

## Water Indicators

Indicator	Value	Description	Source
Overall Basin Risk (score)	2.39	Overall Basin Risk (score)	
Overall Basin Risk (rank)	149	Overall Basin Risk (rank)	
Physical risk (score)	2.41	Physical risk (score)	
Physical risk (rank)	124	Physical risk (rank)	
Regulatory risk (score)	2.28	Regulatory risk (score)	
Regulatory risk (rank)	140	Regulatory risk (rank)	
Reputation risk (score)	2.42	Reputation risk (score)	
Reputation risk (rank)	139	Reputation risk (rank)	
1. Quantity - Scarcity (score)	1.34	1. Quantity - Scarcity (score)	
1. Quantity - Scarcity (rank)	182	1. Quantity - Scarcity (rank)	
2. Quantity - Flooding (score)	3.86	2. Quantity - Flooding (score)	
2. Quantity - Flooding (rank)	48	2. Quantity - Flooding (rank)	
3. Quality (score)	3.00	3. Quality (score)	
3. Quality (rank)	107	3. Quality (rank)	
4. Ecosystem Service Status (score)	3.37	4. Ecosystem Service Status (score)	
4. Ecosystem Service Status (rank)	23	4. Ecosystem Service Status (rank)	
5. Enabling Environment (Policy & Laws) (score)	1.30	5. Enabling Environment (Policy & Laws) (score)	
5. Enabling Environment (Policy & Laws) (rank)	162	5. Enabling Environment (Policy & Laws) (rank)	
6. Institutions and Governance (score)	3.25	6. Institutions and Governance (score)	
6. Institutions and Governance (rank)	76	6. Institutions and Governance (rank)	
7. Management Instruments (score)	2.86	7. Management Instruments (score)	
7. Management Instruments (rank)	95	7. Management Instruments (rank)	
8 - Infrastructure & Finance (score)	1.30	8 - Infrastructure & Finance (score)	
8 - Infrastructure & Finance (rank)	131	8 - Infrastructure & Finance (rank)	
9. Cultural Diversity (score)	3.00	9. Cultural importance (score)	
9. Cultural Diversity (rank)	73	9. Cultural importance (rank)	
10. Biodiversity Importance (score)	3.51	10. Biodiversity importance (score)	

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Indicator	Value	Description	Source
10. Biodiversity Importance (rank)	82	10. Biodiversity importance (rank)	
11. Media Scrutiny (score)	2.55	11. Media Scrutiny (score)	
11. Media Scrutiny (rank)	137	11. Media Scrutiny (rank)	
12. Conflict (score)	1.54	12. Conflict (score)	
12. Conflict (rank)	187	12. Conflict (rank)	
1.0 - Aridity (score)	1.00	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)	157	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)	1.00	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)	179	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)	1.37	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)	126	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)	1.00	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)	178	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)	2.22	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)	62	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)	1.50	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)	171	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)	3.05	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)	56	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)	3.96	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)	49	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.

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Indicator	Value	Description	Source
2.2 - Projected Change in Flood Occurrence (by ~2050) (score)	2.03	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)	119	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)	3.00	<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.

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Indicator	Value	Description	Source
3.1 - Surface Water Contamination Index (rank)	107	<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)	4.12	<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 &lt; 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)	9	<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 &lt; 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)	1.52	<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)	118	<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)	2.02	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)	120	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)	1.00	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)	181	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)	1.00	<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.

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Indicator	Value	Description	Source
5.2 - Freshwater Law Status (SDG 6.5.1) (rank)	174	<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)	37	<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)	3.00	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)	143	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.



