The CEO Water Mandate

Driving Harmonization of Water-Related Terminology

Discussion Paper
September 2014

ALLIANCE FOR WATER STEWARDSHIP
CDP DRIVING SUSTAINABLE ECONOMIES
Ceres
The Nature Conservancy
PACIFIC INSTITUTE
Water Footprint NETWORK
WORLD RESOURCES INSTITUTE
WWF

Participating organizations
Alliance for Water Stewardship, Ceres, CDP (formerly the Carbon Disclosure Project), The Nature Conservancy, Pacific Institute, Water Footprint Network, World Resources Institute, and WWF provided expertise and insights, widely support outcomes-to-date, and will seek to incorporate those outcomes into their organizational efforts where possible.

Global Reporting Initiative (GRI) and PricewaterhouseCoopers offered additional expertise and insights that were essential in the development of this paper.

Acknowledgements
The CEO Water Mandate Secretariat and project team organizations would like thank, Stefan Pfister (ETH – Zürich), Beate Werner (European Environment Agency), Robin Farrington (GIZ), Astrid Michels (GIZ), Sebastien Humbert (Quantis International), Rob Greenwood (Ross Strategic), Maite Aldaya (UN Environment Programme), Llorenç Milá-i-Canals (UN Environment Programme), Marty Matlock (University of Arkansas), Jamie Bartam (University of North Carolina – Chapel Hill), and Josefina Maestu (UN-Water) for their feedback and expertise that were critical in shaping the outcomes and definitions shared in this discussion paper.

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Background

As corporate water assessment tools and stewardship initiatives continue to emerge and their underlying approaches and methodologies evolve, there has been a proliferation of sometimes conflicting interpretations and uses of key water-related terms. This is especially true of terms used to indicate geographic locations where water-related challenges are more pronounced, namely "water scarcity", "water stress", and "water risk". In advance of its March 2013 multi-stakeholder working conference in Mumbai, the CEO Water Mandate developed a briefing paper[1] that describes how definitions and interpretations of these terms have evolved over time and how they are currently being used differently by various corporate water tools and initiatives.

In May 2013, the Mandate Secretariat initiated a dialogue among organizations developing corporate water tools and other initiatives to see if a shared understanding could be reached on a number of key definitional issues. While acknowledging that each group uses these terms to varying extents and orients their tools and other products around different objectives, participating organizations agreed that when making use of these terms, doing so in a harmonized and consistent way supports understanding of their products and limits confusion among their audiences. In this spirit, they sought to work toward a mutual understanding on key questions such as:

- Do "scarcity", "stress", and risk" refer to three distinct, useful concepts in the context of corporate water stewardship?
- What specifically is meant by each term? How do organizations conceive of them differently?
- How do these terms relate to one another?
- How can these terms be used in practice? For what purposes may these terms not be appropriate or useful?

This initial dialogue has led to a year-long, iterative endeavor through which participating organizations have attempted to reach shared understanding of these terms, while also identifying areas where there is divergence in understanding. These discussions have focused on developing a conceptual overview of these terms and their relationship to one another, as opposed to quantitative approaches to calculating and measuring these terms. The latter goal was deemed quite difficult due to data and methodological limitations (and perhaps even undesirable). During this process, the Mandate Secretariat and partnering organizations sought feedback on this work within the corporate water stewardship community, as well as more broadly amongst others in the scientific, water resources management, and risk assessment communities and others helping to shape the development of water-related indicators and metrics. This feedback served as the basis for further refinements of these conceptual definitions.

This paper summarizes key outcomes from this process. Alliance for Water Stewardship, Ceres, CDP (formerly the Carbon Disclosure Project), The Nature Conservancy, Pacific Institute, Water Footprint Network, World Resources Institute, and WWF provided expertise and insights, widely support outcomes-to-date, and will seek to incorporate them into their organizational efforts where possible. Global Reporting Initiative (GRI) and PricewaterhouseCoopers offered additional expertise and insights that were essential in the development of this paper. The Pacific Institute – in its role as member of the CEO Water Mandate Secretariat – shepherded these discussions and prepared this paper. The Mandate Secretariat and participating organizations will look to expand upon and further refine these outcomes as needed in the future.

[1] An adapted version of this briefing paper is presented as Appendices B and C at the end of this document.

Critical factors in assessing the nature of and relative severity of water challenges

Discussion among participating organizations has suggested there are a number of approaches and considerations that are important to incorporate when assessing the nature and severity of water-related challenges, including:

- The terms "water scarcity", "water stress", and "water risk" refer to three distinct concepts and should not be used interchangeably.
- Water consumption, in addition to water withdrawals,[2] is a helpful, often necessary, aspect of understanding an area's water-related challenges, and demand for water specifically.
- High spatial resolution of data is preferable wherever possible.
- Calculations of water abundance should account for upstream consumptive uses that deplete available supplies.
- Accounting for monthly variation in water resources and demand is preferable where data allow.
- Environmental water requirements should be explicitly considered when assessing the extent of an area's water challenges.

