

FIVE HOLDINGS WRI Aqueduct Water Risk Report

Existing Hotels & New Hotel Buildings



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WATER RISK INDICATORS (By WRI AQUEDUCT)

1. Executive Summary

Water is essential to the progress of human societies. It is required for a healthy environment and a thriving economy. Food production, electricity generation, and manufacturing, among other things, all depend on it. However, many decision-makers lack the technical expertise to fully understand hydrological information.

In response to growing concerns from the private sector and other actors about water availability, water quality, climate change, and increasing demand, WRI applied the composite index approach as a robust communication tool to translate hydrological data into intuitive indicators of water-related risks.

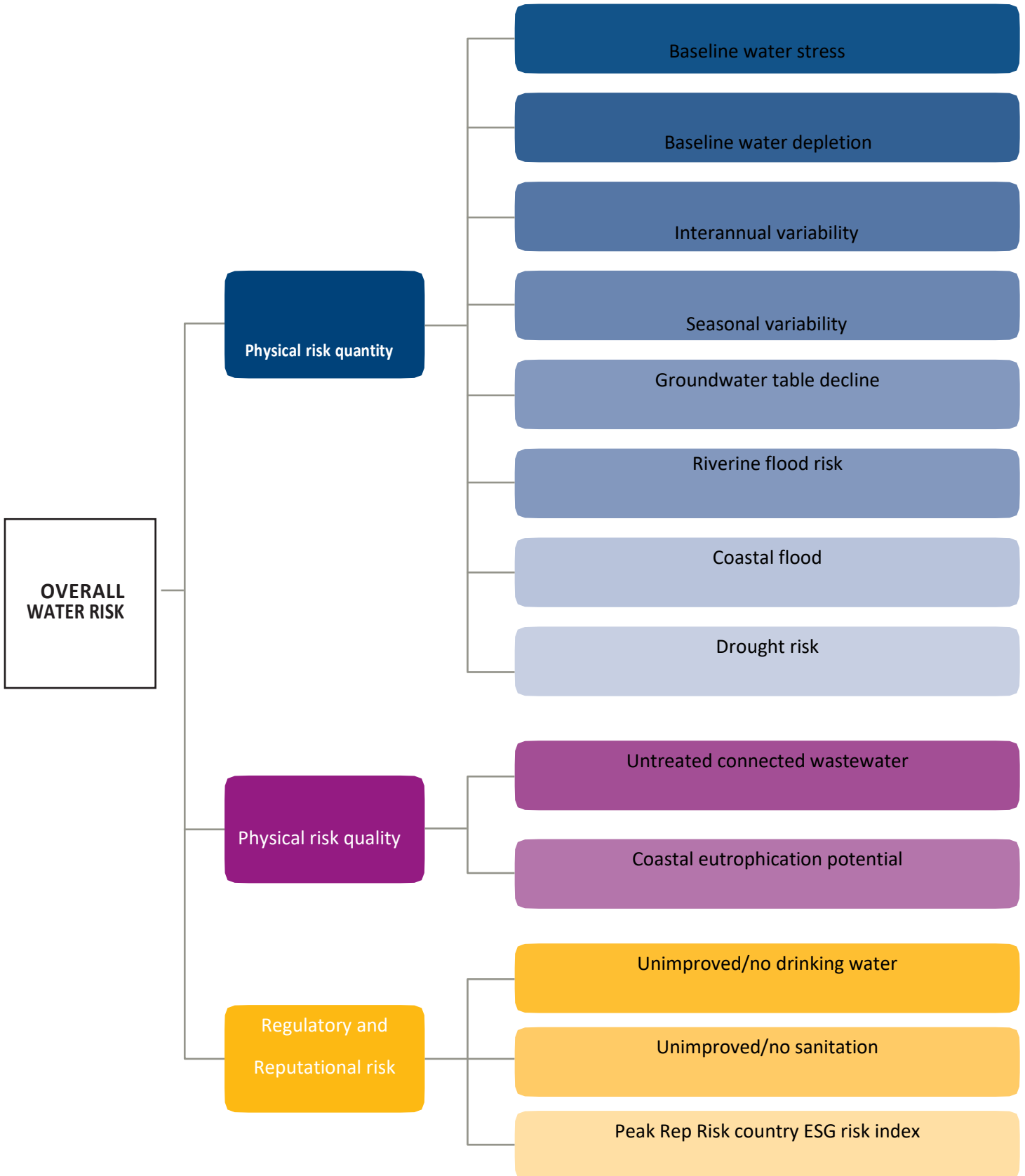
This technical note serves as the main reference for the updated Aqueduct™ water risk framework, in which we combine 13 water risk indicators including quantity, and reputational risks into a composite overall water risk score. The main audience for this technical note includes users of the Aqueduct tool, for whom the short descriptions on the tool and in the metadata document are insufficient.

This technical note lays out the design of the Aqueduct water risk framework, explains how various data sources are transformed into water risk indicators, and covers how the indicators are aggregated into composite scores. This document does not explore the differences with the previous version.

The water risk framework follows a composite index approach and allows multiple water-related risks to be combined.

There are three hierarchical levels, as can be seen in Figure 1. We start with 13 indicators covering various types of water risk. We then group the indicators and calculate the grouped water risk scores (composite score) using default, industry-defined, or user-defined weighting schemes. Finally, the three groups are combined into a single overall water risk score.

Figure 1 | Overview of Aqueduct Framework



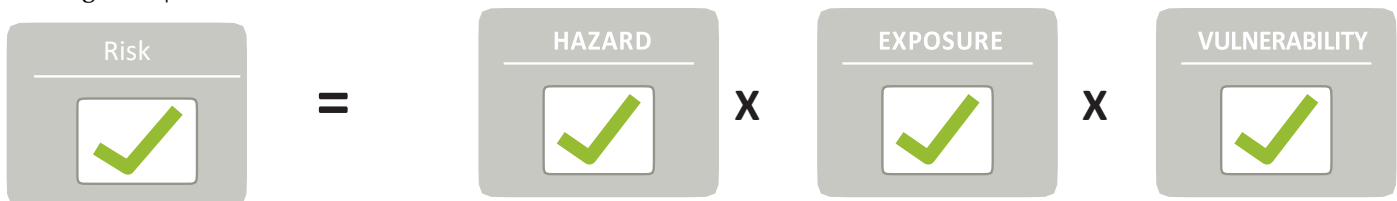
2. Indicators

For each of the 13 indicators in our framework, this describes, as a calculation of raw values, and a conversion to 0–5 scores . This enables us to aggregate the indicators into groups, as well as to provide an overall water risk score. For each indicator, we also include the key limitations.

Aqueduct 3.0 uses the United Nations Office for Disaster Risk Reduction (UNDRR) risk element terminology of hazard, exposure, and vulnerability. Each indicator is assigned a risk element (see Figure 2)

- ❖ **HAZARD:** Threatening event or condition (e.g., flood event, water stress condition).
- ❖ **EXPOSURE:** Elements present in the area affected by the hazard (e.g., population, asset, economic value).
- ❖ **VULNERABILITY:** The resilience or lack of resilience of the elements exposed to the hazard.

