Water Risk Filter

Country Overview - Germany

Water Indicators

Indicator	Value	Description	Source
Overall Basin Risk (score)	2.52	Overall Basin Risk (score)	
Overall Basin Risk (rank)	124	Overall Basin Risk (rank)	
Physical risk (score)	2.76	Physical risk (score)	
Physical risk (rank)	82	Physical risk (rank)	
Regulatory risk (score)	1.02	Regulatory risk (score)	
Regulatory risk (rank)	195	Regulatory risk (rank)	
Reputation risk (score)	3.29	Reputation risk (score)	
Reputation risk (rank)	29	Reputation risk (rank)	
1. Quantity - Scarcity (score)	1.85	1. Quantity - Scarcity (score)	
1. Quantity - Scarcity (rank)	131	1. Quantity - Scarcity (rank)	
2. Quantity - Flooding (score)	3.31	2. Quantity - Flooding (score)	
2. Quantity - Flooding (rank)	90	2. Quantity - Flooding (rank)	
3. Quality (score)	4.23	3. Quality (score)	
3. Quality (rank)	8	3. Quality (rank)	
4. Ecosystem Service Status (score)	3.35	4. Ecosystem Service Status (score)	
4. Ecosystem Service Status (rank)	26	4. Ecosystem Service Status (rank)	
5. Enabling Environment (Policy & Laws) (score)	1.00	5. Enabling Environment (Policy & Laws) (score)	
5. Enabling Environment (Policy & Laws) (rank)	183	5. Enabling Environment (Policy & Laws) (rank)	
6. Institutions and Governance (score)	1.00	6. Institutions and Governance (score)	
6. Institutions and Governance (rank)	188	6. Institutions and Governance (rank)	
7. Management Instruments (score)	1.09	7. Management Instruments (score)	
7. Management Instruments (rank)	195	7. Management Instruments (rank)	
8 - Infrastructure & Finance (score)	1.00	8 - Infrastructure & Finance (score)	
8 - Infrastructure & Finance (rank)	184	8 - Infrastructure & Finance (rank)	
9. Cultural Diversity (score)	3.00	9. Cultural importance (score)	
9. Cultural Diversity (rank)	60	9. Cultural importance (rank)	
10. Biodiversity Importance (score)	4.45	10. Biodiversity importance (score)	

