Water Risk Filter

Country Overview - Namibia

Water Indicators

Indicator	Value	Description	Source
Overall Basin Risk (score)	2.65	Overall Basin Risk (score)	
Overall Basin Risk (rank)	97	Overall Basin Risk (rank)	
Physical risk (score)	2.67	Physical risk (score)	
Physical risk (rank)	93	Physical risk (rank)	
Regulatory risk (score)	2.50	Regulatory risk (score)	
Regulatory risk (rank)	131	Regulatory risk (rank)	
Reputation risk (score)	2.74	Reputation risk (score)	
Reputation risk (rank)	81	Reputation risk (rank)	
1. Quantity - Scarcity (score)	3.14	1. Quantity - Scarcity (score)	
1. Quantity - Scarcity (rank)	38	1. Quantity - Scarcity (rank)	
2. Quantity - Flooding (score)	2.12	2. Quantity - Flooding (score)	
2. Quantity - Flooding (rank)	156	2. Quantity - Flooding (rank)	
3. Quality (score)	2.52	3. Quality (score)	
3. Quality (rank)	129	3. Quality (rank)	
4. Ecosystem Service Status (score)	2.02	4. Ecosystem Service Status (score)	
4. Ecosystem Service Status (rank)	127	4. Ecosystem Service Status (rank)	
5. Enabling Environment (Policy & Laws) (score)	2.55	5. Enabling Environment (Policy & Laws) (score)	
5. Enabling Environment (Policy & Laws) (rank)	112	5. Enabling Environment (Policy & Laws) (rank)	
6. Institutions and Governance (score)	2.25	6. Institutions and Governance (score)	
6. Institutions and Governance (rank)	147	6. Institutions and Governance (rank)	
7. Management Instruments (score)	1.96	7. Management Instruments (score)	
7. Management Instruments (rank)	152	7. Management Instruments (rank)	
8 - Infrastructure & Finance (score)	3.80	8 - Infrastructure & Finance (score)	
8 - Infrastructure & Finance (rank)	49	8 - Infrastructure & Finance (rank)	
9. Cultural Diversity (score)	2.00	9. Cultural importance (score)	
9. Cultural Diversity (rank)	107	9. Cultural importance (rank)	
10. Biodiversity Importance (score)	1.79	10. Biodiversity importance (score)	

Indicator	Value	Description	Source
10. Biodiversity Importance (rank)	188	10. Biodiversity importance (rank)	
11. Media Scrutiny (score)	3.00	11. Media Scrutiny (score)	
11. Media Scrutiny (rank)	79	11. Media Scrutiny (rank)	
12. Conflict (score)	3.12	12. Conflict (score)	
12. Conflict (rank)	36	12. Conflict (rank)	
1.0 - Aridity (score)	3.66	The aridity risk indicator is based on the Global Aridity Index (Global-Aridity) and Global Potential Evapo-Transpiration (Global-PET) Geospatial data sets by Trabucco and Zomer (2009). These data sets provide information about the potential availability of water in regions with low water demand, thus they are used in the Water Risk Filter 5.0 to better account for deserts and other arid areas in the risk assessment.	Trabucco, A., & Zomer, R. J. (2009). Global potential evapo-transpiration (Global-PET) and global aridity index (Global-Aridity) geo-database. CGIAR consortium for spatial information.
1.0 - Aridity (rank)	25	The aridity risk indicator is based on the Global Aridity Index (Global-Aridity) and Global Potential Evapo-Transpiration (Global-PET) Geospatial data sets by Trabucco and Zomer (2009). These data sets provide information about the potential availability of water in regions with low water demand, thus they are used in the Water Risk Filter 5.0 to better account for deserts and other arid areas in the risk assessment.	Trabucco, A., & Zomer, R. J. (2009). Global potential evapo-transpiration (Global-PET) and global aridity index (Global-Aridity) geo-database. CGIAR consortium for spatial information.
1.1 - Water Depletion (score)	1.67	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. Elem Sci Anth, 4.
1.1 - Water Depletion (rank)	97	The water depletion risk indicator is based on annual average monthly net water depletion from Brauman et al. (2016). Their analysis is based on model outputs from the newest version of the integrated water resources model WaterGAP3 which measures water depletion as the ratio of water consumption-to-availability.	Brauman, K. A., Richter, B. D., Postel, S., Malsy, M., & Flörke, M. (2016). Water depletion: An improved metric for incorporating seasonal and dry-year water scarcity into water risk assessments. Elem Sci Anth, 4.
1.2 - Baseline Water Stress (score)	3.71	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.

