., & Larsen, P. B. (2000). Indigenous and traditional peoples of the world and ecoregion conservation: An integrated approach to conserving the world's biological and cultural diversity. Gland: WWF (World Wide Fund for Nature) International.
10.1 - Freshwater Endemism (score)	2.10	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Companies operating in basins with higher number of endemic fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.

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Indicator	Value	Description	Source
10.1 - Freshwater Endemism (rank)	170	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Companies operating in basins with higher number of endemic fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.
10.2 - Freshwater Biodiversity Richness (score)	1.80	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Count of fish species is used as a representation of freshwater biodiversity richness. Companies operating in basins with higher number of fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.
10.2 - Freshwater Biodiversity Richness (rank)	172	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Count of fish species is used as a representation of freshwater biodiversity richness. Companies operating in basins with higher number of fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.
11.1 - National Media Coverage (score)	4.00	This risk indicator is based on joint qualitative research by WWF and Tecnomia (Typsa Group). It indicates how aware local residents typically are of water-related issues due to national media coverage. The status of the river basin (e.g., scarcity and pollution) is taken into account, as well as the importance of water for livelihoods (e.g., food and shelter).	WWF & Tecnomia (TYP SA Group)
11.1 - National Media Coverage (rank)	23	This risk indicator is based on joint qualitative research by WWF and Tecnomia (Typsa Group). It indicates how aware local residents typically are of water-related issues due to national media coverage. The status of the river basin (e.g., scarcity and pollution) is taken into account, as well as the importance of water for livelihoods (e.g., food and shelter).	WWF & Tecnomia (TYP SA Group)
11.2 - Global Media Coverage (score)	3.00	This risk indicator is based on joint qualitative research by WWF and Tecnomia (Typsa Group). It indicates how aware people are of water-related issues due to global media coverage. Familiarity to and media coverage of the region and regional water-related disasters are taken into account.	WWF & Tecnomia (TYP SA Group)
11.2 - Global Media Coverage (rank)	29	This risk indicator is based on joint qualitative research by WWF and Tecnomia (Typsa Group). It indicates how aware people are of water-related issues due to global media coverage. Familiarity to and media coverage of the region and regional water-related disasters are taken into account.	WWF & Tecnomia (TYP SA Group)

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Indicator	Value	Description	Source
12.1 - Conflict News Events (RepRisk) (score)	3.00	This risk indicator is based on 2018 data collected by RepRisk on counts and registers of documented negative incidents, criticism and controversies that can affect a company's reputational risk. These negative news events are labelled per country and industry class.	RepRisk & WWF (2019). Due diligence database on ESG and business conduct risks. RepRisk.
12.1 - Conflict News Events (RepRisk) (rank)	71	This risk indicator is based on 2018 data collected by RepRisk on counts and registers of documented negative incidents, criticism and controversies that can affect a company's reputational risk. These negative news events are labelled per country and industry class.	RepRisk & WWF (2019). Due diligence database on ESG and business conduct risks. RepRisk.
12.2 - Hydro-political Risk (score)	3.21	This risk indicator is based on the assessment of hydro-political risk by Farinosi et al. (2018). More specifically, it is based on the results of spatial modelling by Farinosi et al. (2018) that determined the main parameters affecting water cross-border conflicts and calculated the likelihood of hydro-political issues.	Farinosi, F., Giupponi, C., Reynaud, A., Ceccherini, G., Carmona-Moreno, C., De Roo, A., ... & Bidoglio, G. (2018). An innovative approach to the assessment of hydro-political risk: A spatially explicit, data driven indicator of hydro-political issues. <i>Global environmental change</i> , 52, 286-313.
12.2 - Hydro-political Risk (rank)	22	This risk indicator is based on the assessment of hydro-political risk by Farinosi et al. (2018). More specifically, it is based on the results of spatial modelling by Farinosi et al. (2018) that determined the main parameters affecting water cross-border conflicts and calculated the likelihood of hydro-political issues.	Farinosi, F., Giupponi, C., Reynaud, A., Ceccherini, G., Carmona-Moreno, C., De Roo, A., ... & Bidoglio, G. (2018). An innovative approach to the assessment of hydro-political risk: A spatially explicit, data driven indicator of hydro-political issues. <i>Global environmental change</i> , 52, 286-313.
Population, total (#)	31848200	Population, total	The World Bank 2018, Data , homepage accessed 20/04/2018
GDP (current US\$)	67220335570	GDP (current US\$)	The World Bank 2018, Data , homepage accessed 20/04/2018
EPI 2018 score (0-100)	45.88	Environmental Performance Index	
WGI -Voice and Accountability (0-100)	34.29	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, <i>The Worldwide Governance Indicators: Methodology and Analytical Issues</i> (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132