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Indicator	Value	Description	Source
6.2 - Freedom in the World Index (rank)	125	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)	5.00	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)	5	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)	3.00	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)	102	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)	118	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)	2.08	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 <sup>2</sup> 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)	167	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 <sup>2</sup> 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)	160	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)	170	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)	4.00	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)	51	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)	3.00	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)	73	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)	3.13	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)	120	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)	3.89	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)	74	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 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 (TYPESA Group)
11.1 - National Media Coverage (rank)	156	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 (TYPESA Group)
11.2 - Global Media Coverage (score)	2.00	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 (TYPESA Group)
11.2 - Global Media Coverage (rank)	135	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 (TYPESA Group)

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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)	141	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)	1.08	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)	190	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 (#)	622781	Population, total	The World Bank 2018, Data , homepage accessed 20/04/2018
GDP (current US\$)	4374127212	GDP (current US\$)	The World Bank 2018, Data , homepage accessed 20/04/2018
EPI 2018 score (0-100)	61.33	Environmental Performance Index	
WGI -Voice and Accountability (0-100)	50.95	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: <a href="https://ssrn.com/abstract=1682132">https://ssrn.com/abstract=1682132</a>

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Indicator	Value	Description	Source
WGI -Political stability no violence (0-100)	49.26	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: <a href="https://ssrn.com/abstract=1682132">https://ssrn.com/abstract=1682132</a>
WGI - Government Effectiveness (0-100)	57.69	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: <a href="https://ssrn.com/abstract=1682132">https://ssrn.com/abstract=1682132</a>
WGI - Regulatory Quality (0-100)	62.50	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: <a href="https://ssrn.com/abstract=1682132">https://ssrn.com/abstract=1682132</a>
WGI - Rule of Law (0-100)	53.37	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: <a href="https://ssrn.com/abstract=1682132">https://ssrn.com/abstract=1682132</a>
WGI - Control of Corruption (0-100)	54.33	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: <a href="https://ssrn.com/abstract=1682132">https://ssrn.com/abstract=1682132</a>

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Indicator	Value	Description	Source
WRI BWS all industries (0-5)	0.31	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 <a href="http://wri.org/publication/aqueduct-country-river-basin-rankings">http://wri.org/publication/aqueduct-country-river-basin-rankings</a> .
WRI BWS Ranking (1=very high)	147	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 <a href="http://wri.org/publication/aqueduct-country-river-basin-rankings">http://wri.org/publication/aqueduct-country-river-basin-rankings</a> .
Baseline Water Stress (BWS) - 2020 BAU (1=very high)	102	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 <a href="http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings">http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings</a> .
Baseline Water Stress (BWS) - 2020 Optimistic (increasing rank describes lower risk)	103	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 <a href="http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings">http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings</a> .
Baseline Water Stress (BWS) - 2020 Pessimistic (increasing rank describes lower risk)	101	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 <a href="http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings">http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings</a> .

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Indicator	Value	Description	Source
Baseline Water Stress (BWS) - 2030 BAU (increasing rank describes lower risk)	96	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 <a href="http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings">http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings</a> .
Baseline Water Stress (BWS) - 2030 Optimistic (increasing rank describes lower risk)	99	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 <a href="http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings">http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings</a> .
Baseline Water Stress (BWS) - 2030 Pessimistic (increasing rank describes lower risk)	97	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 <a href="http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings">http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings</a> .
Baseline Water Stress (BWS) - 2040 BAU (increasing rank describes lower risk)	96	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 <a href="http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings">http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings</a> .
Baseline Water Stress (BWS) - 2040 Optimistic (increasing rank describes lower risk)	97	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 <a href="http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings">http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings</a> .
Baseline Water Stress (BWS) - 2040 Pessimistic (increasing rank describes lower risk)	93	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 <a href="http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings">http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings</a> .



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Indicator	Value	Description	Source
Total water footprint of national consumption (m <sup>3</sup> /a/cap)	2389.74	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. <a href="http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf">http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf</a>
Ratio external / total water footprint (%)	7.48	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. <a href="http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf">http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf</a>
Area equipped for full control irrigation: total (1000 ha)	2.41	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)	2.41	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 (%)	0.00	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)	55.20	World Development Indicators	The World Bank 2018, Data , homepage accessed 20/04/2018
Total internal renewable water resources (IRWR) (10 <sup>9</sup> m <sup>3</sup> /year)	0.00	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 <sup>9</sup> m <sup>3</sup> /year)	0.00	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 <sup>9</sup> m <sup>3</sup> /year)	0.00	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 <sup>9</sup> m <sup>3</sup> /year)	0.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Dependency ratio (%)	0.00	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 <sup>3</sup> /inhab/year)	0.00	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]	5.35	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 Republic of Montenegro has a Mediterranean climate with hot dry summers and autumns and relatively cold winters with heavy snowfalls inland. The terrain is a highly indented coastline with a narrow coastal plain backed by rugged high limestone mountains and plateaus.