Indicator	Value	Description	Source
1.2 - Baseline Water Stress (rank)	28	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)	4.65	The blue water scarcity risk indicator is based on Mekonnen and Hoekstra (2016) global assessment of blue water scarcity on a monthly basis and at high spatial resolution (grid cells of 30 × 30 arc min resolution). Blue water scarcity is calculated as the ratio of the blue water footprint in a grid cell to the total blue water availability in the cell. The time period analyzed in this study ranges from 1996 to 2005.	Mekonnen, M. M., & Hoekstra, A. Y. (2016). Four billion people facing severe water scarcity. Science advances, 2(2), e1500323.
1.3 - Blue Water Scarcity (rank)	20	The blue water scarcity risk indicator is based on Mekonnen and Hoekstra (2016) global assessment of blue water scarcity on a monthly basis and at high spatial resolution (grid cells of 30 × 30 arc min resolution). Blue water scarcity is calculated as the ratio of the blue water footprint in a grid cell to the total blue water availability in the cell. The time period analyzed in this study ranges from 1996 to 2005.	Mekonnen, M. M., & Hoekstra, A. Y. (2016). Four billion people facing severe water scarcity. Science advances, 2(2), e1500323.
1.4 - Projected Change in Water Discharge (by ~2050) (score)	1.73	This risk indicator is based on multi-model simulation that applies both global climate and hydrological models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). To estimate the change at 2°C of global warming above 1980-2010 levels, simulated annual water discharge was averaged over a 31-year period with 2°C mean warming. Results are expressed in terms of relative change (%) in probability between present day (1980-2010) conditions and 2°C scenarios by 2050.	Schewe, J., Heinke, J., Gerten, D., Haddeland, I., Arnell, N. W., Clark, D. B., ... & Gosling, S. N. (2014). Multimodel assessment of water scarcity under climate change. Proceedings of the National Academy of Sciences, 111(9), 3245-3250.
1.4 - Projected Change in Water Discharge (by ~2050) (rank)	118	This risk indicator is based on multi-model simulation that applies both global climate and hydrological models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). To estimate the change at 2°C of global warming above 1980-2010 levels, simulated annual water discharge was averaged over a 31-year period with 2°C mean warming. Results are expressed in terms of relative change (%) in probability between present day (1980-2010) conditions and 2°C scenarios by 2050.	Schewe, J., Heinke, J., Gerten, D., Haddeland, I., Arnell, N. W., Clark, D. B., ... & Gosling, S. N. (2014). Multimodel assessment of water scarcity under climate change. Proceedings of the National Academy of Sciences, 111(9), 3245-3250.

Indicator	Value	Description	Source
1.5 - Drought Frequency Probability (score)	2.72	This risk indicator is based on the Standardized Precipitation and Evaporation Index (SPEI). Vicente-Serrano et al. (2010) developed this multi-scalar drought index applying both precipitation and temperature data to detect, monitor and analyze different drought types and impacts in the context of global warming. The mathematical calculations used for SPEI are similar to the Standard Precipitation Index (SPI), but it has the advantage to include the role of evapotranspiration.	Vicente-Serrano, S. M., Beguería, S., & López-Moreno, J. I. (2010). A multiscalar drought index sensitive to global warming: the standardized precipitation evapotranspiration index. Journal of climate, 23(7), 1696-1718.
1.5 - Drought Frequency Probability (rank)	82	This risk indicator is based on the Standardized Precipitation and Evaporation Index (SPEI). Vicente-Serrano et al. (2010) developed this multi-scalar drought index applying both precipitation and temperature data to detect, monitor and analyze different drought types and impacts in the context of global warming. The mathematical calculations used for SPEI are similar to the Standard Precipitation Index (SPI), but it has the advantage to include the role of evapotranspiration.	Vicente-Serrano, S. M., Beguería, S., & López-Moreno, J. I. (2010). A multiscalar drought index sensitive to global warming: the standardized precipitation evapotranspiration index. Journal of climate, 23(7), 1696-1718.
1.6 - Projected Change in Drought Occurrence (by ~2050) (score)	2.79	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)	181	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)	2.10	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)	155	This risk indicator is based on the recurrence of floods within the 34-year time frame period of 1985 to 2019. The occurrence of floods within a given location was estimated using data from Flood Observatory, University of Colorado. The Flood Observatory use data derived from a wide variety of news, governmental, instrumental, and remote sensing source.	Brakenridge, G. R. (2019). Global active archive of large flood events. Dartmouth Flood Observatory, University of Colorado.

Indicator	Value	Description	Source
2.2 - Projected Change in Flood Occurrence (by ~2050) (score)	2.40	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)	88	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)	2.52	The underlying data for this risk indicator is based on a broad suite of pollutants with well-documented direct or indirect negative effects on water security for both humans and freshwater biodiversity, compiled by Vörösmarty et al. (2010). The negative effects are specific to individual pollutants, ranging from impacts mediated by eutrophication such as algal blooms and oxygen depletion (e.g., caused by phosphorus and organic loading) to direct toxic effects (e.g., caused by pesticides, mercury). The overall Surface Water Contamination Index is calculated based on a range of key pollutants with different weightings according to the level of their negative effects on water security for both humans and freshwater biodiversity: soil salinization (8%), nitrogen (12%) and phosphorus (P, 13%) loading, mercury deposition (5%), pesticide loading (10%), sediment loading (17%), organic loading (as Biological Oxygen Demand, BOD; 15%), potential acidification (9%), and thermal alteration (11%).	Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., ... & Davies, P. M. (2010). Global threats to human water security and river biodiversity. Nature, 467(7315), 555.