Indicator	Value	Description	Source
10. Biodiversity Importance (rank)	33	10. Biodiversity importance (rank)	
11. Media Scrutiny (score)	3.55	11. Media Scrutiny (score)	
11. Media Scrutiny (rank)	41	11. Media Scrutiny (rank)	
12. Conflict (score)	2.65	12. Conflict (score)	
12. Conflict (rank)	77	12. Conflict (rank)	
1.0 - Aridity (score)	1.00	The aridity risk indicator is based on the Global Aridity Index (Global-Aridity) and Global Potential Evapo-Transpiration (Global-PET) Geospatial data sets by Trabucco and Zomer (2009). These data sets provide information about the potential availability of water in regions with low water demand, thus they are used in the Water Risk Filter 5.0 to better account for deserts and other arid areas in the risk assessment.	Trabucco, A., & Zomer, R. J. (2009). Global potential evapo-transpiration (Global-PET) and global aridity index (Global-Aridity) geo-database. CGIAR consortium for spatial information.
1.0 - Aridity (rank)	144	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)	1.10	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)	136	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)	2.72	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)	69	World Resources Institute's Baseline Water Stress measures the ratio of total annual water withdrawals to total available annual renewable supply, accounting for upstream consumptive use. A higher percentage indicates more competition among users.	Hofste, R., Kuzma, S., Walker, S., ... & Sutanudjaja, E.H. (2019). Aqueduct 3.0: Updated decision relevant global water risk indicators. Technical note. Washington, DC: World Resources Institute.
1.3 - Blue Water Scarcity (score)	1.36	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)	146	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)	1.56	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. Proceedings of the National Academy of Sciences, 111(9), 3245-3250.
1.4 - Projected Change in Water Discharge (by ~2050) (rank)	127	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)	2.42	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)	99	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)	3.00	This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) . A drought threshold for pre-industrial conditions was calculated based on time-series averages. Results are expressed in terms of relative change (%) in probability between pre-industrial and 2°C scenarios.	Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming–simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development.
1.6 - Projected Change in Drought Occurrence (by ~2050) (rank)	117	This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) . A drought threshold for pre-industrial conditions was calculated based on time-series averages. Results are expressed in terms of relative change (%) in probability between pre-industrial and 2°C scenarios.	Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming–simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development.
2.1 - Estimated Flood Occurrence (score)	3.37	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)	89	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)	2.15	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)	106	This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). The magnitude of the flood event was defined based on 100-year return period for pre-industrial conditions. Results are expressed in terms of change (%) in probability between pre-industrial and 2°C scenarios.	Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming–simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development.
3.1 - Surface Water Contamination Index (score)	4.23	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)	8	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)	3.85	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)	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.
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (score)	2.10	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)	88	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)	2.52	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)	91	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)	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)	178	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	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)	170	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)	1.00	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)	182	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)	1.00	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)	184	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)	158	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)	172	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)	1.00	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)	175	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)	172	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)	1.61	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)	191	The density of monitoring stations for water quantity was applied as proxy to develop this risk indicator. The Global Runoff Data Base was used to estimate the number of monitoring stations per 1000km2 of the main river system (data base access date: May 2018).	BfG (2019). Global Runoff Data Base. German Federal Institute of Hydrology (BfG).
8.1 - Access to Safe Drinking Water (score)	1.00	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017.	WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.
8.1 - Access to Safe Drinking Water (rank)	143	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017.	WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.
8.2 - Access to Sanitation (score)	1.00	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017.	WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.

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Indicator	Value	Description	Source
8.2 - Access to Sanitation (rank)	160	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017.	WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.
8.3 - Financing for Water Resource Development and Management (SDG 6.5.1) (score)	1.00	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)	182	This risk indicator is based on the average 'Financing' score of UN SDG 6.5.1. Degree of IWRM Implementation database. UN SDG 6.5.1 database contains a category on financing which assesses different aspects related to budgeting and financing made available and used for water resources development and management from various sources.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
9.1 - Cultural Diversity (score)	3.00	Water is a social and cultural good. The cultural diversity risk indicator was included in order to acknowledge that businesses face reputational risk due to the importance of freshwater for indigenous and traditional people in their daily life, religion and culture. This risk indicator is based on Oviedo and Larsen (2000) data set, which mapped the world's ethnolinguistic groups onto the WWF map of the world's ecoregions. This cross-mapping showed for the very first time the significant overlap that exists between the global geographic distribution of biodiversity and that of linguistic diversity.	Oviedo, G., Maffi, L., & Larsen, P. B. (2000). Indigenous and traditional peoples of the world and ecoregion conservation: An integrated approach to conserving the world's biological and cultural diversity. Gland: WWF (World Wide Fund for Nature) International.
9.1 - Cultural Diversity (rank)	60	Water is a social and cultural good. The cultural diversity risk indicator was included in order to acknowledge that businesses face reputational risk due to the importance of freshwater for indigenous and traditional people in their daily life, religion and culture. This risk indicator is based on Oviedo and Larsen (2000) data set, which mapped the world's ethnolinguistic groups onto the WWF map of the world's ecoregions. This cross-mapping showed for the very first time the significant overlap that exists between the global geographic distribution of biodiversity and that of linguistic diversity.	Oviedo, G., Maffi, L., & Larsen, P. B. (2000). Indigenous and traditional peoples of the world and ecoregion conservation: An integrated approach to conserving the world's biological and cultural diversity. Gland: WWF (World Wide Fund for Nature) International.
10.1 - Freshwater Endemism (score)	4.95	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Companies operating in basins with higher number of endemic fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.