Figure 2 | Elements of Risk

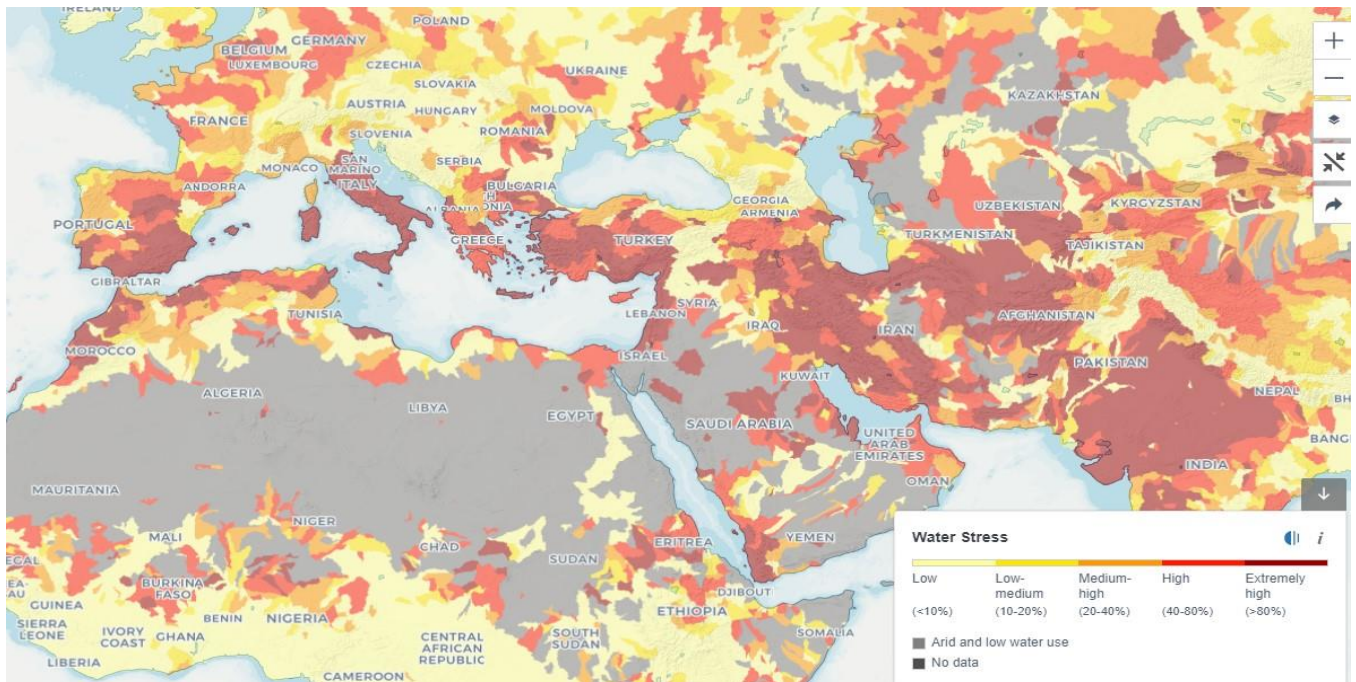


3. Baseline Water Stress

Baseline water stress measures the ratio of total water withdrawals to available renewable surface and ground water supplies. Water withdrawals include domestic, industrial, irrigation, and livestock consumptive and non-consumptive uses. Available renewable water supplies include the impact of upstream consumptive water users and large dams on downstream water availability. **Higher values indicate more competition among users.**

GENERAL:	
Name	Baseline Water Stress
Subgroup	Physical risk quantity
Risk element	

RAW VALUE	RISK CATEGORY	SCORE
<10%	Low	0-1
10-20%	Low-medium	1-2
20-40%	Medium-high	2-3
40-80%	High	3-4
>80%	Extremely high	4-5
	Arid and low water use	5



Water stress Index: United Arab Emirates at High Risk Index and Switzerland at Low Risk Index

4. Baseline Water Depletion

Baseline water depletion measures the ratio of total water consumption to available renewable water supplies. Total water consumption includes domestic, industrial, irrigation, and livestock consumptive uses. Available renewable water supplies include the impact of upstream consumptive water users and large dams on downstream water availability. **Higher values indicate larger impact on the local water supply and decreased water availability for downstream users.**

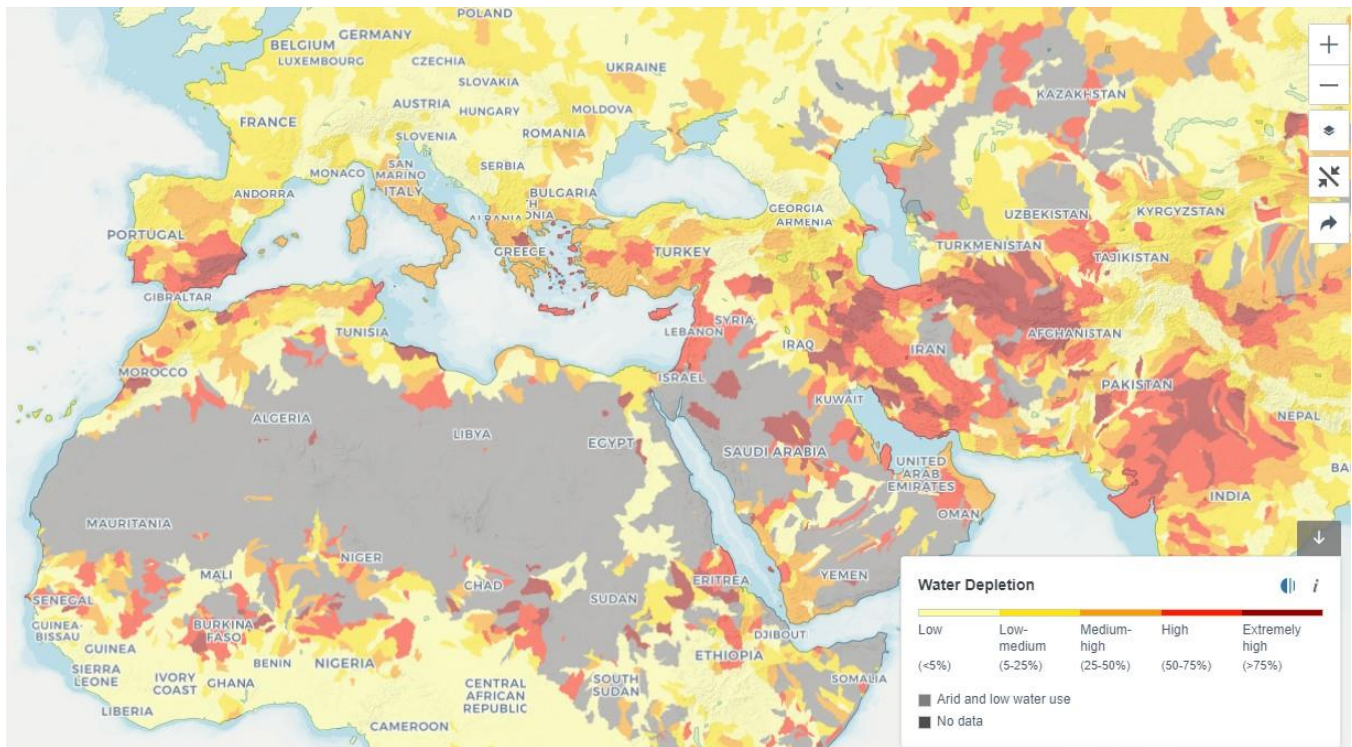
Baseline water depletion is similar to baseline water stress; however, instead of looking at total water withdrawal (consumptive plus non consumptive), baseline water depletion is calculated using consumptive withdrawal only.

