Global Basin Risk Indicators - Descriptions, Sources and Links

Risk type	Risk category	#	Risk indicator	Description	Source	Link
Physical Risk	**1. Water Scarcity**	**1.0**	Aridity Index	The Global Aridity Index is a global climate data for the 1970-2000 period, related to evapotranspiration processes and rainfall deficit for potential vegetative growth, based on the implementation of a Penman-Montieth Reference Evapotranspiration (ET0) equation. It provides information about the potential availability of water in regions with low water demand, thus they are used to account for deserts and other arid areas in risk assessments.	Trabucco, A., & Zomer, R. Global Aridity Index and Potential Evapotranspiration (ET0) Climate Database v2. figshare. Fileset (2019). https://doi. org/10.6084/m9. figshare, 7504448, v3.	https://cgiarcsi.community/2019/01/24/global-aridity-index-and-potential-evapotranspiration-climate-database-v2/
		1.1	Water Depletion	Water depletion measures the ratio of surface and ground water consumptive use to available renewable water. This indicator is based on model outputs from WaterGAP3 to compute average annual and monthly values, for the period 1971-2000, and to map seasonal depletion and dry-year depletion.	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.	http://www.earthstat.org/water-depletion-watergap3-basins/
		1.2	Baseline Water Stress	Baseline water stress measures the ratio of total surface and groundwater withdrawals to available renewable water. This indicator is based on model outputs from PCR-GLOBWB 2 to compute average monthly values, for the period 1960-2014, then to produce regression values for the year 2014 (baseline). Note that, although this indicator is called “water stress”, it does not explicitly take into account environmental flow requirements, water quality, or access to water.	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.	https://www.wri.org/resources/data-sets/aqueduct-global-maps-30-data
		1.3	Blue Water Scarcity	Blue water scarcity measures the ratio of the blue water footprint to the total blue water availability. This indicator is based on the global standard for water footprint assessment to compute average monthly values (10-year average for the period 1996-2005).	Mekonnen, M. M., & Hoekstra, A. Y. (2016). Four billion people facing severe water scarcity. Science advances, 2(2), e1500323.	https://waterfootprint.org/en/resources/waterstat/water-scarcity-statistics/

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		1.4	Available Water Remaining (AWARE)	Available Water Remaining (AWARE) measures the available water remaining in a given river basin relative to the world average, after human and aquatic ecosystem demands have been met. This indicator is based on the Water Use in Life Cycle Assessment (WULCA) to quantify the potential of water deprivation to either humans or ecosystems (for the year 2010) and serves in calculating the impact score of water consumption in Life Cycle Assessments or to calculate a water scarcity footprint as per ISO 14046.	Boulay, A. M., Bare, J., Benini, L., Berger, M., Lathuillière, M. J., Manzardo, A., ... & Ridoutt, B. (2018). The WULCA consensus characterization model for water scarcity footprints: assessing impacts of water consumption based on available water remaining (AWARE). The International Journal of Life Cycle Assessment, 23(2), 368-378.	https://wulca-waterlca.org/aware/
		1.5	Drought Frequency Probability	The Standardized Precipitation and Evaporation Index (SPEI) is a 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. This risk indicator was computed using the monthly time series of the SPEI 36-month time scale and applying the relative frequency approach – the ratio of the number of months when index is below or equal to events of moderate magnitude (SPEI <= -1) to the total number of possible outcomes, considering the last 10 years (August 2011 – July 2021) as reference period.	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.	https://spei.csic.es/index.html
		1.6	Projected Change in Drought Occurrence	This risk indicator is based on a multi-model simulation that applies both global climate and hydrological models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). The 2.5th percentile of soil moisture is calculated for pre-industrial conditions (1661-1860), and defined as the drought threshold. Then years are counted in which soil moisture falls below this threshold for at least 7 consecutive months, and it is estimated the probability that an event of at least this magnitude occurs in a given year. Results are expressed in terms of percentage change in probability between pre-industrial and the time that the average global temperature reach 2°C warming (around the year 2050, based on RCPs 2.6 and 6.0).	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.	https://www.geosci-model-dev.net/10/4321/2017/
	2. Flooding	**2.1**	Estimated Flood Occurrence	This risk indicator is based on empirical evidence of large flood events since 1985 to present, registered by the Dartmouth Flood Observatory's Global Active Archive of Large Flood Events. It includes floods due to overflowing rivers, lakes, or oceans; caused by heavy rainfall, rapid snowmelt, dams or levees break, or storm surge from tropical cyclones or tsunami in coastal areas. The data is derived from a wide variety of news, governmental, instrumental, and remote sensing sources.	Brakenridge, G. R. (2021). Global active archive of large flood events. Dartmouth Flood Observatory, University of Colorado.	http://floodobservatory.colorado.edu/Archives/index.html
		2.2	Projected Change in Flood Occurrence	This risk indicator is based on a multi-model simulation that applies both global climate and hydrological models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP), and subsequent flood modeling with the global inundation model CaMa-Flood. The 100-year discharge is calculated for pre-industrial conditions (1661-1860), and defined as the flood threshold. Then years are counted in which occurs a 100-year discharge or greater, and it is estimated the probability that an event of at least this magnitude occurs in a given year. Results are expressed in terms of percentage change in probability between pre-industrial and the time that the average global temperature reach 2°C warming (around the year 2050, based on RCPs	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.	https://www.geosci-model-dev.net/10/4321/2017/

