Metadata Sheet: Economic Dependency (Indicator No. 12)

Title:	**Economic Dependency**
Indicator Number:	**12**
Cluster:	**Socioeconomics**
Rationale:	Withdrawal from water systems is often related to human activities aimed at supporting /enabling production activities to sustain economic growth (Grey 2006), for example freshwater is often abstracted to provide for irrigated agriculture as well as domestic and industrial needs. Understanding the degree to which economic activity is concentrated in given basins, and therefore the level of dependence on freshwater resources within basins, will help to illuminate the risk to economies within a basin should water supplies be substantially altered. This same metric can also help to assess the level of human pressure on water resources.
Interlinkages:	Water consumption associated with economic activities that underpin growth and contribute to GDP may be associated with impacts on water resources and an upstream- downstream complex of problems. Outtakes from a river system in terms of quantity will impact linked water systems as a result of less water flowing into connected systems. Water consumption for production activities could also give rise to other negative impacts (Barua 2009) associated with consequences of production such as harmful discharges and altered sedimentation levels.
Description:	The indicator measures the (1) fraction of the economic activity, (2) agricultural water withdrawals, (3) energy-related water withdrawals, and (4) industrial water withdrawals of all riparian countries that fall within the river basin. It is a measure of the average dependence of the country economies that share a river basin on the waters of that basin. The first metric, economic activity, is measured by the luminosity of night-time lights (Ghosh et al. 2010). Night-time lights data are commonly used for identifying human settlements and economic activity. We used the 2010 annual global composite of radiance lights inter-calibrated to the digital number (DN) values of gain 55 for satellite F16 (2006). The DNs are on a unitless scale ranging from 0 (no light) to 1,500 (greatest light intensity). The resolution of the grids is 30 arc seconds, or approximately 1 sq. km at the equator. The other three indicators – agricultural, energy-related, and industrial water withdrawals – were obtained from the WaterGap 2.2 model, and are measured in millions of cubic meters per year.
Metrics:	(1) For economic activity the data set used is the intercalibrated night-time lights data for 2010 from the Defense Meteorological Satellite Program-Optical Line Scanner (DMSP-OLS) instrument. The data were provided by the NOAA National Geophysical Data Center. The data are unpublished, but the file name is referenced below. (2, 3, 4) The other three indicators – agricultural, energy-related, and industrial water withdrawals – were obtained from the WaterGap 2.2 model.
Computation:	Night time lights radiance and water withdrawals in the three sectors were summed by basin and by country, and the basin total was divided by the country total for all countries that share the basin to get a ratio of economic activity/withdrawals that fall within the basin.
Units:	(1) Digital numbers and (2, 3, 4) m^3/year

Risk categorization	All data were heavily left-skewed, with long tails to the right. The indicators were log-transformed, the tails were trimmed at 2.5% and 97.5% of the distribution, and the indicators were transformed to z-scores and added together without weights. The z-score was then transformed to a percentile. The top 10% countries with the highest dependency (fractions of economic activity and withdrawals) were considered to be the highest risk category 5 (28 basins), followed by the next 10% in category 4 (28 basins), 30% in category 3 (83 basins), 40% in category 2 (110 basins), and 10% in category 1 (28 basins). Raw values for the untransformed data were fractions of ranging from approximately 0.2-0.6 for the high risk category down to 0 for the low risk category.
Limitations:	This indicator would benefit by looking at the patterns of dependence among the riparian countries within the individual basin-country units (BCUs). Currently, large countries with a very small proportion the basin land area, population, and river flow bias the results, Because the vast majority of their economic activity is outside the basin, it tends to bring the fractions of overall economic activity within the basin down significantly. The best way to address this is to calculate the fraction of economic activity occurring within each BCU, and then aggregating the BCU fractions as a weighted average based on an average of he proportion of the basin land area, population, and river flow. A limitation of the agricultural dependence sub-indicator is that there is a very high level of clustering in basins with fractions below 0.1 that have basin sizes below 25,000 sq. km. Larger basins are more prone, by definition, to have high water withdrawal fractions in the basins, and therefore to be considered “at risk”. Further analysis on the BCU level is needed, and some normalization by basin size may be warranted.
Spatial Extent:	Global
Spatial Resolution:	(1) 30 arc seconds, (2, 3, 4) 0.5 decimal degrees
Year of Publication:	2013
Time Period:	(1) 2010, (2, 3, 4) average annual for 1970-2000
Additional Notes:	
Date:	
Format:	ASCII
File Name:	(1) F16_20100111_20101209.F16_20110129_20110731.peg.op_blended.intercal_to_2006.avg_vis , (2, 3, 4)
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