

EPI2008 Variables Metadata

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Indicator Code: DALY

Objective: Environmental Health

Policy Category: Environmental Health

Subcategory: Environmental Burden of Disease

Indicator Short Name: Environmental Burden of Disease

Indicator Full Name: Disability Adjusted Life Years (DALY) Due to the Environmental Burden of Disease

Indicator Description: The Disability Adjusted Life Year or DALY is a health gap measure that extends the concept of potential years of life lost due to premature death (PYLL) to include equivalent years of 'healthy' life lost by virtue of being in states of poor health or disability (Murray et al. 2002). The DALY combines in one measure the time lived with disability and the time lost due to premature mortality. One DALY can be thought of as one lost year of 'healthy' life and the burden of disease as a measurement of the gap between current health status and an ideal situation where everyone lives into old age free of disease and disability (WHO 2007).

The WHO also captures environmental impact on human health through the DALY. These DALYs adjust the nominal deaths due to given, environmentally related diseases to take into account the years of life lost due to premature mortality and the loss in quality of life due to disability (morbidity). They are the sum of the number of life years lost due to premature mortality on account of an environmentally influenced disease and the years of life due to disability caused by that disease.

Units: Years of life lost per 1,000 population

Country Coverage: 192

Reference Year: 2002

Target: 0

Target Source: Expert judgment

Short Source: WHO 2007

Source: WHO (World Health Organization). 2007, Country Profiles of Environmental Burden of Disease, Available online at http://www.who.int/quantifying_ehimpacts/countryprofiles/en/index.html. This report draws on WHO/UNICEF (2006).

Taiwan: Department of Environmental Monitoring and Information Management, EPA.

Source URL: http://www.who.int/quantifying_ehimpacts/countryprofiles/en/index.html

Methodology: The complete methodology for calculating DALYs is described in the source publication. The DALY indicator used by the 2008 EPI is an aggregate of DALY data that has been collected by the WHO. In order to represent Environmental Health across a broad spectrum of risks, the 2008 EPI does not limit its inquiry to one source of risk. Instead, the DALY indicator is an un-weighted aggregate sum of DALY data from three sources of environmental health risk: diarrhea (due to inadequate sanitation and unclean drinking water), indoor air (combustion of solid fuels for household use), and outdoor air (concentration of particulate matter in urban areas). Twenty three countries had missing diarrhea data; these were mostly wealthy countries for which it made sense to assume relatively low levels of diarrhea. We analyzed the relationship between per-capita income and diarrhea, and imputed missing values according to the following table:

Per-capita income*	Imputed Diarrhea DALY
> \$20,000.	0.1
\$10,000-\$20,000	0.5
\$5,000-\$10,000	1.0
\$1,900-\$5,000	4.0

We did not impute for countries with per-capita income less than \$1900. The imputed values reflect the average observed values within the income range, although for the \$5,000-10,000 group we excluded Equatorial Guinea when computing the average because it was anomalously high.

* US Dollars, 2000 USD, PPP

Additional Citations: Murray CJL, Salomon JA, Mathers CD, Lopez AD (eds.) (2002). Summary measures of

population health: concepts, ethics, measurement and applications. WHO, Geneva. Available at <http://www.who.int/pub/smph/en/index.html>

Murray CJL, Lopez AD (1996). The Global Burden of Disease. Cambridge: Harvard University Press.

WHO/UNICEF. 2006. Meeting the MDG Drinking Water and Sanitation. The Urban and Rural Challenge of the Decade. Geneva: World Health Organization and United Nations Children's Fund.

Indicator Code: ACSAT

Objective: Environmental Health

Policy Category: Environmental Health

Subcategory: Water (Effects on Humans)

Indicator Short Name: Adequate Sanitation

Indicator Full Name: Percentage of Population with Access to Improved Sanitation

Indicator Description: Adequate Sanitation measures the percentage of a country's population that has access to an improved source of sanitation.

Units: Percentage

Country Coverage: 214

Reference Year: 2004 or MRYA

Target: 100% coverage

Target Source: MDG 7, Target 10, Indicator 31

Short Source: WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation, 2006

Source World Development indicators, <http://devdata.worldbank.org/dataonline/old-default.htm>;

World Health Organization and United Nations Children's Fund. Water Supply and Sanitation Collaborative Council. Global Water Supply and Sanitation Assessment, 2000 Report, Geneva and New York. Last updated data in November 2006, available at <http://www.childinfo.org/areas/sanitation/countrydata.php>

Other sources: Millennium Development Goals Indicators,

<http://millenniumindicators.un.org/unsd/mdg/Handlers/ExportHandler.ashx?Type=Excel&Series=667>;

Taiwan: Department of Environmental Monitoring and Information Management, EPA.

Source URL: <http://devdata.worldbank.org/dataonline/old-default.htm>;

<http://www.childinfo.org/areas/sanitation/countrydata.php>

Methodology: Improved sanitation technologies are: connection to a public sewer, connection to septic system, pour-flush latrine, simple pit latrine, ventilated improved pit latrine. The excreta disposal system is considered adequate if it is private or shared (but not public) and if hygienically separates human excreta from human contact. "Not improved" are: service or bucket latrines (where excreta are manually removed), public latrines, latrines with an open pit. The total population of a country may comprise either all usual residents of the country (de jure population) or all persons present in the country (de facto population) at the time of the census.

