Water Risk Filter

Country Overview - Armenia

Water Indicators

Indicator	Value	Description	Source
Overall Basin Risk (score)	2.91	Overall Basin Risk (score)	
Overall Basin Risk (rank)	45	Overall Basin Risk (rank)	
Physical risk (score)	3.26	Physical risk (score)	
Physical risk (rank)	22	Physical risk (rank)	
Regulatory risk (score)	2.84	Regulatory risk (score)	
Regulatory risk (rank)	99	Regulatory risk (rank)	
Reputation risk (score)	1.94	Reputation risk (score)	
Reputation risk (rank)	192	Reputation risk (rank)	
1. Quantity - Scarcity (score)	2.95	1. Quantity - Scarcity (score)	
1. Quantity - Scarcity (rank)	46	1. Quantity - Scarcity (rank)	
2. Quantity - Flooding (score)	3.05	2. Quantity - Flooding (score)	
2. Quantity - Flooding (rank)	101	2. Quantity - Flooding (rank)	
3. Quality (score)	4.18	3. Quality (score)	
3. Quality (rank)	11	3. Quality (rank)	
4. Ecosystem Service Status (score)	3.52	4. Ecosystem Service Status (score)	
4. Ecosystem Service Status (rank)	16	4. Ecosystem Service Status (rank)	
5. Enabling Environment (Policy & Laws) (score)	2.30	5. Enabling Environment (Policy & Laws) (score)	
5. Enabling Environment (Policy & Laws) (rank)	118	5. Enabling Environment (Policy & Laws) (rank)	
6. Institutions and Governance (score)	3.25	6. Institutions and Governance (score)	
6. Institutions and Governance (rank)	70	6. Institutions and Governance (rank)	
7. Management Instruments (score)	3.70	7. Management Instruments (score)	
7. Management Instruments (rank)	19	7. Management Instruments (rank)	
8 - Infrastructure & Finance (score)	1.65	8 - Infrastructure & Finance (score)	
8 - Infrastructure & Finance (rank)	117	8 - Infrastructure & Finance (rank)	
9. Cultural Diversity (score)	1.00	9. Cultural importance (score)	
9. Cultural Diversity (rank)	138	9. Cultural importance (rank)	
10. Biodiversity Importance (score)	3.50	10. Biodiversity importance (score)	

Indicator	Value	Description	Source
10. Biodiversity Importance (rank)	87	10. Biodiversity importance (rank)	
11. Media Scrutiny (score)	2.10	11. Media Scrutiny (score)	
11. Media Scrutiny (rank)	157	11. Media Scrutiny (rank)	
12. Conflict (score)	1.65	12. Conflict (score)	
12. Conflict (rank)	178	12. Conflict (rank)	
1.0 - Aridity (score)	2.05	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) geo-database. CGIAR consortium for spatial information.
1.0 - Aridity (rank)	59	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) geo-database. CGIAR consortium for spatial information.
1.1 - Water Depletion (score)	3.58	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. Elem Sci Anth, 4.
1.1 - Water Depletion (rank)	13	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. Elem Sci Anth, 4.
1.2 - Baseline Water Stress (score)	3.63	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.

Country Overview - Armenia

Indicator	Value	Description	Source
1.2 - Baseline Water Stress (rank)	34	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)	2.19	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. Science advances, 2(2), e1500323.
1.3 - Blue Water Scarcity (rank)	109	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. Science advances, 2(2), e1500323.
1.4 - Projected Change in Water Discharge (by ~2050) (score)	3.00	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. Proceedings of the National Academy of Sciences, 111(9), 3245-3250.
1.4 - Projected Change in Water Discharge (by ~2050) (rank)	14	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. Proceedings of the National Academy of Sciences, 111(9), 3245-3250.