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Indicator	Value	Description	Source
10.1 - Freshwater Endemism (rank)	34	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Companies operating in basins with higher number of endemic fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.
10.2 - Freshwater Biodiversity Richness (score)	3.94	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)	71	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 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)	49	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)	61	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)

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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)	43	This risk indicator is based on 2018 data collected by RepRisk on counts and registers of documented negative incidents, criticism and controversies that can affect a company's reputational risk. These negative news events are labelled per country and industry class.	RepRisk & WWF (2019). Due diligence database on ESG and business conduct risks. RepRisk.
12.2 - Hydro-political Risk (score)	1.31	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)	174	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 (#)	82667685	Population, total	The World Bank 2018, Data , hompage accessed 20/04/2018
GDP (current US$)	3477796274497	GDP (current US$)	The World Bank 2018, Data , hompage accessed 20/04/2018
EPI 2018 score (0-100)	78.37	Environmental Performance Index	
WGI -Voice and Accountability (0-100)	70.95	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132

Indicator	Value	Description	Source
WGI -Political stability no violence (0-100)	94.58	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)	94.23	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)	96.15	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)	91.35	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)	93.75	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132

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Indicator	Value	Description	Source
WRI BWS all industries (0-5)	1.90	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)	85	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)	79	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)	80	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)	79	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.

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Indicator	Value	Description	Source
Baseline Water Stress (BWS) - 2030 BAU (increasing rank describes lower risk)	80	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)	79	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)	79	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)	85	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)	80	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)	86	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.

Indicator	Value	Description	Source
Total water footprint of national consumption (m3/a/cap)	1426.26	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 (%)	68.76	WFN Water Footprint Data	Mekonnen, M.M. and Hoekstra, A.Y. (2011) National water footprint accounts: The green, blue and grey water footprint of production and consumption, Value of Water Research Report Series No. 50, UNESCO-IHE, Delft, the Netherlands.http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf
Area equipped for full control irrigation: total (1000 ha)	639.00	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)	639.00	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 (%)	58.34	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)	2.94	World Development Indicators	The World Bank 2018, Data , hompage accessed 20/04/2018
Total internal renewable water resources (IRWR) (10^9 m3/year)	107.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Total internal renewable water resources (IRWR) (10^9 m3/year)	47.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Water resources: total external renewable (10^9 m3/year)	107.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13

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Indicator	Value	Description	Source
Total renewable water resources (10^9 m3/year)	154.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Dependency ratio (%)	30.52	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)	1909.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
World happiness [0-8]	6.96	WorldHappinessReport.org	World Happiness Report, homepage accessed 20/04/2018

Country Aspects

1. PHYSICAL ASPECTS

1.1. WATER RESOURCES

1.1.1. WATER RESOURCES

According to FAO (AQUASTAT) data water resources in Germany are as follows:

Internal Renewable Water Resources (IRWR),1977-2001 (km3)	
Surface water produced internally	106
Groundwater recharge	46
Overlap (shared by groundwater and surface water)	45
Total internal renewable water resources	107
Per capita IRWR, 2001 (m3)	1,305
Natural Renewable Water Resources	
Total, 1977-2001 (km3)	154
Per capita, 2002 (m3 per person)	1,878
Annual River Flows:	
From other countries (km3)	71
To other countries (km3)	x

According to Umweltbundesamt 2011 (Wasserwirtschaft Deutschland) based on data 2007 some of the figures are slightly different, though per capita renewable water resources are considered higher.