GENERAL:

Name	Baseline Water Depletion
Subgroup	Physical risk quantity
Risk element	

RISK = HAZARD x EXPOSURE x VULNERABILITY

RAW VALUE	RISK CATEGORY	SCORE
<5%	Low	0-1
5-25%	Low-medium	1-2
25-50%	Medium-high	2-3
50-75%	High	3-4
>75%	Extremely high	4-5
	Arid and low water use	5

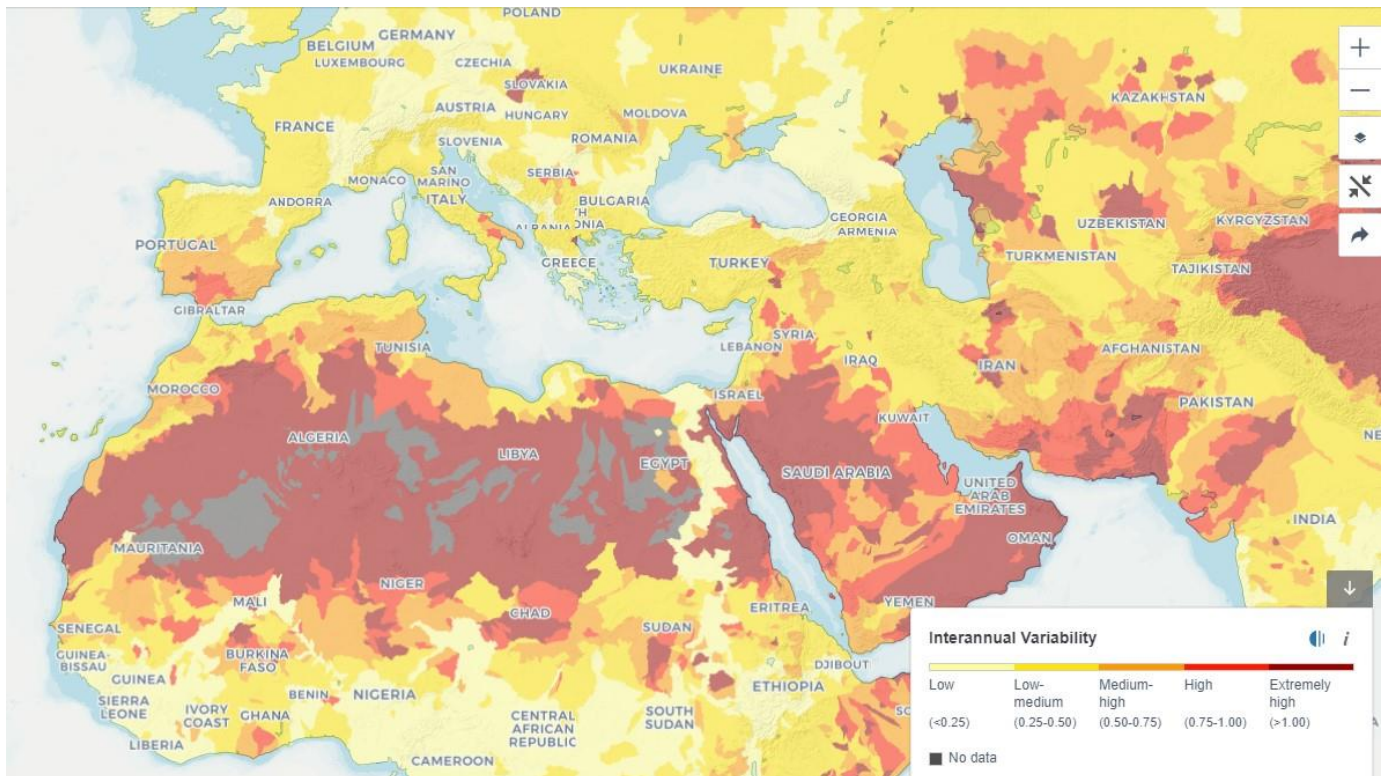


Water Depletion Index: United Arab Emirates at Medium High Risk Index and Switzerland at Low Risk Index

5. Interannual Variability

Interannual variability measures the average between year variability of available water supply, including both renewable surface and groundwater supplies. **Higher values indicate wider variations in available supply from year to year.**

GENERAL:		RAW VALUE	RISK CATEGORY	SCORE
Name	Interannual Variability	<0.25	Low	0-1
Subgroup	Physical risk quantity	0.25-0.50	Low-medium	1-2
Risk element		0.50-0.75	Medium-high	2-3
		0.75-1.00	High	3-4
		>1.00	Extremely high	4-5

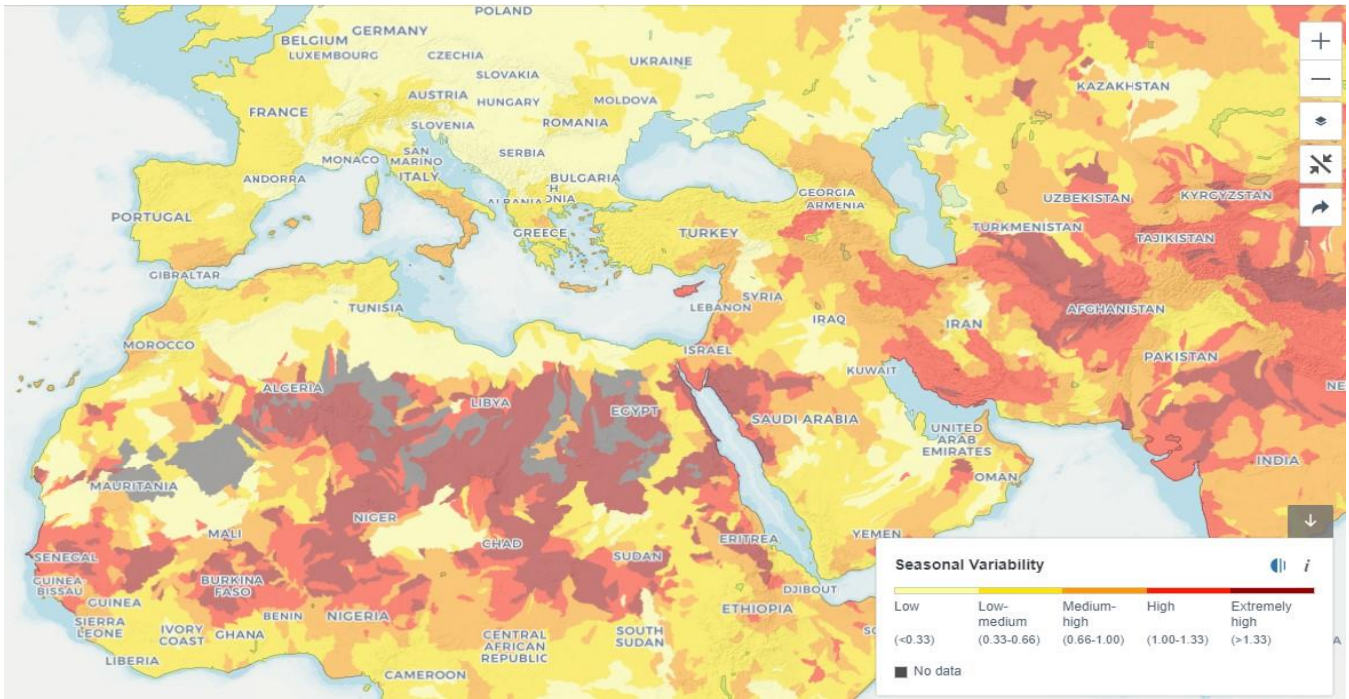


Interannual Variability Index: United Arab Emirates at Extremely High Risk Index and Switzerland at Low Risk Index

6. Seasonal Variability

Seasonal variability measures the average within-year variability of available water supply, including both renewable surface and groundwater supplies. **Higher values indicate wider variations of available supply within a year.**