Conceptual definitions of key terms

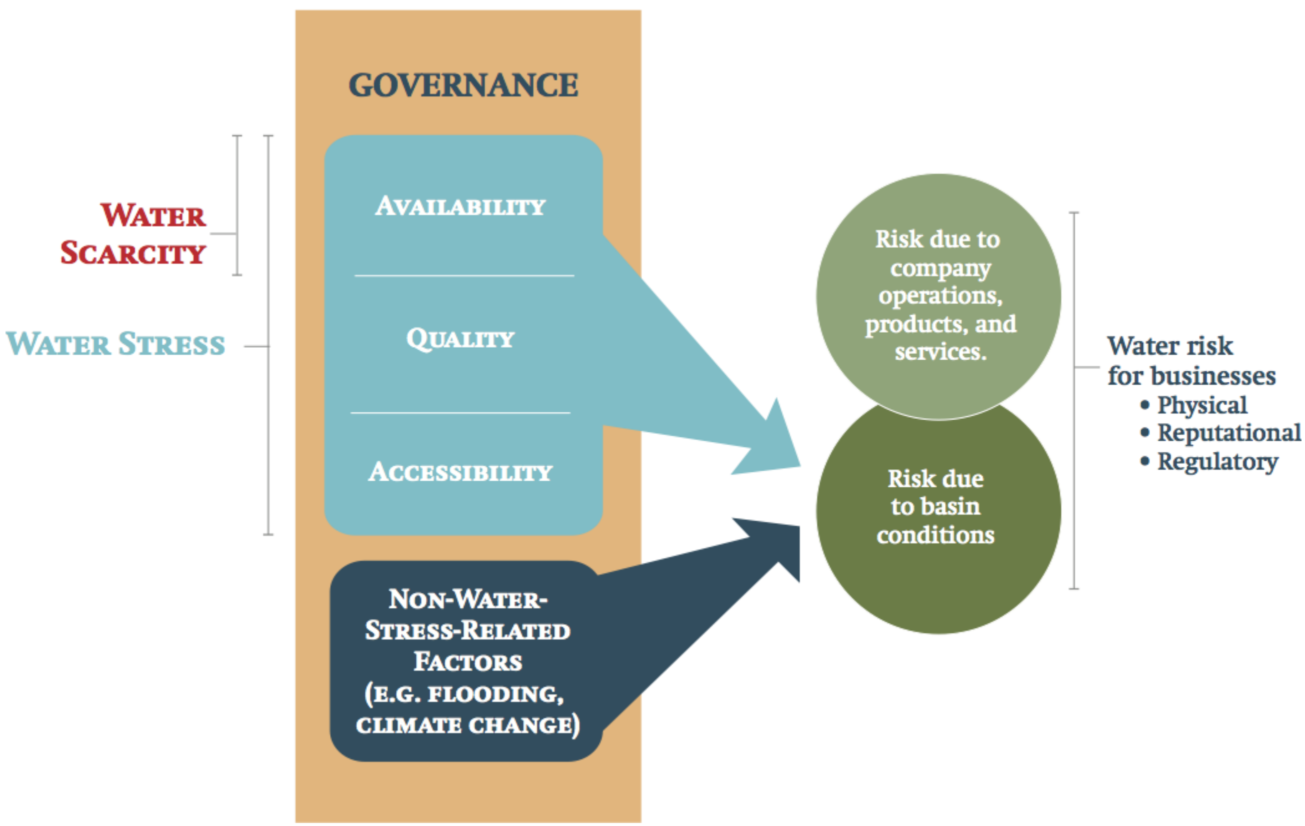


Figure 1: How key concepts and terms related to one another

[2] For a more in-depth description and explanation of the terms "consumption" and "withdrawals", see Appendix A.

Water scarcity

"Water scarcity" refers to the volumetric abundance, or lack thereof, of freshwater resources. "Scarcity" is human-driven; it is a function of the volume of human water consumption relative to the volume of water resources in a given area. As such, an arid region with very little water, but no human water consumption would not be considered "scarce," but rather "arid." Water scarcity is a physical, objective reality that can be measured consistently across regions and over time. Water scarcity reflects the physical abundance of fresh water rather than whether that water is suitable for use. For instance, a region may have abundant water resources (and thus not be considered water scarce), but have such severe pollution that those supplies are unfit for human or ecological uses.

Tool developers and organizations differ on whether environmental water requirements should be included when assessing water scarcity. Water Footprint Network (WFN), for example, takes environmental water requirements into consideration when calculating water scarcity, whereas other organizations do not and rather opt to address environmental water requirements in their respective approaches to characterizing water stress.

Water stress

"Water stress" refers to the ability, or lack thereof, to meet human and ecological demand for fresh water. Compared to scarcity, "water stress" is a more inclusive and broader concept. It considers several physical aspects related to water resources, including water availability, water quality, and the accessibility of water (i.e., whether people are able to make use of physically-available water supplies), which is often a function of the sufficiency of infrastructure and the affordability of water, among other things. Both water consumption and water withdrawals provide useful information that offers insight into relative water stress. There are a variety of physical pressures related to water, such as flooding, that are not included in the notion of water stress. Water stress has subjective elements and is assessed differently depending on societal values. For example, societies may have different thresholds for what constitutes sufficiently clean drinking water or the appropriate level of environmental water requirements to be afforded to freshwater ecosystems, and thus assess stress differently.

In contrast to other available water risk assessment tools, WFN's Water Footprint Assessment Tool does not use the term "water stress", but instead identifies water-challenged regions (sometimes referred to as "hot spots") based on water scarcity, water pollution levels, benchmarks, (i.e., where the water consumption can be reduced or avoided for reasonable cost) and indicators of social equity. It can be understood that these hot spots are areas experiencing water stress.

