Metadata Sheet: Ecosystem Impacts from Dams
(Indicator No. 7)

Title:	***Ecosystem Impacts from Dams***
Indicator Number:	***7***
Thematic Group:	***Ecosystems***
Rationale:	*In addition to core geophysical and chemical indicators of water quantity and quality in international river basins, assessment of ecosystem state is also needed to fully evaluate basin condition. Drinking water quality, sustainable fisheries, and other basin services depend on the collective role of a diverse flora and fauna to maintain ecosystem function. While the aggregate impact of many stressors defines the state of modern river basins, one factor in particular was highlighted in recent work (Vörösmarty et al. 2010) as having a pre-eminent negative impact on aquatic biota: human management of water systems. And, among these management systems impoundment and reservoir operation was emblematic of stresses on aquatic ecosystems and resident biodiversity. The negative impacts on ecosystems of altering waterways through river fragmentation and flow disruption by dams, water transfers and canals must be considered for managing water resources in a sustainable way. It is no longer acceptable to draw water from nature for use in agriculture, industry, and everyday life without taking into account the role that ecosystems play in sustaining a wide array of goods and services, including water supply. Very large dams account for 85 per cent of registered water storage worldwide. In order to compensate for considering only the impacts of very large dams on river fragmentation and flow disruption, dam density has also been factored in this indicator.*
Interlinkages:	*GW (reduction in mean annual discharge due to impoundments may affect the amount of groundwater recharge), Lakes (reduction in the rate of sedimentation in lakes and reservoirs), LMEs (reduction in the amount of nutrients that reaches marine ecosystems).*
Description:	Three sub- indicators were developed for this indicator to address the various impacts dams can have on ecosystem: **a) River Fragmentation (sub-indicator 7a)** **b) Flow Disruption (sub-indicator 7b)** **c) Dam Density (sub-indicator 7c)** 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 (BCU) and transboundary basin regions.
Metrics:	C.J. Vorosmarty, P.B. McIntyre, M.O. Gessner, D. Dudgeon, A. Prusevich, P. Green, S. Glidden, S.E. Bunn, C.A. Sullivan, C. Reidy Liermann, and P.M. Davies Nature 467, 555-561 (30 September 2010) doi:10.1038/nature09440 Lehner, B., C. Reidy Liermann, C. Revenga, C. Vörösmart, B. Fekete, P. Crouzet, P. Döll, M. Endejan, K. Frenken, J. Magome, C. Nilsson, J.C. Robertson, R. Rodel, N. Sindorf, and D. Wisser. 2011. High-Resolution Mapping of the World's Reservoirs and Dams for Sustainable River-Flow Management. Frontiers in Ecology and the Environment 9:494-502. DOI: 10.1890/100125. ICOLD (International Commission on Large Dams). World Register of Dams. Paris, France (1998).
Computation:	**1. River Fragmentation (sub-indicator 7a):** Computed as the River Fragmentation threat driver from Vörösmarty et al. 2010 at 30-minute grid cell resolution. Described as the 'swimmable area' between barriers

<table>
<tr><td></td><td>that remains accessible to aquatic species, river fragmentation is a measure of the swimmable distance in any direction from a grid cell to the nearest barrier. The GWSP-GRAND data set of georeferenced large dams was used to define swimmable barriers.

<u>2. Flow Disruption (sub-indicator 7b):</u>
Computed as the Flow Disruption threat driver from Vörösmarty et al. 2010 at 30-minute grid cell resolution. Flow disruption was calculated as the magnitude of flow distortion as the residence time of water in large reservoirs.

<u>3. Dam Density (sub-indicator 7c):</u>
Computed as the Dam Density threat driver from Vörösmarty et al. 2010 at 30-minute grid cell resolution. Dam density represents the density and distribution of very large and medium to large dams mapped at the global scale.

<u>Ecosystem Impacts from Dams (Main indicator):</u> Numerical average of the three sub-indicators was calculated at the 30-minute grid cell level then rescaled to fit a 0-1 scale. Average Ecosystem Impacts from Dams over the TFDD BCU and basin regions was calculated as the area-weighted average of the grid cell values within each TFDD BCU and basin.
To maintain the integrity of the approach, only results for basins greater than 25,000 – 30,000 km2 can be provided with a scientifically credible level of certainty and thus used in the ranking system. Results for basins smaller than 25,000 – 30,000 km2 have been provided with the tabular information for reference only and were not used in the calculation of rankings.</td></tr>
<tr><td>Units:</td><td>See description</td></tr>
<tr><td>Scoring system:</td><td>Due to the standardized nature of the original Vörösmarty et al. 2010 datasets, risk categories were defined as 20% equal-interval classes with the lowest corresponding to very low risk and the highest corresponding to very high risk.

Table below summarizes results of the combined indicator:

<table>
<tr><th>Relative risk category</th><th>Range (normalized score)</th><th>No. of Basins</th><th>Proportion of Basins</th><th>No. of BCUs</th><th>Proportion of BCUs</th></tr>
<tr><td>1 - Very low</td><td>0.00 – 0.19</td><td>35 (22*)</td><td>15%</td><td>63 (44*)</td><td>11.4%</td></tr>
<tr><td>2 - Low</td><td>0.20 – 0.39</td><td>40 (25*)</td><td>17%</td><td>95 (65*)</td><td>17.2%</td></tr>
<tr><td>3 - Moderate</td><td>0.40 – 0.59</td><td>63 (26*)</td><td>26%</td><td>140 (71*)</td><td>25.5%</td></tr>
<tr><td>4 - High</td><td>0.60 – 0.79</td><td>57 (26*)</td><td>24%</td><td>152 (83*)</td><td>27.6%</td></tr>
<tr><td>5 - Very high</td><td>0.80-1.00</td><td>43 (7*)</td><td>18%</td><td>101 (45*)</td><td>18.3%</td></tr>
</table>
* Number of basins/BCUs for which results have been calculated, but bear a lower level of confidence due to modelling limitations. See more under ‘Computation’ section.</td></tr>
<tr><td>Limitations:</td><td>The dam density map used should not be construed as the spatial distribution of dams, because it reflects a probabilistic estimation of spatial patterns within each country, and excludes a very large number of small dams and other structural barriers for which global data are unavailable.
The rate of dam construction in some regions is so high that the indicator may change faster than the ability to update the reference base.
The inclusion of additional dams for which no data are available may alter the impact classification for a given river basin. Therefore, the indicator represents the minimum level of impact.
Dam and reservoir operation is more-or-less unknown over the domains analysed</td></tr>
<tr><td>Spatial Extent:</td><td>Global</td></tr>
<tr><td>Spatial Resolution:</td><td>30- X 30-min Lat X Lon</td></tr>
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Year of Publication:	2010
Time Period:	2000
Additional Notes:	For detailed information on the threat drivers see http://www.nature.com/nature/journal/v467/n7315/extref/nature09440-s1.pdf
Date:	16.02.2015.
Format:	Excel Spreadsheets
File Name:	TWAP_RB_indicator_07_results.xlsx TWAP_RB_indicator_07a_results.xlsx TWAP_RB_indicator_07b_results.xlsx TWAP_RB_indicator_07c_results.xlsx
Contact person:	Charles J. Vörösmarty, Pamela Green
Contact details:	cvorosmarty@ccny.cuny.edu, pgreen.ccny@gmail.com