Internal Renewable Water Resources (IRWR), 2007 (km3)		Average
Surface water produced internally	120	
Groundwater recharge	11	
Overlap (shared by groundwater and surface water)	45	
Total internal renewable water resources	135	
Per capita IRWR, 2001 (m3)	1652	
Natural Renewable Water Resources		
2007 (km3)	202	188
Per capita, 2007 (m3 per person)	2,472	2,292
Annual River Flows:		
From other countries (km3)	67	
To other countries (km3)	x	

The most important rivers of Germany are:
-flowing into the Baltic Sea: Oder
-flowing into the Black Sea: Danube (and its main tributaries Inn, Isar, and Lech)
-flowing into the North Sea: Rhine (and its main tributaries Moselle, Main and Neckar), Weser and Elbe (and its main tributaries Havel and Saale)

The Oder River is 854km long: 112 in the Czech Republic, 742 in Poland (including 187 on the border between Germany and Poland) and is the second longest river in Poland (after the Vistula). It drains 118,861km² of watershed, 106,056 of which are in Poland (89 per cent), 7,217 in the Czech Republic (6 per cent), and 5,587 in Germany (5 per cent). Channels connect it to the Havel, Spree, Vistula system and Kłodnica. It flows through Silesian, Opole, Lower Silesian, Lubusz, and West Pomeranian voivodeships of Poland and the states of Brandenburg and Mecklenburg-Vorpommern in Germany.

The Danube River is Europe's second longest river after the Volga. It is notable for being classified as an international waterway. In addition to the bordering countries (see above), the drainage basin includes parts of nine more countries: Italy (0.15 per cent), Poland (0.09 per cent), Switzerland (0.32 per cent), the Czech Republic (2.5 per cent), Slovenia (2.2 per cent), Bosnia and Herzegovina (4.8 per cent), the Republic of Macedonia, and Albania (0.03 per cent). The highest point of the drainage basin is the summit of Piz Bernina at the Italy–Switzerland border, 4,049m.

The River Rhine flows from the Swiss Alps to the Netherlands, and is one of the longest and most important rivers in Europe, at about 1,232km, with an average discharge of more than 2,000m3/s.

The Rhine is the longest river in Germany. It is here that the Rhine encounters some of its main tributaries, such as the Neckar, the Main and, later, the Moselle, which contributes an average discharge of more than 300m3/s. Northeastern France drains to the Rhine via the Moselle; smaller rivers drain the Vosges and Jura mountains and uplands. Most of Luxembourg and a very small part of Belgium also drain to the Rhine via the Moselle. It approaches the Dutch border and the Rhine has an annual mean discharge of 2,290m3/s and an average width of 400m.

1.1.2. WATER USE

Water in Germany is abundant. The total annual water reserve amounts to 188 billion m3. Only 19 per cent of these resources are actually used by the different users. The water utilities use 5.4 billion m3 per year, which accounts for only 2.9 per cent of the available resources. 22 billion m3 or 12 per cent go to thermal power plants for public supply and 7.7 billion m3 or 4.1 per cent to mining and manufacturing. More than 152 billion m3 or 81 per cent of all resources remain unused.
According to FAO (AQUASTAT) data from 1991, water withdrawals in Germany have been stated as:

Water withdrawals	
Year of withdrawal data	1991
Total withdrawals (km3)	46
Withdrawals per capita (m3)	579
Withdrawals (as a percentage of actual)	
Renewable water resources	31 per cent
Withdrawals by sector (as a percentage of total)	
Agriculture	20 per cent
Industry	69 per cent
Domestic	11 per cent

According to BMU 2011 (Wasserwirtschaft Deutschland) based on data 2007 the withdrawals are much lower and the role of agriculture is negligible in terms of water abstraction.

Water withdrawals	
Year of withdrawal data	2007
Total withdrawals (km3)	32
Withdrawals per capita (m3)	392
Withdrawals (as a percentage of actual)	
Renewable water resources	‹ 17 per cent
Withdrawals by sector (as a percentage of total)	
Agriculture	1 per cent
Industry	84 per cent
Domestic	11 per cent

1Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (2011): Wasserwirtschaft in Deutschland – Wasserversorgung – Abwasserbeseitigung
About 80 per cent of public water use is accounted for by residential and small commercial users. The remainder is accounted for by industries supplied from public water systems (14 per cent) and other users (6 per cent).
Residential and small commercial water use is the second lowest among 14 European countries and only a fraction of what it is in North America. Despite forecasts about increasing per capita water use, use actually declined from 145 litre/capita/day in 1990 to only 122 litre/capita/day in 2007.
Low water consumption has had some negative operational, health and even environmental impacts. On the operational side, sewers have to be flushed occasionally with injected drinking water in order to prevent stagnation of raw sewage. On the health side, there are concerns about potable water contamination due to low flows. On the environmental side, in some cities such as Berlin water tables are rising and cause damage to the foundations of buildings because of decreased pumping of groundwater by utilities.
The sources of public water supply are as follows:
-65 per cent from groundwater
-9 per cent from springs
-5 per cent from bank filtration, i.e. from wells close to rivers and lakes, drawing essentially surface water
-21 per cent directly from surface water
With a share of 65 per cent, groundwater is the most important resource for drinking water abstraction. Another 9 per cent of water abstraction in public water supply is springwater and 26 per cent comes from surface water. From 1990 to 2004, the water delivery volume of the public water supply has declined from almost 6 to 4.7 billion m3, i.e. by approximately 22 per cent.

1.2. WATER QUALITY, ECOSYSTEMS AND HUMAN HEALTH

One of the major constraints with respect to freshwater is the pollution of groundwater caused by nitrates from agricultural sources. The biological water quality of rivers has continuously improved since 1975 in the old federal states in the west and since 1990 in the new federal states in the east.
The quality objective of moderate or less pollution has been reached on about 45 per cent of the river stretches. Only 9 per cent of the stretches were severely or excessively polluted in 1995. Among hazardous substances, pollution with heavy metals (from agricultural soil erosion and urban storm waters) and pesticides (from agriculture) is still problematic.
The intensive use of rivers for shipping and energy supply as well as the maintenance of brooks in agricultural areas created an unnatural river morphology lacking in ecologically sound living areas for water organisms.
A comparative study of environmental pollution caused by private consumption in households over the past 10 years has shown reduction in water consumption (-8.5 per cent) and waste water (-4.5 per cent). Water quality control measures have significantly reduced the pollution of nature in

Germany in recent years.

2. GOVERNANCE ASPECTS

2.1. WATER INSTITUTIONS

The Federal government consists of the Federal Chancellor and the Federal Ministries, the former determining the general policy guidelines.

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety deals with basic questions of water resources management as well as with transboundary cooperation in this field. It is responsible, inter alia, for the Federal Water Act and the Wastewater Charges Act. The revenue from wastewater charges is earmarked for measures that prevent water pollution. The Ministry is also responsible for provisions of the European Union.

The most important partners of the Federal Environment Ministry are the Federal Ministry of Consumer Protection, Food and Agriculture; the Federal Ministry for Health; the Federal Ministry of Transport, Building and Housing; the Federal Ministry of Education and Research; the Federal Ministry for Economic Cooperation and Development; and the Federal Ministry of Economics and Labour. Cooperation takes place at Federal, state and district levels.

The Federal Environment Ministry is assisted by other Federal authorities and research institutions, including the Federal Environmental Agency in Berlin, the Federal Agency for Nature Conservation in Bonn and the Federal Office for Radiation Protection in Salzgitter, all of which report to the Federal Environment Ministry. In addition, the Federal Institute for Hydrology at Koblenz, the Federal Institute for Navigation and Hydrography in Hamburg, the Federal Institute for Waterway Engineering in Karlsruhe and the German Meteorological Service in Offenbach report to the Federal Ministry of Transport, Building and Housing. The Federal Institute for Geosciences and Natural Resources in Hanover reports to the Federal Ministry of Economics and Labour. The Federal Biological Research Centre for Agriculture and Forestry (BBA) and the Federal Agricultural Research Centre (FAL) report to the Federal Ministry of Consumer Protection, Food and Agriculture. There are national as well as European (EC) regulations affecting water resource management issues.

2.2. WATER MANAGEMENT

The general principle of German water policy is to manage water in such a manner that the common good is served and that every avoidable harmful impact is prevented.