Water risk

"Water risk" refers to the possibility of an entity experiencing a water-related challenge (e.g., water scarcity, water stress, flooding, infrastructure decay, drought). The extent of risk is a function of the likelihood of a specific challenge occurring and the severity of the challenge's impact. The severity of impact itself depends on the intensity of the challenge, as well as the vulnerability of the actor.

Water risk is felt differently by every sector of society and the organizations within them and thus is defined and interpreted differently (even when they experience the same degree of water-related challenges). That notwithstanding, many water-related challenges create risk for many different sectors and organizations simultaneously. This reality underpins the notion of what some refer to as "shared water risk" that suggests that different sectors of society have a common interest in understanding and addressing shared water-related challenges. However, some contest the appropriateness of this term on the basis that risk is felt uniquely and separately by individual entities and is typically not shared, per se.

“Water risk for businesses” refers to the ways in which water-related challenges potentially undermine business viability. It is commonly categorized into three inter-related types:

- *Physical* – Having too little water, too much water, water that is unfit for use, or inaccessible water
- *Regulatory* – Changing, ineffective, or poorly-implemented public water policy and/or regulations
- *Reputational* – Stakeholder perceptions that a company does not conduct business in a sustainable or responsible fashion with respect to water

“Water risk for businesses” is also sometimes divided into two categories that shed light on the source of that risk and therefore what types of mitigation responses will be most appropriate:

- *Risk due to company operations, products, and services* – A measure of the severity and likelihood of water challenges derived from the way in which a company or organization, and the suppliers from which it sources goods, operate and how its products and services affect people and ecosystems.
- *Risk due to basin conditions* – A measure of the severity and likelihood of water challenges derived from the watershed/basin context in which a company or organization and/or its suppliers from which it sources goods operate, which cannot be addressed through changes in its operations or its suppliers and requires engagement outside the fence.

If a company experiences a high degree of water-related risk due to company operations then it likely will seek to implement water efficiency, wastewater treatment, and other improvements in its own facilities or through its suppliers in response. However, if a company primarily experiences risk due to basin conditions then such operational measures would likely not sufficiently address this risk. Because of this, the company might instead seek to collaborate with other interests in the basin to advance an aspect of sustainable water management (e.g., by facilitating water use efficiency in other water users or supporting infrastructure improvements).

Appendix D features a diagram developed by GIZ that further illustrates the underlying causes and effects of water risks for businesses, governments, and others.

The relationship between “water scarcity”, “water stress”, and “water risk”

Water scarcity is an indicator of a problem with water availability where there is a high ratio of water consumption to water resources in a given area. Water availability, water quality, and water accessibility are the three components that are comprised by water stress. As such, water scarcity and additional indicators (e.g., biological oxygen demand, access to drinking water) can be used to assess water stress. Scarcity and stress both directly inform one’s understanding of risks due to basin conditions. Companies and organizations cannot gain robust insight into water risk unless they have a firm understanding of the various components of water stress (i.e., availability, quality, accessibility), as well as governance and other non-water-related-stress factors. Figure 1 illustrates these relationships.

Applications and functionality

These terms are useful insofar as they help society and organizations understand the degree and nature of water-related challenges for a geographic region and make informed decisions on how to manage them. Below we describe some of the specific applications of each term and identify applications for which they are not typically well-suited.

Applications of "water scarcity"
Water scarcity (illustrated by the red text in Figure 1), at its core, serves as one way to assess and compare the health of river systems. Indeed, WFN's Water Footprint Assessment Tool, which aims to understand how water use by companies and others may affect the sustainability of a river basin (as opposed to assessing business risk), uses basins' relative water scarcity (and specifically "blue water scarcity") as a way of understanding where equivalent water footprints will have more severe impacts. Since scarcity is a relatively simple measure that reflects an objective reality, it is also useful as the basis of quantitative measurements and comparisons. However, this measurement alone is not an effective approximation for water risk, but rather is only one of many factors that contribute to and inform water risk for businesses.

Applications of "water stress"
Water stress (illustrated by the three light blue boxes in Figure 1) serves as a way of understanding where it is challenging to meet human and ecological demands for water. Since it addresses a wider range of factors, water stress is considered more useful than scarcity when evaluating water risk. As such, water stress is sometimes used as an approximation of areas that are likely to lead to water risk, especially when a more comprehensive assessment of qualitative risk factors is not available. The WRI Aqueduct tool, for example, uses water stress as a key factor in understanding where companies might face water risk. Similarly, WWF Water Risk Filter accounts for water scarcity, pollution, and impacts on ecosystems when assessing physical water risk. WFN's Water Footprint Assessment Tool combines blue water scarcity and water pollution levels, in addition to water use efficiency benchmarks to identify hot spots or basins with water stress, which can also indicate where companies might face water risk.

However, since stress is a somewhat subjective concept and our ability to comprehensively measure it scientifically and consistently is limited, using water stress as the basis of sound quantitative comparison is not possible at present. That said, it may be possible to develop simplified proxy measures that indicate areas that would generally be thought of as water stressed, based on more easily-quantifiable metrics. This would greatly improve its utility in disclosure and communications settings.

