Metadata Sheet: Hydropolitical Tension: Projected
Risk of Potential Hydro-political Tensions due to Basin Development in Absence of Adequate Institutional Capacity – projected scenario (Indicator No. 11 - projected)

Title:	**Risk of Potential Hydro-political Tensions due to Basin Development in Absence of Adequate Institutional Capacity – projected scenario**
Indicator Number:	*11 Projected*
Cluster:	*Governance*
Rationale:	The analysis of the history of past conflict and cooperation over water in transboundary basins suggests that some political, socioeconomic and physical circumstances could act as exacerbating factors and increase the risk of hydro-political tensions due to basin development in absence of institutional capacity (Wolf et al., 2003). The calculation of the projected scenario for the Hydropolitical Tension Indicator combines the results from the baseline indicator (11) with a set of exacerbating factors.
Interlinkages:	GW (results likely to be similar for lakes overlapping with transboundary river basins), Lakes (results likely to be similar for lakes overlapping with transboundary river basins)
Description:	Hazards scores are calculated based on a combination of 6 exacerbating factors (high or increased climate-driven water variability, recent trends in water reserves, risk of internationalization of basins due to presence of intrastate armed conflicts, presence of active international armed conflicts, recent history of non-cooperation over water and level of per capita income). Hazard scores from the exacerbating factors are added to the baseline indicator results to produce a projected indicator value at the BCU level.
Metrics:	▪ Climate-Driven Water Variability – Coefficient of Variation ▪ Sen's Slope – GRACE satellite. Monthly terrestrial water storage anomalies measurements obtained from the GRACE RL-05 (Swenson and Wahr, 2006; Landerer and Swenson, 2012) dataset from NASA's Tellus website (http://grace.jpl.nasa.gov). ▪ Risk of Internationalization – Minorities at Risk (MAR) Dataset, developed by the Center for International Development and Conflict Management (CIDCM). http://www.cidcm.umd.edu/mar/data.asp ▪ Armed Conflicts – UCDP/PRIO Dataset, developed by the Uppsala Conflict Data Program/International Peace Research Institute. http://www.pcr.uu.se/research/ucdp/datasets/ucdp_prio_armed_conflict_dataset/ ▪ Basins at Risk (BAR) Scale – Recent history of water events. Developed by Oregon State University http://www.transboundarywaters.orst.edu/database/interwatereventdata.html ▪ Gross National Income, GNI per capita, Atlas method (current US$), http://data.worldbank.org/indicator/NY.GNP.PCAP.CD and http://data.un.org/Default.aspx ▪ Weighting of Basin-Country Unit (BCU) values by population. Population values are taken from GPW v.3, 2010 projection. http://sedac.ciesin.columbia.edu/data/set/gpw-v3-population-density-future-estimates (CIESIN, 2005). ▪ Weighting of BCU values by area – GAUL shapefile using World Cylindrical Equal Area projection.

http://www.fao.org/geonetwork/srv/en/metadata.show?id=12691

Computation:

The computation of the projected indicator required the following steps to calculate BCU level scores:

1. Calculation of Climate-driven Water Variability Hazard Score (Change in Coefficient of Variation) – following Vörösmarty et al. (2005), the absolute values for coefficient of variation were grouped into three levels: 'low' (CV < 0.25) 'medium' (0.25 ≤ CV ≤ 0.75) and 'high' (CV > 0.75) variability. The change in the CV from 2000 to 2030 was then calculated. For BCUs where the CV was at the high level (3) in both years, the final water variability hazard score assigned was 1. Where CV was higher in 2030 than it was in 2000, the final water variability hazard score assigned was also 1. Otherwise, the final water variability hazard score assigned was 0 (Table 1).

Water variability	Water Variability Hazard Score
CV: No change (Med or Low) OR decrease	0
CV: High present & future OR increase	1

Table 1

2. Calculation of Sen's Slope Hazard Score[1] (Recent Trends in Water Resource Reserves). The Sen's Slope values range from -0.94 to 0.39. The values were grouped into two classes: stable and positive (>-0.1 to 0.39) and negative (≤-0.1 to -0.94). The threshold for the hazard score is -0.1 as shown in the Table 2.

Sen's Slope	Sens Slope Hazard Score
Stable or Positive (>-0.1 to 0.39)	0
Negative (≤-0.1 to -0.94)	1

Table 2

3. Calculation of Minorities at Risk (Risk of Internationalization) – In the CIDCM database, conflicts during the time period of 2004-2006 are recorded and coded by level of severity. All countries with a conflict severity values (FACTSEV1) equal or greater than 3 were marked as having a MAR score of 1. All BCUs within a country were assigned the same MAR value. All countries with no data were assigned a score of 0 as the MAR value (no conflict) (Table 3).

FACTSEV1 value	MAR Hazard Score
< 3	0
≥ 3	1

[1] Sens Slope values are calculated from GRACE satellite data, which provide an eleven-year record of monthly terrestrial water storage anomalies, changes in the vertical sum of water stored as snow, surface, soil and groundwater.

Table 3

4. Calculation of Armed Conflict / War Hazard Score – Within the UCDP/PRIO Armed Conflict Dataset, incidents were selected that occurred between years 2000 and 2013, and where both sides of the conflict included a government, either in a primary or secondary (supporting) role (SideA or SideA2nd and SideB or SideB2nd). All intensity levels (Int) were included. The War Hazard scores were assigned as per Table 4.

