

## Water Indicators

| Indicator                                       | Value | Description                                     | Source |
|---|-------|---|--------|
| Overall Basin Risk (score)                      | 2.88  | Overall Basin Risk (score)                      |        |
| Overall Basin Risk (rank)                       | 50    | Overall Basin Risk (rank)                       |        |
| Physical risk (score)                           | 3.15  | Physical risk (score)                           |        |
| Physical risk (rank)                            | 37    | Physical risk (rank)                            |        |
| Regulatory risk (score)                         | 1.85  | Regulatory risk (score)                         |        |
| Regulatory risk (rank)                          | 160   | Regulatory risk (rank)                          |        |
| Reputation risk (score)                         | 3.08  | Reputation risk (score)                         |        |
| Reputation risk (rank)                          | 45    | Reputation risk (rank)                          |        |
| 1. Quantity - Scarcity (score)                  | 3.19  | 1. Quantity - Scarcity (score)                  |        |
| 1. Quantity - Scarcity (rank)                   | 34    | 1. Quantity - Scarcity (rank)                   |        |
| 2. Quantity - Flooding (score)                  | 2.76  | 2. Quantity - Flooding (score)                  |        |
| 2. Quantity - Flooding (rank)                   | 123   | 2. Quantity - Flooding (rank)                   |        |
| 3. Quality (score)                              | 3.45  | 3. Quality (score)                              |        |
| 3. Quality (rank)                               | 57    | 3. Quality (rank)                               |        |
| 4. Ecosystem Service Status (score)             | 3.22  | 4. Ecosystem Service Status (score)             |        |
| 4. Ecosystem Service Status (rank)              | 33    | 4. Ecosystem Service Status (rank)              |        |
| 5. Enabling Environment (Policy & Laws) (score) | 1.10  | 5. Enabling Environment (Policy & Laws) (score) |        |
| 5. Enabling Environment (Policy & Laws) (rank)  | 166   | 5. Enabling Environment (Policy & Laws) (rank)  |        |
| 6. Institutions and Governance (score)          | 2.00  | 6. Institutions and Governance (score)          |        |
| 6. Institutions and Governance (rank)           | 157   | 6. Institutions and Governance (rank)           |        |
| 7. Management Instruments (score)               | 1.92  | 7. Management Instruments (score)               |        |
| 7. Management Instruments (rank)                | 153   | 7. Management Instruments (rank)                |        |
| 8 - Infrastructure & Finance (score)            | 2.90  | 8 - Infrastructure & Finance (score)            |        |
| 8 - Infrastructure & Finance (rank)             | 74    | 8 - Infrastructure & Finance (rank)             |        |
| 9. Cultural Diversity (score)                   | 2.00  | 9. Cultural importance (score)                  |        |
| 9. Cultural Diversity (rank)                    | 98    | 9. Cultural importance (rank)                   |        |
| 10. Biodiversity Importance (score)             | 2.35  | 10. Biodiversity importance (score)             |        |