For purposes of international comparisons, the de facto definition is recommended. (Source: United Nations. Multilingual Demographic Dictionary, English Section. Department of Economic and Social Affairs, Population Studies, No. 29, United Nations publication, Sales No. E.58.XIII.4).

Values for Iran and Oman are 2000 values. Belgium, Denmark, France, Greece, Ireland, Italy, Luxembourg, New Zealand, Portugal, Korea, Great Britain, Aruba, Bahrain, Bermuda, Brunei Darussalam, Cayman Islands, Falkland Islands, Faeroe Islands, Gibraltar, Greenland, Hong Kong Special Administrative Region of China, Israel, Kuwait, Liechtenstein, Macao Special Administrative Region of China, Malta, Puerto Rico, San Marino, Slovenia and Holy See were also set to 100 on the basis that their per capita incomes exceeded US\$15,971, which is the empirical threshold beyond which all countries have 100% coverage. Lithuania, Macedonia and Poland were imputed based on the regression model predicting ACSAT using log of per-capita income, and Saudi Arabia were imputed using a model that included WATSUP and log per capita income.

Additional Citation: not available

Indicator Code: WATSUP

Objective: Environmental Health

Policy Category: Environmental Health

Subcategory: Water (Effects on Humans)

Indicator Short Name: Drinking Water

Indicator Full Name: Percentage of Population with Access to Improved Drinking Water Source

Indicator Description: The WHO defines an improved drinking water source as piped water into dwelling, plot or yard; public tap/standpipe; tubewell/borehole; protected dug well; protected spring; and rainwater collection.

Units: Percentage

Country Coverage: 204

Reference Year: 2004

Target: 100%

Target Source: MDG 7, Target 10, Indicator 31

Short Source: WDI and MDG, 2007

Source: World Development indicators, <http://devdata.worldbank.org/dataonline/old-default.htm>;

World Health Organization and United Nations Children's Fund. Water Supply and Sanitation Collaborative Council. Global Water Supply and Sanitation Assessment, 2000 Report, Geneva and New York. Last updated data in November 2006, available at <http://www.childinfo.org/areas/water/countrydata.php>

Other sources: Millennium Development Goals Indicators,

<http://millenniumindicators.un.org/unsd/mdg/Handlers/ExportHandler.ashx?Type=Excel&Series=667>.

Taiwan: Department of Environmental Monitoring and Information Management, EPA.

Source URL: <http://devdata.worldbank.org/dataonline/old-default.htm>

Methodology: The WHO defines an improved drinking water source as piped water into dwelling, plot or yard; public tap/standpipe; tubewell/borehole; protected dug well; protected spring; and rainwater collection (WHO 2007). Values for Lybia, Oman and Saudi Arabia are 2000 values, and for New Zealand are 1995 values. Belgium, Greece, Ireland, Italy, Portugal, Bahrain, Bermuda, Cayman Islands, Falkland Islands, Faeroe Islands, Hong Kong Special Administrative Region of China, Kuwait, Liechtenstein, Macao Special Administrative Region of China, San Marino and Holy See were also set to 100 on the basis that their per capita incomes exceeded US\$15,971, which is the empirical threshold beyond which all countries have 100% coverage. Lithuania, Macedonia and Poland were imputed based on the regression model predicting ACSAT using log of per-capita income.

Additional Citations: WHO (World Health Organization). 2007, Country Profiles of Environmental Burden of Disease, Available online at http://www.who.int/quantifying_ehimpacts/countryprofiles/en/index.html.

Indicator Code: PM10

Objective: Environmental Health

Policy Category: Environmental Health

Subcategory: Air Pollution (Effects on Humans)

Indicator Short Name: Urban Particulates

Indicator Full Name: Population-weighted PM10 Concentration in Urban Areas

Indicator Description: Data for countries and aggregates for regions and income groups are urban-population weighted PM10 levels in residential areas of cities with more than 100,000 residents. The state of a country's technology and pollution controls is an important determinant of particulate matter concentrations (WDI 2007); see: Pandey et al. (2006).

Units: micro-grams per cubic meter

Country Coverage: 186

Reference Year: 2004 or MRYA

Target: 20 micro-grams per cubic meter

Target Source: WHO guidelines

Short Source: WDI, 2007

Source: World Development Indicators, 2007, World Bank

Taiwan: Department of Environmental Monitoring and Information Management, EPA.

Source URL: <http://devdata.worldbank.org/dataonline/old-default.htm>

Methodology: PM10 data are acquired from modeling data. The model is based on reliable PM10 and TSP measurement with multiple determinants such as energy consumption, atmospheric and geographical factors, city and national population density, and others. Then concentration levels of each city are weighted according to their urban populations in residential areas of cities with more than 100,000 residents. The estimates represent the average annual exposure level of the average urban resident to outdoor particulate matter.

Additional Citations: Pandey, K.D., D. Wheeler, B. Ostro, U. Deichmann, K. Hamilton, and K. Bolt. (2006). "Ambient Particulate Matter Concentrations in Residential and Pollution Hotspot Areas of World Cities: New Estimates Based on the Global Model of Ambient Particulates (GMAPS)," World Bank, Development Research Group and Environment Department.

