Metadata Sheet Template

Title:	**Human Water Stress**
Indicator Number:	*2*
Cluster:	*Water quantity*
Rationale:	Water scarcity is a, if not the, *key* limiting factor to development in many transboundary basins. Water stress can be caused by a combination of increasing demands from different sectors and decreasing supply due climate change-related variability. Human water stress has been defined in a number of different ways since Falkenmark (1989, Rijsbeman 2005).
Interlinkages:	GW (some of the renewable water supply is available from aquifers) (and many non-renewable sources), Lakes (this is also a reflection of the pressure on lake water), LMEs (indication of the quantity of water likely to reach the coast).
Description:	This indicator deals with the quantity of water available per person per year relative to the internal and upstream area water supplies, on the premise that the less water available per person, the greater the impact on human development and well-being, and the less water there is available for other sectors. Water benefits must be defined not only by the locally generated runoff but also by remote runoff transported horizontally through river corridors as discharge often across international borders. Along the way the supply can be withdrawn, depleted, redirected, and/or polluted, thus setting-up constraints on the accessible water resource system or potential for human water stress. Therefor we have constructed three indicators of human water stress to address the differents facets of water supply, water use/withdrawals and impacts on water supplies by human induced stressors: *a.) Renewable Water Supply, b.) Relative Water Use, and c.) Delimited Availability*. All data are computed in 30' latitude-longitude (i.e., 0.5° degree) gridded format in the Geographic projection over the TFDD basin-country-unit transboundary basin regions.
Metrics:	Center for International Earth Science Information Network (CIESIN)/Columbia University, International Food Policy Research Institute (IFPRI), The World Bank, and Centro Internacional de Agricultura Tropical (CIAT), 2011. Global Rural-Urban Mapping Project, Version 1 (GRUMPv1): Population Count Grid. NASA Socioeconomic Data and Applications Center (SEDAC), Pallisades, NY. Charles J. Vörösmarty, Pamela Green, Joseph Salisbury, and Richard B. Lammers Global water resources: Vulnerability from climate change and population growth. *Science* 289: 284-288 (in Reports). Charles J. Vörösmarty, C. Leveque, C. Revenga (Convening Lead Authors) Coordinating Lead Authors: Chris Caudill, John Chilton, Ellen M. Douglas, Michel Meybeck, Daniel Prager, 2005. Chapter 7: Fresh Water. In: Millennium Ecosystem Assessment, Volume 1: Conditions and Trends Working Group Report. Island Press. Charles J. Vörösmarty, Ellen M. Douglas, Pamela A. Green, and Carmen Revenga. Geospatial Indicators of Emerging Water Stress: An Application to Africa, *Ambio*, 34 (3): 230-236, 2005b.

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Malin Falkenmark. "The massive water scarcity threatening Africa-why isn't it being addressed." Ambio 18, no. 2 (1989): 112-118.
Malin Falkenmark. "Rapid Population Growth and Water Scarcity: The Predicament of Tomorrow's Africa." Population and Development Review (Population Council) 16 (1990): 81-94.
Malin Falkenmark and C Widstrand. Population and Water Resources: A Delicate Balance. Population Bulletin, Population Reference Bureau, 1992.
Lila Warszawski, Katja Frieler, Veronika Huber, Franziska Piontek, Olivia Serdeczny, and Jacob Schewe, The Inter-Sectoral Impact Model Intercomparison Project (ISI–MIP): Project framework, PNAS 2014 111 (9) 3228-3232; published ahead of print December 16, 2013, doi:10.1073/pnas.1312330110.
Wisser D, Fekete BM, Vörösmarty CJ, Schumann AH (2010) Reconstructing 20th century global hydrography: a contribution to the Global Terrestrial Network- Hydrology (GTN-H). Hydrol Earth Sys Sci 14:1-24.