Methods of good agricultural practice are seen as being essential for environmentally sound and resource-efficient production methods. But it should be kept in mind that profitability is essential for staying in business and complying with responsibilities in terms of sustainable development. In the interests of supporting efficient, competitive, market-oriented and environmentally sound agriculture and forestry, Germany promotes, for example, attempts to overcome structural deficits, the use of farmland for non-food renewable commodities and methods of good agricultural practice, sustainable forest management and organic farming. Furthermore, programmes have been launched to foster the economic and social development of disadvantaged rural areas, especially those located in the eastern part of Germany, through improved infrastructure, promotion of economically viable farms, job procurement schemes and farm-income combinations, e.g. direct marketing, rural tourism, off-farm employment opportunities.

Under the new European scenario, management of water resources is a social function which finds material form in the orderly carrying out of the activities required for the fair and sustainable use of water. Management always relates to the territory in which plans, programmes and actions to rationalise demand are executed, promoting savings and economic, social and environmental efficiency in the different uses of water by means of the utilisation of water resources in accordance with the forecasts contained in general economic planning.

In water resource management in the European Union, the following characteristics are noteworthy: rationality, proximity to users, integrated management, prior planning and public participation.

The Water Framework Directive prescribes that management activities should aim to achieve the goals of the Directive within geographical areas or river basin districts (RBDs). These are based largely on surface water catchments, together with the boundaries of associated groundwater and coastal water bodies.

For each river basin district, a river basin planning process must be set up. The first milestone of this planning process (analysis, monitoring, objective-setting and consideration of measures to maintain or improve water status) is the initial river basin management plan (RBMP).

These RBMPs should be made available for information and consultation by the public. The RBMP will:

-record the current status of water bodies within the river basin district;

-set out the measures planned to meet the objectives;

-act as the main reporting mechanism to the Commission and the public.

The whole process of river basin management planning includes the preparation of programmes of measures at basin level for achieving the environmental objectives of the Water Framework Directive cost-effectively. Basic measures include control of pollution at source through the setting of emission limit values as well as through the setting of environmental quality standards. The use of economic instruments, such as water pricing, is part of the basic measures. Here, in particular, the 'polluter pays' principle should be taken into account. The Directive aims to ensure that pricing policies improve the sustainable use of water resources.

The planning, implementation and evaluation of the programme of measures is an iterative process that will probably include the RBMP of the first (2009), second (2015) or further cycles (2021, 2027).

2.3. WATER POLICY AND LEGAL FRAMEWORK

The legal framework in Germany concerning water resources management and protection is defined by European legislation, national legislation and the water law of the federal states.