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| Indicator                           | Value | Description  | Source  |
|-------------------------------------|-------|--|---|
| 10. Biodiversity Importance (rank)  | 174   | 10. Biodiversity importance (rank)   |   |
| 11. Media Scrutiny (score)          | 3.55  | 11. Media Scrutiny (score)   |   |
| 11. Media Scrutiny (rank)           | 26    | 11. Media Scrutiny (rank)  |   |
| 12. Conflict (score)                | 3.25  | 12. Conflict (score)   |   |
| 12. Conflict (rank)                 | 29    | 12. Conflict (rank)  |   |
| 1.0 - Aridity (score)               | 3.10  | 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)                | 37    | 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)       | 2.62  | 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)        | 67    | 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) | 2.98  | 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)                           | 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.  |
| 1.3 - Blue Water Scarcity (score)                            | 4.30  | 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)                             | 31    | 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) | 2.56  | 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)  | 37    | 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)                     | 3.10  | 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)                      | 60    | 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) | 3.01  | 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)  | 63    | 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)                        | 2.79  | This risk indicator is based on the recurrence of floods within the 34-year time frame period of 1985 to 2019. The occurrence of floods within a given location was estimated using data from Flood Observatory, University of Colorado. The Flood Observatory use data derived from a wide variety of news, governmental, instrumental, and remote sensing source.   | Brakenridge, G. R. (2019). Global active archive of large flood events. Dartmouth Flood Observatory, University of Colorado.  |
| 2.1 - Estimated Flood Occurrence (rank)                         | 124   | 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) | 2.11  | 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)  | 111   | 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)               | 3.45  | <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)                                 | 57    | <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)                                   | 3.74  | <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)                                    | 25    | <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) | 1.57  | <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) | 115   | <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)                    | 4.17  | 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)                     | 21    | 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)                             | 162   | 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)                            | 150   | <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) | 2.00  | <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)  | 137   | <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  | <p>This risk Indicator is based on the latest Transparency International's data: the Corruption Perceptions Index 2018. This index aggregates data from a number of different sources that provide perceptions of business people and country experts on the level of corruption in the public sector.</p>  | Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International.   |
| 6.1 - Corruption Perceptions Index (rank)                                 | 104   | <p>This risk Indicator is based on the latest Transparency International's data: the Corruption Perceptions Index 2018. This index aggregates data from a number of different sources that provide perceptions of business people and country experts on the level of corruption in the public sector.</p>  | Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International.   |
| 6.2 - Freedom in the World Index (score)                                  | 1.00  | <p>This risk indicator is based on Freedom House (2019), an annual global report on political rights and civil liberties, composed of numerical ratings and descriptive texts for each country and a select group of territories. The 2019 edition involved more than 100 analysts and more than 30 advisers with global, regional, and issue-based expertise to covers developments in 195 countries and 14 territories from January 1, 2018, through December 31, 2018.</p> | Freedom House (2019). Freedom in the world 2019. Washington, DC: Freedom House.   |



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| 6.2 - Freedom in the World Index (rank)                               | 137   | 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)  | 1.00  | 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)   | 148   | This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Business Participation in Water Resources Development, Management and Use" indicator, which corresponds to one of the six national level indicators under the Institutions and Participation category.   | UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation. |
| 7.1 - Management Instruments for Water Management (SDG 6.5.1) (score) | 2.00  | This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Sustainable and efficient water use management" indicator, which corresponds to one of the five national level indicators under the Management Instruments category.<br><br>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)  | 128   | 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.<br><br>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) | 1.00  | 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)  | 156   | 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)                   | 2.45  | 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)                    | 145   | 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)                           | 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. |
| 8.1 - Access to Safe Drinking Water (rank)                            | 75    | 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)                                    | 4.00  | 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. |

## Country Overview - South Africa

| Indicator   | Value | Description  | Source  |
|---|-------|--|---|
| 8.2 - Access to Sanitation (rank)   | 54    | 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) | 2.00  | 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)  | 151   | 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)  | 2.00  | 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.<br>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)   | 98    | 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.<br>This risk indicator is based on Oviedo and Larsen (2000) data set, which mapped the world's ethnolinguistic groups onto the WWF map of the world's ecoregions. This cross-mapping showed for the very first time the significant overlap that exists between the global geographic distribution of biodiversity and that of linguistic diversity. | Oviedo, G., Maffi, L., & Larsen, P. B. (2000). Indigenous and traditional peoples of the world and ecoregion conservation: An integrated approach to conserving the world's biological and cultural diversity. Gland: WWF (World Wide Fund for Nature) International. |
| 10.1 - Freshwater Endemism (score)  | 2.10  | The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Companies operating in basins with higher number of endemic fish species are exposed to higher reputational risks.  | WWF & TNC (2015). Freshwater Ecoregions of the World.   |