Indicator	Value	Description	Source
1.5 - Drought Frequency Probability (score)	2.54	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 multiscalar drought index sensitive to global warming: the standardized precipitation evapotranspiration index. Journal of climate, 23(7), 1696-1718.
1.5 - Drought Frequency Probability (rank)	91	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 multiscalar drought index sensitive to global warming: the standardized precipitation evapotranspiration index. Journal of climate, 23(7), 1696-1718.
1.6 - Projected Change in Drought Occurrence (by ~2050) (score)	4.09	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)	17	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)	3.15	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)	95	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)	1.19	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)	178	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)	4.18	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). 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%).	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. Nature, 467(7315), 555.

Indicator	Value	Description	Source
3.1 - Surface Water Contamination Index (rank)	11	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). 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%).	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. Nature, 467(7315), 555.
4.1 - Fragmentation Status of Rivers (score)	4.40	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.	Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., ... & Macedo, H. E. (2019). Mapping the world's free-flowing rivers. Nature, 569(7755), 215.
4.1 - Fragmentation Status of Rivers (rank)	2	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.	Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., ... & Macedo, H. E. (2019). Mapping the world's free-flowing rivers. Nature, 569(7755), 215.
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (score)	1.00	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.	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. science, 342(6160), 850-853.

Indicator	Value	Description	Source
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (rank)	165	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.	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. science, 342(6160), 850-853.
4.3 - Projected Impacts on Freshwater Biodiversity (score)	3.70	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. Journal of Applied Ecology, 50(5), 1105-1115.
4.3 - Projected Impacts on Freshwater Biodiversity (rank)	44	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. Journal of Applied Ecology, 50(5), 1105-1115.
5.1 - Freshwater Policy Status (SDG 6.5.1) (score)	2.00	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)	119	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)	2.00	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. 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.	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)	115	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. 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.	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)	5.00	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. 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.	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)	4	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. 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.	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	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.	Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International.
6.1 - Corruption Perceptions Index (rank)	43	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.	Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International.
6.2 - Freedom in the World Index (score)	2.00	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.

Indicator	Value	Description	Source
6.2 - Freedom in the World Index (rank)	97	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)	62	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)	4.00	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)	10	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.

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 GGMN Portal. UN International Groundwater Resources Assessment Centre (IGRAC).
7.2 - Groundwater Monitoring Data Availability and Management (rank)	54	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 GGMN Portal. UN International Groundwater Resources Assessment Centre (IGRAC).
7.3 - Density of Runoff Monitoring Stations (score)	3.00	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 1000km2 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)	120	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 1000km2 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)	110	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)	2.00	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.

Indicator	Value	Description	Source
8.2 - Access to Sanitation (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.
8.3 - 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)	84	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)	138	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)	4.00	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.

Country Overview - Armenia

Indicator	Value	Description	Source
10.1 - Freshwater Endemism (rank)	78	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)	3.00	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)	102	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)	3.00	This risk indicator is based on joint qualitative research by WWF and Tecnoma (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 & Tecnoma (TYPSA Group)
11.1 - National Media Coverage (rank)	84	This risk indicator is based on joint qualitative research by WWF and Tecnoma (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 & Tecnoma (TYPSA Group)
11.2 - Global Media Coverage (score)	1.00	This risk indicator is based on joint qualitative research by WWF and Tecnoma (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 & Tecnoma (TYPSA Group)
11.2 - Global Media Coverage (rank)	160	This risk indicator is based on joint qualitative research by WWF and Tecnoma (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 & Tecnoma (TYPSA Group)

Country Overview - Armenia

Indicator	Value	Description	Source
12.1 - Conflict News Events (RepRisk) (score)	2.00	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)	123	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)	1.30	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. Global environmental change, 52, 286-313.
12.2 - Hydro-political Risk (rank)	175	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. Global environmental change, 52, 286-313.
Population, total (#)	2924816	Population, total	The World Bank 2018, Data , hompage accessed 20/04/2018
GDP (current US$)	10572298342	GDP (current US$)	The World Bank 2018, Data , hompage accessed 20/04/2018
EPI 2018 score (0-100)	62.07	Environmental Performance Index	
WGI -Voice and Accountability (0-100)	24.76	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

Indicator	Value	Description	Source
WGI -Political stability no violence (0-100)	30.54	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)	49.52	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)	62.98	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)	50.48	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)	32.69	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

Country Overview - Armenia

Indicator	Value	Description	Source
WRI BWS all industries (0-5)	3.07	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)	63	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)	22	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)	22	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)	22	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.