The Treaty establishing the European Community (EC) provides the basis for the regulations governing water within its territory. Title XIX thereto, on the environment, refers to natural resources, one of which is water, and is made up of three articles of a markedly protective nature. Article 175.2.b) grants the Council the power to adopt, on a proposal from the Commission and acting unanimously, measures affecting the quantitative management of water resources, after consulting the European Parliament, the Economic and Social Committee and the Committee of the Regions.
The European Water Framework Directive is the first large-scale regulatory outcome of the Treaty establishing the European Community covering water resources. This regulation codifies and unifies other Community directives related to this resource.
The Directive also provides a regulatory umbrella for all the other Community rules which govern different aspects of the management and use of water in the European Union. These include, but are not limited to, the following:
-Directive 75/440/EEC, concerning the quality required of surface water intended for the abstraction of drinking water in the Member States.
-Directive 91/271/EEC, concerning urban wastewater treatment.
-Directive 91/676/EEC, concerning the protection of waters against pollution caused by nitrates from agricultural sources.
-Directive 96/61/EC, concerning integrated pollution prevention and control.
-Directive 2006/7/EC of the European Parliament and of the Council, concerning the management of bathing water quality.
-Directive 2006/44/EC of the European Parliament and of the Council on the quality of fresh waters needing protection or improvement in order to support fish life.
-Directive 2006/113/EC of the European Parliament and of the Council, of 12 December 2006, on the quality required of shellfish waters.
-Directive 2006/118/EC of the European Parliament and of the Council, of 12 December 2006, on the protection of groundwater against pollution and deterioration developed in response to the requirements of Article 17 of the Water Framework Directive with regard to the adoption of specific measures to prevent and control groundwater contamination. It has been given the function of ensuring the continuity of the protection provided by Directive 80/68/EEC and modifications thereto, incorporating transitional measures that will govern the application of said system until its expiration, due to repeal, on 22 December 2013. These measures affect, in the main, authorisation procedures for the disposal of substances in Lists I and II, from 16 January 2009 to 22 December 2013.
-Directive 2007/60/EC of the European Parliament and of the Council, of 23 October 2007, on the assessment and management of flood risks.
European Union water law is made up, principally, of the regulations issued by EU bodies and by those belonging to the national law of each of the Member States.
As determined by the basic law in Germany, in the field of water policy the Federal government only has the right to enact general provisions (framework competence). Freshwater-related issues are to be decided, in principle, by state authorities or institutions. However, the principal national framework is laid out by the Federal Water Act (Wasserhaushaltsgesetz), which has been updated to implement the EC Water Framework Directive.
With the Federal Law in the first place the Federal Water Act (Wasserhaushaltsgesetz WHG) of 1957 is to be mentioned, last amended on 31 July 2009, which as basic national framework legislation meets fundamental regulations for water management with respect to water quantity and water quality.
The Federal Water Act requires sustainable management of water bodies with the goal to improve their function and efficiency with respect to public welfare as well as in conformity with the interest of particular water users (see § 6 WHG).
Waters uses like the withdrawal of water or an introducing of materials require a permission or a grant according to the WHG. The permission stands in principle in the discretion of the responsible water authority. This discretion is limited in certain cases for the sake of the protection of water bodies. So a permission may be given to the sewage inlet only if it fulfills certain minimum requirements, which correspond to the state of the art (see § 57 WHG). The minimum requirements are made more concrete in the federal waste water regulation.
The appointment of water protection zones is another important instrument of the Federal Water Act. Beside this a number of planning instruments is existing, i.e. sewage disposal plans, pure retaining orders, water management plans and water framework plans.
In some federal states, charges for the abstraction of ground and surface water are levied, the so-called “Water Cent”. In addition, the municipalities in the context of their statute sovereignty can levy charges on the water supply and sewage disposal and issue supplementary regulations for disposal into their sewage systems.
The Sewage Charges Law of 1976 (Abwasserabgabengesetz AbwAG), last amended in 2005, plans that for the direct introduction of waste water into a water body an effluent charge has to be paid. This was the first environmental protection tax in Germany which brought the polluter pays principle to application, since the producer of sewage must compensate at least a part of the external costs that are caused by the pollution of the environmental medium water. The charge rate depends on the quantity and the injurious character of certain introductory materials. The charge per unit was increased from DM12 in the year 1981 in several steps up to DM70 since 01.01.1997 (converted to € 35.79 since the beginning of 2002). The sewage charge should create economic incentives to reduce sewage as much as possible. Therefore the Sewage Charges Law allows charge reductions if the polluter fulfills certain minimum requirements for sewage treatment. In addition certain investments costs for the improvement of waste water treatment can be subtracted from the payments.
The sewage charge is to be paid to the federal states and the revenue is exclusively used for the financing of measures for the preservation and the improvement of water quality.
The Federal State Working Group Water (LAWA), which was established in order to harmonize Federal State water laws, is made up of the superior water authorities. The Federal States have also formed working groups for co-ordination in the management of river basins.

3. GEOPOLITICAL ASPECTS

The International Commission for the Protection of the Danube River (ICPDR) is an organization consisting of 14 member states (Germany, Austria, the Czech Republic, Slovakia, Slovenia, Hungary, Croatia, Bosnia and Herzegovina, Serbia, Bulgaria, Romania, Moldova, Montenegro and Ukraine) and the European Union. The Commission, established in 1998, deals with the whole Danube River Basin, which includes tributaries and the groundwater resources. Its goal is to implement the Danube River Protection Convention by promoting and coordinating sustainable and equitable water management, including conservation, improvement and rational use of waters.