## Country Overview - South Africa

| Indicator                                       | Value | Description   | Source  |
|---|-------|---|---|
| 10.1 - Freshwater Endemism (rank)               | 171   | 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) | 2.60  | 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)  | 129   | The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Count of fish species is used as a representation of freshwater biodiversity richness. Companies operating in basins with higher number of fish species are exposed to higher reputational risks.                              | WWF & TNC (2015). Freshwater Ecoregions of the World. |
| 11.1 - National Media Coverage (score)          | 4.00  | This risk indicator is based on joint qualitative research by WWF and Tecnomia (Typsa Group). It indicates how aware local residents typically are of water-related issues due to national media coverage. The status of the river basin (e.g., scarcity and pollution) is taken into account, as well as the importance of water for livelihoods (e.g., food and shelter). | WWF & Tecnomia (TYPESA Group)                         |
| 11.1 - National Media Coverage (rank)           | 27    | 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)            | 3.00  | This risk indicator is based on joint qualitative research by WWF and Tecnomia (Typsa Group). It indicates how aware people are of water-related issues due to global media coverage. Familiarity to and media coverage of the region and regional water-related disasters are taken into account.  | WWF & Tecnomia (TYPESA Group)                         |
| 11.2 - Global Media Coverage (rank)             | 33    | 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)                         |

## Country Overview - South Africa

| Indicator                                     | Value        | Description  | Source   |
|---|--------------|--|--|
| 12.1 - Conflict News Events (RepRisk) (score) | 4.00         | 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)  | 19           | 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)           | 2.50         | 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)            | 79           | 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 (#)                         | 55908865     | Population, total  | The World Bank 2018, Data , homepage accessed 20/04/2018   |
| GDP (current US\$)                            | 295456189492 | GDP (current US\$)   | The World Bank 2018, Data , homepage accessed 20/04/2018   |
| EPI 2018 score (0-100)                        | 44.73        | Environmental Performance Index  |  |
| WGI -Voice and Accountability (0-100)         | 42.38        | 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> |

## Country Overview - South Africa

| Indicator                                    | Value | Description                | Source  |
|--|-------|----------------------------|---|
| WGI -Political stability no violence (0-100) | 67.98 | 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: <a href="https://ssrn.com/abstract=1682132">https://ssrn.com/abstract=1682132</a> |
| WGI - Government Effectiveness (0-100)       | 64.90 | 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)             | 62.02 | 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)                    | 58.17 | 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)          | 60.10 | Water Governance Indicator | Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: <a href="https://ssrn.com/abstract=1682132">https://ssrn.com/abstract=1682132</a> |

## Country Overview - South Africa

| Indicator   | Value | Description                     | Source   |
|---|-------|---------------------------------|--|
| WRI BWS all industries (0-5)  | 3.04  | 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)   | 65    | 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)                                  | 50    | 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)  | 49    | 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) | 50    | 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> .   |

## Country Overview - South Africa

| Indicator  | Value | Description         | Source   |
|--|-------|---------------------|--|
| Baseline Water Stress (BWS) - 2030 BAU<br>(increasing rank describes lower risk)         | 52    | 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<br>(increasing rank describes lower risk)  | 49    | 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<br>(increasing rank describes lower risk) | 51    | 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<br>(increasing rank describes lower risk)         | 53    | 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<br>(increasing rank describes lower risk)  | 56    | 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<br>(increasing rank describes lower risk) | 54    | 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> . |



## Country Overview - South Africa

| Indicator  | Value   | Description                  | Source  |
|--|---------|------------------------------|---|
| Total water footprint of national consumption (m <sup>3</sup> /a/cap)                  | 1255.40 | 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 (%)   | 22.02   | 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)                             | 1670.00 | Aquastat - Irrigation        | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13  |
| Area equipped for irrigation: total (1000 ha)  | 1670.00 | Aquastat - Irrigation        | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13  |
| % of the area equipped for irrigation actually irrigated (%)                           | 100.00  | 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)                         | 0.39    | 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) | 44.80   | 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) | 6.55    | 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)       | 44.80   | Aquastat - Water Ressources  | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13  |

## Country Overview - South Africa

| Indicator   | Value  | Description                 | Source   |
|---|--------|-----------------------------|--|
| Total renewable water resources (10 <sup>9</sup> m <sup>3</sup> /year)  | 51.35  | Aquastat - Water Ressources | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13 |
| Dependency ratio (%)  | 12.84  | 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) | 942.40 | 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]   | 4.72   | 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 drainage network of South Africa can be divided into four major systems:

-Approximately 48 per cent of the country (606,000km<sup>2</sup>) is drained to the Atlantic Ocean by the Orange River, which rises in the Lesotho Highlands, and its tributaries. Chief among these are the Caledon and the Vaal rivers. Total mean annual runoff is 11.1km<sup>3</sup>.