Indicator Code: INDOOR

Objective: Environmental Health

Policy Category: Environmental Health

Subcategory: Air Pollution (Effects on Humans)

Indicator Short Name: Indoor Air Pollution

Indicator Full Name: Percentage of Population Using Solid Fuels

Indicator Description: Solid fuels include biomass fuels, such as wood, charcoal, crops or other agricultural waste, dung, shrubs and straw, and coal. The use of solid fuels in households is associated with increased mortality from pneumonia and other acute lower respiratory diseases among children as well as increased mortality from chronic obstructive pulmonary disease and lung cancer (where coal is used) among adults (WHO, 2007).

Units: Percentage of population using solid fuels

Country Coverage: 175

Reference Year: 2003

Target: 0 percent

Target Source: Expert judgment

Short Source: Smith et al., 2004

Source: Smith KR, Mehta S, Maeusezahl-Feuz M. 2004. Indoor air pollution from household use of solid fuels. In: Comparative Quantification of Health Risks: Global and Regional Burden of Disease Attributable to Selected Major Risk Factors (Ezzati M, Lopez AD, Rodgers A, Murray CJL, eds). Geneva: World Health Organization, 1435-1493
Taiwan: Department of Environmental Monitoring and Information Management, EPA.

Source URL: http://www.who.int/quantifying_ehimpacts/national/countryprofile/mapiap/en/index.html

Methodology: These data were collected from national wide household surveys. The survey data of percentage of solid fuel use population cover 52 countries. The rest of the data are generated from models predicting solid fuel use. The model used SFU values from the household fuel use database, and assumed that as countries develop economically, people gradually shift up an energy ladder from solid fuels to cleaner fuels. The final exposed population is calculated as: Household equivalent solid fuel exposed population = population using solid fuel × ventilation factor.

Additional Citations: Desai, M.A., S. Mehta, K.R. Smith. (2004) Indoor smoke from solid fuels: Assessing the environmental burden of disease. Environmental burden of disease series No. 4. Geneva, World Health Organization.

Mehta S, et al. Modeling household solid fuel use towards reporting of the Millennium Development Goal indicator. In press. Energy for Sustainable Development, June 2006.

WHO (World Health Organization). 2007, Country Profiles of Environmental Burden of Disease, Available online at http://www.who.int/quantifying_ehimpacts/countryprofiles/en/index.html.

Indicator Code:OZONE_H

Objective: Environmental Health

Policy Category: Environmental Health

Subcategory: Air Pollution (Effects on Humans)

Indicator Short Name: Local Ozone

Indicator Full Name: Local Ozone with Effects on Human Health

Indicator Description: Population-weighted accumulated hourly concentrations of high level ozone with a threshold of 85ppb

Units: Exceedance person ppb per capita

Country Coverage: 223

Reference Year: 2000

Target: 0 exceedance above 85 ppb

Target Source: Expert Judgment

Short Source: MOZART-2 Global Chemical Tracer Model, 2000

Source: Ozone concentrations data: MOZART-2 Global Chemical Tracer Model, The National Center for Atmospheric Research (NCAR), <http://gctm.acd.ucar.edu/mozart/models/m2/index.shtml>

Source URL: <http://gctm.acd.ucar.edu/mozart/models/m2/index.shtml>

Methodology: Ozone has an impact on human health and has been associated in epidemiological studies with premature mortality.

The health ozone measure was calculated using MOZART-2 data using the following method:

- 1) For each grid cell, for each hour in the year, the exceedance (if any) above 85 ppb was calculated.
- 2) The exceedance value was resampled to 30 arc seconds and overlaid with the GRUMP population data. Exceedance values were multiplied by population total for each 30-arc-second grid cell.
- 3) Using zonal statistics the exceedance-person-hours were summed by country.
- 4) The summed exceedance-person-hours were divided by total county population.

Additional Citations Horowitz, L., et al., A global simulation of tropospheric ozone and related tracers: Description and evaluation of MOZART, version 2, J. Geophys. Res., 108(D24), 4784, doi:10.1029/2002JD002853, 24 December 2003.

Indicator Code: OZONE_E

Objective: Ecosystem Vitality

Policy Category: Ecosystem Impacts of Atmospheric

Subcategory: Air Pollution (Effects on Environment)

Indicator Short Name: Regional Ozone

Indicator Full Name: Regional Ozone with Effects on Ecosystem

Indicator Description: An accumulated exposure concentration over a threshold of 40ppb in daylight time of growing season

Units: Exceedance square-kilometer-hours per square kilometer

Country Coverage: 223

Reference Year: 2000

Target: 0 exceedance above 3000 ppb.h

Target Source: Expert Judgment

Short Source: MOZART-2 Global Chemical Tracer Model, 2000

Source: Ozone concentrations data: MOZART-2 Global Chemical Tracer Model, The National Center for Atmospheric Research (NCAR), <http://gctm.acd.ucar.edu/mozart/models/m2/index.shtml>

Source URL: <http://gctm.acd.ucar.edu/mozart/models/m2/index.shtml>

Methodology: The ecological ozone measure was calculated using MOZART-2 data using the following method:

- 1) We assigned latitudes >0 to the northern hemisphere and latitudes ≤ 0 to the southern.
- 2) We assigned daylight hours to each band of latitude using information on sunrise and sunset times at: http://aa.usno.navy.mil/data/docs/RS_OneYear.php.
- 3) We subset the database to include only summer daylight hours (June-August in the north and December-February in the south).
- 4) We summed exceedances above 40 ppb.
- 5) We multiplied exceedance sums by land area, for each grid cell.
- 6) Using zonal statistics, we summed these exceedance-square kilometer products by country.
- 7) We divided these sums by total country area.