Indicator	Value	Description	Source
3.1 - Surface Water Contamination Index (rank)	129	The underlying data for this risk indicator is based on a broad suite of pollutants with well-documented direct or indirect negative effects on water security for both humans and freshwater biodiversity, compiled by Vörösmarty et al. (2010). The negative effects are specific to individual pollutants, ranging from impacts mediated by eutrophication such as algal blooms and oxygen depletion (e.g., caused by phosphorus and organic loading) to direct toxic effects (e.g., caused by pesticides, mercury). The overall Surface Water Contamination Index is calculated based on a range of key pollutants with different weightings according to the level of their negative effects on water security for both humans and freshwater biodiversity: soil salinization (8%), nitrogen (12%) and phosphorus (P, 13%) loading, mercury deposition (5%), pesticide loading (10%), sediment loading (17%), organic loading (as Biological Oxygen Demand, BOD; 15%), potential acidification (9%), and thermal alteration (11%).	Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., ... & Davies, P. M. (2010). Global threats to human water security and river biodiversity. Nature, 467(7315), 555.
4.1 - Fragmentation Status of Rivers (score)	2.23	This risk indicator is based on the data set by Grill et al. (2019) mapping the world's free-flowing rivers. Grill et al. (2019) compiled a geometric network of the global river system and associated attributes, such as hydro-geometric properties, as well as pressure indicators to calculate an integrated connectivity status index (CSI). While only rivers with high levels of connectivity in their entire length are classified as free-flowing, rivers of CSI < 95% are considered as fragmented at a certain degree.	Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., ... & Macedo, H. E. (2019). Mapping the world's free-flowing rivers. Nature, 569(7755), 215.
4.1 - Fragmentation Status of Rivers (rank)	103	This risk indicator is based on the data set by Grill et al. (2019) mapping the world's free-flowing rivers. Grill et al. (2019) compiled a geometric network of the global river system and associated attributes, such as hydro-geometric properties, as well as pressure indicators to calculate an integrated connectivity status index (CSI). While only rivers with high levels of connectivity in their entire length are classified as free-flowing, rivers of CSI < 95% are considered as fragmented at a certain degree.	Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., ... & Macedo, H. E. (2019). Mapping the world's free-flowing rivers. Nature, 569(7755), 215.
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (score)	1.00	For this risk indicator, tree cover loss was applied as a proxy to represent catchment ecosystem services degradation since forests play an important role in terms of water regulation, supply and pollution control. The forest cover data is based on Hansen et al.'s global Landsat data at a 30-meter spatial resolution to characterize forest cover and change. The authors defined trees as vegetation taller than 5 meters in height, and forest cover loss as a stand-replacement disturbance, or a change from a forest to non-forest state, during the period 2000 – 2018.	Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A. A., Tyukavina, A., ... & Kommareddy, A. (2013). High-resolution global maps of 21st-century forest cover change. science, 342(6160), 850-853.

Indicator	Value	Description	Source
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (rank)	176	For this risk indicator, tree cover loss was applied as a proxy to represent catchment ecosystem services degradation since forests play an important role in terms of water regulation, supply and pollution control. The forest cover data is based on Hansen et al.'s global Landsat data at a 30-meter spatial resolution to characterize forest cover and change. The authors defined trees as vegetation taller than 5 meters in height, and forest cover loss as a stand-replacement disturbance, or a change from a forest to non-forest state, during the period 2000 – 2018.	Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A. A., Tyukavina, A., ... & Kommareddy, A. (2013). High-resolution global maps of 21st-century forest cover change. science, 342(6160), 850-853.
4.3 - Projected Impacts on Freshwater Biodiversity (score)	4.12	The study by Tedesco et al. (2013) to project changes [% increase or decrease] in extinction rate by ~2090 of freshwater fish due to water availability loss from climate change is used as a proxy to estimate the projected impacts on freshwater biodiversity.	Tedesco, P. A., Oberdorff, T., Cornu, J. F., Beauchard, O., Brosse, S., Dürr, H. H., ... & Hugueny, B. (2013). A scenario for impacts of water availability loss due to climate change on riverine fish extinction rates. Journal of Applied Ecology, 50(5), 1105-1115.
4.3 - Projected Impacts on Freshwater Biodiversity (rank)	23	The study by Tedesco et al. (2013) to project changes [% increase or decrease] in extinction rate by ~2090 of freshwater fish due to water availability loss from climate change is used as a proxy to estimate the projected impacts on freshwater biodiversity.	Tedesco, P. A., Oberdorff, T., Cornu, J. F., Beauchard, O., Brosse, S., Dürr, H. H., ... & Hugueny, B. (2013). A scenario for impacts of water availability loss due to climate change on riverine fish extinction rates. Journal of Applied Ecology, 50(5), 1105-1115.
5.1 - Freshwater Policy Status (SDG 6.5.1) (score)	2.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Policy" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.1 - Freshwater Policy Status (SDG 6.5.1) (rank)	137	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)	3.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Law(s)" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.

Indicator	Value	Description	Source
5.2 - Freshwater Law Status (SDG 6.5.1) (rank)	79	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation “National Water Resources Law(s)” indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.3 - Implementation Status of Water Management Plans (SDG 6.5.1) (score)	2.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation “National IWRM plans” indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.3 - Implementation Status of Water Management Plans (SDG 6.5.1) (rank)	151	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation “National IWRM plans” indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
6.1 - Corruption Perceptions Index (score)	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)	124	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)	1.00	This risk indicator is based on Freedom House (2019), an annual global report on political rights and civil liberties, composed of numerical ratings and descriptive texts for each country and a select group of territories. The 2019 edition involved more than 100 analysts and more than 30 advisers with global, regional, and issue-based expertise to covers developments in 195 countries and 14 territories from January 1, 2018, through December 31, 2018.	Freedom House (2019). Freedom in the world 2019. Washington, DC: Freedom House.