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Indicator	Value	Description	Source
WGI -Political stability no violence (0-100)	2.46	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132
WGI - Government Effectiveness (0-100)	30.77	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132
WGI - Regulatory Quality (0-100)	4.33	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132
WGI - Rule of Law (0-100)	11.06	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132
WGI - Control of Corruption (0-100)	10.10	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132

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Indicator	Value	Description	Source
WRI BWS all industries (0-5)	4.32	WRI Baseline Water Stress (BWS)	Gassert, F., P. Reig, T. Luo, and A. Maddocks. 2013. "Aqueduct country and river basin rankings: a weighted aggregation of spatially distinct hydrological indicators." Working paper. Washington, DC: World Resources Institute, December 2013. Available online at http://wri.org/publication/aqueduct-country-river-basin-rankings .
WRI BWS Ranking (1=very high)	30	WRI Baseline Water Stress (BWS)	Gassert, F., P. Reig, T. Luo, and A. Maddocks. 2013. "Aqueduct country and river basin rankings: a weighted aggregation of spatially distinct hydrological indicators." Working paper. Washington, DC: World Resources Institute, December 2013. Available online at http://wri.org/publication/aqueduct-country-river-basin-rankings .
Baseline Water Stress (BWS) - 2020 BAU (1=very high)	25	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings .
Baseline Water Stress (BWS) - 2020 Optimistic (increasing rank describes lower risk)	26	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings .
Baseline Water Stress (BWS) - 2020 Pessimistic (increasing rank describes lower risk)	25	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings .

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Indicator	Value	Description	Source
Baseline Water Stress (BWS) - 2030 BAU (increasing rank describes lower risk)	26	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings .
Baseline Water Stress (BWS) - 2030 Optimistic (increasing rank describes lower risk)	26	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings .
Baseline Water Stress (BWS) - 2030 Pessimistic (increasing rank describes lower risk)	27	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings .
Baseline Water Stress (BWS) - 2040 BAU (increasing rank describes lower risk)	29	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings .
Baseline Water Stress (BWS) - 2040 Optimistic (increasing rank describes lower risk)	27	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings .
Baseline Water Stress (BWS) - 2040 Pessimistic (increasing rank describes lower risk)	30	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings .

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Indicator	Value	Description	Source
Total water footprint of national consumption (m ³ /a/cap)	1278.30	WFN Water Footprint Data	Mekonnen, M.M. and Hoekstra, A.Y. (2011) National water footprint accounts: The green, blue and grey water footprint of production and consumption, Value of Water Research Report Series No. 50, UNESCO-IHE, Delft, the Netherlands. http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf
Ratio external / total water footprint (%)	21.36	WFN Water Footprint Data	Mekonnen, M.M. and Hoekstra, A.Y. (2011) National water footprint accounts: The green, blue and grey water footprint of production and consumption, Value of Water Research Report Series No. 50, UNESCO-IHE, Delft, the Netherlands. http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf
Area equipped for full control irrigation: total (1000 ha)	4198.00	Aquastat - Irrigation	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Area equipped for irrigation: total (1000 ha)	4198.00	Aquastat - Irrigation	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
% of the area equipped for irrigation actually irrigated (%)	88.14	Aquastat - Irrigation	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Electricity production from hydroelectric sources (% of total)	21.35	World Development Indicators	The World Bank 2018, Data , homepage accessed 20/04/2018
Total internal renewable water resources (IRWR) (10 ⁹ m ³ /year)	16.34	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Total internal renewable water resources (IRWR) (10 ⁹ m ³ /year)	32.53	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Water resources: total external renewable (10 ⁹ m ³ /year)	16.34	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13

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Indicator	Value	Description	Source
Total renewable water resources (10 ⁹ m ³ /year)	48.87	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Dependency ratio (%)	80.07	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Total renewable water resources per capita (m ³ /inhab/year)	1635.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
World happiness [0-8]	6.10	WorldHappinessReport.org	World Happiness Report, homepage accessed 20/04/2018

Country Aspects

1. PHYSICAL ASPECTS

1.1. WATER RESOURCES

1.1.1. WATER RESOURCES

Two river basins are found in Uzbekistan. These basins form the Aral Sea basin.