Additional Citations: Horowitz, L., et al., A global simulation of tropospheric ozone and related tracers: Description and evaluation of MOZART, version 2, J. Geophys. Res., 108(D24), 4784, doi:10.1029/2002JD002853, 24 December 2003.

International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops. 2007. AOT40 – The Parameter Used to Represent the Accumulated Dose of Ozone. Available at: <http://icpvegetation.ceh.ac.uk/8AOT40.htm>

Indicator Code: SO2

Objective: Ecosystem Vitality

Policy Category: Ecosystem Impacts of Atmospheric

Subcategory: Air Pollution (Effects on Environment)

Indicator Short Name: Sulfur Dioxide (SO2) emissions

Indicator Full Name: Sulfur Dioxide (SO2) emissions per populated land area

Indicator Description: Data used in EDGAR are taken from the best possible international information sources; however it is stressed that the uncertainties in the resulting datasets may be substantial at the country level, especially for methane and nitrous oxide. These uncertainties are due to the limited accuracy of international activity data and, in particular, the emission factors utilized in calculating emissions at the national level. Data presented, however, do provide a reliable dataset for comparability since EDGAR employs methods that are comparable to IPCC methodologies and has global totals that agree with budgets used in other atmospheric studies. In addition to the data reliability issues described above, please see the "Uncertainties" and "Disclaimer" sections of the EDGAR website for more information regarding the various nuances of this dataset. The EDGAR 3.2 database provides global annual emissions per country and on a 1x1 degree grid for 1990 and 1995 for direct greenhouse gases CO₂, CH₄, N₂O and HFCs, PFCs and SF₆ and the precursor gases CO, Nox, NMVOC and SO₂."

Units: Metric Tons

Country Coverage: 215

Reference Year: 2000

Target: 0 Metric Tons

Target Source: Expert Judgment

Short Source: EDGAR V2.0 by Netherlands National Institute for Public Health and the Environment (RIVM) and the Netherlands Organization for Applied Scientific Research (TNO).

Source: EDGAR V2.0 by Netherlands National Institute for Public Health and the Environment (RIVM) and the Netherlands Organization for Applied Scientific Research (TNO).

The Netherlands National Institute for Public Health and the Environment/The Netherlands Environmental Assessment Agency (RIVM/MNP) and the Netherlands Organization for Applied Scientific Research (TNO). (2005).

The Emission Database for Global Atmospheric Research (EDGAR) 3.2 Fast Track 2000 and 3.2. Acidifying gases: SO₂ (Sulfur Dioxide): Extended Emissions 2000 and Aggregated Emissions 1990/1995. The Netherlands, MNP.

Source URL: <http://www.mnp.nl/edgar/>

Methodology: The sulfur dioxide emissions were divided by the land area populated at more than five persons per square kilometer. Total land area was not used in order not to favor countries with very large land areas.

Additional Citations: Olivier, J.G.J., Bouwman, A.F., Berdowski, J.J.M., Veldt, C., Bloos, J.P.J., Visschedijk, A.J.H., Van der Maas, C.W.M. and P.Y.J. Zandveld. (1999). Sectoral emission inventories of greenhouse gases for 1990 on a per country basis as well as on 10 x 10. Environmental Science & Policy, 2, 241-264.

Indicator Code: WATQI

Objective: Ecosystem Vitality

Policy Category: Water

Subcategory: Water (Effects on Environment)

Indicator Short Name: Water Quality Index

Indicator Full Name: Water Quality Index

Indicator Description: The water quality parameters chosen to be included in the EPI were selected for two reasons. Firstly, they are good indicators of specific issues relevant on a global basis (eutrophication, nutrient pollution, acidification, salinization). Secondly, the parameters were chosen because they are the most consistently reported; that is, we have the most data for these parameters compared to other relevant parameters that were not included. Because water quality is a function of a number of different physical and chemical parameters measured during routine water quality monitoring, as outlined above, a global index of the general status of water quality, ranked on a country by country basis, is best developed as a composite index of several key parameters.