Indicator	Value	Description	Source
6.2 - Freedom in the World Index (rank)	150	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)	2.00	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)	128	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation “Business Participation in Water Resources Development, Management and Use” indicator, which corresponds to one of the six national level indicators under the Institutions and Participation category.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
7.1 - Management Instruments for Water Management (SDG 6.5.1) (score)	2.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation “Sustainable and efficient water use management” indicator, which corresponds to one of the five national level indicators under the Management Instruments category. For SDG 6.5.1, management instruments refer to the tools and activities that enable decision-makers and users to make rational and informed choices between alternative actions.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
7.1 - Management Instruments for Water Management (SDG 6.5.1) (rank)	140	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation “Sustainable and efficient water use management” indicator, which corresponds to one of the five national level indicators under the Management Instruments category. For SDG 6.5.1, management instruments refer to the tools and activities that enable decision-makers and users to make rational and informed choices between alternative actions.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.

Indicator	Value	Description	Source
7.2 - Groundwater Monitoring Data Availability and Management (score)	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 GGMN Portal. UN International Groundwater Resources Assessment Centre (IGRAC).
7.2 - Groundwater Monitoring Data Availability and Management (rank)	166	This risk indicator is based on the data set by UN IGRAC (2019) to determine the level of availability of groundwater monitoring data at country level as groundwater management decisions rely strongly on data availability. The level of groundwater monitoring data availability for groundwater management is determined according to a combination of three criteria developed by WWF and IGRAC: 1) Status of country groundwater monitoring programme, 2) groundwater data availability for NGOs and 3) Public access to processed groundwater monitoring data.	UN IGRAC (2019). Global Groundwater Monitoring Network GGMN Portal. UN International Groundwater Resources Assessment Centre (IGRAC).
7.3 - Density of Runoff Monitoring Stations (score)	2.71	The density of monitoring stations for water quantity was applied as proxy to develop this risk indicator. The Global Runoff Data Base was used to estimate the number of monitoring stations per 1000km2 of the main river system (data base access date: May 2018).	BfG (2019). Global Runoff Data Base. German Federal Institute of Hydrology (BfG).
7.3 - Density of Runoff Monitoring Stations (rank)	134	The density of monitoring stations for water quantity was applied as proxy to develop this risk indicator. The Global Runoff Data Base was used to estimate the number of monitoring stations per 1000km2 of the main river system (data base access date: May 2018).	BfG (2019). Global Runoff Data Base. German Federal Institute of Hydrology (BfG).
8.1 - Access to Safe Drinking Water (score)	3.00	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)	56	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)	5.00	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.

Water Risk Filter

Country Overview - Namibia

Indicator	Value	Description	Source
8.2 - Access to Sanitation (rank)	28	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)	157	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. 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)	107	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)	1.11	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 - Namibia

Indicator	Value	Description	Source
10.1 - Freshwater Endemism (rank)	192	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)	2.47	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)	134	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Count of fish species is used as a representation of freshwater biodiversity richness. Companies operating in basins with higher number of fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.
11.1 - National Media Coverage (score)	3.00	This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group). It indicates how aware local residents typically are of water-related issues due to national media coverage. The status of the river basin (e.g., scarcity and pollution) is taken into account, as well as the importance of water for livelihoods (e.g., food and shelter).	WWF & Tecnoma (TYPSA Group)
11.1 - National Media Coverage (rank)	117	This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group). It indicates how aware local residents typically are of water-related issues due to national media coverage. The status of the river basin (e.g., scarcity and pollution) is taken into account, as well as the importance of water for livelihoods (e.g., food and shelter).	WWF & Tecnoma (TYPSA Group)
11.2 - Global Media Coverage (score)	3.00	This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group). It indicates how aware people are of water-related issues due to global media coverage. Familiarity to and media coverage of the region and regional water-related disasters are taken into account.	WWF & Tecnoma (TYPSA Group)
11.2 - Global Media Coverage (rank)	51	This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group). It indicates how aware people are of water-related issues due to global media coverage. Familiarity to and media coverage of the region and regional water-related disasters are taken into account.	WWF & Tecnoma (TYPSA Group)

Water Risk Filter

Country Overview - Namibia

Indicator	Value	Description	Source
12.1 - Conflict News Events (RepRisk) (score)	3.00	This risk indicator is based on 2018 data collected by RepRisk on counts and registers of documented negative incidents, criticism and controversies that can affect a company's reputational risk. These negative news events are labelled per country and industry class.	RepRisk & WWF (2019). Due diligence database on ESG and business conduct risks. RepRisk.
12.1 - Conflict News Events (RepRisk) (rank)	83	This risk indicator is based on 2018 data collected by RepRisk on counts and registers of documented negative incidents, criticism and controversies that can affect a company's reputational risk. These negative news events are labelled per country and industry class.	RepRisk & WWF (2019). Due diligence database on ESG and business conduct risks. RepRisk.
12.2 - Hydro-political Risk (score)	3.24	This risk indicator is based on the assessment of hydro-political risk by Farinosi et al. (2018). More specifically, it is based on the results of spatial modelling by Farinosi et al. (2018) that determined the main parameters affecting water cross-border conflicts and calculated the likelihood of hydro-political issues.	Farinosi, F., Giupponi, C., Reynaud, A., Ceccherini, G., Carmona-Moreno, C., De Roo, A., ... & Bidoglio, G. (2018). An innovative approach to the assessment of hydro-political risk: A spatially explicit, data driven indicator of hydro-political issues. Global environmental change, 52, 286-313.
12.2 - Hydro-political Risk (rank)	20	This risk indicator is based on the assessment of hydro-political risk by Farinosi et al. (2018). More specifically, it is based on the results of spatial modelling by Farinosi et al. (2018) that determined the main parameters affecting water cross-border conflicts and calculated the likelihood of hydro-political issues.	Farinosi, F., Giupponi, C., Reynaud, A., Ceccherini, G., Carmona-Moreno, C., De Roo, A., ... & Bidoglio, G. (2018). An innovative approach to the assessment of hydro-political risk: A spatially explicit, data driven indicator of hydro-political issues. Global environmental change, 52, 286-313.
Population, total (#)	2479713	Population, total	The World Bank 2018, Data , hompage accessed 20/04/2018
GDP (current US$)	10947880690	GDP (current US$)	The World Bank 2018, Data , hompage accessed 20/04/2018
EPI 2018 score (0-100)	58.46	Environmental Performance Index	
WGI -Voice and Accountability (0-100)	70.00	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132