GENERAL:		RAW VALUE	RISK CATEGORY	SCORE
Name	Seasonal Variability	<0.33	Low	0-1
Subgroup	Physical risk quantity	0.33-0.66	Low-medium	1-2
Risk element 		0.66-1.00	Medium-high	2-3
		1.00-1.33	High	3-4
		>1.33	Extremely high	4-5



Seasonal Variability Index: United Arab Emirates at Low Medium Risk Index and Switzerland at Low Risk Index

7. Groundwater Table Decline

Groundwater table decline measures the average decline of the groundwater table as the average change for the period of study (1990–2014). The result is expressed in centimetres per year (cm/yr). **Higher values indicate higher levels of unsustainable groundwater withdrawals.**

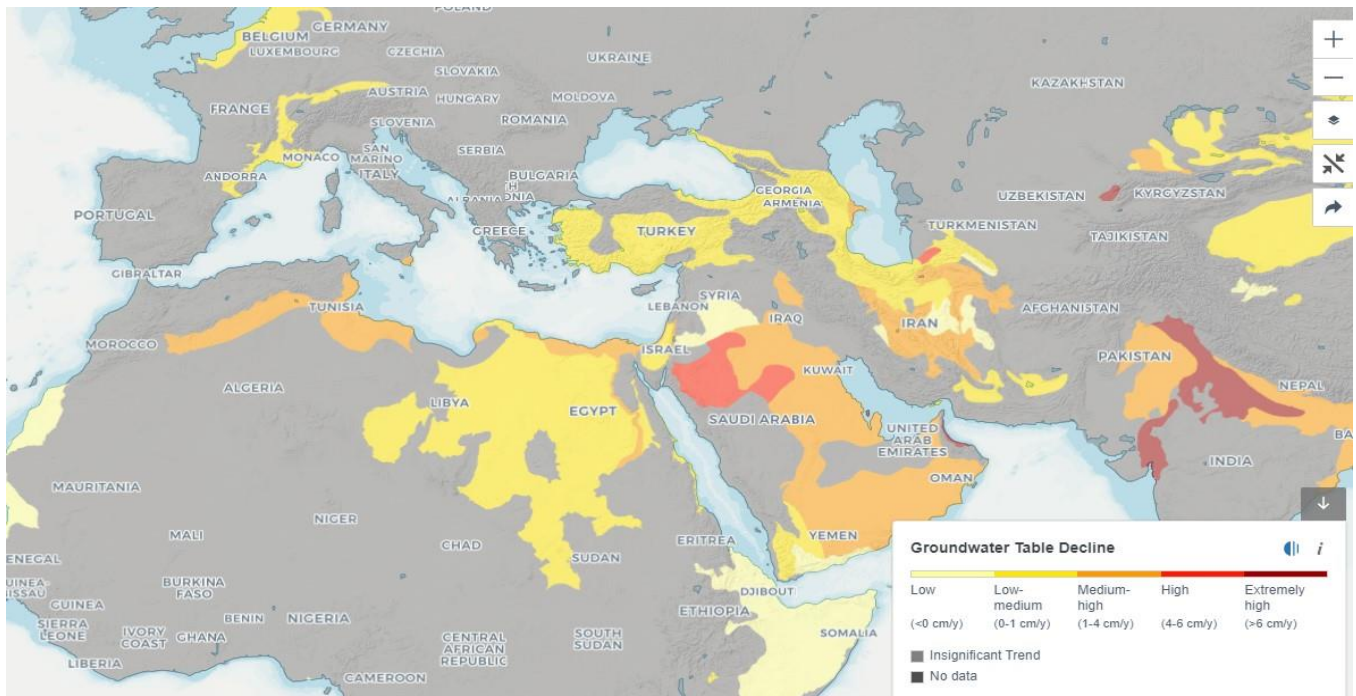
GENERAL:

Name	Groundwater Table Decline
Subgroup	Physical risk quantity

Risk element

RISK = HAZARD × EXPOSURE × VULNERABILITY

RAW VALUE	RISK CATEGORY	SCORE
<0 cm/y	Low	0–1
0–2 cm/y	Low–medium	1–2
2–4 cm/y	Medium–high	2–3
4–8 cm/y	High	3–4
>8 cm/y	Extremely high	4–5



Groundwater Index: United Arab Emirates at Medium High Risk Index and Switzerland at Low Medium Risk Index

8. Riverine Flood Risk

Riverine flood risk measures the percentage of population expected to be affected by riverine flooding in an average year, accounting for existing flood-protection standards. Flood risk is assessed using hazard (inundation caused by river overflow), exposure (population in flood zone), and vulnerability.¹⁶ The existing level of flood protection is also incorporated into the risk calculation. It is important to note that this indicator represents flood risk not in terms of maximum possible impact but rather as average annual impact. The impacts from infrequent, extreme flood years are averaged with more common, less newsworthy flood years to produce the “expected annual affected population.” **Higher values indicate that a greater proportion of the population is expected to be impacted by riverine floods on average.**

GENERAL:

Name	Riverine Flood Risk
Subgroup	Physical risk quantity

Risk element

RISK

=

HAZARD

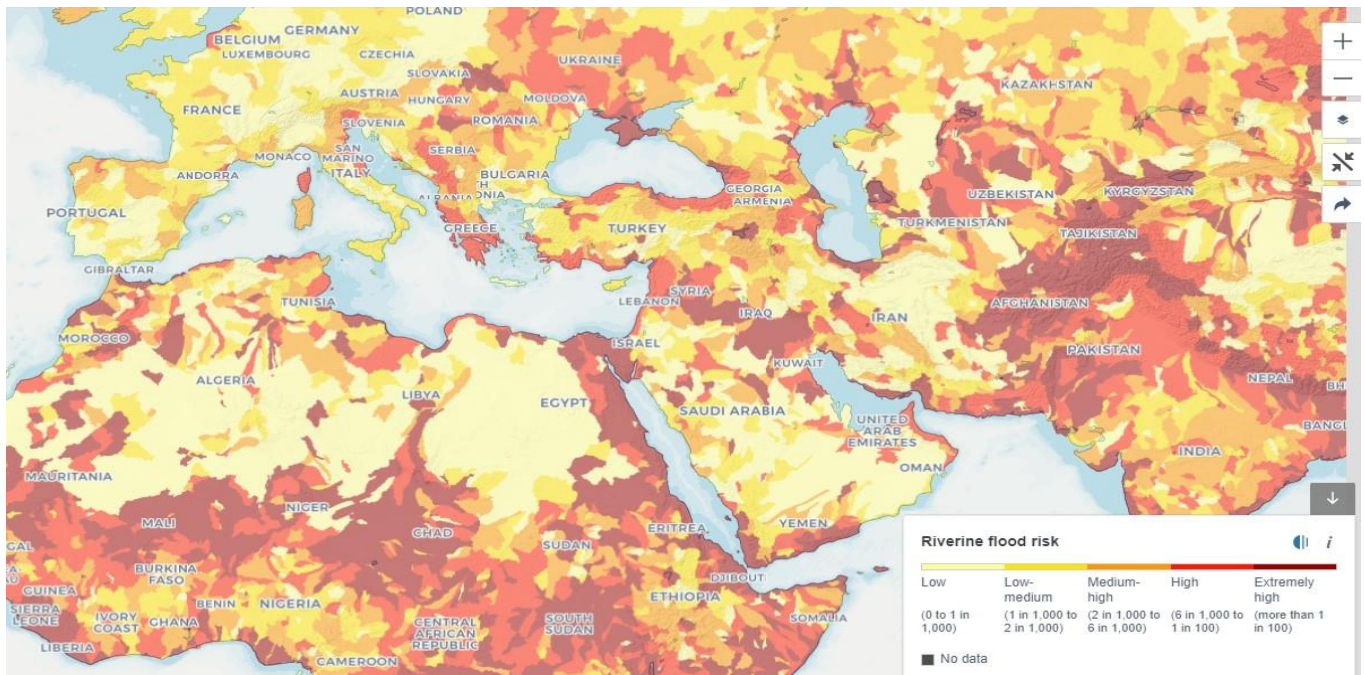
x

EXPOSURE

x

VULNERABILITY

RAW VALUE	RISK CATEGORY	SCORE
0 to 1 in 1,000	Low	0-1
1 in 1,000 to 2 in 1,000	Low-medium	1-2
2 in 1,000 to 6 in 1,000	Medium-high	2-3
6 in 1,000 to 1 in 100	High	3-4
More than 1 in 100	Extremely high	4-5