-North of the Witwatersrand ridge, the plateau is drained to the Indian Ocean by the Limpopo system, with major tributaries such as the Crocodile and the Elephant rivers. This basin has a mean annual runoff of 5.1km<sup>3</sup> draining approximately 14 per cent of the country.

-All other rivers draining into the Indian Ocean, the largest of which is the Tugela River, cover approximately 29 per cent of the country with a mean annual runoff of 28km<sup>3</sup>.

-Rivers draining the fold mountains of the south-western Cape into the Atlantic and Indian oceans cover approximately 9 per cent of the total area, with a mean annual runoff of 5km<sup>3</sup>. The most important rivers in this area are the Olifants and the Breede rivers.

River flows reflect the rainfall pattern. Rivers that have their origin on the eastern great escarpment and in the fold mountains of Western Cape normally have perennial flows. Rivers that originate in the immediate adjoining areas have periodic flows, whereas rivers that originate on the western great plateau have highly episodic flows.

The total annual surface runoff is estimated at 48.2km<sup>3</sup>, or approximately 9 per cent of annual rainfall. Of this amount, 5.2km<sup>3</sup> come from Lesotho and Swaziland. Of the 48.2km<sup>3</sup>, an estimated 9.5km<sup>3</sup> is assumed to be required for the ecological reserve. However, much of the total runoff volume is lost through flood spillage and evaporation, so that in 2000 the available yield was estimated at only 13.9km<sup>3</sup>/yr. The total dam capacity is estimated at 28.5km<sup>3</sup>. The dams command virtually all the runoff from the plateau, while the untapped resources are concentrated along the east and south coasts.

About 5% of mean annual rainfall recharges aquifer and approximately Groundwater is limited due to the geology of the country, and most of the country is underlain by low yielding secondary aquifers. Primary aquifers occur in dry river beds and on the coastal plain. The highest yielding aquifers are the dolomites in Gauteng and the north-west of the country, and the Table Mountain Group aquifer (TMG) in the western and eastern Cape. Groundwater, is used to supply more than 300 small towns and extensively for irrigation. Available yields from these resources are estimated at 1km<sup>3</sup>/yr in 2000. It is foreseen that groundwater use for human consumption will increase, especially in the western part of the country, which lacks perennial rivers and in the Cape, linked to

the Table Mountain Group aquifer.

Taking into consideration the overlap between surface water and groundwater, total internal renewable water resources are estimated at 44.8km<sup>3</sup>/yr out of the total actual renewable water resource. This includes incoming water from other countries, at 50.0km<sup>3</sup>/yr.

A projection for 2025 by the Department of Water Affairs and Forestry (DWAF) shows that the total annual water withdrawal will be 14.5km<sup>3</sup> by then, against 12.5km<sup>3</sup> in 2000. The Department of Water Affairs also has a programme of technical support for municipalities to implement managed aquifer recharge (MAR) with treated storm water and waste water.

Desalination of seawater offers particular future opportunities for coastal water users. Some desalination plants have been installed, which in 1990 had a capacity of 18 million m<sup>3</sup>/yr. The mining industry has established some reverse-osmosis plants to treat acid mine drainage. This is then incorporated into town supplies in the case of eMalahleni. Although expensive, the government plans to increase desalination to treat acid mine drainage and in coastal areas where non-saline sources are not available. It is not foreseen that importing water or other unconventional options will be economically competitive in the near future.

##### 1.1.2. WATER USE

In the northern parts of the country, both surface water and groundwater resources are nearly fully developed and used. Some overexploitation occurs in localized areas, with little undeveloped resource potential remaining. By contrast, in the well-watered south-eastern regions of the country there is more potential to develop some new resources.