Water Risk Filter

Country Overview - Namibia

Indicator	Value	Description	Source
WGI -Political stability no violence (0-100)	66.50	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: https://ssrn.com/abstract=1682132
WGI - Government Effectiveness (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: https://ssrn.com/abstract=1682132
WGI - Regulatory Quality (0-100)	49.52	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132
WGI - Rule of Law (0-100)	64.42	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132
WGI - Control of Corruption (0-100)	65.87	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132

Indicator	Value	Description	Source
WRI BWS all industries (0-5)	1.88	WRI Baseline Water Stress (BWS)	Gassert, F., P. Reig, T. Luo, and A. Maddocks. 2013. "Aqueduct country and river basin rankings: a weighted aggregation of spatially distinct hydrological indicators." Working paper. Washington, DC: World Resources Institute, December 2013. Available online at http://wri.org/publication/aqueduct-country-river-basin-rankings.
WRI BWS Ranking (1=very high)	87	WRI Baseline Water Stress (BWS)	Gassert, F., P. Reig, T. Luo, and A. Maddocks. 2013. "Aqueduct country and river basin rankings: a weighted aggregation of spatially distinct hydrological indicators." Working paper. Washington, DC: World Resources Institute, December 2013. Available online at http://wri.org/publication/aqueduct-country-river-basin-rankings.
Baseline Water Stress (BWS) - 2020 BAU (1=very high)	64	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2020 Optimistic (increasing rank describes lower risk)	63	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2020 Pessimistic (increasing rank describes lower risk)	63	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.

Water Risk Filter

Country Overview - Namibia

Indicator	Value	Description	Source
Baseline Water Stress (BWS) - 2030 BAU (increasing rank describes lower risk)	63	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2030 Optimistic (increasing rank describes lower risk)	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 http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2030 Pessimistic (increasing rank describes lower risk)	65	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2040 BAU (increasing rank describes lower risk)	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 http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2040 Optimistic (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 http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2040 Pessimistic (increasing rank describes lower risk)	57	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.

Water Risk Filter

Country Overview - Namibia

Indicator	Value	Description	Source
Total water footprint of national consumption (m3/a/cap)	1682.23	WFN Water Footprint Data	Mekonnen, M.M. and Hoekstra, A.Y. (2011) National water footprint accounts: The green, blue and grey water footprint of production and consumption, Value of Water Research Report Series No. 50, UNESCO-IHE, Delft, the Netherlands.http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf
Ratio external / total water footprint (%)	25.97	WFN Water Footprint Data	Mekonnen, M.M. and Hoekstra, A.Y. (2011) National water footprint accounts: The green, blue and grey water footprint of production and consumption, Value of Water Research Report Series No. 50, UNESCO-IHE, Delft, the Netherlands.http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf
Area equipped for full control irrigation: total (1000 ha)	7.57	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)	7.57	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)	99.13	World Development Indicators	The World Bank 2018, Data , hompage accessed 20/04/2018
Total internal renewable water resources (IRWR) (10^9 m3/year)	6.16	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Total internal renewable water resources (IRWR) (10^9 m3/year)	33.75	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Water resources: total external renewable (10^9 m3/year)	6.16	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13