Water Risk Filter

Country Overview - Armenia

Indicator	Value	Description	Source
Baseline Water Stress (BWS) - 2030 BAU (increasing rank describes lower risk)	24	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)	22	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)	24	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)	22	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)	23	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)	22	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.

Country Overview - Armenia

Indicator	Value	Description	Source
Total water footprint of national consumption (m3/a/cap)	1438.76	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 (%)	38.29	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)	273.50	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)	273.50	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 (%)	64.35	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)	25.70	World Development Indicators	The World Bank 2018, Data , hompage accessed 20/04/2018
Total internal renewable water resources (IRWR) (10^9 m3/year)	6.86	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 m3/year)	0.91	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 m3/year)	6.86	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13

Water Risk Filter

Country Overview - Armenia

Indicator	Value	Description	Source
Total renewable water resources (10^9 m3/year)	7.77	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Dependency ratio (%)	11.71	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 (m3/inhab/year)	2574.00	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]	4.32	WorldHappinessReport.org	World Happiness Report, homepage accessed 20/04/2018

Country Aspects

1. PHYSICAL ASPECTS

1.1. WATER RESOURCES

1.1.1. WATER RESOURCES

The rivers in Armenia are tributaries of the main rivers of the southern Caucasus, namely the Araks and the Kura. About 76 per cent of the total territory is part of the Araks basin and 24 per cent of the Kura basin (UNDP/GEF, 2006). Total outflow is equal to the IRWR. The outflow to Georgia through the Debet river is estimated at about 0.89km3/year and the outflow to Azerbaijan through the Agstay river at about 0.35km3/year; both these rivers are located in the Kura basin. The total outflow to Azerbaijan through the Araks and its tributaries (Arpa, Vorotan, Vokhchi) is estimated at about 5.62km3/year. The Araks river forms the border between Turkey and Armenia and further downstream, between the Islamic Republic of Iran and Armenia, it flows into Azerbaijan, joining the Kura river about 150km before its mouth at the Caspian Sea. The border flow of the Akhuryan (with Turkey) is estimated at 1.03km3/year and the Araks at 0.79km3/year. Half of the border flow is accounted for in Armenia's water balance, bringing the total actual renewable water resources to 7.769km3/year.

The 14 sub-basins of the two main river basins (Kura and Araks) have been grouped into five basin management areas: Akhuryan, Northern, Sevan-Hrazdan, Ararat and Southern. About 9,500 rivers and streams with a total length of 23,000km flow in Armenia. Out of that number, 379 rivers are around 10-100 km long and seven, namely the Akhuryan, Debet, Vorotan, Hrazdan, Aghstev, Arpa and Metsamor-Kasakh, are longer than 100km. Armenian rivers are typically of a mountainous nature, with sharp seasonal variations, spring freshets and low water flow in summer.