Units: Proximity-to-Target

Country Coverage: 232: 94 countries with water

Reference Year: 2003 (average year for all stations and parameters)

Target: proximity-to-target score of 100 (based on monitoring station parameter scores)

Target Source: Expert judgment and national

Short Source: GEMS, 2008

Source: United Nations Environment Program GEMS/Water Programme 2008, online database available at:

<http://www.gemstat.org>

European Environment Agency Waterbase Rivers & Lakes data sets, v7 (2007), available at:

<http://www.eea.europa.eu/themes/water/datasets>

Taiwan Environmental Protection Administration Executive Yuan, R.O.C. 2005. River and lake water quality data available at: http://edb.epa.gov.tw/eng/Index_water.htm

National contacts:

Niger: Mr. Iliia Bounari, Hydrochimie à la Division de la Qualité et Pollution des Eaux, Niger

Algeria : Mr. Mohamed Ramdane, Agence Nationale des Ressources Hydrauliques, ALGERIE

Israel: Dr. Ami Nishri, Kinneret Limnological Laboratory, Israel Oceanographic & Limnological Research

Source URL: <http://www.gemswater.org/>

Methodology: WATQI is a proximity-to-target composite indicator with station density adjustment that was calculated as follows. Raw data for five parameters -- Dissolved Oxygen (DO), Electrical Conductivity (EC), pH, Total Phosphorus (P) (or Ortho Phosphorus), Total Nitrogen (N) (or Dissolved inorganic Nitrogen, Nitrate+Nitrite, or Ammonia) -- were obtained from UNEP/GEMS Water and European Environmental Agency (EEA) Waterbase, and national sources listed in the source field. The raw data for all parameters except pH and DO were winsorized (trimmed) at the extreme 95th percentile. Then proximity-to-target (PTT) values were calculated using the targets specified by UNEP/GEMS water such that 100 corresponds to meeting the target (or falling into the target range in the case of pH) and values between 0 and less than 100 indicate an increasing distance from the target (or target range in the case of pH).

The individual targets used were as follows: DO of 6 mg/L for "warm waters" (>20C) and 9.5 mg/L for "cold waters" (<20C); pH of 6.5-9.0; EC of 500 micro-Siemens/cm; P of 0.05 mg/L (or 0.025 for orthophosphate); N of 1 mg/L (or 0.5 for dissolved inorganic N or nitrate+nitrite and 0.05 for ammonia). Total N and Total P are the preferred indicators of nutrient pollution; thus, maximum possible scores for countries that reported other forms of nutrients were adjusted such that the best possible PTT scores for Ortho P and Dissolved inorganic N were set to 80, and for Nitrate+Nitrite and Ammonia were set to 60. Station-level PTT values were summed and divided by 5 to generate a station-level WQI that ranged from 0 to 100. Station-level WQI's were averaged to country WATQI's using only those stations that report the maximum number of parameters within the country.

Country WATQIs were adjusted for density of monitoring stations based on national water quality monitoring data collated by UNEP/GEMS Water. Country WATQI scores were adjusted using the following multipliers based on the density of the monitoring station network per populated land area (land area populated at >5 persons per sq. km, as calculated by CIESIN, 2007). Countries received full credit (using a multiplier of 1) if they have a station density greater than or equal to 1 per 1,000 sq. km; PTT scores were multiplied times 0.95 if they had a station density of 0.1-0.99 per 1,000 sq. km; PTT scores were multiplied times 0.9 if they had a station density of 0.01-0.099 per 1,000 sq. km; PTT scores were multiplied times 0.85 if they had a station density of 0.001-0.0099 per 1,000 sq. km; and PTT scores were multiplied times 0.8 if they had a station density of <0.001 per 1,000 sq. km.

We were able to use the above methodology to complete data for 94 countries. For countries with no WATQI from UNEP/GEMS or the EEA, a regional imputed value was used according to this rule: For UNEP-GEO sub regions with UNEP/GEMS WATQI available for at least half of the countries in that region, the 0.33 percentile WATQI was used; for UNEP-GEO sub regions with UNEP/GEMS WQI available for less than half of the countries in that region but more than 3 WQIs, the average minus a 10 point penalty was used. For remaining regions, we applied the following method: for Meso-America the average of available WQI's for Meso and North America minus a 10pt penalty was used; for Eastern Africa, we took the average for Kenya and Uganda and applied a 10 point penalty; for Southern Africa we took the average for South Africa and Tanzania and applied a 10 point penalty; for Central Africa we took the score for the Democratic Republic of Congo and applied a 10 point penalty; for Central Asia we took the average of the 33rd percentile score for South Asia and the score for Russia with a 10 point penalty; for the Caribbean we took the score for Cuba with 10 point penalty; for the South Pacific we took the average scores for Fiji and Papua New Guinea and applied a 10 point penalty; for the Arabian Peninsula & Mashriq, we took the average scores for Iraq and Jordan and applied a 10 point penalty.

Additional Citations: Center for International Earth Science Information Network (CIESIN), Columbia University, (2007). National Aggregates of Geospatial Data: Population, Landscape and Climate Estimates, v. 2 (PLACE II), Palisades, NY: CIESIN, Columbia University. Available at: <http://sedac.ciesin.columbia.edu/place/>.

Indicator Code: WATSTR

Objective: Ecosystem Vitality

Policy Category: Water

Subcategory: Water (Effects on Environment)

Indicator Short Name: Water Stress

Indicator Full Name: Percentage of National Territory Experiencing Water Stress (withdrawals exceed 40% of available supply)

Indicator Description: The EPI water stress indicator is the percentage of a country's territory affected by oversubscription of water resources. A high degree of oversubscription is indicated when the water use is more than 40% of available supply (WMO, 1997). Countries can to some extent accommodate oversubscription in one region with inter-basin transfers, water re-use and desalination but some of these engender significant environmental impacts of their own. Thus, the ultimate target for each country is to have no area of their territory affected by oversubscription.