Water Risk Filter

Country Overview - Namibia

Indicator	Value	Description	Source
Total renewable water resources (10^9 m3/year)	39.91	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Dependency ratio (%)	84.57	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Total renewable water resources per capita (m3/inhab/year)	16230.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
World happiness [0-8]	4.44	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 main river basins in Namibia are:
-The Zambezi river basin, with an area of 17,426km2 in Namibia, is the country's richest water source. The Zambezi has a mean flow of 40 km3/yr. The northeastern Caprivi Strip forms 100km of the border between Namibia and Zambia and a short distance of the border between Namibia and Zimbabwe.
-The Okavango river basin is an interior basin covering 106,798km2 in Namibia. The river rises in Angola, then flowing in a narrow alluvial plain up to 6km wide, forms the border with Namibia for some 350km before crossing the Caprivi Strip and flowing into Botswana, where it forms the Okavango swamps. Its mean flow is slightly above 10km3/yr. It has two major tributaries, the Cubango and the Cuito. While the flow in the Cubango River upstream of the Cuito River confluence drops to very low levels during dry years, the flow from the Cuito River is more reliable. The Omatako River is a Namibian tributary of the Okavango, but contributes no flow at all. Originating in the dry interior of Namibia, there is no evidence that the Omatako has ever flowed further than 400km from its source.
-The southwest coast basin, including the Kunene River, covers an area of 17,549km2. Rainfall over the Kunene catchment is unreliable and variable, and the mean flow of the river is 5km3/yr. The relatively small catchment area and steep riverbed slope in the upper section also mean that flows run relatively quickly to the coast, leaving the river almost dry at the end of the dry season. With the inception of the Ruacana hydroelectric scheme and its associated storage dams, flows should have become more regulated. This did not happen because the Gove Dam in Angola has never been adequately operational. In addition to generating hydropower, the Kunene also supplies a significant amount of water to the four northern regions of Namibia, where approximately 700,000 people – over one third of the total population – live. Demand peaks in October, which corresponds with the period of minimum flow in the Kunene.
-The south Atlantic coast, including the Huab, Ugab, Omaruru, Swakop and Kuiseb rivers, with a total area of 264,160km2.
-The Orange river basin covers 219,249km2 in Namibia. The river forms 600km of the southern border of Namibia and South Africa. It has a mean flow of about 11km3/yr. The major Namibian tributary, the Fish River, has a mean flow of 0.48km3/yr at its confluence with the Orange River. The flow in the lower parts of the Orange has reduced by nearly two thirds, especially since the Orange River Project (ORP) in South Africa began 35 years ago. This project transfers water from the Caledon and Orange rivers to rivers outside the basin that flow toward cities in South Africa's Eastern Cape Province. The ORP uses more than a dozen dams with a combined capacity of 8.5km3. These include the Gariep Dam, built in 1979 and previously known as the Hendrick Verwoerd Dam, which has a reservoir capacity of almost 5.7km3.
-The interior basins, including the Cuvelai river basin and part of the Kalahari Desert, cover 199,718km2. The Cuvelai River enters Namibia as a 130km wide delta of ephemeral watercourses, known as oshanas, which then converge to terminate in the Etosha Pan. Runoff in the Cuvelai is erratic and varies from no flow to 0.1km3/yr (gauged in 1995). Due to flat topography and shallow saline groundwater, surface water storage facilities are limited to shallow earth or excavation dams, which suffer from high evaporation rates.
The percentage of mean annual precipitation that ends up as river flow in ephemeral systems in Namibia varies from as little as below 1 per cent to around 12.5 per cent for parts of the Fish river basin. The remainder goes to direct evaporation and evapotranspiration, with the latter being by far the greatest component. Some of the runoff recharges alluvial aquifers on its way downstream, and in so doing the majority of ephemeral river floods ultimately disappear entirely into the sand. Namibia's ephemeral rivers are "effluent" systems. This means that the river feeds the groundwater table, rather than a high groundwater table sustaining its flow, as with "influent" rivers.
Namibia's groundwater occurs in a wide range of rock types, making groundwater management a complex process. It provides a buffer against drought in many regions of the country, but it remains inherently vulnerable to over-abstraction and pollution. Aquifers occurring in Namibia are classified as alluvial, Kalahari, fracture, Karst or artesian aquifers. Parts of the Grootfontein-Otavi-Tsumeb Karstland aquifer have been subject to thorough investigations and modelling. For the Otavi mountain area, the following recharge conditions were identified:
-The recharge rate amounts to 2 per cent of the long-term mean annual rainfall after a sequence of rainy seasons in each of which the long-term annual rainfall is exceeded;
-The recharge rate amounts to 1 per cent of the long-term mean annual rainfall after a single rainy season in which the long-term mean annual rainfall is exceeded;
-The recharge rate amounts to 0 per cent if the rainfall does not exceed the long-term mean annual rainfall.
Although the ephemeral rivers of Namibia have dry sandy or rocky riverbeds for most of the year, they are conduits for subsurface flow and contain a number of wetlands defined as "shallow, swampy or marshy areas with little or no water flow" or "waterlogged solid dominated by emergent vegetation". In Namibia this description applies to most sections of all westward flowing rivers north of the Kuiseb River. Wetlands are periodically used for hunting and seasonal fishing. They are also used for communal domestic stock farming, small mining enterprises and small-scale gardening. The ecology of Namibia's wetlands is very fragile. Overexploitation of alluvial

aquifers and dam building, which reduce flow downstream, especially on the Kunene and Orange rivers, are potential threats to wetlands that depend on them. The protection and conservation of wetlands is therefore an important priority; the government of the Republic of Namibia has made several efforts toward ensuring this. The Etosha Pan, the Orange river mouth, Sandwich Harbour and Walvis Bay are wetlands of international importance in Namibia, and also Ramsar sites.
Namibia's total natural renewable water resources are estimated at 45.46km3/yr, of which only 6.16km3/yr is internally produced. Over half of external water resources come from the Zambezi River, while the Orange, Kunene and Kwando rivers and rivers from the Okavango contribute smaller amounts. From the 28km3/yr total accounted natural flow of the Zambezi, Kunene and Orange rivers, only 0.255km3/yr is under agreement (0.07 from the Orange River and 0.185 from the Kunene River) and should thus be considered as actual flow. This reduces the natural renewable water resources of 45.46km3/yr to actual renewable water resources of 17.715km3/yr.
Building dams has tapped a number of ephemeral rivers. The total storage capacity of the major dams is about 0.71km3 and their 95 per cent assured combined yield is 95.83 million m3/yr. In addition to these larger reservoirs, there are thousands of small farm dams scattered around the ephemeral river basins.
The total assured safe yield of Namibia's water resources is 660 million m3/yr, distributed as follows: groundwater – 300 million m3/yr; ephemeral rivers – 200 million m3/yr; perennial rivers – 150 million m3/yr; and unconventional sources – 10 million m3/yr.
Treated wastewater is used more and more often for applications that do not require drinking water quality, such as landscape irrigation. It was found that the return flow in Windhoek and urban centres equals 40 per cent of fresh water consumption and can be reused after treatment. Many urban areas in Namibia reuse water, such as Swakopmund, Walvis Bay, Tsumeb, Otjiwarongo, Okahandja, Mariental, Oranjemund and Windhoek. In Windhoek, 1.14 million m3 of treated effluent was used for irrigation in 1997. Reclamation of water for potable reuse has been practised since 1968. The plant could supply 8,000 m3/day, which was about 19 per cent of the city's average daily water demand in 1997. A new reclamation plant with an increased capacity of 21,000 m3/day was completed in 2002, and the old plant will in future be used for reclaiming irrigation water. A number of mines practise wastewater recycling. It is estimated that in the future 7 million m3/yr from Windhoek and 10 million m3/yr from other centres could potentially become available.
Recently a contract for the design and construction of a coastal desalination project was tendered.