Armenia has more than 100 small lakes, some of which regularly dry out in the dry season. The Sevan and Arpi lakes are the most important in terms of size and economic importance. The Hrazdan and Akhuryan rivers originate from these two lakes, the larger of which is Lake Sevan, located in the centre of the country. It lies at 1,900m above sea level, which makes it a strategic source of energy and irrigation water. The level of the lake, originally with a surface area of about 1,414km2 and 58km3 of stored water, has fallen since the 1930s due to the lake's increasing use for irrigation and domestic water supply. By 1972, its level had fallen by almost 19m and its surface area had been reduced to 1,250km2. At present, it covers an area of about 1,200km2, has a volume of approximately 34km3, and plays a central and important hydrological role in the country. It serves the densely populated Hrazdan river basin and the Ararat Valley where Yerevan, the capital, is situated. Through its regulated surface outflow into the Hrazdan river, the lake's water provides a substantial amount of hydropower and irrigation to croplands in the Ararat Valley. The lake is also an important recreational area, natural habitat and cultural resource for the Armenian population. Since 1960, two inter-basin transfer schemes have been implemented to restore the ecology of the lake and its storage capacity as a strategic water reserve for multipurpose use. A 48km tunnel was built between 1963 to 1982 to divert some 250 million m3 of water annually from the Arpa river to Lake Sevan. A similar project, to divert 165 million m3 of water annually from the upper Vorotan river to the Arpa river through a 22km tunnel was completed in 2004. In the last few years, the lake's level has risen by about 2.7m as a result of favourable meteorological conditions and improved management. Electricity generation at the Sevan-Hrazdan Cascade is currently tied to irrigation releases. During the last few years, irrigation releases have ranged from 120 to 150 million m3.

The second most important lake is Lake Arpi. It is located in the western part of the Ashotsk depression at an altitude of 2,020 m above sea level. With the construction of a dam to solve irrigation problems, the lake became a reservoir.

Most of the reservoirs were constructed during the Soviet period. In 2004, some 83 reservoirs were operating in Armenia and total capacity was estimated at 1,399 million m3, of which approximately 1,350 million m3 was stored in reservoirs with a capacity of over 5 million m3 each. Most of the water is used for irrigation. Some reservoirs are used for hydropower, recreation, fisheries and environmental protection. In 1995, about 145 million m3 was used for municipal and industrial purposes. The largest reservoir is on the Akhuryan river, which forms the border with Turkey. It has a storage capacity of 525 million m3, is shared with Turkey, and provides water for the irrigation of about 300km2 in Armenia. In contrast, many small off-channel reservoirs in the southwest of Aragats (Talish, Talin, Kakavadzor, Bazmaberd, Katnakhpyur), which accumulate spring tide waters, have a capacity of only 10,000-50,000 m3 (UNDP, 2006).

1.1.2. WATER USE

Since the mid-1980s, there has been a decrease in total water withdrawal, mainly due to a decrease in agricultural and industrial water withdrawal. In fact, the reduction in water use has been accompanied by a remarkable improvement in surface water quality. In 2006, total water withdrawal for agricultural, municipal and industrial purposes was 2,827 million m3, of which about 66 per cent was for agricultural purposes, 30 per cent for municipal use and 4 per cent for industrial purposes. Agricultural water withdrawal mainly refers to irrigation of crops. Works for the watering of pastures, including providing water for cattle in the pasturing period, began in 1956. Sources of pasture watering are springs, mountain melted snow, and non-discharge water bodies. Surface water withdrawals represent 78 per cent of total water withdrawals.

In most of Armenia's territory, it is possible to use groundwater for drinking needs without any additional treatment. Indeed, about 95 per cent of the water used for drinking purposes comes from groundwater sources. Both surface water and underground springs are used for industrial water supply. Industrial water supply is provided by independently operating water supply systems as well as from the city drinking water supply network. For the past 10-15 years, the water requirements of industrial enterprises have significantly decreased due to reductions in the activity of many enterprises. It should be mentioned that 40 per cent of the industrial enterprises using water in Armenia are located in Yerevan. The largest water-using industrial enterprise is the Armenian Nuclear Power Plant, which uses about 35 million m3/year.

There are 35 high- and middle-capacity hydropower plants in Armenia, nine of which are the plants at the Vorotan and Hrazdan hydropower cascades. Hydropower accounts for 20 per cent of electricity generation. The total installed hydropower generating capacity of Armenia is about 1,100MW, of which 1,050MW is operational. Almost 95 per cent of this capacity is installed along two important hydropower cascades: the Sevan-Hrazdan Cascade and the Vorotan Cascade. Electricity generation at the Sevan-Hrazdan Cascade is tied to irrigation releases from Lake Sevan on the basis of an annual water allocation plan. As a result of insufficient regulation of volumes, hydropower production is also subject to seasonal variations.