Units: Percentage of national territory with water withdrawals exceeds 40% of available supply

Country Coverage: 171

Reference Year: Contemporary (mean annual 1950-1995)

Target: 0 percent

Target Source: Expert Judgment

Short Source: University of New Hampshire, Water Systems Analysis Group.

Source: University of New Hampshire, Water Systems Analysis Group.

Source URL: <http://www.watsys.sr.unh.edu>

Methodology: Human water demand was computed using the following data sources: population per grid cell; per capita country or sub national level domestic water demand; per capita country or sub national level industrial water demand; irrigated land extent per grid cell according to Döll et al. (2000); and country or sub national level agricultural water demand (irrigation). Global discharge fields were computed by blending mean annual discharge observations (where available) with a climatology (1950-1995) of discharge output from the Water Balance Model based on Vörösmarty et al. (1998).

An indicator of relative water demand (RWD) for each 1/4 degree grid cell was computed by dividing total human water demand (domestic + industrial + agricultural water or DIA) by renewable water supply (Q). $RWD = 0.4$ was established as the threshold for water stressed conditions. The percentage of territory in which water resources are oversubscribed was computed by summing the area of grid cells in each country where $RWD \geq 0.4$. Details on the computation and use of RWD (alternatively known as the Relative Water Stress Index or RWSI) can be found in Vörösmarty et al. (2000) and Vörösmarty et al. (2005).

Additional Citations Döll, P., Siebert, S. 2000. A digital global map of irrigated areas. *ICID Journal*, 49(2), 55-66.

Vörösmarty, C. J., C. A. Federer and A. L. Schloss. (1998). Evaporation functions compared on US watershed: Possible implications for global-scale water balance and terrestrial ecosystem modeling, *Journal of Hydrology*, 207 (3-4): 147-169.

WMO (World Meteorological Organization).et al. (1997). *Comprehensive Assessment of the Freshwater Resources of the World*. Geneva, Switzerland.

Vörösmarty, C. J., P. Green, J. Salisbury and R. B. Lammers. (2000). Global water resources: vulnerability from climate change and population growth, *Science*, 289:284-288.

Vörösmarty, C. J., E. M. Douglas, P. Green and C. Revenga. (2005). Geospatial Indicators of Emerging Water Stress: An Application to Africa, *Ambio*, 34 (3): 230-236.

Indicator Code: CRI

Objective: Ecosystem Vitality

Policy Category: Biodiversity and Habitat

Subcategory: Biodiversity and Habitat

Indicator Short Name: Conservation Risk Index

Indicator Full Name: Ratio of Protected to Converted Lands

Indicator Description: The Conservation Risk Index measures the ratio of protected to converted lands and is calculated by WWF biome within each country. It compares the area of each biome in the country that is under protection to the area of each biome that has been converted to other land uses (e.g., from forests to cropland). This indicator is a more comprehensive measure of whether countries are protecting their natural environment on the same spatial scale as habitats are being converted.

Units: Ratio

Country Coverage: 205

Reference Year: 2006 for protected areas, 2000 for land cover

Target: 0.5

Target Source: Expert Judgment

Short Source: The Conservation Strategies Division of The Nature Conservancy calculated this indicator based on third party source data.

Source: Calculations by Timothy Boucher of the Conservation Strategies Division, The Nature Conservancy, based on these data sets:

UNEP-WCMC (United Nations Environment Programme-World Conservation Monitoring Center). (2007). Global Protected Areas Data Set extracted from the World Database on Protected Areas (WDPA) in August 2007 by UNEP World Conservation Monitoring Centre (WDPA custodian) (www.unep-wcmc.org), Cambridge, UK.

Joint Research Centre. Global Land Cover 2000. Available at <http://www-gvm.jrc.it/glc2000/>. (Note: the USA, Central America and Australia portions of the GLC2000 were updated by TNC using more recent and finer resolution data. The sources include the National Land-cover Dataset of the U.S. (Vogelmann 2001), regional datasets for Mesoamerica (Mas et al., 2002; World Bank 2001), National Vegetation Information System (NVIS) Australasia, 2000.)

World Wildlife Fund. (2001). Terrestrial Ecoregions of the World. Available from

<http://www.worldwildlife.org/science/ecoregions.cfm>

Source URL: www.unep-wcmc.org; <http://www.worldwildlife.org/science/ecoregions.cfm>

Methodology: The CRI value per country-biome is based on two 1 km global spatial datasets: the World Database on Protected Areas (2007), which reports the location and distribution of protected areas, and an updated version of the Global Land Cover 2000 data set, which provides the areas of natural habitat converted to human uses versus those not converted to human uses. The target for the Conservation risk index is the global average ratio of 1:2 (protected lands : converted lands). A ratio of protected to converted of less than 0.5 reflects poor performance in protecting a particular terrestrial biome. A score above 0.5 reflects a better than average performance in protecting a given biome. For example, the CRI for the Namibian Tropical Grasslands is 1.4 (i.e. 9.3% Protected and 6.6% Converted), which is a good performance rating.