Application of "water risk"
Water risk (illustrated by the green circles in Figure 1) serves as a comprehensive compilation of the ways water-related challenges may affect specific businesses, governments, communities, and others. Because of this, by definition, it is the most useful term to use as the basis of decision-making and strategy planning geared toward supporting business viability, if effectively assessed and understood. However, robust water risk assessment requires a wide range of robust information and analysis. Various dimensions that inform water risk are elusive to measure with scientific certainty due to their complexity and inherent subjectivity. Thus, water risk, at the moment, is mostly an anecdotal approach, as opposed to a scientific approach, and is not well-suited for quantitative comparison. It may also be too complex for typical communications and awareness raising efforts. Risk encapsulates some factors that affect business viability, but that do not necessarily affect the degree to which a basin is managed sustainably. For example, if infrastructure delivering water to a company facility is insufficient or damaged, the company may not be able to operate optimally (and thus face risk), but the basin will likely be unaffected. As such, risk is not necessarily the most helpful concept for driving water sustainability in specific basins.

Areas of further inquiry

Despite numerous areas of emerging alignment, this discussion to date has also revealed areas where participating organizations interpret and conceptualize water terminology differently. Understanding these areas of divergence is important in understanding related tools appropriately and communicating water-related information in a more meaningful manner. It also shines a light on priority areas for future discussion before shared understanding of key terms can be achieved in the corporate water stewardship space. Questions for which there is no consensus as of yet include:

- What is meant by “water security”? How does “security” relate to “water scarcity”, “water stress”, and “water risk”?
- How do environmental water requirements relate to and inform “water scarcity” and “water stress”?
- In the absence of location-specific environmental water requirements, is it helpful to use a generalized approach to understanding sufficient volumes of water for environmental purposes? If so, what might this approach look like?
- How does “economic efficiency” relate to the concepts presented in this work?
- What is the relationship between allocations and “accessibility”? Does social equity fit within the notion of accessibility? How?
- To be considered “stressed”, does an area have to be deficit in all three components or just one? For example, is a region with very poor water quality, but sufficient water availability and accessibility considered stressed?

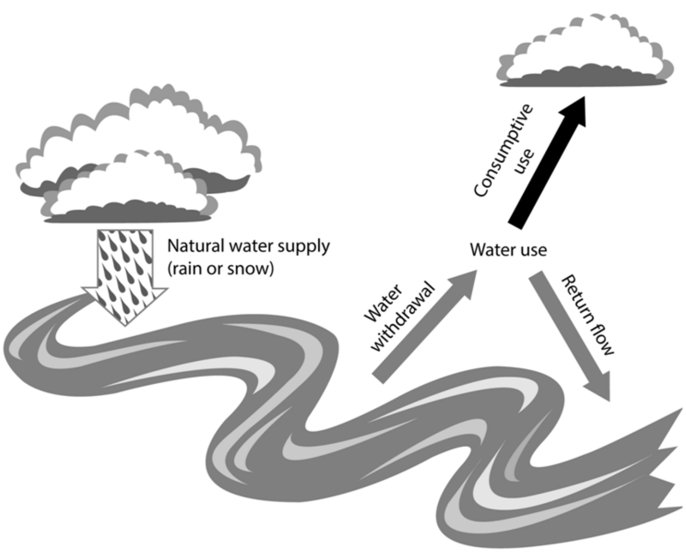
Appendix A: Explaining water "consumption" and "withdrawal" and the relationship between them

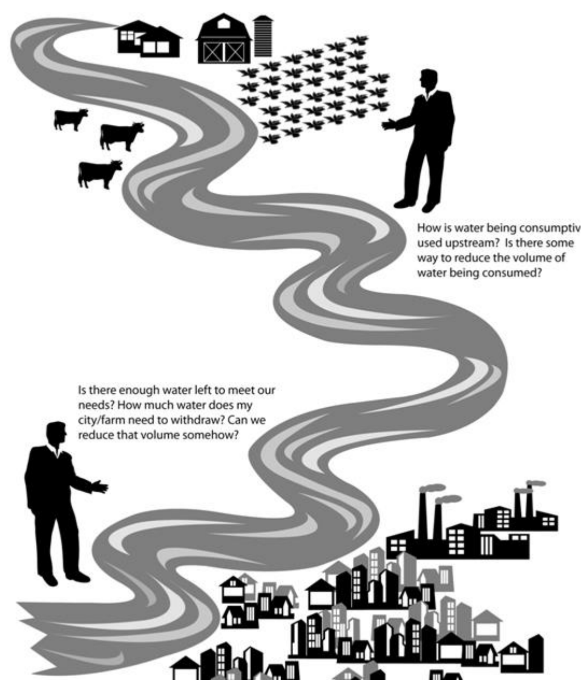
In this document, we assert that, depending on whether one is assessing "scarcity" or "stress", different approaches to understanding water demand might be more or less appropriate. Specifically, we state that water "consumption" is most appropriate when trying to understand water "scarcity" and that both "consumption" and "withdrawal" can provide meaningful information on the relative extent of water "stress". This appendix explains and further unpacks these terms for those unfamiliar with them.

- <u>Water withdrawals:</u> The volume of freshwater extracted from a surface or groundwater source, without accounting for how much is returned to the freshwater source after use.
- <u>Water consumption (also known as consumptive use of water):</u> The volume of water that is extracted (withdrawn) from a freshwater source and *not returned* to that source after use. Water is consumed due to evaporation or being incorporated into a product. For example, water that is used as an ingredient in a beverage and therefore does not return to the basin is considered to be consumed. Water is also considered to be consumed if it is returned to a different catchment or the sea.