Total water withdrawal was estimated at 12,496 million m<sup>3</sup> in the year 2000, with irrigation accounting for 62 per cent.

Substantial volumes of water from urban and industrial developments are returned to streams and are available for reuse, with specific potential in some coastal cities where wastewater is discharged into the sea. Total usable water return flows are close to double the current yield from groundwater.

The government has a focus on water demand management and has made significant savings in urban areas where some systems were shown to be leaking almost half the water flowing through them. Leakage detection and pressure maintenance schemes have made significant savings.

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

Major environmental problems are: lack of important arterial rivers; dams that require extensive water conservation and control measures; growth in water usage outpacing supply; pollution of rivers from agricultural runoff and urban discharge; acid mine drainage; air pollution resulting in acid rain; soil erosion and desertification.

The DWAF acts against polluters, if they can be identified, and some cases have been taken to

court. Cases include herbicide pollution by farmers and industrial pollution. There is a general tendency for the salt content of rivers to increase further downstream, mainly through industrial, irrigation and drainage return flows. Research on the negative effect of this on crop production is being funded by the Water Research Commission (WRC), but to date no concerted extension programmes to minimize this problem have been launched by the various departments of agriculture.

The Water Act states that a specific amount of water should be kept earmarked to satisfy ecological requirements. All future water balance calculations must include a provision for this ecological reserve, although the application of this principle has not yet been described in full detail.

An estimated 260,000ha of irrigated land in South Africa is affected by waterlogging and/or salinization. The salinization of about 15,000ha is serious enough to limit the choice of crops to salt-tolerant species only, and would require costly rehabilitation programmes. On balance, salinity would suppress production levels of salt-sensitive crops, but the choice of crops is not seriously limited and treatment with ameliorants and leaching will usually suffice. Government extension personnel and consultants on remedial actions are on hand to advise farmers who experience salinization and/or waterlogging problems.

Rapid urbanization results in informal shanty towns that spring up near cities. In most of these cases waste management is at a very low level or absent. These local populations become threatened by waterborne diseases as pollution occurs. Surveys are under way to identify high-risk areas and inhabitants, with the aim of launching information and other programmes to reduce pollution.

The shifting of water management to the local level through Water User Associations (WUAs) also transfers the responsibility for the following advisory services to that level:

- Effective water use and measures to prevent misuse;
- Environmentally friendly production practices;
- Prevention of salinization and reclaiming salinized areas;
- The management of water-borne diseases.

Pilot studies on how this could be implemented are in process.

Sedimentation of dams is a problem, especially in the dams that impound parts of the Central Plateau. This area is covered by the very old rock of the Karoo (Karroo) System and its sediments. As a general rule the soils that develop from this material are prone to erosion and as a result some dams in the central parts of the country have lost a substantial amount of their capacity. The exact dimensions of this problem have not been determined but some exceptional cases are known where dams have lost more than 25 per cent of their capacity over the last 80 years.

## 2. GOVERNANCE ASPECTS

### 2.1. WATER INSTITUTIONS

Four ministries are involved in water management, impact mitigation and irrigation development:

- The Ministry of Water Affairs and Environment– through the Department of Water Affairs (DWA) – monitors surface water and groundwater resources, formulates the national water strategy and is responsible for the implementation of the Water Act; The Department of Environmental Affairs is responsible for the conservation of biodiversity, including aquatic biodiversity, and setting National Freshwater Ecosystem Priority Areas (NFEPAs);
- The Ministry of Agriculture – through the National and Provincial Departments of Agriculture (NDA and PDA) – promotes irrigation engineering concepts and is responsible for agricultural extension, with the aim of improving irrigation efficiency;
- The Ministry of Land Reform and Rural development is responsible for the settlement of new farmers.
- The Ministry for Mineral resources is responsible for mining and mineral development, and this requires links to DWA for water use licenses.

Water management is coordinated via DWA with links to regional offices. The National Water Act states that Catchment Management Agencies should be established. Two have been established and a further 17 are pending. Irrigation boards are transforming in to Water User Associations.