The method for calculating CRI (Hoekstra et al. 2005) was implemented as the ratio between the percent of protected area per country-biome and the percent of converted land per country-biome. Data were generated at a 1 km level of resolution and percent values derived at the country-biome unit of analysis. The World Database on Protected Areas (2007), which gives us the protected vs. non-protected areas was processed as follows: (1) only National PAs were used (no international PAs); (2) PAs were removed that had the following Status: "proposed", "voluntary" or "recommended"; (3) only PA points that did not have polygons and did not have a status according

to #2 were buffered according to their defined area (using a Mollweide Projection); (4) the buffered points and polygons datasets were merged for the final WDPA dataset; and (5) an Arcinfo GRID with a 1km resolution was created from the final protected areas mask, with a value of 0 for unprotected and 1 for protected.

For the reclassified and updated GLC2000, an Arcinfo GRID was created with a value of 0 for unconverted lands, and a value of 1 for converted lands.

The zonal mean was calculated for each GRID for the WWF-biome-country dataset (the union of the country dataset and the WWF biome dataset). Calculating the zonal mean of each GRID by country-biome (pixel value 0 or 1) results in a value that can be used a percentage.

Note: For the country-biome units that were smaller than what can be reasonable calculated from the 1 km spatial data, areas were counted as 'no data'. Given their size the resulting indicator should not be impacted.

Additional Citations: Hoekstra et al. 2005

National Vegetation Information System (NVIS) - Australasia, 2000. <http://www.deh.gov.au/erin/nvis/index.html>

Vogelmann, J.E., S.M. Howard, L. Yang, C.R. Larson, B.K. Wylie, N. Van Driel. (2001). Completion of the 1990s National Land Cover Data Set for the Conterminous United States from Landsat Thematic Mapper Data and Ancillary Data Sources, *Photogrammetric Engineering and Remote Sensing*, 67, pp. 650-652.

Mas, J.-M., Velazquez, A., Palacio-Prieto, J.L., Bocco, G., Peralta, A., and Prado, J. (2002). Assessing forest resources in Mexico: wall-to-wall land use/cover mapping. *Photogrammetric Engineering & Remote Sensing*, Vol. 68, No. 10, pp. 966-1000.

Indicator Code: EFFCON

Objective: Ecosystem Vitality

Policy Category: Biodiversity and Habitat

Subcategory: Biodiversity and Habitat

Indicator Short Name: Effective Conservation

Indicator Full Name: Effective Conservation by Biome

Indicator Description: This indicator measures the percentage habitat by biome that has been effectively conserved within each biome by country. The effective conservation index gives a protected area value for each terrestrial biome within a country by spatially overlaying three 1 km global spatial datasets, the World Database on Protected Areas (2007), the Wildlife Conservation Society/CESIN Human Footprint (2007), and biomes from the WWF Ecoregions of the World dataset (Olson et al., 2001). By combining these measures the index provides a measure of how much habitat within protected areas is actually intact or relatively intact (i.e., has a low human footprint). The World Database on Protected Areas (2007) is a dataset on the location and distribution of protected areas.

The CIESIN/Wildlife Conservation Society Human Footprint is a dataset on human impacts on land, measured by transportation networks (roads, railroads and rivers), population densities, and urban areas. The Human footprint is used here to classify locations that are either under high or low threat/use by humans. Areas within a designated protected area that have a high human footprint (one which is incompatible with biodiversity) are deducted from the protected area, with the effect of lowering the area of specific biomes identified as protected within that country. This is a better measure of the amount of land under protection because it accounts for areas that are not fully protected because of land conversion, roads, and populated places that might exist within a protected area.

All three datasets are widely accepted and used, even though as all other global databases they do have limitations relative to the resolution of the data and problems with protected area delineations. The effective conservation target is 10% of each terrestrial biome within a country. In order to ensure that above target performance for one biome does not mask below target performance for another, performance is capped at 10% for each biome. This target is based upon the internationally agreed upon target set by the Convention on Biological Diversity.

Units: Percentage Territory

Country Coverage: 233

Reference Year: 2007

Target: 10 percent

Target Source: Convention on Biological

Short Source: The Conservation Strategies Division of The Nature Conservancy calculated this indicator based on third party source data.

Source: Calculations by Timothy Boucher of the Conservation Strategies Division, The Nature Conservancy, based on three data sets:

UNEP-WCMC (United Nations Environment Programme-World Conservation Monitoring Center). (2007). Global Protected Areas Data Set extracted from the World Database on Protected Areas (WDPA) in August 2007 by UNEP World Conservation Monitoring Centre (WDPA custodian) (www.unep-wcmc.org), Cambridge, UK.

CIESIN and Wildlife Conservation Society. (2007). Human Footprint v.2 (beta). Available from http://sedac.ciesin.columbia.edu/wild_areas/.

World Wildlife Fund. (2001). Terrestrial Ecoregions of the World. Available from <http://www.worldwildlife.org/science/ecoregions.cfm>

Source URL: www.unep-wcmc.org; http://sedac.ciesin.columbia.edu/wild_areas/;
<http://www.worldwildlife.org/science/ecoregions.cfm>

Methodology: The Effective Conservation value per country-biome is based on three 1 km global spatial datasets: (a) the World Database on Protected Areas (2007), which gives us the protected vs. non-protected areas; (b) the CIESIN and Wildlife Conservation Society Human Footprint (2007) which, by using statistic natural breaks and calibrated with known areas, was reclassified into high or low threat/use by humans; and (c) biomes from the WWF Ecoregions of the World dataset (Olson et al., 2001). The following specific steps were taken.