Comparing the volume of "consumption" relative to available water resources allows one to understand how much water is remaining in the freshwater source, and is thus directly related to the concept of "scarcity". Additionally, understanding whether the volume of "withdrawals" exceeds available water resources in a given area, sheds light on whether this is enough water to meet human and ecological demand, thus the usefulness of both "consumption" and "withdrawals" in understanding "stress". Figures 2 and 3, reprinted with permission from the book *Chasing Water* by Brian Richter (Island Press 2014), illustrate this difference.

Figures 2[3] and 3





[3] Figure 2 is meant to illustrate the differences between water withdrawals and water consumption in the most basic sense. As such, it does not include some ways which water can be consumed (e.g., being included in a product or sent to another basin).

Appendix B: Existing and evolving definitions of "scarcity" and "stress"

This discussion paper came out of the realization that past uses of the terms "water scarcity", "water stress", and "water risk" have conflicted with one another and that these terms are often used interchangeably. This appendix sheds light on an overview of how these terms have been used in the past and continue to be used by some in order to provide further background and context.

Key concepts related to scarcity and stress

The first and most basic conceptions of water scarcity/stress measure the extent to which sufficient water resources physically exist in a specific location, sometimes referred to as physical water scarcity. Physical water scarcity has been measured in two different general ways:

1. Volume of water available per capita: The most commonly used (at least until recent years), and perhaps most crude, measure of water stress/scarcity is known as the Falkenmark Indicator developed in 1989. This measure divides the volume of renewable fresh water in a country by the national population to calculate the volume of water available per capita.
2. Proportion of available water in a region that is actually being used[4]: A slightly more sophisticated approach to measuring scarcity/stress compares the abundance of renewable fresh water in an area to the actual volume of water used (sometimes based on water withdrawals and sometimes based on consumption) in that area. This measure, sometimes referred to as the "withdrawal-to-availability (WTA) ratio" or "criticality ratio", allows for an understanding of the proportion of available water in a region that is being used.

However, within these two broad conceptions of physical water scarcity, there are a number of different variables and layers of complexity that can be used to create quite different calculations, including:

- Water quality / pollution: In some cases, excessive pollution makes physically-available water unsuitable for human or environmental uses. Increasingly, water stress indices are trying to account for the quality of water when assessing a region's water supply.
- The inclusion of man-made freshwater sources (e.g., desalination plants): These measurements sometimes consider man-made water sources, though this is typically a quite small proportion of overall supply.
- The inclusion of environmental water requirements: Acknowledging that water scarcity is closely associated with ecosystem degradation and other environmental challenges, more sophisticated approaches to physical water scarcity consider the extent to which environmental water requirements are met. In short, a proportion of the water available in a region is not included as water available for human uses, as it is needed to fulfil environmental uses.
- Rate of population growth: Some measures assess the extent to which water demand will continue to grow based on population growth and other factors, assuming countries with faster population growth rate (and therefore faster growing water demand) will likely have a more difficult time coping with increasing levels of water scarcity.

Water scarcity/stress methodologies also often vary with respect to geographic and temporal granularity. However, it appears that it is widely-accepted that more granular geographic and temporal assessments are preferable. The existence of methodologies and tools that use country-level and annual

[4] The definition of "water scarcity" put forth in this discussion paper is closely related to the notion of WTA or criticality ratios.

assessments, as opposed to sub-basin-level and monthly assessments, is largely a function of lacking data and the complexity of assessment required.

In addition to the relative abundance of freshwater resources in a specific location, water scarcity/stress indicators are increasingly trying to understand the extent to which water users have sufficient access to that water. When a country or region is thought to be unable to meet water demand without investment in water efficiency and infrastructure despite physically-abundant supplies, it is deemed to be "economically water scarce."[5] Symptoms of economic water scarcity include inadequate infrastructure, such that people do not have enough water for agriculture and domestic purposes; high vulnerability to seasonal water variability; and inequitable distribution of water resources.

Economic water scarcity/accessibility has been measured in at least two ways:

- Current level of access: Some methodologies seek to understand what proportion of the population has access to sufficient water resources and services in order to understand the extent to which demand is met.
- Capacity: Others seek to measure society's ability to manage water resources and/or adapt to changing realities. In this context, capacity is often thought of as a function of the distribution of wealth, education, and governance, which is sometimes approximated by use of the UN Development Programme's Human Development Index.

Methods to define and measure economic water scarcity/accessibility are inherently complex and difficult to assess and are as of now largely under-developed. Well-known methodologies that consider economic water scarcity include the "water poverty index" and a widely-used approach developed by the International Water Management Institute (IWMI).