-The Amu Darya basin in the south covers 86.5 per cent of Uzbekistan. The main Amu Darya River can be divided into three reaches: the upper reach bordering Afghanistan and Tajikistan, where most of the water flow is generated; the middle reach, which first borders Uzbekistan and Afghanistan and then enters Turkmenistan; and the lower reach in Uzbekistan, before it discharges into the Aral Sea. The main tributaries within Uzbekistan are the Sherabad, Kashkadarya, Surkhandarya and Zeravshan rivers. These last two rise in Tajikistan. The total amount of flow produced in the Amu Darya basin is estimated at 78.46km³/yr. Because of important losses in the desertic part of its course, and because of major water withdrawal by agriculture, the flow reaching the Aral Sea is limited to a small percentage of this figure (less than 10 per cent in the driest years). About 4.7km³/yr, or 6 per cent of the average total surface water resources of the Amu Darya basin, are generated within Uzbekistan.

-The Syr Darya basin in the north covers 13.5 per cent of the territory. The main Syr Darya River can be divided into three reaches: the upper reach in the Kyrgyz Republic, where most of the water flow is generated; the middle reach in Uzbekistan and Tajikistan; and the lower reach in Kazakhstan, before it discharges into the Aral Sea. The main tributaries within Uzbekistan are the Chirchik and Akhangaran rivers, which rise in the Kyrgyz Republic. The total amount of flow produced in the Syr Darya basin is estimated at 37.14km³/yr; the 5 per cent and 95 per cent probabilities are estimated at 54.1km³/yr and 21.4km³/yr respectively. As above, because of losses in the desertic part of its course and major water withdrawal by agriculture, the flow reaching the Aral Sea is limited to a small percentage of this figure (less than 5 per cent in the driest years). About 4.84km³/yr, or 13 per cent of the average surface water resources of the Syr Darya river basin, are generated within Uzbekistan.

The total river flow generated inside Uzbekistan is thus estimated at 9.54km³/yr.

There are 94 major aquifers in Uzbekistan. The renewable groundwater resources are estimated at 19.68km³/yr, of which 12.88km³/yr is considered to be overlap with surface resources. The annual renewable water resource can thus be estimated at 50.41km³/yr.

Limits to groundwater abstraction for each aquifer in Central Asia have been established. It is permitted to use only such a quantity of groundwater that does not cause surface flow reduction. This quantity is estimated at 6.8km³/yr for Uzbekistan. However, the actual groundwater abstraction is estimated at 7.5km³/yr, leading to surface flow reduction.

Between 1990 and 1994, the return flow on the territory of Uzbekistan was estimated at about 32.4km³/yr, of which 21.5km³/yr formed in the Amu Darya Rbasin and 10.9km³/yr in the Syr Darya basin. This total consists of 30.9km³/yr of drainage flow from irrigated areas (of which 2.55km³/yr is the result of vertical drainage by pumping) and about 1.5km³/yr of untreated domestic and industrial wastewater.

The main part of the return flow, 15.9km³/yr, returns to rivers: 9.5km³/yr in the Amu Darya basin and 6.4km³/yr in the Syr Darya basin. About 12.0km³/yr ends up in natural depressions (Arnasay, Parsankul, Sarakamish and Lake Sudochie) from which water evaporates. More than 4.5km³/yr (about 15 per cent of total return waters) is re-used for irrigation:

-2.9km³/yr is re-used without any treatment, mainly for cotton on light soils;

-1.6km³/yr is re-used after an in situ desalting treatment ('phytomelioration').

The collector-drainage water outflow has led to the creation of artificial lakes in natural depressions. The largest lakes are Lake Aydarkul, in the Arnasay depression in the middle reach of Syr Darya, storing about 30km³ in 1995, and the Sarykamish and Sudochie lakes, both located in the lower reach of the Amu Darya, storing 8km³ and 2km³ respectively. Several lakes have also been formed in the central part of the country in the Amu Darya basin, the largest being Lake Parsankul, which stores about 2km³, close to the Zeravshan River.

There are 50 reservoirs in Uzbekistan with a total capacity of about 19km³; 21 of them with a total capacity of 5km³ in the Syr Darya basin, and 29 with a total capacity of 14km³ in the Amu Darya basin. The largest reservoirs are multipurpose dams, used for irrigation, flood control and hydropower production.