While the industrial sector is not considered a major water user, an important problem for this sector is the implementation of industrial wastewater removal and treatment. Most industrial facilities were never equipped individually because they had been connected to the public sewer network during the Soviet era, and thus were able to access municipal wastewater treatment. Attention should therefore be paid to those industries that have resumed production and from which the wastewater generated is channelled to the municipal wastewater treatment system, where only the mechanical treatment step is currently being operated. Also, the industries that are not connected to a municipal sewerage system discharge their mostly untreated wastewater directly into streams or rivers. In general, old industries that resume production are the most polluting.

The total quantity of wastewater produced in 2006 amounted to 363 million m3, of which 89 million m3 was treated

1.2. WATER QUALITY, ECOSYSTEMS AND HUMAN HEALTH

Armenia's major environmental problems are: soil pollution from toxic chemicals such as DDT; deforestation resulting from the energy crisis of the 1990s, when citizens scavenged for firewood; pollution of the Hrazdan (Razdan) and Aras rivers; the draining of Lake Sevan, a result of its use as a source for hydropower, which threatens drinking water supplies; and the resumption of operations at Metsamor nuclear power plant, in spite of its location in a seismically active zone.

Most of the drinking water is provided by groundwater, which has high organoleptic properties and is very pure. Due to the poor state of the water supply networks, however, the risk of water contamination is high. Due to the lack of liquid and lime chlorine and the electric power deficit, water in most cases is supplied without chlorination. In many places, sewage and drinking water supply networks are connected, and at present the sewage system is in an emergency situation: 63 per cent of the network is more than 20 years old and 22 per cent requires immediate renewal. According to data provided by the Ministry of Health, between 1984 and 1991 no infection outbreak episodes related to drinking water quality were recorded in Armenia. However, since 1992 such episodes have been periodically registered. During the 1999-2002 period, 18 outbreak episodes relating to water pollution were recorded, with a total of 5,690 diseased persons. In 2003, 21,839 incidents were recorded, 5,839 of which (26.7 per cent) occurred in Yerevan.

Solonetzic soils, which are characterized by a tough, impermeable hardpan that may vary from 5 to 30cm or more below the surface soils, are widespread. These soils are most exposed to the risk of irrigation-related salinization, mainly as a result of rising groundwater in the plains, where the majority of irrigated lands are located. In the Ararat plain, solonetzic soils cover about 10 per cent of the area. In 2006, the part of the irrigated land that was salinized was 204km2, of which 151km2 was weakly salinized, 24km2 medium salinized, and 29km2 strongly salinized.

The malaria situation was stable in Armenia until 1994. In subsequent years, a downgrading of malaria prevention services and a weakening of the malaria surveillance system resulted in a steady increase in the number of malaria cases, which reached 1,156 in 1998. Over 98 per cent of these cases were detected in the Masis district of the Ararat valley, an area bordering Turkey. In recent years, owing to epidemic control interventions, the number of autochthonous malaria cases has continued to decrease, dropping to 8 in 2003. However, although numbers have been in decline, the situation must be monitored closely because of the existence of favourable conditions for malaria transmission. In 2003, Armenia redefined and adjusted its malaria control strategy, objectives and approaches, bearing in mind the results achieved to date, the extent of the problem, and potential threats in the country.