Differentiating between scarcity and stress

Though at times the terms "scarcity" and "stress" are used interchangeably, they are typically thought of as distinct concepts. The three primary ways in which existing definitions differentiate between these terms are:

- Different severity of challenge: Some existing definitions and systems think of "scarcity" and "stress" as different degrees of the same challenge. For example, under the Falkenmark Indicator, an area is thought to reach water stress when per capita water availability is below 1,700 cubic meters per person per year (based on an estimation of human water requirements), and to have reached scarcity when per capita water availability is below 1,000 cubic meters per person per year.
- Different nature of challenge: Others think of scarcity and stress as challenges that are distinct in nature (even if slightly) and consider different factors. For example, according to the European Environment Agency, scarcity refers to "long-term water imbalances, combining low water availability with a level of water demand exceeding the supply capacity of the natural system", whereas stress occurs when "the demand for water exceeds the available amount during a certain period or when poor quality restricts its use"
- Causal relationship: Others conceptualize water stress as the effects of water scarcity. For example, FAO AQUASTAT considers water stress to be "the symptoms of water scarcity or

[5] This discussion paper does not make use of the term "economic water scarcity". However, the term water "accessibility" – one of the three pillars of stress as defined in this discussion paper – is closely related to "economic water scarcity" and might be thought of as synonymous.

shortage, e.g. widespread, frequent and serious restrictions on use, growing conflict between users and competition for water, declining standards of reliability and service, harvest failures and food insecurity."

Existing definitions of scarcity and stress

The wide variety of methods to conceptualize water scarcity and stress has led to an abundance of different, sometimes conflicting definitions of these terms. Table 1 captures many of these existing definitions.

Table 1: Existing definitions and conceptions of "water scarcity" and "water stress"

Name / Organization	Term	Definition	Source
Water Footprint Network	Blue water scarcity	The ratio of blue water footprint to blue water availability where blue water availability is equal to natural flows minus environmental water requirements. Blue water scarcity varies within the year and from year to year.	Link
Water Footprint Network	Green water scarcity	The ratio of green water footprint to green water availability. Green water scarcity varies within the year and from year to year.	Link
European Union	Water scarcity	Water scarcity occurs where there are insufficient water resources to satisfy long-term average requirements. It refers to long-term water imbalances, combining low water availability with a level of water demand exceeding the supply capacity of the natural system	Link
FAO AQUASTAT	Water scarcity	A shortage of water supply of an acceptable quality; low levels of water supply, at a given place and a given time, relative to design supply levels. The shortage may arise from climatic factors, or other causes of insufficient water resources, a lack of, or poorly maintained, infrastructure; or a range of other hydrological or hydro-geological factors.	Link
ISO 14046	Water scarcity	Extent to which demand for water compares to the replenishment of water in an area, e.g. a drainage basin, without taking into account the quality	Link
Stefan Pfister – ETH Zurich	Water scarcity	Water scarcity relates to natural water availability and natural water needs. A situation is water scarce independent of the current water use or consumption.	
European Union	Water stress	Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use. Water stress causes deterioration of fresh water resources in terms of quantity (aquifer over-exploitation, dry rivers, etc.) and quality (eutrophication, organic matter pollution, saline intrusion, etc.)	Link
FAO AQUASTAT	Water stress	The symptoms of water scarcity or shortage, e.g. widespread, frequent and serious restrictions on use, growing conflict between users and competition for water, declining standards of reliability and service, harvest failures and food insecurity.	Link
WRI AQUEDUCT	Baseline water stress	The annual water withdrawals divided by the mean of available blue water. Baseline water stress measures the level of competition for available water, and estimates the degree to which freshwater availability is an ongoing concern	Link
Stefan Pfister – ETH Zurich	Water stress	Water stress is a function of use and availability and can be caused by degradative as well as consumptive use. The stress is induced by human activities and can occur in scarce and water abundant regions. It does not account for mitigation capability/vulnerability of the population as this is how the stress impacts ecosystem and/or humans.	

Appendix C: How different water assessment tools make use of "water scarcity", "water stress", and "water risk" at present

While originally "water stress" was used to refer strictly to the physical availability (or lack thereof) of fresh water, use of this term has evolved over time to sometimes include a variety of different considerations. This evolution has continued to the point that some tools and initiatives increasingly using "water stress" and "scarcity" as umbrella terms describing the relative severity of water-related challenges in a specific location. However, at the same time, some tools, especially those dealing with corporate water assessment, use "water risk" as an umbrella term for the relative severity of water-related challenges in a given area, with "water stress" as but one of several components of this measure. Here we unpack existing uses of these terms among existing corporate water assessment tools.

The primary corporate water assessment tools use these terms as follows:

- GEMI Local Water Tool: Asks users to self-assess "external stress severity levels" around their facility using a variety of different parameters, including water availability (i.e., supply per capita), water quality, access to water services, incidence of drought, and others.
- WRI Aqueduct: Assesses local "water risk" by looking at a variety of indicators, including upstream storage, ecosystem services, access to improved services, water quality, as well as "baseline water stress". In this context, "baseline water stress" is used to refer specifically to the ratio of water withdrawals to water availability annually.
- WWF DEG Water Risk Filter: Uses "scarcity" as a term to refer broadly to physical water quantity challenges, including availability (i.e., the ratio of water consumption to water supply), incidence of droughts, and incidence of floods. "Scarcity" is used as one component to evaluate "physical water risk." Pollution, access to water services, ecosystem vulnerability, and the sophistication of water-related legal frameworks, are used to inform a more comprehensive "basin water risk" assessment.
- WBCSD Global Water Tool: Unlike many other tools, the GWT does not put forth one methodology for assessing conditions, but rather offers a variety of different datasets that can help companies understand the watersheds and countries in which they operate. For this reason, the GWT typically uses "stress" in reference to existing methodologies such as the Mean Annual Relative Water Stress Index. It also uses "stress" and "scarcity" to indicate different levels of severity for water challenges. All of these metrics are designed to help companies better understand their "water risk".
- WFN Water Footprint Assessment Tool: Following the Water Footprint Assessment methodology developed by WFN, the WFA Tool uses blue water scarcity and water pollution levels of river basins and water footprint benchmarks of specific processes to assess the sustainability of a water footprint. The sustainability assessment can be done for a single or multiple facilities, the agricultural supply chain, a product or a company. It does not make use of the terms "water stress" or "water risk".