In the Syr Darya basin, the largest reservoirs are the Charvak reservoir, with a capacity of 1.99km³, on the Chirchik River near the capital Tashkent, and the Andijan reservoir, with a capacity of 1.9km³, on the Karadarya River in the Fergana valley.

In the Amu Darya basin, the largest reservoir is the Tuaymuyun, in the Khorezm vilayat, with a storage capacity of 7.8km³, consisting of four separate reservoirs. It is expected that in the future one reservoir of this system (Kaparas) will be used to provide drinking water for Karakalpakstan. This area is experiencing severe environmental problems as a result of the shrinking of the Aral Sea. At present, the drinking water supply for this zone comes from groundwater which is too saline.

The gross theoretical hydropower potential is estimated at 88,000GWh/yr and the economically feasible potential would be 15,000GWh/yr. The total installed capacity, 1.7GW in 1993, provided about 12 per cent of the country's electricity in 1995.

1.1.2. WATER USE

In 1994, the total annual water withdrawal for agricultural, domestic and industrial purposes was estimated at 58.05km³. This amount included withdrawal from surface water (46.16km³), from

groundwater (7.39km³) and withdrawal from return flow collector-drainage for irrigation purposes, estimated at 4.5km³. Requirements for fisheries were estimated at 530 million m³. The total water withdrawal increased steadily from 45.5km³ in 1975 to 62.8km³ in 1985, mainly because of irrigation expansion.

1.2. WATER QUALITY, ECOSYSTEMS AND HUMAN HEALTH

The shrinkage of the Aral Sea has resulted in growing concentrations of chemical pesticides and natural salts, which are then blown from the increasingly exposed lake bed and contribute to desertification. Other environmental problems include water pollution from industrial wastes and the heavy use of fertilizers and pesticides, which is the cause of many human health disorders; increasing soil salination; and soil contamination from buried nuclear processing and agricultural chemicals, including DDT.

Irrigation has created serious environmental problems in Uzbekistan, the most dramatic effect being the shrinking of the Aral Sea. According to a World Bank report, the main environmental impacts of irrigation in the Aral Sea basin include:

- the loss of fish resources in the Aral Sea, due to an increase in salinity and chemical pollution;
- land degradation through waterlogging and salination of irrigated land;
- crop diseases and pests, due especially to the cotton monoculture;
- adverse health effects on people and animals, due to wind-blown chemicals and the poor quality of water;
- possible local climatic change.

Drainage water is the principal carrier of environmental pollution, since it contains the results of mineralization and residues from pesticides.

2. GOVERNANCE ASPECTS

2.1. WATER INSTITUTIONS

The Water Resources Department of the Ministry of Agriculture and Water Resources Management, established in 1996 after the merger of the Ministry of Agriculture and the Ministry of Water Resources, is in charge of water resources research, planning, development and distribution. It also undertakes the construction, operation and maintenance of the irrigation and drainage networks at the inter-farm level in the country. Water allocations are regularly reduced in order to promote savings, satisfy the demand from new users and increase the water flow to the Aral Sea. Water withdrawal per year thus declined from 17,500m³ in 1980 to 11,600m³ in 1995, while irrigation efficiency increased.

Institutional organizations dealing with water management at state, provincial and district level come under the Water Resources Department. Such organizations are responsible for water distribution and delivery to the farm inlet, for assisting water users in implementing advanced technologies, and for water use and water quality control. The Special Land Reclamation Service, under the Water Resources Department, monitors the main reclamation indicators of irrigated

lands (groundwater level, drainage discharge, soil salinity, situation of the collector-drainage network) at national, provincial and local level. It also plans the required measures for irrigation and drainage network maintenance and for the reclamation of degraded lands, including leaching, repairing and cleaning of drainage-collectors and network rehabilitation.

A water law was approved in May 1993, which introduced the notion of water rights. Within the general objective of water savings, Article 30 emphasizes the need for water pricing, although it still leaves room for subsidies to the water sector.

The Ministry of Agriculture and Water Resources Management is also in charge of agricultural research and extension, on-farm agricultural and land reclamation development, and on-farm operation and maintenance of the irrigation network.

The Ministry of Municipal Affairs is responsible for domestic water supply and wastewater treatment.

Research in the water resources development sector is undertaken by the Central Asia Scientific Research Institute of Irrigation (SANIIRI). This autonomous institute of the Ministry of Agriculture and Water Resources Management was previously responsible for all Central Asia. It also manufactures irrigation equipment.