Montenegro's surface, which totals 13,812km<sup>2</sup>, is drained into two catchment areas: the Adriatic and the Black Sea. The total area of the Black Sea catchment area is 7,545km<sup>2</sup> (54.6 per cent of the territory). This part is drained by the River Ibar and further by the Zapadna Morava and by the rivers Tara, Piva, Lim and Cehotina, as well as by the Drina. The Montenegro part of the Adriatic catchment area is around 6,560km<sup>2</sup> (45.4 per cent of the territory). The biggest water courses are the Zeta and the Moraca, or the Moraca after their confluence in Podgorica, and the Bojana. Also the Suturina, Drenovštica, Lukavac, Građevica, Bečićka and Reževića rivers, Željeznica, Rikavac, Bratica, Brdela, and Međureč empty directly into the Adriatic sea.

Lake Skadar is the largest in the Balkans, and by the volume of retained water the second after Lake Ohrid. The complex of Lake Skadar, Drim and Bojana has extremely complicated hydrogeography, with a catchment area of around 20,000km<sup>2</sup>. It is formed on the territory of Serbia, Macedonia, Greece, Albania and Montenegro and there are a large number of hydroelectric power stations.

With an average outflow of 40l/sec/km<sup>2</sup> (or 19.5km<sup>3</sup>/year) Montenegro ranks among the top four per cent of countries with the highest average outflow. Given that at least 95.3 per cent of Montenegro's waterways originate in its territory, it is safe to say that water is the country's greatest natural resource. In fact, Montenegro is one of the wealthiest countries in Europe in terms of water.

However, although the country records high levels of precipitation, a large part of its territory (Orijen, Lovćen, Rumija and Katunska Nahija) does not have enough water because it is lost in the underground karst.

##### 1.1.2. WATER USE

In 2005, the total volume of water delivered was 53,671,000m<sup>3</sup>; 33,460,000m<sup>3</sup> to households, 13,165,000m<sup>3</sup> to businesses and 7,046,000m<sup>3</sup> to other consumers. Total losses were 48,195,000m<sup>3</sup>. Despite the apparent abundance of water, around 35 per cent of Montenegrin territory suffers from a chronic lack of water, which can only be solved by means of expensive hydraulic procedures. Around 10 per cent of the territory has a problem with seasonal surplus water.

The problem is caused by an inadequate infrastructure in terms of water supply. As a consequence of climatic conditions, the uncontrolled use of water, huge losses in the water supply system and inadequate infrastructure, water consumption is double that in western Europe. Moreover, there is insufficient provision for drinking water in the coastal region during the tourist season.

#### 1.2. WATER QUALITY, ECOSYSTEMS AND HUMAN HEALTH

The quality of most Montenegrin surface waters is generally adequate during most of the year, but there are exceptions and hotspots. Water quality monitoring of the rivers, lakes and coastal waters reveals the negative impact of industrial and municipal waste-water discharges. The most polluted are two small rivers in the vicinity of Pljevlja in northern Montenegro – the Vezisnica and the Cehotina. The stretch of the River Ibar also exceeds standards for BOD, ammonia, phosphates, nitrates, phenols, detergents, mineral oils, manganese, mercury and pathogens. The water quality of Skadarsko Jezero meets all water quality standards for its category, with the exception of ammonia and the resultant eutrophication is documented in the northwest part of the lake.

Around 65–70 per cent of the population is provided with water through a water supply system in city centres and larger towns, while around 30 per cent in villages use alternative sources. The population of Montenegro is supplied with water from groundwater sources. The measures implemented for the sanitary protection of water sources used to supply the population comply with and exceed existing legal obligations. To date, legal investigations have not been carried out and the protection zones have not been determined for most water sources. At present, the precise identification and mapping of all water sources and their zones of protection is not possible. Water consumption is twice the western European average as the result of climatic conditions, uncontrolled use of water and significant losses in the water supply system and there is insufficient protection of drinking water in the coastal region during the tourist season.