Table 2 further describes and unpacks the datasets and terminology underpinning these tools.

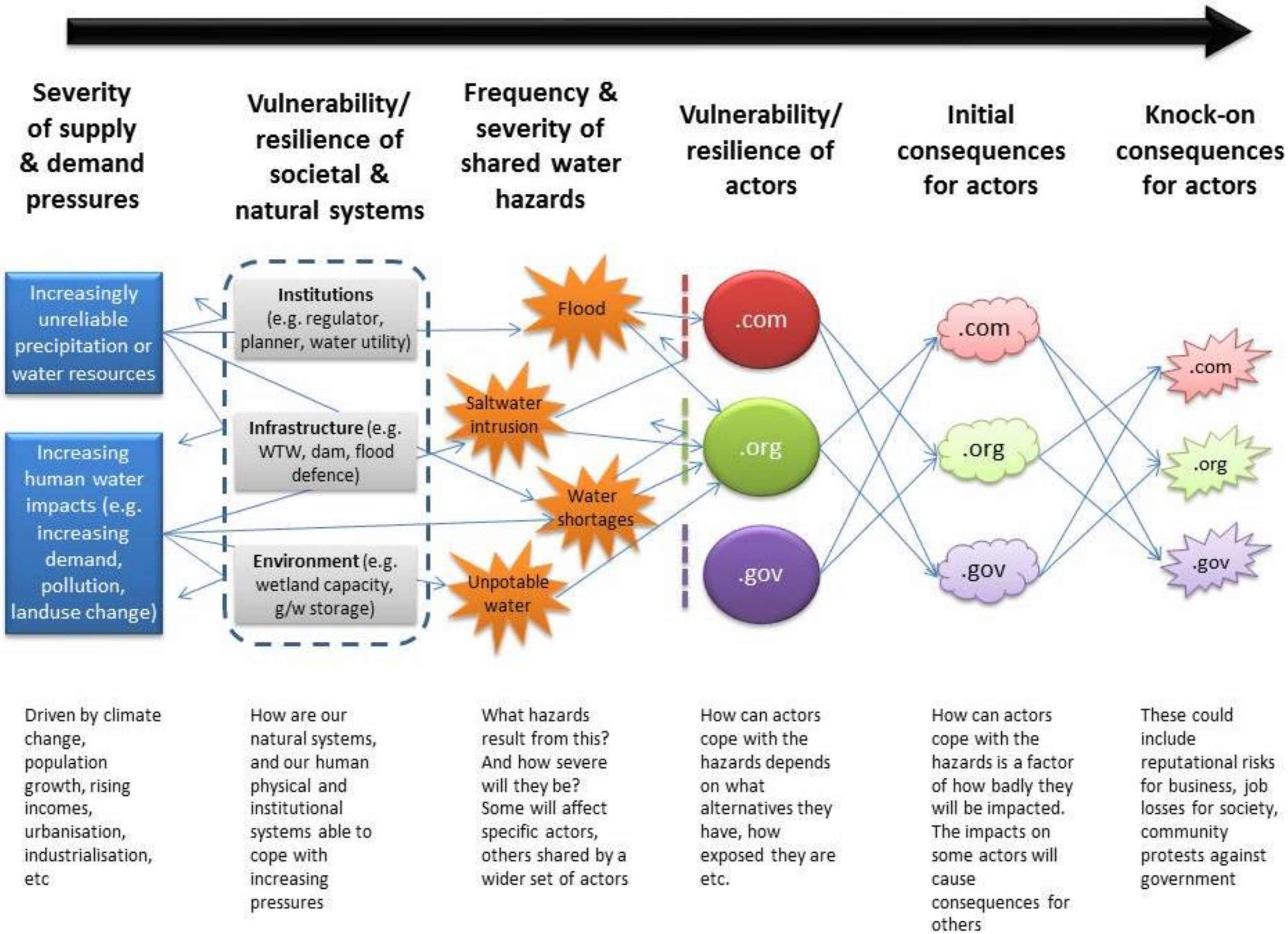
Table 2: Concepts and data underpinning existing corporate water assessment tools