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				2.6 and 6.0).		
	3. Water Quality	**3.1**	Surface Water Quality Index	The Surface Water Quality Index is based on a combination of monitoring data and a Machine Learning prediction model. It comprises three water quality parameters with well documented direct and indirect negative effects on water security for both humans and freshwater biodiversity, which are aligned to the Sustainable Development Goal (SDG) 6.3.2: biological oxygen demand (BOD) as a widely used umbrella proxy for overall water quality; electrical conductivity (EC) as proxy for salinity balance and pH alteration; and nitrogen, to capture nutrient loading in water bodies.	Damania, R., Desbureaux, S., Rodella, A. S., Russ, J., & Zaveri, E. (2019). Quality unknown: The invisible water crisis. The World Bank.	https://openknowledge.worldbank.org/handle/10986/32245
		3.1.1	BOD	Biological oxygen demand (BOD) is a widely used umbrella proxy for overall water quality. This risk sub-indicator is based on predictions of biological oxygen demand in rivers, as an annual average.	Damania, R., Desbureaux, S., Rodella, A. S., Russ, J., & Zaveri, E. (2019). Quality unknown: The invisible water crisis. The World Bank.	https://openknowledge.worldbank.org/handle/10986/32245
		3.1.2	Electrical Conductivity	Electrical conductivity (EC) is a proxy for salinity balance and pH alteration. This risk sub-indicator is based on predictions of electrical conductivity in rivers, as an annual average.	Damania, R., Desbureaux, S., Rodella, A. S., Russ, J., & Zaveri, E. (2019). Quality unknown: The invisible water crisis. The World Bank.	https://openknowledge.worldbank.org/handle/10986/32245
		3.1.3	Nitrogen	Nitrogen (N) is a proxy for nutrient loading in water bodies. This risk sub-indicator is based on predictions of nitrogen (nitrate/nitrite) in rivers, as an annual average.	Damania, R., Desbureaux, S., Rodella, A. S., Russ, J., & Zaveri, E. (2019). Quality unknown: The invisible water crisis. The World Bank.	https://openknowledge.worldbank.org/handle/10986/32245
	4. Ecosystem Services Status	**4.1**	Fragmentation Status of Rivers	The mapping world's free-flowing rivers is a compilation of 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). This indicator uses the CSI to calculate the percentage of the river basins' volume considered as fragmented (CSI < 95%).	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.	https://figshare.com/articles/Mapping_the_world_s_free-flowing_rivers_data_set_and_technical_documentation/7688801
		4.2	Catchment Ecosystem Services Degradation Level	This risk indicator is based on the forest cover data as a proxy to represent catchment ecosystem services degradation, as forests play an essential role in terms of water regulation, supply and pollution control. It calculates the percentage of tree cover loss within river basins during the period 2000-2020.	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.	https://glad.earthengine.app/view/global-forest-change
		4.3	Projected Impacts on Freshwater Biodiversity	This risk indicator is based on project changes [% increase or decrease] in freshwater fish extinction rate by ~2090 due to climate-related decrease in water availability, as a proxy to estimate the projected impacts of climate change 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	http://atlas.freshwaterbiodiversity.eu/atlasApp/full/?map=3.2.1-fish-extinction-rates-climate-change