This is of particular significance since most pollutants are found outside areas with developed collection systems and large-scale purifiers, which is why the implementation of adequate solutions for water treatment is vital for environmental protection.

The percentage of the population with access to sanitation is relatively small and most of the coverage is in areas close to town centres. Approximately 35 per cent of the population in urban areas is not connected to sewers. This is due to the underdevelopment of the primary and, in particular, secondary system of waste water.

A large percentage of the population use septic tanks and wells for the drainage of waste water and, in towns, where natural conditions allow, waste water is discharged directly into watercourses.

The status of water in Montenegro is determined by the Regulation on the Classification and Categorization of Surface and Groundwater, in which there have been established three different

categories. A regulation on the classification and categorisation of surface and groundwater was passed so as to ensure that 'the marginal value of quality' was brought into line with the terms of Directive 98/83/EC on the quality of waters intended for human consumption and Directives 75/440/EEC and 79/86/EEC.

## 2. GOVERNANCE ASPECTS

### 2.1. WATER INSTITUTIONS

The Law on Waters of the Republic of Montenegro (Nos. 16/95, 22/95) is the legal basis for water protection.

The responsibility for water management in Montenegro is shared amongst ministries and the municipalities. The Ministry of Agriculture, Forestry and Water Management and the Ministry of Environmental Protection and Spatial Planning have some responsibilities. The Ministry of Environmental Protection and Spatial Planning has taken the lead in sector planning and organization, including the involvement of the private sector. All water sector infrastructures belong to Montenegro. It delegates its use and the responsibility for service provision to municipalities, each with its own water company. The Institute of Public Health in Montenegro is responsible for monitoring drinking water supplies and has the authority to close systems that do not produce water according to standards.

### 2.2. WATER MANAGEMENT

Montenegro is piloting a new approach to utility management involving the private sector. A public-private partnership for utility management called Monte-Aqua has been formed by merging the assets of four principals: (i) Aquaregia Public Company, created by merging the water companies of Ulcinj, Bar, Budva, Tivat, Kotot, Herceg Novi and Ceinje, and the Montenegrin Seaboard Regional Network Public Company; (ii) a German company, Aquamundo, which sponsors the project; (iii) DEG Investment Fund from Germany; and (iv) a private company, Mercur, from Budva. Monte-Aqua will rehabilitate, upgrade, extend and manage the water supply and sanitation services of the area under its responsibility.

Six of the seven coastal municipalities that will be part of this regional scheme have signed letters of intent to participate in the programme according to the concept of public-private ownership. The investment for all town water-supply networks and the Montenegrin Seaboard Regional Water Network to 2020, as well as investment in priority facilities and work for improvements and further development, is €178.55 million. Of this, 52 per cent will be used to complete the construction of the Montenegrin Seaboard Regional Water Network (€89.76 million), 44.5 per cent would be allocated to all other town water networks and 3.8 per cent to rural water networks (€6.74 million). Investment into priority facilities and work that is needed to improve the present water-supply systems is €19.66 million.

User charges for water supply and waste-water services are kept low by local authorities, since they are considered "social services". Like Serbia, charges are not sufficient to cover maintenance

or even, at times, operating costs related to these services. Low collection rates and system inefficiencies are also among the reasons why the public utilities are incurring such high losses, which have to be covered by the municipal and central governments, increasing their budget deficits. However, some steps are being taken to achieve cost recovery through charges. In Podgorica, charges for water supply, waste and waste-water collection were raised significantly in early 2002.

### 2.3. WATER POLICY AND LEGAL FRAMEWORK

In Montenegro's Economic Reforms and Recovery Strategy environmental issues are reflected in a special programme for infrastructure development, highlighting the need to develop and improve the water supply and waste-water treatment. The programme also emphasizes the urgency of an integrated coastal zone management strategy, to steer the development of tourism in Montenegro. The Long-term Water Supply Protection for Montenegro Study, adopted in 1999, is the foundation for water-supply development in Montenegro.