To achieve good water status in the water bodies of the Danube region by 2015 (and beyond) and to ensure a sufficient supply of clean water for future generations, the contracting parties to the DRPC nominated the ICPDR as the co-ordination body for the development of a comprehensive management plan for the entire Danube River Basin using the principles of the EU Water Framework Directive.

The International Commission for the Protection of the Elbe River Agreement was signed in Magdeburg on October 8, 1990. Principal objectives of the Commission are:

-making the use of water possible, especially promoting the retrieval of drinking water via river bank infiltration and enabling agriculture to utilise the water and the sediments;

-achieving the most natural ecosystem possible; one that can provide for healthy species population;

-a permanent strategy to decrease the burden imposed on the North Sea by the Elbe River basin.

In September 2005, after considering the priorities, the new structure of the ICPER was approved. The structure consists of three work groups: (i) Implementation of the EU Water Framework Directive in the Elbe River basin (WFD); (ii) Flood protection (FP); (iii) Accidental water pollution (H).

The International Commission for the Protection of the Rhine (ICPR). Nine states and regions in the Rhine watershed closely co-operate in order to harmonize the many interests of use and protection in the Rhine area. Focal points of work are sustainable development of the Rhine, its alluvial areas and the good state of all waters in the watershed.

At the Conference of Rhine Ministers 2007 the ministers and the representative of the European Commission confirmed that the partly competing interests of uses and the protection of Rhine ecosystems must be harmonized. Water in the watershed serves navigation as well as leisure activities and is used as drinking water, cooling water and industrial water and for energy production. Therefore, water and flood protection must be even more integrated into other areas of policy, such as agriculture, traffic, spatial planning and tourism.

There is an urgent need for action above all in the fields of flood prevention and ecosystem improvement, as effects of climate change are liable to increase existing water management problems. Above all, pollutant and nitrogen inputs mainly of diffuse origin, such as agriculture and micro-pollutions from urban wastewater, must be further reduced so as to avoid putting human health, the ecosystem or its uses at a risk. On 18 October 2007 the Conference of Rhine Ministers staged in Bonn decided:

-to draft a common strategy in order to adequately meet the challenge of micro-pollutions (certain pharmaceuticals, household chemicals, etc.);

-to draft an “Overall strategy for sediment management of the Rhine”;

-to draft a “Master Plan Migratory Fish Rhine” by the end of 2009; first steps to implement by 2015 will be to improve upstream fish migration into the Rhine system via the floodgates of the Haringvliet and to construct a fish passage at the Strasbourg barrage;

-within the timely implementation of the Action Plan on Floods and taking into account effects of climate change, to look into all realistic possibilities of creating additional retention areas aimed at reducing extreme water tables and flood damage;

-to jointly develop adapting strategies for water management in the Rhine watershed in order to be able to cope with the challenges of climate change.

The International Commission of the Meuse (ICD) was established in 2002 by the signing of the International Agreement on the Meuse (Treaty of Ghent). The objective of the agreement is to achieve a sustainable and integrated water basin district of the Meuse. The Agreement was signed by the Walloon Region, the Netherlands, France, Germany, the Flemish Region, the Brussels-Capital, Belgium and Luxembourg and entered into force on 1 December 2006. ICD's main tasks are:

-Co-ordinating the obligations of the European Framework Directive on Water,

-Co-ordinating the obligations of the EU Directive on the assessment and management of flood risks; and

-To provide advice and recommendations to the parties for the prevention and fight against accidental pollution (warning and alarm).

The Commission has an agenda and meets once a year. For the preparation, the ICD has five permanent working groups and different groups of temporary projects.

The Moselle Commission is a public institution whose head office is based in Trier. With the competent authorities, the Moselle Commission assumes the role of provider and represents interests in the Greater Region Saar-Lor-Lux as well as ports and shipping.