Armed Conflict 2000 to 2013 (UCDP/PRIO Dataset)	War Hazard Score
No occurrence	0
Occurrence	1

Table 4

5. Calculation of Basins at Risk (BAR) Hazard Score – The BAR average value was calculated for all events occurring between 2000 and 2008 in each BCU. Negative average values were given a BAR Hazard score of 1. Averages of 0 or greater were given a score of 0 (Table 5).

BAR scale Average (2000-2008 period)	BAR Hazard Score
≥ 0	0
< 0	1

Table 5

6. Calculation of Gross National Income Hazard Score – GNI for each country was calculated as an average of the five most recent years in the dataset: 2008-2012. The variable used was GNI per capita, Atlas method (current US$). Countries with GNI per capita greater than $1,035.00 were given a GNI Hazard score of 0. Countries below the threshold were given a score of 1 (Table 6).

GNI per capita, Atlas method (2008-2012 Average, current US$)	GNI Hazard Score
≥ 1035 $	0
< 1035 $	1

Table 6

7. The resulting six exacerbating factor hazard scores were added together. The sum was then used to convert the baseline indicator values (Hydropolitical Tension Indicator no. 11) to projected risk values based on Table 7. The final values range from 1 to 5, and Projected Risk Values higher than 5 are considered equal to 5.

Sum of Exacerbating Factors by BCU	**Effect on BASELINE RISK INDICATOR score of a BCU**		Projected Risk Value

0	Baseline Risk doesn't change
1	
2	+1 to Baseline Risk
3	
4	+2 to Baseline Risk
5	
6	

1 Low Risk
2
3
4
5 High Risk

* Final Risk Values > 5 are considered equal to 5

Table 7

8. To obtain basin scores, a weighted score was calculated for each BCU of the basin by taking an average of the area ratio and the population ratio (BCU area/population weight within basin). This BCU weight (in basin) was then multiplied by the projected indicator value for each BCU.
9. The basin score was calculated as the sum of the resulting BCU values for the respective basin.
10. The resulting basin scores were regrouped into 5 relative risk categories (Table 8). The resulting values represent the risk of potential hydro-political tensions due to basin development in absence of institutional capacity at a basin level.

Weighted Basin Risk Score	Relative Risk category
1.00-1.50	1 – Very Low Risk
1.51-2.50	2
2.51-3.50	3
3.51-4.50	4
4.51-5.00	5 – Very High Risk

Table 8

Units: *Unitless, risk categories*

Risk categorization

Basins with lower scores have lower levels of risk of potential hydro-political tension due to basin development in absence of institutional capacity

Relative risk category	Weighted Basin Risk Score	No. of Basins	Proportion of Basins	No. of BCUs	Proportion of BCUs
1 - Very low	1.00-1.50	37 (0*)	13%	107 (29*)	13.4%
2 - Low	1.51-2.50	44 (0*)	15%	129 (53*)	16.2%
3 - Moderate	2.51-3.50	153 (0*)	54%	400 (243*)	50.3%
4 - High	3.51-4.50	28 (0*)	10%	104 (36*)	13.1%
5 - Very high	4.51-5.00	24 (0*)	8%	56 (29*)	7.0%

* Number of basins/BCUs for which results have been calculated, but bear a lower level of confidence due to modeling/methodological limitations in climate change projections for future water variability.

Limitations: As with any global indicator, the factors considered to potentially exacerbate risk of transboundary tensions surely represent a simplification of the large number of

	factors that could have an impact on international relationships over water. For instance, issues such water quality degradation or intersectorial conflict between water uses (e.g. hydropower generation vs agriculture) are other important factors that do contribute to stain transboundary relationships and that are out of the scope of this indicator. The indicator is based on the assumption that institutional capacity in the future will be as it is at present, as there is no way to foresee how it will evolve in the future. However, often the negotiation and signature of new treaties is a process that can take several years so it can be assumed that the institutional context won't change drastically within the next 15 years, For two of the exacerbating factors (risk of internationalization of basins expressed by the presence of minorities involved in armed conflicts and conflict/cooperation over water) there could be situations of conflict or cooperation that occurred after the last update of the datasets used in the analysis.
Spatial Extent:	Global
Spatial Resolution:	BCU, basin
Year of Publication:	NA
Time Period:	NA
Additional Notes:	For data sources see 'Metrics' **<u>Cited Literature</u>** Landerer, F. W., and S. C. Swenson (2012), Accuracy of scaled GRACE terrestrial water storage estimates, Water Resour. Res., 48(4), W04531, doi:10.1029/2011wr011453. Swenson, S., and J. Wahr (2006), Post-processing removal of correlated errors in GRACE data, Geophys. Res. Lett., 33(8), L08402, doi:10.1029/2005gl025285. Vörösmarty, Charles J; Ellen M Douglas, Pamela A Green & Carmen Revenga (2005) Geospatial indicators of emerging water stress: An application to Africa. Ambio 34(3): 230(3):4 Wolf, A. T., Yoffe, S. B., and Giordano, M. 2003. International waters: identifying basins at risk. Water Policy. 5 (1): 29-60.
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