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					rates. Journal of Applied Ecology, 50(5), 1105-1115.	
Regulatory Risk	**5. Enabling Environment**	**5.1**	Freshwater Policy Status (SDG 6.5.1)	This risk indicator is based on SDG 6.5.1. Degree of Integrated Water Resource Management (IWRM) Implementation "National Water Resources Policy" 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.	UNEP & UNEP-DHI (2021). SDG Indicator 6.5.1 database for reporting year 2020 (second round of reporting on indicator).	http://iwrmdataportal.unepdhi.org/
		5.2	Freshwater Law Status (SDG 6.5.1)	This risk indicator is based on SDG 6.5.1. Degree of Integrated Water Resource Management (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.	UNEP & UNEP-DHI (2021). SDG Indicator 6.5.1 database for reporting year 2020 (second round of reporting on indicator).	http://iwrmdataportal.unepdhi.org/
		5.3	Implementation Status of Water Management Plans (SDG 6.5.1)	This risk indicator is based on SDG 6.5.1. Degree of Integrated Water Resource Management (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.	UNEP & UNEP-DHI (2021). SDG Indicator 6.5.1 database for reporting year 2020 (second round of reporting on indicator).	http://iwrmdataportal.unepdhi.org/
	6. Institutions & Governance	**6.1**	Corruption Perceptions Index	This risk indicator is based on the latest Transparency International's data: the Corruption Perceptions Index 2020. This index aggregates data from different sources that provide perceptions of business people and country experts on the level of corruption in the public sector.	Transparency International (2021). Corruption Perceptions Index 2020. Berlin: Transparency International.	https://images.transparencycdn.org/images/CPI2020_Report_EN_0802-WEB-1_2021-02-08-103053.pdf
		6.2	Freedom in the World Index	This risk indicator is based the latest Freedom House's data: the Freedom in the World 2021, 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 2021 edition involved more than 125 analysts and nearly 40 advisers with global, regional, and issue-based expertise to covers developments in 195 countries and 15 territories from January 1, 2020, through December 31, 2020.	Freedom House (2021). Freedom in the world 2021. Washington, DC: Freedom House.	https://freedomhouse.org/sites/default/files/2021-02/FIW2021_World_02252021_FINAL-web-upload.pdf
		6.3	Business Participation in Water Management (SDG 6.5.1)	This risk indicator is based on SDG 6.5.1. Degree of Integrated Water Resource Management (IWRM) Implementation "Private Sector 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.	UNEP & UNEP-DHI (2021). SDG Indicator 6.5.1 database for reporting year 2020 (second round of reporting on indicator).	http://iwrmdataportal.unepdhi.org/
	7. Management Instruments	**7.1**	Management Instruments for Water	This risk indicator is based on SDG 6.5.1. Degree of Integrated Water Resource Management (IWRM) Implementation "Sustainable and efficient water use management" indicator, which corresponds to one of the five national level indicators under the Management Instruments category.	UNEP & UNEP-DHI (2021). SDG Indicator 6.5.1 database for reporting year 2020 (second round of reporting on indicator).	http://iwrmdataportal.unepdhi.org/

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			Management (SDG 6.5.1)	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.		
		7.2	Groundwater Monitoring Data Availability and Management	This risk indicator measures 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).	https://www.un-igrac.org/special-project/ggmn-global-groundwater-monitoring-network
		7.3	Density of Runoff Monitoring Stations	This risk indicator measures the density of water monitoring stations as water management decisions rely strongly on data availability. The Global Runoff Data Base was used to estimate the number of monitoring stations per 1000km2 of the main river system (database access date: August 2021).	BfG (2021). Global Runoff Data Base. German Federal Institute of Hydrology (BfG).	https://www.bafg.de/GRDC/EN/01_GRDC/13_dtbse/database_node.html
	8. Infrastructure & Finance	**8.1**	Access to Safe Drinking Water	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (WHO/UNICEF) 2021 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2020.	WHO & UNICEF (2021). Progress on household drinking water, sanitation and hygiene 2000-2020: five years into the SDGs. Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.	https://washdata.org/data
		8.2	Access to Sanitation	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (WHO/UNICEF) 2021 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2020.	WHO & UNICEF (2021). Progress on household drinking water, sanitation and hygiene 2000-2020: five years into the SDGs. Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.	https://washdata.org/data
		8.3	Financing for Water Resource Development and Management (SDG 6.5.1)	This risk indicator is based on the average "Financing" score of UN SDG 6.5.1. Degree of Integrated Water Resource Management (IWRM) Implementation database. The UN SDG 6.5.1 database contains a category on financing that assesses different aspects of budgeting and financing made available and used for water resources development and management from various sources.	UNEP & UNEP-DHI (2021). SDG Indicator 6.5.1 database for reporting year 2020 (second round of reporting on indicator).	http://iwrmdataportal.unepdhi.org/
Reputational Risk	**9. Cultural Importance**	**9.1**	Cultural Diversity	This risk indicator is based on the count of ethnolinguistic groups by country as a proxy of cultural diversity. The rationale is that the greater the number of culture within a given region, the greater the chance that water is perceived as a social and/or cultural good and that would pose reputational risk to businesses.	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.	https://terralingua.org/shop/indigenous-and-traditional-peoples-of-the-world-and-ecoregion-conservation/

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	10. Biodiversity Importance	**10.1**	Freshwater Endemism	This risk indicator is based on the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. The rationale is that companies operating in river basins with higher number of endemic fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.	http://www.feow.org/
		10.2	Freshwater Biodiversity Richness	This risk indicator is based on the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC, and the count of fish species is used as a representation of freshwater biodiversity richness. The rationale is that companies operating in river basins with higher number of fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.	http://www.feow.org/
	11. Media Scrutiny	**11.1**	National Media Coverage	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., water scarcity and pollution) is taken into account, as well as the importance of water for livelihoods (e.g., food and shelter).	WWF & Tecnoma (2018)	
		11.2	Global Media Coverage	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 (2018)	
	12. Conflict	**12.1**	Conflict News Events	This risk indicator is based on 2021 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 (2021). Due diligence database on ESG and business conduct risks. RepRisk.	https://www.reprisk.com/
		12.2	Hydro-political Likelihood	This risk indicator is based on the assessment of hydro-political risk. This spatial modelling used historical cross-border water interactions as indicators of the magnitude of corresponding water joint-management issues, then determined the main parameters affecting water 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.	https://doi.org/10.1016/j.gloenvcha.2018.07.001