<table>
<tr><th></th><th>WBCSD Global Water Tool</th><th>WRI Aqueduct: Stress</th><th>WRI Aqueduct: Risk</th><th>GEMI Local Water Tool</th><th>WWF/DEG Water Risk Filter: Scarcity</th><th>WWF/DEG Water Risk Filter: Basin-related Risk</th><th>WFN Water Footprint Assessment Tool</th></tr>
<tr><td>Water resources</td><td>• Mean average runoff
• Aquifer recharge</td><td>Mean average runoff</td><td>Mean average runoff</td><td>• Mean average runoff
• Pollution
• Droughts</td><td>• Mean average runoff minus environmental flows
• Droughts
• Floods</td><td>• Mean average runoff minus environmental flows
• Droughts
• Floods</td><td>• Natural average runoff minus environmental flows
• Ambient water quality requirements</td></tr>
<tr><td>Water demand</td><td>• Population (per capita availability)
• Total withdrawals</td><td>Withdrawals</td><td>Withdrawals</td><td>Population (per capita availability)</td><td>Consumption</td><td>Consumption</td><td>Consumption</td></tr>
<tr><td rowspan="2">Geographic scale</td><td rowspan="2">• Basin-level
• Country-level
(depending on metric)</td><td rowspan="2">Basin and sub-basin level</td><td rowspan="2">Basin and sub-basin level</td><td rowspan="2">Facility vicinity</td><td>• Basin-level (sub-basin to be added in 2014)
• Grid-level
(depending on metric)</td><td>• Basin-level (sub-basin to be added in 2014)
• Grid-level
• Country-level
(depending on metric)</td><td rowspan="2">Basin-level (sub-basin to be added in 2014)</td></tr>
<tr><td colspan="2">Agricultural risk assessment: User can choose between basin/grid- and country-level in basin risk assessment</td></tr>
<tr><td>Temporal scale</td><td>Annual</td><td>Annual</td><td>Inter-annual and seasonal variability</td><td>Recent/Seasonal</td><td>Monthly</td><td>Monthly</td><td>Monthly</td></tr>
<tr><td>Future projections</td><td>Yes (for 2025 and 2050)</td><td>Yes (for 2025, 2050, and 2095)</td><td>Unclear</td><td>Assesses future reliability based on projected population, industrial, and electrification growth, as well as agricultural demand and</td><td>Forecasted impact of climate change</td><td>Forecasted impact of climate change</td><td>No</td></tr>
</table>

	WBCSD Global Water Tool	WRI Aqueduct: Stress	WRI Aqueduct: Risk	GEMI Local Water Tool	WWF/DEG Water Risk Filter: Scarcity	WWF/DEG Water Risk Filter: Basin-related Risk	WFN Water Footprint Assessment Tool
				impacts of climate change			
Access to water resources and services	Yes (assessed separately, based on access to improved services)	No	Yes (assessed based on access to improved services)	Yes (assessed based on access to safe drinking water and water for food production)	No	Yes (assessed based on access to safe drinking water and improved sanitation)	No
Adaptive capacity	No	No	Yes, using upstream storage as proxy	No	No	• Water strategy of local, national and upstream governments • Sophistication and clarity of water-related legal framework	No

Appendix D: The causes and effects of water risks for businesses, governments, and others

Figure 2 features a diagram developed by GIZ that illustrates the causes and effects of water risks for businesses, governments, and others.



References

Alcamo, J; T. Henrichs, and T. Rosch. 2000. *World Water in 2025: Global modeling and scenario analysis for the World Commission on Water for the 21st Century*. Kassel World Water Series Report No. 2, Center for Environmental Systems Research, Germany: University of Kassel, 1-49. Accessed on June 9, 2014 at http://ncsp.undp.org/document/world-water-2025-global-modeling-and-scenario-analysis-21st-century-alcamo-j-henrichs-t-and

Alcamo, J. and Henrichs, T. 2002. *Critical regions: A model-based estimation of worldwater resources sensitive to global changes*. Aquatic Sciences, Vol. 64, no 4, pp352–362. http://link.springer.com/article/10.1007%2FPL00012591 (accessed June 9, 2014)

Alcamo, J., Florke, M., Marker, M. 2007. *Future long-term changes in global water resources driven by socio-economic and climatic changes.* Journal of Hydrological Sciences: Vol. 52, No. 2, pp. 247-275.

Brown, A. and M.D. Matlock. 2011. *A review of water scarcity indices and methodologies*. University of Arkansas. The Sustainability Consortium White Paper #106. Accessed on June 9, 2014 at http://www.sustainabilityconsortium.org/wp-content/themes/sustainability/assets/pdf/whitepapers/2011_Brown_Matlock_Water-Availability-Assessment-Indices-and-Methodologies-Lit-Review.pdf

Falkenmark. M. 1989. *The massive water scarcity threatening Africa -why isn't it being addressed*. Ambio 18, no. 2: 112-118.

Hoekstra, A.Y., Mekonnen, M.M., Chapagain, A.K., Mathews, R.E. and Richter, B.D. 2012. *Global monthly water scarcity: Blue water footprints versus blue water availability*. PLoS ONE 7(2): e32688. Accessed on June 9, 2014 at http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0032688

Molden, D. 2007. *A comprehensive assessment of water management in agriculture*. International Water Management Institute, Colombo, Sri Lanka. Accessed on June 9, 2014 at http://www.iwmi.cgiar.org/assessment/

Ohlsson, L. 2000. *Water conflicts and social resource scarcity*. Phys. Chem. Earth 25, no. 3: 213-220. Accessed on June 9, 2014 at http://www.sciencedirect.com/science/article/pii/S146419090000006X

Smakhtin, V.; Revenga, C.; and Döll, P. 2004.*Taking into account environmental water requirements in global-scale water resources assessments*. Comprehensive Assessment Research Report 2. Colombo, Sri Lanka: Comprehensive Assessment Secretariat. Accessed on June 9, 2014 at http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/4649/CARR2.pdf?sequence=1