2. GOVERNANCE ASPECTS

2.1. WATER INSTITUTIONS

The most important institutions involved in water resources development and management are:

•the National Water Council (NWC), the highest advisory body in the water sector, chaired by the Prime Minister. It advises on water management issues, and makes recommendations on policies, legal documents, and the National Water Programme;

•the Ministry of Nature Protection, with the Underground Resources Protection Department;

•the Environmental Protection Department;

•the Water Resources Management Agency, which controls the use of water resources through water use permits;

•the Climate Change Information Centre;

•the State Environmental Inspectorate;

•the Ministry of Agriculture, responsible for the development of agricultural policy and strategies, including irrigation and drainage policies, with the Planning of Agricultural and Social Development of Rural Areas Department;

•the Crop Production, Forestry and Plant Protection Department;

•the Vorogum-Jrar Closed Joint Stock Company (CJSC), which brings together state organizations with responsibility for the provision of irrigation and drainage services. The company pumps or diverts water from the river, operates and maintains the primary canals, and sells the water to

WUAs under seasonal water supply contracts;
•the Public Services Regulatory Commission (PSRC), responsible for the economic regulation of natural monopolies in the irrigation and municipal water sectors. Its main responsibilities are water infrastructure use permits, the monitoring of the quality of service provisions, and the setting of tariffs;
•the Ministry of Territorial Administration, with the State Committee on Water Systems (SCWS), which is responsible for the management and operation of state-owned municipal and irrigation water supply, sewerage and wastewater treatment systems; it includes the 'Melioration' CJSC, which is responsible for operation and maintenance of drainage systems;
•the Armenian State Hydrometeorological and Monitoring Service (Armstatehydromet) and Environmental Impact Monitoring Centre (EIMC), which provide surface water monitoring data;
•the Hydrogeological Monitoring Centre, responsible for monitoring all groundwater bodies.

2.2. WATER MANAGEMENT

Reforms in the water sector have been initiated since the implementation of the World Bank-supported Integrated Water Resources Management Project in 1999-2000. The idea of river basin management was also promoted through the introduction of annual and perspective planning mechanisms for water resources.
By law, local mayors are responsible for providing water services within a municipality unless the water sources and facilities serve more than one municipality, in which case one of the five state-owned water companies provides water services. In 2006, about 80 per cent of the population was served by the state water companies.
The remainder of the population is served by small municipal systems and numerous community-based organizations. The Yrevan Djur CJSC is the largest of the five state companies and provides water and sewer services to the city of Yerevan and 28 neighbouring villages, covering around 50 per cent of the total population. It operates under a recently signed lease contract with a French water company. The next largest state water company is the Armenian Water and Sewerage Company (AWSC), which operates under the terms of a management contract with another French water company. AWSC provides services to roughly 22 per cent of the population. The other three state water companies, Lori, Shirak and Nor Akunk, are managed with significant input from foreign consultants under the terms of a financing agreement between the state and a German lending agency. At the beginning of 2006, the average monthly water bill for most residential customers in Armenia was less than US$2. The collection rate has been improving but is still less than desirable.
USAID designed the Programme for Institutional and Regulatory Strengthening of Water Management in Armenia (2004-2008) to provide technical assistance, training and equipment to improve water resource management and the regulation of the increasingly decentralized irrigation and municipal water sectors. The programme will lay the foundation for effective water resource management and planned investment in the Armenian drinking water, sewerage, and irrigation sectors, and assist the government and leading water sector agencies in enhancing their effectiveness through initiatives based on international best practices adapted for the Armenian context.

2.3. WATER POLICY AND LEGAL FRAMEWORK

One of the most important steps towards reform in the water sector was the adoption of a new Water Code on 4 June, 2002. In order to ensure its enforcement, 80 regulations have been adopted by the government since 2002, relating to, among other things, the procedures for water use permit provisions, transparency and public participation in the decision-making processes, accessibility of information, the formation of water resources monitoring, and management of transboundary water resources.
The Code also incorporates the idea of integrated river basin management, for which a methodology of developing integrated water basin management plans has been developed, making it possible to use economic tools for water resources management and cost recovery. In order to promote more efficient, targeted and decentralized management of water resources, five territorial divisions (Basin Management Organizations) have been established under the umbrella of the Water Resources Management Agency: Northern, Akhuryan, Araratian, Sevan-Hrazdan and Southern.
The Law on Fundamental Provisions of the National Water Policy was adopted in 2005; this represents a forward-looking development concept for water resources and water systems' strategic use and protection. Since 2005, the water basin management principle has been applied in the sector of water resources management. In addition, a law concerning the National Water Programme has been developed. This law is the key document for the prospective development of water resources and water systems management and protection. As a result of the above-mentioned legal and institutional reforms, Armenia is currently one of the leaders in the region in the sector of water resource management.