Riverine Flood risk Index: United Arab Emirates at High Risk Index and Switzerland at Low Risk Index

9. Coastal Flood Risk

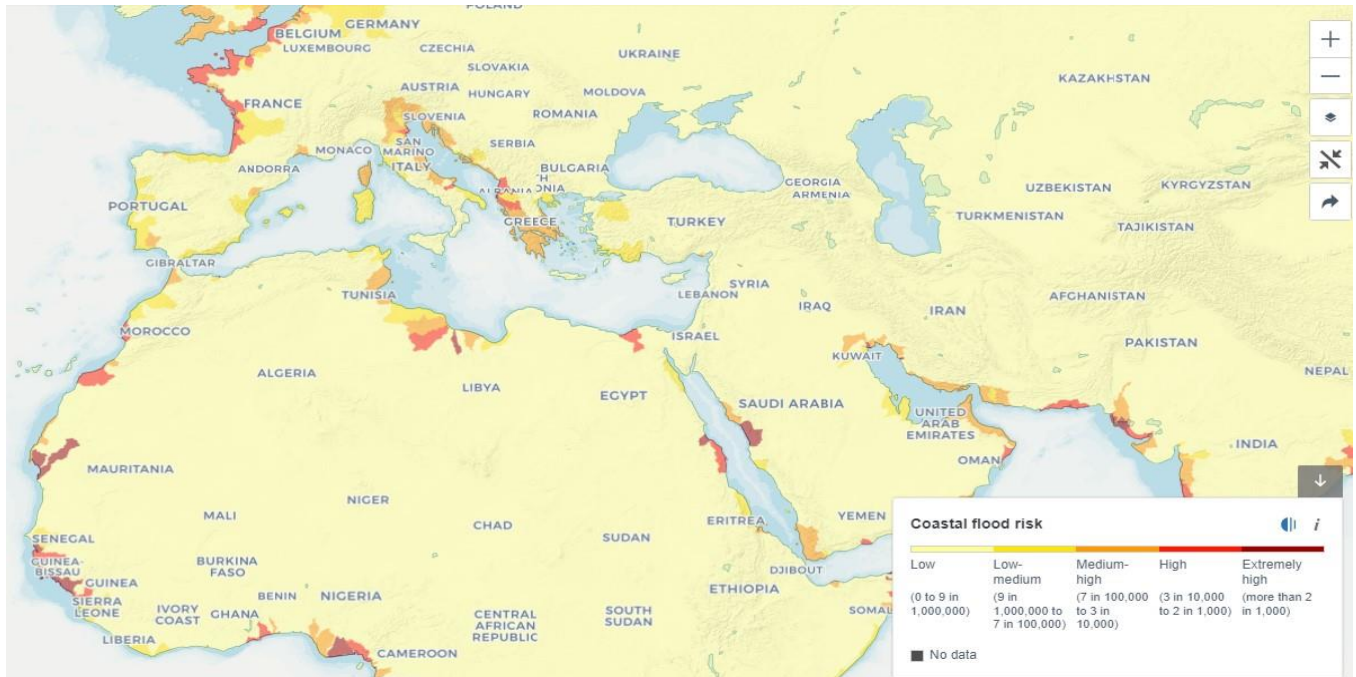
Coastal flood risk measures the percentage of the population expected to be affected by coastal flooding in an average year, accounting for existing flood protection standards. Flood risk is assessed using hazard (inundation caused by storm surge), exposure (population in flood zone), and vulnerability.¹⁷ The existing level of flood protection is also incorporated into the risk calculation. It is important to note that this indicator represents flood risk not in terms of maximum possible impact but rather as average annual impact. The impacts from infrequent, extreme flood years are averaged with more common, less newsworthy flood years to produce the “expected annual affected population.” **Higher values indicate that a greater proportion of the population is expected to be impacted by coastal floods on average.**

GENERAL:

Name	Coastal Flood Risk
Subgroup	Physical risk quantity

Risk element

RAW VALUE	RISK CATEGORY	SCORE
0 to 9 in 1,000,000	Low	0–1
9 in 1,000,000 to 7 in 100,000	Low–medium	1–2
7 in 100,000 to 3 in 10,000	Medium–high	2–3
3 in 10,000 to 2 in 1,000	High	3–4
More than 2 in 1,000	Extremely high	4–5



Coastal flood risk Index: United Arab Emirates at Medium High Risk Index and Switzerland at Low Risk Index

10.Drought Risk

Drought risk measures where droughts are likely to occur, the population and assets exposed, and the vulnerability of the population and assets to adverse effects.

Higher values indicate higher risk of drought.

GENERAL:

Name	Drought Risk
Subgroup	Physical risk quantity

Risk element

RISK
✓

=

HAZARD
✓

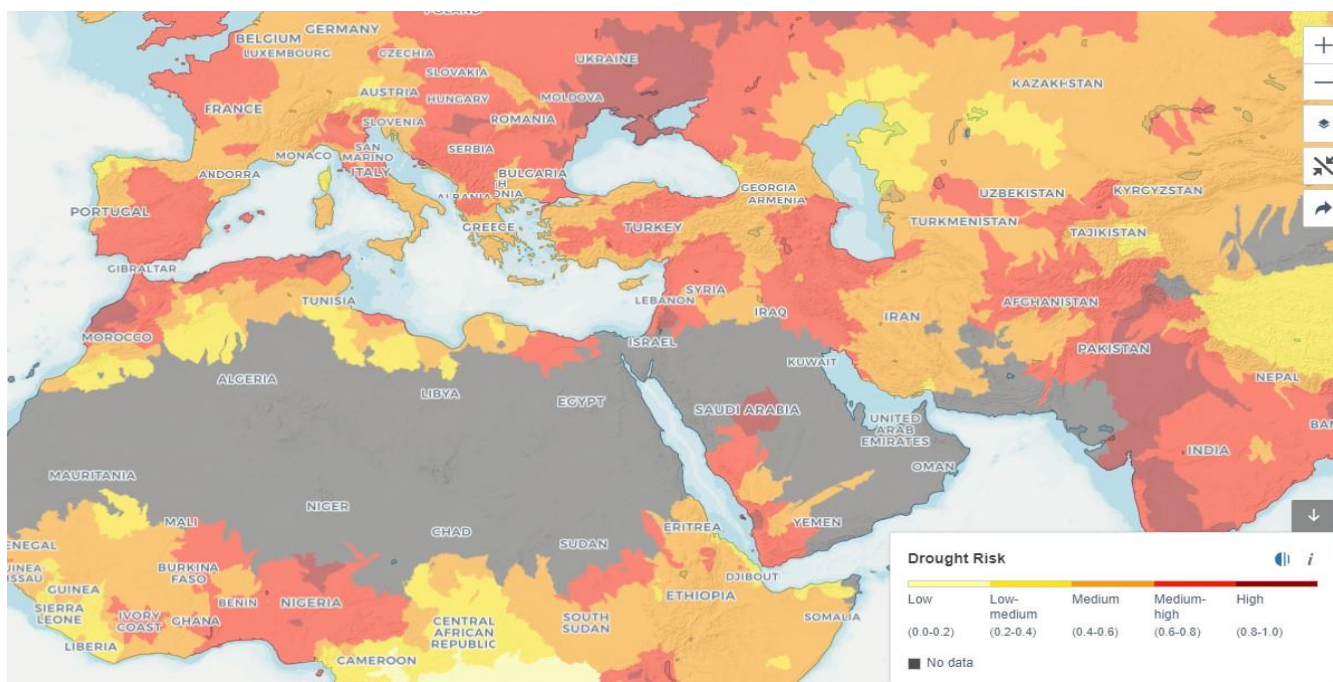
x

EXPOSURE
✓

x

VULNERABILITY
✓

RAW VALUE	RISK CATEGORY	SCORE
0.0–0.2	Low	0–1
0.2–0.4	Low–medium	1–2
0.4–0.6	Medium	2–3
0.6–0.8	Medium–high	3–4
0.8–1.0	High	4–5



Drought Risk Index: United Arab Emirates at No Risk Index and Switzerland at Medium Risk Index

11. Untreated Connected Wastewater

Untreated connected wastewater measures the percentage of domestic wastewater that is connected through a sewerage system and not treated to at least a primary treatment level. Wastewater discharge without adequate treatment could expose water bodies, the general public, and ecosystems to pollutants such as pathogens and nutrients. The indicator compounds two crucial elements of wastewater management: connection and treatment. Low connection rates reflect households' lack of access to public sewerage systems; the absence of at least primary treatment reflects a country's lack of capacity (infra-structure, institutional knowledge) to treat wastewater. Together these factors can indicate the level of a country's current capacity to manage its domestic wastewater through two main pathways: extremely low connection rates (below 1 percent), and high connection rates with little treatment. **Higher values indicate higher percentages of point source wastewater discharged without treatment.**

GENERAL:

Name: Untreated Connected Wastewater

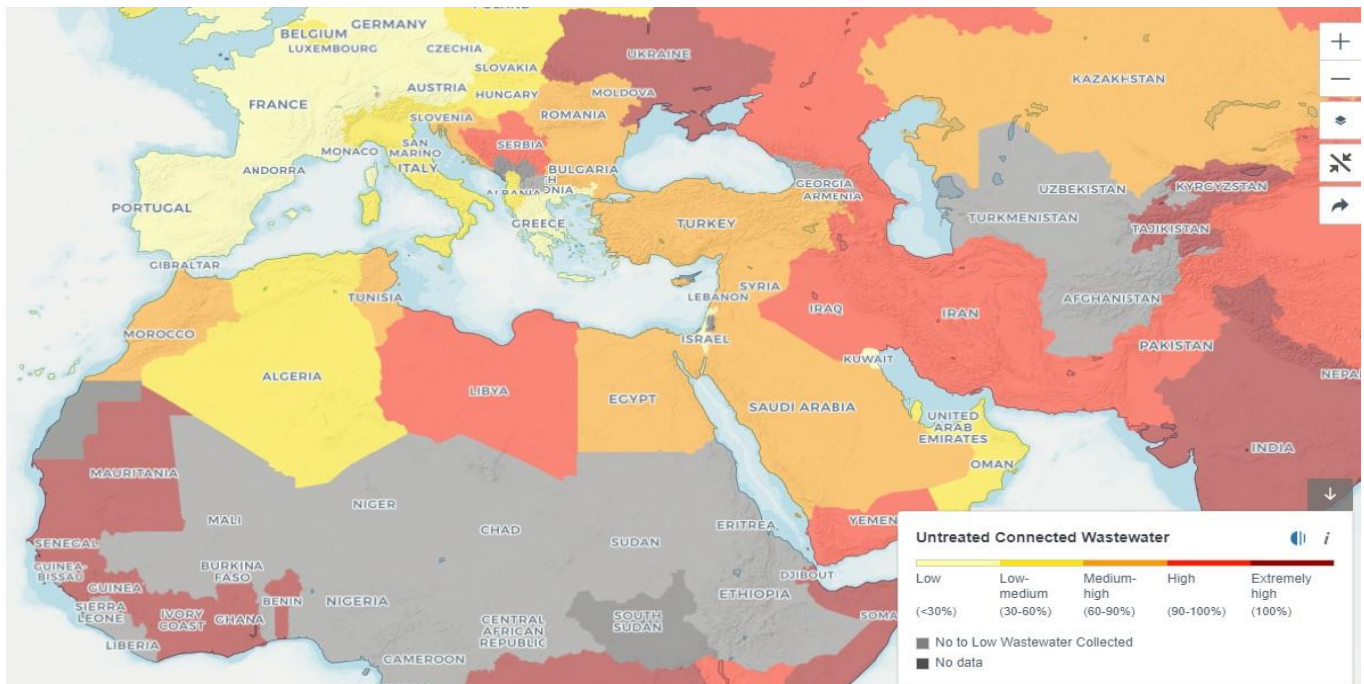
Subgroup: Physical risk quality

Risk element

RISK = HAZARD x EXPOSURE x VULNERABILITY

Diagram showing Risk = Hazard (with a green checkmark) x Exposure x Vulnerability.

RAW VALUE	RISK CATEGORY	SCORE
<30%	Low	0-1
30-60%	Low-medium	1-2
60-90%	Medium-high	2-3
90-100%	High	3-4
100%	Extremely high	4-5
Low to no wastewater connected		5



Untreated Connected Wastewater Index: United Arab Emirates at Low Medium Risk Index and Switzerland at Low Risk Index

12.Coastal Eutrophication Potential

Coastal eutrophication potential (CEP) measures the potential for riverine loadings of nitrogen (N), phosphorus (P), and silica (Si) to stimulate harmful algal blooms in coastal waters. The CEP indicator is a useful metric to map where anthropogenic activities produce enough point-source and nonpoint-source pollution to potentially degrade the environment. When N and P are discharged in excess over Si with respect to diatoms, a major type of algae, undesirable algal species often develop. The stimulation of algae leading to large blooms may in turn result in eutrophication and hypoxia (excessive biological growth and decomposition that reduces oxygen available to other organisms). It is therefore possible to assess the potential for coastal eutrophication from a river’s N, P, and Si loading. **Higher values indicate higher levels of excess nutrients with respect to silica, creating more favourable conditions for harmful algal growth and eutrophication in coastal waters downstream.**

GENERAL:

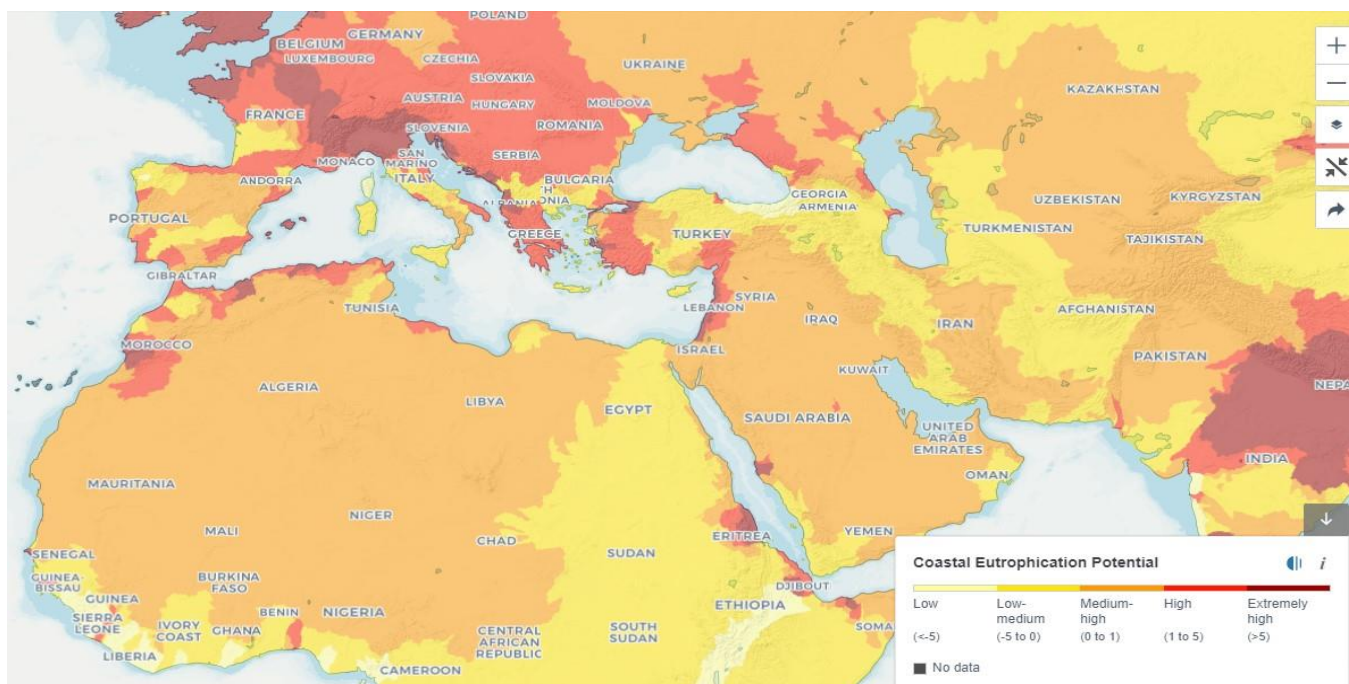
Name Coastal Eutrophication Potential

Subgroup Physical risk quality

Risk element

RISK = HAZARD x EXPOSURE x VULNERABILITY

RAW VALUE	RISK CATEGORY	SCORE
<-5	Low	0-1
-5-0	Low-medium	1-2
0-1	Medium-high	2-3
1-5	High	3-4
>5	Extremely high	4-5



Coastal Eutrophication Potential Index: United Arab Emirates at Medium High Risk Index and Switzerland at High Risk Index

13.Unimproved/No Drinking Water

Unimproved/no drinking water reflects the percentage of the population collecting drinking water from an unprotected dug well or spring, or directly from a river, dam, lake, pond, stream, canal, or irrigation canal (WHO and UNICEF 2017). Specifically, the indicator aligns with the unimproved and surface water categories of the Joint Monitoring Programme (JMP)the lowest tiers of drinking water services. **Higher values indicate areas where people have less access to safe drinking water supplies.**

GENERAL:

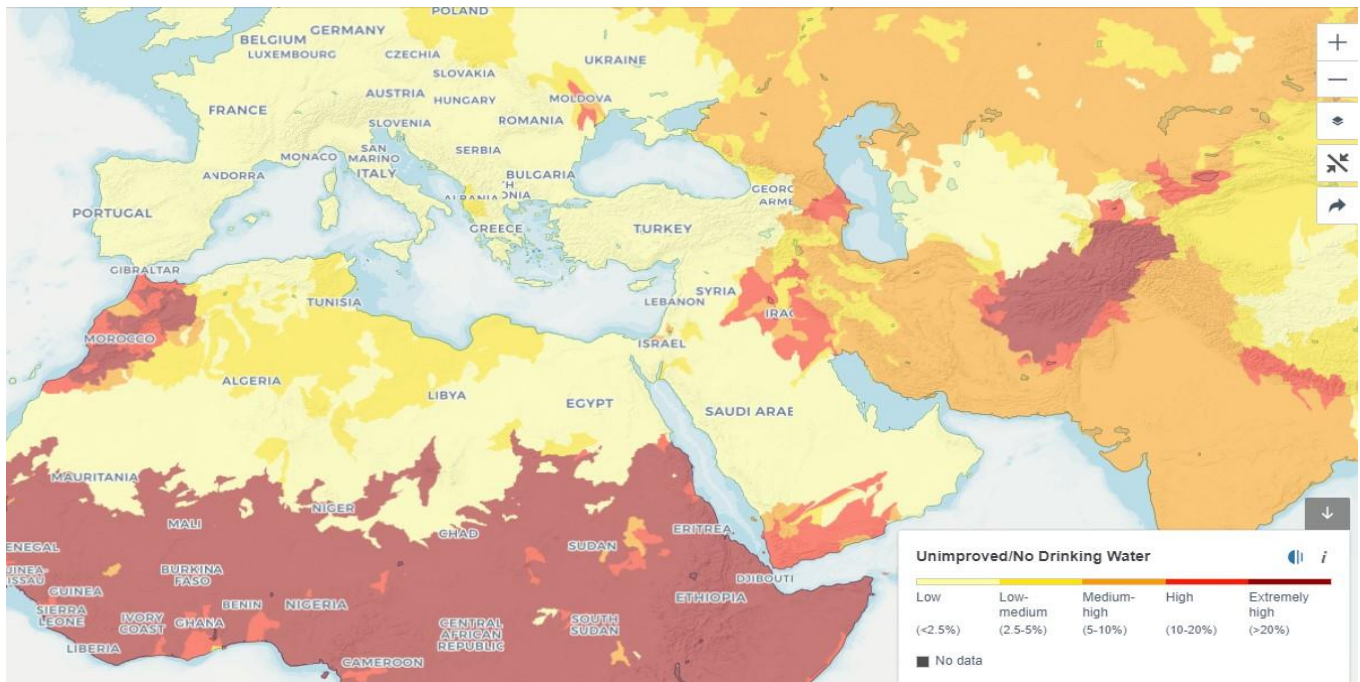
Name Unimproved/No Drinking Water

Subgroup Regulatory and reputational risk

Risk element

RISK = HAZARD x EXPOSURE x VULNERABILITY

RAW VALUE	RISK CATEGORY	SCORE
<2.5%	Low	0-1
2.5-5.0%	Low-medium	1-2
5.0-10.0%	Medium-high	2-3
10.0-20.0%	High	3-4
>20.0%	Extremely high	4-5