The Goskompriroda (Environment State Committee) is in charge of water quality monitoring and control of industrial and municipal pollutants.

Uzbekistan is a member of the International Fund for Saving the Aral Sea (IFAS), the Interstate Commission for Water Coordination of Central Asia (ICWC), and the Amu Darya and Syr Darya Basin Water Offices (BWOs).

2.2. WATER MANAGEMENT

The restoration of the Aral Sea to its 1960 level is not an objective for the country, although assistance to the 'disaster' zone is seen as a priority. Actions to be taken are: the stabilization of the exposed seabed; land reclamation in the delta; improved drinking water supply, health and general actions to promote the socio-economic conditions of the population in the area.

In a context of demographic growth and higher demand for water from the industrial and domestic sectors, it is now generally accepted that the Aral Sea should be maintained at its present level. This also implies that water management has to be improved, in order to constantly reduce water withdrawal for irrigation. This could be achieved through reducing water losses from the inter- and on-farm irrigation network, and through increasing overall production in a sustainable way, notably by implementing techniques for the desalinization of irrigated land. The construction of a major collector to bring drainage water from the lower Amu Darya irrigated areas directly to the Aral Sea has been undertaken. This measure also favours the stabilization of the Aral Sea level and the improvement of water quality in the main rivers.

Water savings in irrigation should enable the development of other sectors of the economy. An important thrust of irrigation and water management improvement at the on-farm level would be to move from a state-run system to privatization of irrigated agriculture, notably through the establishment of water user associations (WUAs). This process is developing at a very slow pace.

Implementation of water pricing in the industrial and municipal sectors, as well as agricultural water pricing, may also provide room for water savings in the future. At international level, mechanisms to introduce water quality issues into water sharing agreements are under discussion.

2.3. WATER POLICY AND LEGAL FRAMEWORK

The main legislation governing water management is the 1993 Law on Water and Water Use. Uzbekistan is in the process of adopting a series of measures intended to improve water supply so as to promote employment and better living standards. In 2002, Uzbekistan developed the Concept of Sustainable Water Supply of the Regions of the Republic of Uzbekistan, which sets out Principal Directions of Water Management and Amelioration Measures for 2008–2011. These directives envisage major improvements in land use through better drainage, an increase in agricultural water supply through modernization of irrigation, and the introduction of integrated water resources management.

3. GEOPOLITICAL ASPECTS

During the Soviet period, the sharing of water resources among the five Central Asian republics was on the basis of the master plans for water resources development in the Amu Darya (1987) and Syr Darya (1984) basins. In 1992, with the establishment of the ICWC, the newly independent republics decided to prepare a regional water strategy, but to continue to respect the existing principles until the adoption of a new water sharing agreement.

The surface water resources allocated to Uzbekistan are calculated every year, depending on the climatic situation and the existing flows. However, the estimated average surface runoff from the upstream countries is:

- 22.33km³/yr for the Syr Darya basin at the border between the Kyrgyz Republic and Uzbekistan, of which 11.8km³/yr is transit flow to Tajikistan;
- 11.54km³/yr for the Syr Darya basin at the border between Tajikistan and Uzbekistan, of which 10km³/yr is transit flow to Kazakhstan;
- 22km³/yr for the Amu Darya basin.

The ICWC is a parity collective body of Central Asian States acting on the basis of equity, equality and consensus. It is included in IFAS and has the status of an international organization.

The Ashgabat Declaration (1999) focused on the consequences of the Aral Sea crisis, which had negatively affected people's standard of living in Central Asia. The five presidents of the Central Asian countries declared to:

- admit the importance of a comprehensive solution to the social and ecological problems in the Aral Sea basin;
- strengthen, both in the Central Asian states and abroad, activity to attract the attention of the international community and attract funding for projects related to the Aral Sea basin problems;
- provide every kind of assistance and support for implementing a "Control on Water Resources and Environment in Aral Sea basin" project, under the aegis of the World Bank and the Global

- Economic Forum;
- give more consideration to the problems of mountain territories where the rivers within the Aral Sea basin originate;
- realize a number of all-round measures and priority projects on social protection of people living in the Aral Sea basin;
- accelerate efforts against desertification and pollution;
- assist international organizations and institutions working on programmes and projects related to the Aral Sea basin problems;
- raise public awareness (through educational and other programmes) of the urgent problems of nature protection, rational use of natural resources, and improving the environment for present and future generations.