3. GEOPOLITICAL ASPECTS

Armenia has an agreement with Turkey concerning the use of the Araks and Akhuryan rivers, according to which the water of these two transboundary rivers is divided equally between the two countries. Another agreement with Turkey concerns the joint use of the dam and the reservoir of the Akhuryan river. According to an agreement between the Islamic Republic of Iran and Armenia, the water of the Araks River is divided equally between them. Though these agreements were signed by the USSR, Armenia is considered a successor country, and consequently is required to fulfil any related obligations. There have also been decrees issued and agreements signed between Armenia and Georgia concerning the Debet river. Corresponding decrees have been passed by Armenia and Azerbaijan concerning the use of the water of the Arpa, Vorotan, Aghstay and Tavush rivers.
In 1998, Armenia ratified an agreement with Georgia on environmental protection, according to which the governments pledged their cooperation in creating specifically protected areas within the transboundary ecosystems. The Ministry of Nature Protection (MNP) develops and implements

international environmental projects, some of which are related to water issues. Part of the Caucasus Initiative, launched by the German Ministry of Cooperation and Development, involves the implementation of the Ecoregional Nature Protection Programme for the Southern Caucasus. The programme, covering the three Caucasus countries, will be implemented in the very near future and will facilitate the protection and sustainable use of water resources in the region.

In 2002, the Republic of Armenia Commission on Transboundary Water Resources was established. It is chaired by the Head of the Water Resources Management Agency. This commission, together with corresponding commissions in neighbouring countries, deals with issues related to transboundary water resources use and protection.

From 2000 to 2002, USAID, in collaboration with Development Alternatives, Inc. (DAI), implemented the South Caucasus Water Management project, which has the aim of strengthening cooperation among water-related agencies at the local, national and regional levels in order to provide integrated water resources management. In parallel, between 2000 and 2006, the EU and the Technical Assistance Commonwealth of Independent States (TACIS) developed the Joint River Management Programme on Monitoring and Assessment of Water Quality on Transboundary Rivers, aimed at the prevention, control and reduction of transboundary pollution. The programme covers four basins, including the Kura River basin. In addition, regional organisations such as REC and the Eurasia Foundation, as well as numerous local foundations, promote national and regional activities in the field of water resources management and protection. USAID also funded the national project for Sustainable Water Resources Management in Armenia.

From 2002 to 2007, NATO-OSCE developed the South Caucasus River Monitoring Project, the general objectives of which were “to establish the social and technical infrastructure for an international, cooperative transboundary river water quality and quantity monitoring, data sharing and watershed management system among the Republics of Armenia, Azerbaijan and Georgia”.

The Reducing Transboundary Degradation in the Kura-Araks River Basin project, implemented by the UNDP Bratislava Regional Centre in collaboration with the GEF, has involved four of the basin countries: Armenia, Azerbaijan, Georgia and the Islamic Republic of Iran. The project preparation phase lasted 18 months and began in July 2005. The project, which is co-funded by Sweden, aims to ensure that the quality and quantity of the water throughout the Kura-Araks river system meets the short and long-term needs of the ecosystem and the communities that rely upon this ecosystem. The project will achieve its objectives by fostering regional cooperation, increasing capacity to address water quality and quantity problems, demonstrating water quality/quantity improvements, initiating the required policy and legal reforms, identifying and preparing priority investments, and developing sustainable management and financial arrangements.

There are currently no water treaties between the three South Caucasian countries, a condition directly related to the political situation in the region. Nagorno-Karabakh is one of the main obstacles, making it difficult for Azerbaijan and Armenia to sign a treaty, even one relating only to water resource management.