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Read more about:
Resource efficiency, Sustainable consumption and production, Water

1. Maps and data can be downloaded from http://www.ifu.ethz.ch/ESD/maps

European Commission

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Afghanistan has the highest 'water criticality score'; Finland the lowest

Increasing population, overconsumption and technological development have depleted many of the world's natural resources, with profound impacts on the environment. This study applies the concept of criticality, which determines whether a resource may become a limiting factor to future development, to water.

Water underpins the function of the world's ecosystems, economic activity and human health. Its availability is also under direct threat from climate change and population growth, and therefore a target of environmental protection.

Protecting water resources requires an understanding of how much water is currently available, and how much will be available in the future. One way of making these estimations is criticality, a concept used to assess whether a resource may become a limiting factor to economic activities. It has traditionally been applied to metals but can also be applied to renewable resources like water, which can be overused.

Current methods for water assessment include Life Cycle Assessment (LCA) and the Water Footprint. These approaches measure the amount of water used to produce goods and services and quantify the impacts of human water use on the environment but they cannot offer the 'user perspective', e.g. whether water availability may become a limiting factor for economic activities in a specific region. Criticality offers this perspective, and also considers vulnerability (such as dependency on water for economic activity) and the ability to adapt to supply restrictions (by storing water, for example), which broadens water use assessment and is useful for analysing future scenarios.

In this study, researchers developed a framework to assess the criticality of water by adapting the approach presented in the widely cited paper *Methodology of Metal Criticality Determination*. The fundamental structure was maintained, but with some modifications due to the different properties of metals and water. For example, while metals can be substituted with other metals, water can only be conserved or treated for (re-)use to reduce pressure on the resource.

The researchers calculated 'criticality scores' for 159 countries, subdivided into 512 geographic units, for the year 2000. Criticality was a combined measure of *supply risk*, which assesses water availability and accessibility in terms of physical availability, governance, and geopolitical situations in supplying countries; *environmental implications*, which indicates the potential environmental impact of using water in a particular location, from a particular source and for a particular purpose; and *vulnerability to supply restrictions*, which accounts for the importance of water to national economies and the amounts of water that could be compensated, such as by wastewater treatment. Each indicator was assessed on a scale of 0–100, with higher scores indicating higher criticality.

The analysis was used to create maps[1] that showed the risk for each indicator individually, and for overall criticality. The global distribution of low and high scores was different for each indicator. Supply risk was lowest in New Zealand (2) and highest in Turkmenistan (80). Environmental implications were rated as zero in several places, but were as high as 93 in some US states. Vulnerability to supply restrictions was lowest in Iceland (12) and highest in Afghanistan (72). Overall, the country with the lowest criticality score (and thus at the least risk of water becoming a limiting factor) was Finland (score of 9). The most at-risk country was Afghanistan (78).

Water criticality enables a user-focused assessment of water availability and accessibility. The method presented here can be used to assess the water criticality of different locations, which will be useful for organisations and companies that rely on water resources. In addition, its vulnerability indicator can highlight problems related to water scarcity and therefore identify possible mitigation options, which is useful for policymakers. However, it should be noted that the method does not account for water quality.