Most of the research on the various aspects of water use is promoted, funded and coordinated by WRC, whose funds are generated by a levy on water use. Various institutes of the Agricultural Research Council (ARC) are to a greater or lesser degree involved in irrigation-related research, as are some of the universities and the Council for Scientific and Industrial Research. The South African Sugar Research institute, does some irrigation-related research and extension work.

### 2.2. WATER MANAGEMENT

The Water Act stipulates water management by Catchment Management Agencies (CMAs) and WUAs at a local level. Each WUA will have all water users in an area as members, and the local management should eventually be the responsibility of the WUA. Each WUA will have an elected management body, with all sectors of water users represented on the committee.

Several WUAs will fall under an umbrella organization, the Catchment Management Agency (CMA). Each CMA will have an area of responsibility, which could be a catchment, a portion of a large catchment or a combination of small catchments. There are 19 such water management areas identified.

The administrative procedures for converting irrigation board areas, private schemes and government water schemes into WUAs are currently in progress. Until the CMAs are in place, the DWA will carry out their function. The conditions for the use of water that the CMAs and WUAs must oversee include:

- i)Equal access to water by all interested parties;
- ii)Safeguards against water wastage and low efficiencies of water use;
- iii)Safeguards against pollution.

Construction of private reservoirs is restricted to a maximum capacity of 250,000m<sup>3</sup> and diversion of discharge must not exceed 110L/sec. Specifications on dam safety are also set.

### **2.3. WATER POLICY AND LEGAL FRAMEWORK**

No definite policy is in place regarding natural disasters such as floods and droughts. Each case is judged on merit, but experience has been that in most cases no or very little government aid is given. The baseline message seems to be that the prevalence of disasters should be part of the irrigator's risk management strategy and that the irrigator should be as self-reliant as possible under all circumstances.

Major changes in policy are a shift from the previous practice of selling irrigation water on an area basis, to selling it on a volumetric basis, and the initiation of a water market. This has allowed potential for efficient irrigators to save on their irrigation expense and to sell surplus water.

One unfortunate result of changes in policy is that the agricultural extension services that were available to the commercial irrigation sector have been scaled down. Instead, services have been directed toward previously disadvantaged communities where very little irrigation takes place. The result is that a large sector of the irrigation community is no longer advised on the latest developments in irrigation technology, as these community members cannot afford irrigation consultants. Innovators and early adopters are an exception, although they are not necessarily people who will actively and independently seek out and apply new irrigation technology.

The Water Act of 1998 determines that all water use, with the exception of reasonable domestic use, home garden use and stock water requirements, must be licensed. This ends the era of a distinction between government irrigation schemes, irrigation boards, private irrigation schemes, as well as public and private water – with all that it entailed. The Act also provides for stiff penalties if non-effective use of water can be proved.

The Water Act is the result of various discussion papers that have been circulated and widely debated. To ensure the involvement of all potential irrigators, these discussion papers were included as parts of discussion papers on other, but related, fields such as a discussion paper on an agricultural policy and discussions on a white paper on a national water policy.

### **3. GEOPOLITICAL ASPECTS**

South Africa has signed and ratified the Southern African Development Community (SADC) Shared Water Course System Protocol and the Revised Protocol on Shared Water Courses, which describes how the signatory parties will use and develop internationally shared water resources. Intergovernmental discussions and studies are underway on the sharing of Orange River water between South Africa and Namibia, as well as on the sharing of Limpopo River water between South Africa and the other three countries in the Limpopo river basin: Botswana, Zimbabwe and Mozambique.

The Lesotho Highlands Water Project (LHWP) was conceived principally to export water from Lesotho to the north of South Africa. This 30-year scheme will eventually consist of five vast reservoirs and more than 200km of tunnels that will divert water from the natural southwesterly flow of rivers, arising in an upstream sub-basin of the Orange river basin in Lesotho highlands, northwards to deliver 70m<sup>3</sup>/sec to the Vaal river basin – which is another sub-basin of the Orange

river basin. This scheme will secure future water supplies for South Africa's industrial powerhouse in the Gauteng area. Most of the construction will take place inside Lesotho.