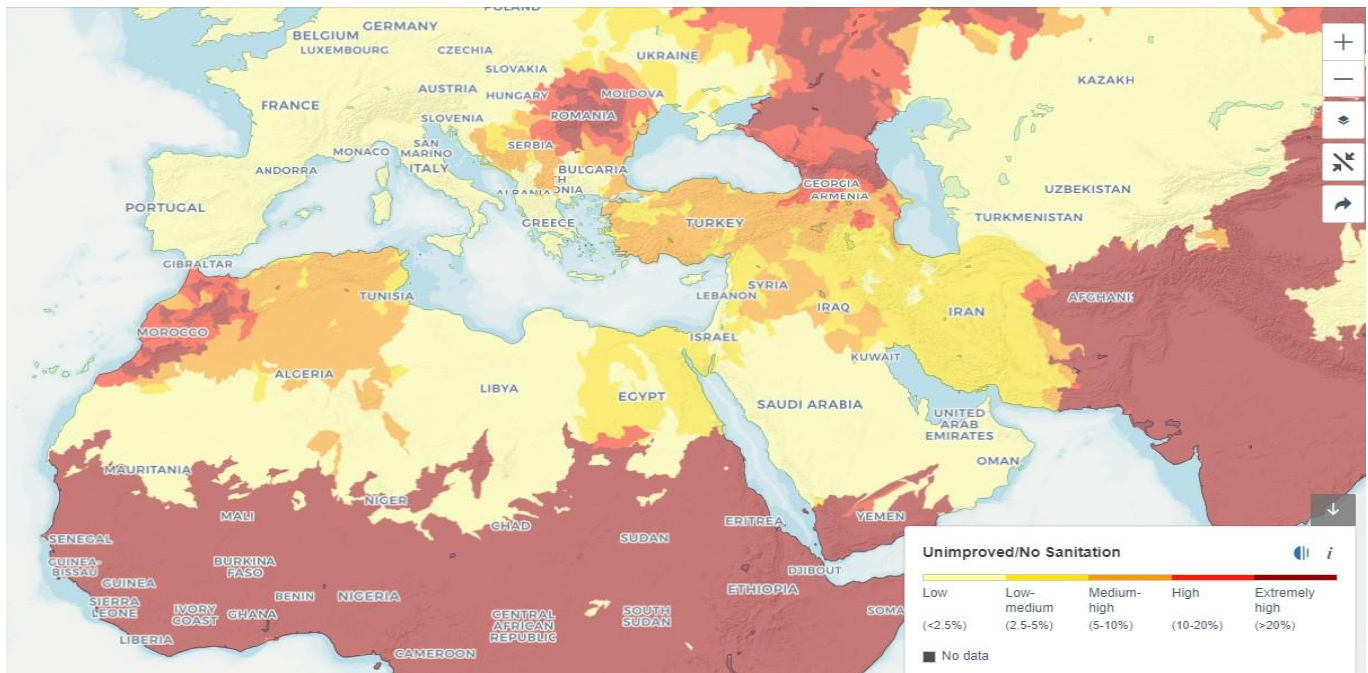


Unimproved/no drinking Water Index: United Arab Emirates at Low-Risk Index and Switzerland at Low Risk Index

14. Unimproved/No Sanitation

Unimproved/no sanitation reflects the percentage of the population using pit latrines without a slab or platform, hanging/bucket latrines, or directly disposing human waste in fields, forests, bushes, open bodies of water, beaches, other open spaces, or with solid waste (WHO and UNICEF 2017). Specifically, the indicator aligns with JMP’s unimproved and open defecation categories the lowest tier of sanitation services. **Higher values indicate areas where people have less access to improved sanitation services.**

GENERAL:		RAW VALUE	RISK CATEGORY	SCORE
Name	Unimproved/No Drinking Water	<2.5%	Low	0-1
Subgroup	Regulatory and reputational risk	2.5-5.0%	Low-medium	1-2
Risk element		5.0-10.0%	Medium-high	2-3
		10.0-20.0%	High	3-4
		>20.0%	Extremely high	4-5



Unimproved/no sanitation Index: United Arab Emirates at Low-Risk Index and Switzerland at Low Risk Index

15. Peak RepRisk Country ESG Risk Index

The Peak RepRisk country ESG risk index quantifies business conduct risk exposure related to environmental, social, and governance (ESG) issues in the corresponding country. The index provides insights into potential financial, reputational, and compliance risks, such as human rights violations and environmental destruction. RepRisk is a leading business intelligence provider that specializes in ESG and business conduct risk research for companies, projects, sectors, countries, ESG issues, NGOs, and more, by leveraging artificial intelligence and human analysis in 20 languages. WRI has elected to include the Peak RepRisk country ESG risk index in Aqueduct to reflect the broader regulatory and reputational risks that may threaten water quantity, quality, and access. While the underlying algorithm is proprietary, we believe that our inclusion of the Peak RepRisk country ESG risk index, normally unavailable to the public, is a value-add to the Aqueduct community. The peak value equals the highest level of the index in a given country over the last two years. **The higher the value, the higher the risk exposure.**

GENERAL:

Name Peak RepRisk Country ESG Risk Index

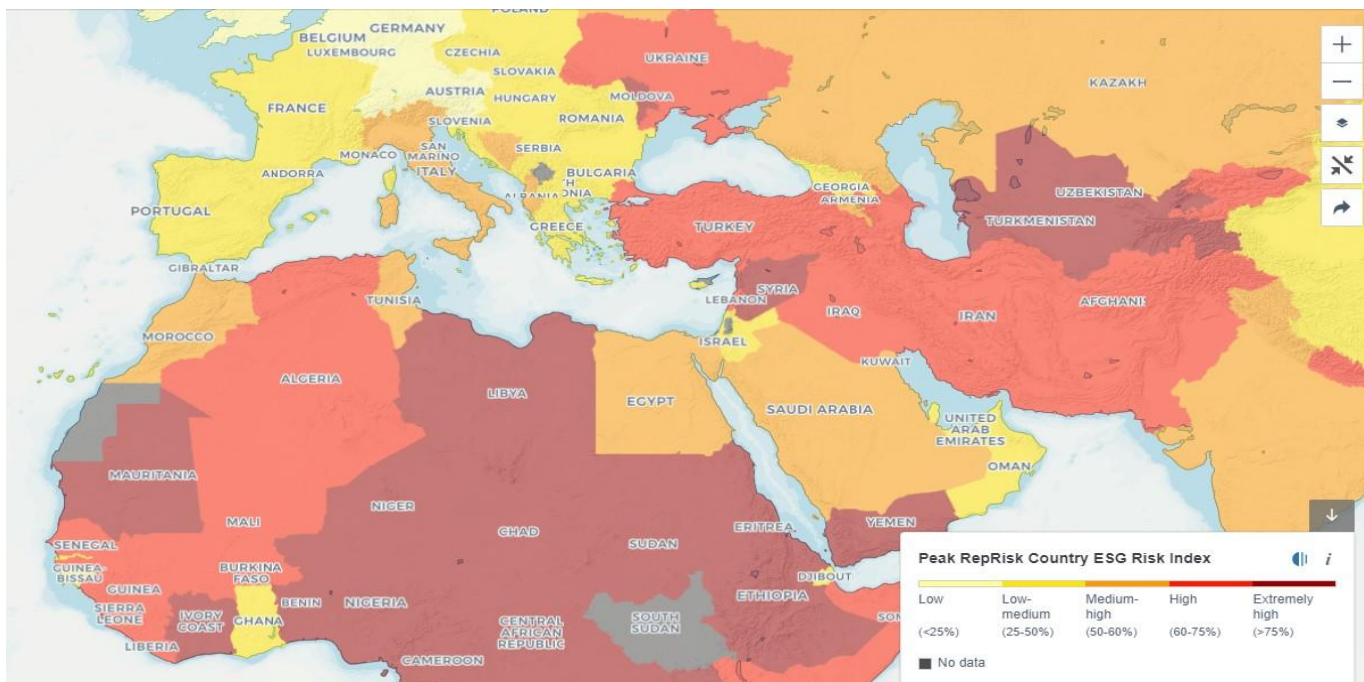
Subgroup Regulatory and reputational risk

Risk element

RISK = HAZARD x EXPOSURE x VULNERABILITY

= x x

RAW VALUE	RISK CATEGORY	SCORE
<25%	Low	0-1
25-50%	Low-medium	1-2
50-60%	Medium-high	2-3
60-75%	High	3-4
>75%	Extremely high	4-5



Peak Rep Risk Country ESG Risk Index: United Arab Emirates at Low Medium Risk Index and Switzerland at Low Risk Index

The remainder of this document contains the definitions, formulas, and data specifications for the Aqueduct Water Risk Atlas global maps.