The Law on Waters (Official Gazette Nos. 16/95, 22/95) is the legal basis for water protection in Montenegro.

In order to achieve standards and bring Montenegrin legislation into conformity with the EU directives in the field of solid and water waste management, during 2005 important strategic documents were adopted (Republican Strategic Master Plan for Solid Waste Management and the Master Plan for Montenegrin Coast and Cetinje Municipality Waste Water Disposal and Purification, Strategic Master Plan for Sewerage and Waste Water for Central and Northern Montenegro).

In addition to the main water law, there are other sources of legislation in Montenegro dealing directly or indirectly with water management or having reference to water related matters, including:

- The Law on sea and internal shipping (Nos. 13/78, 8/79, 19/87, 36/89, 13/91)
- The Law on water supplying, removal of waste water and depositing of solid waste in the territory of municipalities: Herceg Novi, Kotor, Tivat, Budva, Ulcinj and Cetinje (No. 46/91)
- The Law on coastal assets (Official Gazette No. 14/92)
- Regulations on the classification and categorization of waters (Official Gazette Nos. 14/95, 19/96, 15/97)
- Regulations on measuring methods and the monitoring of the quality of sea water for bathing and recreation (Official Gazette No. 9/91)
- Regulations on the contents of technical documentation necessary for issuing water resources compliance and water resources permits (Official Gazette No. 4/96)
- Regulations on keeping the water registry and surface and groundwater cadastre, the users and polluters of water, torrent flows and erosive areas and water production premises and facilities (Official Gazette Nos. 5/96, 19/96)
- Regulations on methods for determining and maintaining sanitary protection zones for drinking-water sources and restrictions in the related zones (Official Gazette No. 8/97)

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- Regulations on waste-water quality and the methods of its emission into the public sewerage system and natural recipients (Official Gazette Nos. 10/97, 21/97)
- Decisions on establishing a public enterprise for the water supply, the treatment and removal of waste water and depositing solid waste for areas of the Montenegrin coast and Cetinje (Official Gazette No. 50/91)
- Decision on establishing a public enterprise for managing the coastal assets (Official Gazette No. 25/92)
- Decision on establishing a public enterprise for water resources (Official Gazette No. 39/92)
- Decision on criteria, level and payment methods for compensation for water pollution protection, compensation for material extracted from the pipeline system and compensation for use of water resources facilities (Official Gazette Nos.15/96, 19/96, 35/98)
- Decision on starting the drafting of the spatial plan for the coastal assets (Official Gazette No. 16/97)
- Programme of systematic water quality investigations into water operations (the zone of sanitary protection) and public beaches (Official Gazette No. 13/00)
- Regulations on permitted amounts of hazardous and harmful substances in soil and water for irrigation and their testing methods (Official Gazette No. 23/94)

### 3. GEOPOLITICAL ASPECTS

The Republic of Montenegro is a country located in southeastern Europe. It has a coast on the Adriatic Sea to the southwest and is bordered by Croatia to the west, Bosnia and Herzegovina to the northwest, Serbia to the northeast and Albania to the southeast. Its capital and largest city is Podgorica.

The country has a diversified and potentially sound economic base. Industry is the dominant sector, accounting for 35 per cent of GSP and 39.9 per cent of employment. However, most of the technologies in the industrial sector are outdated and do not comply with environmental standards of the European Union (EU). Despite lower production levels, industries continue to be the major polluters. Old inefficient production technologies, inadequate waste control equipment and weak environmental enforcement are the primary causes for industrial pollution. In general, the areas of significant environmental concerns in Macedonia are located near large urban areas, with industrial sources being the major polluters.

It is expected in future that the ongoing economic and social reform will have a favourable influence on the environment. Large polluting industries are expected to be restructured to be more efficient and less polluting. Also, energy and other resource consumption should decline, with price liberalization and industrial reforms promoting sustainable use of natural resources. The introduction of "polluter pays" and "user pays" principles in environmental policy will further reduce pollution, minimizing clean-up and promoting rational use of natural resources.

### 4. SOURCES

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