1.1.2. WATER USE

Total water consumption in Namibia was 300 million m3 in 2000. Agriculture was the largest water user, accounting for 213 million m3, of which 136 million m3 was used for irrigation (45 per cent all water used in the country) and the remaining 77 million m3 was used for livestock (26 per cent of all water used). The municipal sector followed with 73 million m3 (24 per cent) and industry with 14 million m3 (5 per cent).
The highest consumption of irrigation water was in the Fish and Orange river basins, with 41.5 and 41.0 million m3 respectively. In 2000, 30 million m3 of groundwater was used for irrigation, which is 22 per cent of the total consumption of irrigation.

1.2. WATER QUALITY, ECOSYSTEMS AND HUMAN HEALTH

Major environmental problems in Namibia include: limited natural fresh water resources; desertification; wildlife poaching; and land degradation leading to few conservation areas.
Namibia's irrigation schemes have experienced a variety of environmental difficulties. While no figures exist as to the extent of these problems, anecdotal evidence suggests that most are small-scale and manageable. They include soil salinity problems in the Hardap and Aussenkehr schemes; siltation of and reed growth in canals and weed invasion in the Hardap scheme; and soil compaction and runoff problems at the Shadikongoro farm in the Okavango region.
Apart from the above, good drainage and/or good quality water leave most schemes trouble-free. For example, although the Naute scheme's soils are saline, water quality and drainage are good and so leaching effectively deals with salinity. On small-scale groundwater irrigation schemes, it is often found that boreholes with sufficient pressure for irrigation tend to be those with good quality water, and vice versa.

2. GOVERNANCE ASPECTS

2.1. WATER INSTITUTIONS

A number of institutions are responsible for different aspects of water supply, management and use, including government departments, parastatal institutions (such as municipalities and community-based Water Point Committees), private organizations, and individuals.
Three key institutions are:
-NamWater, a parastatal institution responsible for bulk water supply;
-The Department of Water Affairs within the Ministry of Agriculture, Water and Rural Development, responsible for all water resource development projects, including irrigation planning and development;
-The National Development Corporation, which executes new government developments and manages schemes.

2.2. WATER MANAGEMENT

Government policy is that so-called "irrigation scheme management boards" should be established to take over ownership and responsibility for irrigation scheme infrastructure. Management agreements should be established for each scheme.
A joint Namibian/South African Irrigation Authority, known as the Noordoewer/Viooldrift Irrigation Board, was established 1993. This board only covers irrigation schemes along the Orange River. In the Etunda scheme, lack of continuity, proper management and discipline is evident, leading to poor performance and maintenance. In the Shadikongoro scheme there was a lack of a clear understanding between project management and the local authority. This led to continuous

interference by the local authority and resulted in unrest among workers on more than one occasion. Eventually the farm manager was removed and since then, with proper management in place, the project seems to be coping financially and has achieved good yields.
Decentralization is a national policy and thus responsibility for rural water supply is being transferred to the regional level through the establishment of Water Point Committees (WPCs) in the communal areas of Namibia. In total 3,673 WPCs are needed. By 1997/98, 1,703 (or 46 per cent) had been established.

2.3. WATER POLICY AND LEGAL FRAMEWORK

According to Article 100 of the Constitution of the Republic of Namibia: "Land, water and natural resources below and above the surface of the land...of Namibia shall belong to the State if they are not otherwise lawfully owned."
The Water Act 54 of 1956 has a colonial origin and applies the riparian principles of well-watered European countries to Namibia. It is not only outdated but also inconsistent with the country's hydrologic reality. It predicates the right to water through ownership of riparian land and thus effectively excludes non-landowners, particularly in rural areas, from having adequate access to water. The government of Namibia is drafting a blueprint for a new Water Act. The draft includes:
-The establishment of a Water Advisory Council as the nation's supreme advisory authority in water resource matters;
-The establishment of units of water resources governance at the river basin level, with broad-based stakeholder representation;
-The creation and regulation of Water Users' Associations for the management of rural water supply services;
-The formation and periodic review of a National Water Master Plan.
Legislation on irrigation in Namibia has been in draft form since 1993. Two main constraints are impeding progress. On the one hand, the government lacks the capacity to draft legislation in line with existing national and neighbouring countries' legislation. On the other hand, massive investment is needed to upgrade existing irrigation scheme infrastructures to levels that users could be expected to assume responsibility for.
The 1995 National Agricultural Policy has the following guidelines relating to irrigation:
-To improve regional irrigation performance through improved economic efficiency;
-To ensure that future irrigation development should be socially and economically viable;
-To minimize direct government intervention and investment in present and future irrigation development, thereby reducing the government's financial burden within the sector. This should not however exclude the government from providing major, general infrastructural investment;
-To create an enabling atmosphere, whereby the non-government sector is encouraged to invest in irrigation development and manage their own operations;
-To establish the principle that the water user, rather than the government, pays for irrigation operation and maintenance;
-To encourage and support development of the informal irrigation sector, bearing in mind the need to limit direct government financial intervention;
-The government to provide sound national planning, monitoring and evaluation of irrigation development;
-To provide sound extension to irrigators, especially smallholders;
-To encourage the participation of women at all levels of the irrigation sector;
-To ensure that future irrigation development is environmentally sustainable;
-To ensure adequate health standards on irrigation schemes;
-To ensure close regional cooperation in future irrigation development.
The 1997 Namibia Water Corporation Act 12 (also known as the NamWater Act) stipulates the objectives of NamWater.
In 1998, the Namibian government launched a major review of water resource management practices, approaches and policies, with the long-term objective of achieving equitable access to, and the sustainable development of, water resources by all sectors of the population.
The National Water Policy was adopted in 2000 and paved the way for the implementation of integrated water resources management.