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<td>Computation:</td>
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1. Renewable Water supply: Computed as the internal water supplies available to the region divided by the total population in the region.
Water Supply in region / Number of people in region
Where Water Supply in region = sum of volume of discharge generated locally in the TFDD basin-country-unit regions (long-term annual average discharge over years 1971-2000 from ISI-MIP Project Warszawski et al 2013; Wisser et al 2010); Number of people in region = sum of local gridded population (GPW3, CIESIN 2011) for year 2010 in TFDD basin-country-unit regions.
Sub-indicator was ranked according to five relative risk categories from very low to very high based on scientifically agreed thresholds (Falkenmark 1989, 1990; Falkenmark and Widstrand 1992; Vorosmarty et al 2000, 2005) as noted below:
<table>
<tr><th></th><th>Relative risk categories</th><th>m3/person/yr</th></tr>
<tr><td>1</td><td>Very low</td><td>> 1,700</td></tr>
<tr><td>2</td><td>Low</td><td>1,300 – 1,700</td></tr>
<tr><td>3</td><td>Moderate</td><td>1,000 – 1,300</td></tr>
<tr><td>4</td><td>High</td><td>500 – 1,000</td></tr>
<tr><td>5</td><td>Very high</td><td>< 500</td></tr>
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2. Relative water Use: Computed as the mean annual withdrawals (by sectoral
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and total water use) divided by internal and upstream water supplies available to the region.

Total Water Withdrawals in region / Water Supply in region

Where ***Total Water Withdrawals in region*** **= sum of** volume of water withdrawals (km^3/yr) from the domestic, electricity production, manufacturing and agricultural sectors for year 2010 (from ISI-MIP Project, Warszawski et al 2013) in the TFDD basin-country-unit regions**; Water Supply in region** = sum of volume of discharge generated locally in the TFDD basin-country-unit regions (long-term annual average discharge over years 1971-2000 from ISI-MIP Project Warszawski et al 2013; Wisser et al 2010).

Sub-indicator was ranked according to five relative risk categories from very low to very high based on scientifically agreed thresholds (Falkenmark 1989, 1990; Falkenmark and Widstrand 1992; Vorosmarty et al 2000, 2005) as noted below:

	Relative risk categories	**Ratio water Demand/Supply**
1	Very low	< 0.1
2	Low	0.1-0.2
3	Moderate	02.-0.4
4	High	0.4-0.8
5	Very high	> 0.8

Combined Indicator is defined as the greater ranking category of the two sub-indicators.

Units: *See description*

Scoring system: *As per UNEP-DHI scoring definitions*

Limitations:

- Does not consider water quality explicitly, though it can be compared to the aggregate inland water threat mapping, as well as the water quality subcomponents thereof (Vörösmarty et al. 2010) . The level of water stress may also be impacted by the water quality, as the available water needs to be of a certain standard fit for the required use. This indicator can be compared with the water quality indicators.
- Does not explicitly consider water demands from the domestic and industrial sectors (though could do depending on withdrawal dataset to be used (to be coordinated with CESR).
- To maintain the integrity of the approach, only results for basins greater than 25,000 – 30,000 km^2 can be provided with a scientifically credible level of certainty. Results for basins smaller than 25,000 – 30,000 km^2 may be provided, though either using a different (higher resolution) approach, or produced with a higher degree of uncertainty.

	The higher resolution approach could involve the construction of basin-specific high resolution stream networks (based on Hydrosheds on the order of km in length scale) or the simulation of composite hydrologic behaviors integrating the behavior of the full basin or major tributaries. In either case, there would be mismatches with several of the underlying data sets for which the remainder of the TWAP analysis is configured (i.e., 30' L/L). Alternative resampling or downscaling would need to be explored. Reconciling these inconsistencies, in order to establish the level of trust in the outputs will require additional analysis.
Spatial Extent:	Global
Spatial Resolution:	30- X 30-min Lat X Lon
Year of Publication:	2010
Time Period:	2000
Additional Notes:	
Date:	April 23, 2014
Format:	Excel Spreadsheets
File Name:	TWAP_RB_indicator_2-HumanWaterStress_results_201404
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