River Basins TWAP
TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

UNEP gef

Metadata Sheet: Agricultural Water Stress
(Indicator No. 3)

Title:	***Agricultural water stress***
Indicator Number:	*3*
Thematic Group:	*Water Quantity*
Rationale:	*Throughout history, agriculture has been an important user of water resources. Today, agriculture accounts for approximately 70 per cent of all water abstraction worldwide (FAO statistics 2012), of which most of the water is withdrawn for irrigation purposes. In the year 2000, more than 30% of the global crop production was generated on irrigated areas, which account for almost 24% of the total global cropland (Portmann et al. 2011). Consequently, the impact of agriculture on global water resources is large and often the main originator for the appearance of water stress.* *Higher levels of irrigation will generally indicate higher levels of water withdrawal, less available water for other sectors, and potential vulnerability to decreases in rainfall as a result of climate change. On the other hand, agriculture is important for food security and livelihoods in many countries, and can be a key source of export income. Indeed, agriculture is the most important economic sector in many developing countries.* *The Agricultural Water Stress indicator identifies agricultural water stress of agricultural land under irrigation. Here, the irrigation consumption-to-availability(c.t.a.) ratio is applied for estimating agricultural water stress. In a further step, the share of groundwater being used for irrigation purposes can be estimated (Siebert et al. 2010).The results of this indicator can be compared to the human and environmental water stress indicators to see which issue is likely to be of greatest importance to the basin in terms of water quantity.*
Interlinkages:	*GW: potential abstraction & recharge* *Lakes: potential abstraction & inflow* *LMEs: quantity of water output to LMEs*
Description:	Mean annual irrigation water consumption divided by the sum of mean annual runoff (MMR).
Metrics:	▪ Mean Annual Runoff (MAR) – 1971-2000 data computed by CESR based on WATCH meteorological input (Weedon et al., 2011) at 30 min. grid using the Global Hydrology sub-model of the WaterGAP 2.2 model (Müller Schmied et al 2014). ▪ Irrigation water consumption per gird cell for the climate normal period 1971-2000 (Alcamo et al. 2003, aus der Beek et al. 2010, Döll and Siebert 2002) considering latest available data on area equipped for irrigation. ▪ Area equipped for irrigation around the year 2005 (GMIAv5, Siebert et al. 2013)
Computation:	Calculation of indicator was done in following steps: 1. Mean annual irrigation water consumption per grid cell summed per basin/BCU 2. MAR computed per grid cell and summed up per basin/ BCU 3. Irrigation water consumption divided by MAR and calculated for each basin/ BCU. Simulation of underlying results: The amount of water required by irrigated crops depends on many factors. For this indicator, the global water model WaterGAP2.2 has been used to simulate net and gross irrigation water requirements for the climate normal period 1971-2000 based on climate, local topography, crop type, area equipped for irrigation, and the irrigation project efficiency (aus der Beek et al. 2010, Döll and Siebert 2002). In order to

simulate mean monthly runoff (MMR) for the climate normal period, the hydrological component of WaterGAP2.2 (Müller Schmied et al 2014) was applied. For both runoff and irrigation water use, the WATCH Forcing Data (WFD, Weedon et al. 2011) were used as input to drive WaterGAP2.2. All calculations were performed on a 30 arc minute grid cell raster and summed up to the BCUs.

By using this indicator, it is assumed that a drainage basin suffers from severe water stress if c.t.a. > 0.3 or, in other words, if irrigation consumption exceeds 30% of the reliable annual (or seasonal) water availability. A c.t.a. below 0.3 indicates low to moderate water stress. The thresholds are chosen arbitrarily, but have been derived from EEA (2003) which shows a figure for the water consumption index ranging from (almost) zero to 30% in Europe.

The agricultural water stress indicator has been calculated for all TWAP basins and BCUs which could be assigned on the WaterGAP2.2 grid cell raster (corresponding to a spatial extent of more than 2000 km2). However, here it is necessary to note that verified conclusions can only be drawn for transboundary basins > 25,000 km², broadly equivalent to 10 grid cells at the equator. Hence, results for smaller basins are provided but might contain a lower level of confidence.

Units: [million m³ water consumed per million m³ water available]

Scoring system:

Basins/ BCUs with the highest scores have the highest agricultural water stress. In relation to the c.t.a. ratio the following (relative) risk categorization was applied:

Relative risk category	Range (normalized score)	No. of Basins	Proportion of Basins	No. of BCUs	Proportion of BCUs
1 - Very low	0.00	59 (28*)	22%	166 (124*)	26%
2 - Low	0.01 – 0.05	156 (63*)	58%	344 (176*)	54%
3 - Moderate	0.06 – 0.20	30 (12*)	11%	66 (26*)	11%
4 - High	0.21 – 0.30	10 (2*)	3%	14 (5*)	2%
5 - Very high	>0.30	15 (2*)	6%	45 (12*)	7%

* Number of basins/BCUs for which results have been calculated, but bear a lower level of confidence due to modeling limitations

Category 5 indicates basins/ BCUs with very high levels of irrigation water consumption which leads to less available water for other sectors, and potential vulnerability to decreases in rainfall as a result of climate change. In addition, food security, export income and livelihoods might be threatened in basins/ BCUs of Category 5.

Limitations: Considers areas equipped for irrigation rather than real irrigated areas

Spatial Extent: Global (transboundary river basins)

Spatial Resolution: Basin country unit (BCU) + river basin scale

Year of Publication: -

Time Period: 1971-2000

Additional Notes:

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