3. GEOPOLITICAL ASPECTS

Namibia shares the following perennial rivers with five riparian states:
-The Orange River with Botswana, Lesotho and South Africa in the south of the country with a mean annual runoff (MAR) of 11km3 at Noordoewr. The existing agreed abstraction is 70 million m3/yr, and estimated actual abstraction was 36.2 million m3 in 1996 and 48.8 million m3 in 1999.
-The Kunene River with Angola in the north to northwest of the country, with a MAR of 5km3 at Ruacana. The existing agreed abstraction is 185 million m3/yr. Estimated actual abstraction was 51 million m3 in 1996 and 23 million m3 in 1999.
-The Okavango River with Angola and Botswana, with a MAR of 5.5km3 at Rundu and 10km3 at Mukwe. The estimated abstraction at Rundu, without an agreement in place at present, was 27 million m3 in 1996 and 21.5 million m3 in 1999.
-The Kwando River with Angola with a MAR of 1.3km3 at Kongola. Estimated actual abstraction in 1996 was minimal.
-The Zambezi River with Angola, Botswana, Malawi, Mozambique, the United Republic of Tanzania, Zimbabwe and Zambia with a MAR of 40km3 at Katima Mulilo. Estimated abstraction, without an agreement in place at present, was 2.3 million m3 in 1996 and 6.4 million m3 in 1999.
A number of ephemeral rivers, such as the Auob and Nossob, cross into Botswana and South Africa, but their flows are so irregular that their importance as shared surface water sources is not significant. Groundwater flow in eastern Namibia is generally in an eastern direction, but no attempt has been made to quantify this flow and it has not been raised as an issue of shared resources.
Namibia is highly dependent on its neighbouring countries for securing its water supply, particularly South Africa and Angola due to the large portion of the country's population living near or along the banks of the rivers shared with these countries. It is estimated that shared rivers

currently provide around one third of the water consumed in Namibia. Total abstraction from the shared perennial rivers in 1999 was estimated at almost 100 million m3. To ensure good cooperation with its neighbours, Namibia has developed a regulatory framework, facilitates the establishment of Basin Management Committees and is reviewing all agreements signed during pre-colonial and post-colonial times. The process of setting up a structure for dealing with shared water issues is at an advanced stage.

Some of the existing agreements and commissions between Namibia and its neighbours related to shared water resources are:

-The Permanent Joint Technical Commission between Angola and Namibia on the Kunene river basin was established in 1990. Its current major priority is the development of a hydroelectric power scheme on the lower Kunene River.

-The Joint Operating Authority between Angola and Namibia was reinstated in 1990. It deals specifically with the operation of the regulating dam on the Kunene River at Gove (Angola), and with the infrastructure for the Ruacana hydropower station on the same river in Namibia. The power station itself is in Namibia, but part of the infrastructure (diversion weir, intakes) is in Angola.

-The Permanent Okavango River Basin Water Commission (OKACOM) between Angola, Botswana and Namibia was established in 1994 and oversees developments in the Okavango basin.

-The Joint Permanent Water Commission between Botswana and Namibia concerning the development and use of water resources of common interest was established in 1990, after the countries had cooperated on a technical level since the early 1980s. It has jurisdiction over activities in the Kwando-Linyanti-Chobe System in the Zambezi river basin and had jurisdiction over the Okavango River before OKACOM was formed.

-The Permanent Water Commission between Namibia and South Africa was established in 1992 to deal with water matters of mutual concern. Since the re-integration of Walvis Bay into Namibia in 1994, the commission has concentrated its activities on the Orange river basin.

-The Treaty of the Vioolsdrift and Noordoewer Joint Irrigation Scheme between Namibia and South Africa was signed in 1992, establishing a parastatal authority to operate the irrigation project located on both sides of the Orange River at Vioolsdrift and Noordoewer.

Namibia has either signed or ratified numerous international protocols and conventions concerning water, notably those designed to protect the environment, including the Zambezi River System Action Plan, the UN Convention on the Law of the Non-Navigable Uses of International Watercourses, the International Convention on Wetlands (Ramsar) and the Southern African Development Community Protocol on Shared Watercourses. Another multinational agreement with a bearing on water matters is the Southern African Regional Commission for the Conservation and Utilization of the Soil, established in 1948 with Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa and Swaziland as members. One of its components was the Standing Committee for Hydrology.