The World Database on Protected Areas (2007) was processed as follows:

- (1) only National PAs were used (no international PAs);
- (2) PAs were removed that had the following Status: "proposed", "voluntary" or "recommended";
- (3) only PA points that did not have polygons and did not have a status according to #2 were buffered according to their defined area (using a Mollweide Projection);
- (4) the buffered points and polygons datasets were merged for the final WDPA dataset; and (5) an Arcinfo GRID with a 1km resolution was created from the final protected areas mask, with a value of 0 for unprotected and 1 for protected.

By using statistic natural breaks and calibrated with known areas, the CIESIN and Wildlife Conservation Society Human Footprint(2007) was reclassified into high or low threat/use by humans. TNC classified the continuous index data of the Human Influence Index according to frequency distribution and variance using Jenk's Natural Breaks. The 0-24 range of values was identified as a surrogate for the least threatened and human-impacted areas. This class not only encompasses the "Last of the Wild" (Sanderson et al. 2002) areas, but also includes areas with low levels of human population that are distant from human access points, such as roads. Index values equal or above the 25 mark were identified as moderately to heavily impacted. This class includes all human-disturbed areas - those within and nearby roads, populated places, and agriculture. The reclassified HII was reclassified using the following values: a 1 for low and a 0 for high.

Multiplying the two datasets (using the Spatial Analysis Tool in Arcinfo) produced a final GRID with areas that are (a) protected and have a low threat/use have a value of 1, and (b) other areas (those with high threat/use or unprotected) resulted in a value of 0.

The zonal mean was calculated using the final GRID for the Country-Biome dataset. Calculating the Zonal Mean of the GRID by Country-Biome (pixel value 0 or 1) results in a value that can be used a percentage.

The effective conservation target is 10% of land by biome conserved within a country. Protection by biome is capped at 10% so that countries cannot offset less than 10% protection of any given biome with greater than 10% protection in another.

Caveats: All three datasets are widely accepted and used, even though as with all other global databases they do have limitations relative to the resolution of the data and problems with protected area delineations. Further spatial errors can arise in the overlay process, especially for the smallest island nations.

Additional Citations Olson, D.M., E. Dinerstein, E.D. Wikramanayake, et al. (2001). Terrestrial Ecoregions of the World: A New Map of Life on Earth, *Bioscience* 51(11), pp. 933-938.

Sanderson, E.W., M. Jaiteh, M.A. Levy, K.H. Redford, A.V. Wannebo, and G. Wolmer. (2002). "The Human Footprint and the Last of the Wild," *BioScience*, Vol. 52, No. 10, pp. 891-904.

Indicator Code: AZE

Objective: Ecosystem Vitality

Policy Category: Biodiversity and Habitat

Subcategory: Biodiversity and Habitat

Indicator Short Name: Critical Habitat Protection

Indicator Full Name: Percent of Alliance for Zero Extinction Sites Protected

Indicator Description: Percent of Alliance for Zero Extinction (AZE) Sites Protected is designed to give more rigorous insight into the protection of highly endangered species. It catalogs whether countries provide protection for sites designated by the Alliance for Zero Extinction (AZE). Indices that look at species conservation by country can be difficult to develop, as the percentage of endangered species within a country is tied to the natural endowment of the country. Moreover, species are assessed as threatened on the basis of their global conservation status. This means that even if a country takes extensive measures to protect that species in its own territory, they might still rank poorly on an index that looks at the percentage of endangered species at the global level. The Alliance for Zero Extinction is a joint initiative of 52 biodiversity conservation organizations, which aims to prevent extinctions by identifying and safeguarding key sites, each one of which is the last remaining refuge of one or more Endangered or Critically Endangered species. They follow the IUCN Red List criteria for Endangered or Critically Endangered species; therefore it uses a consistent and standardized approach and criteria across the world. To date, AZE has identified 595 sites that each represents the last refuge of one or more of the world's most highly threatened species.

An AZE site must meet all three of the following criteria:

- a) Endangerment. An AZE site must contain at least one Endangered (EN) or Critically Endangered (CR) species, as listed by IUCN - World Conservation Union.
- b) Irreplaceability. An AZE site should only be designated if it is the sole area where an EN or CR species occurs, or contains the overwhelmingly significant known resident population of the EN or CR species, or contains the overwhelmingly significant known population for one life history segment (e.g., breeding or wintering) of the EN or CR species.
- c) Discreteness. The area must have a definable boundary within which the character of habitats, biological communities, and/or management issues have more in common with each other than they do with those in adjacent areas.

Units: Percentage

Country Coverage: 86

Reference Year: 2004

Target: 100%

Target Source: Expert Judgment

Short Source: Conservation Strategies Division, The Nature Conservancy.

Source: Results based on Ricketts et al., 2005.

Source URL: not available

Methodology: We calculated the percent of AZE sites within each country that are within a protected area, based on the published paper by Ricketts et al. (2005).

Additional Citations: Ricketts, T.H., et al. (2005). Pinpointing and preventing imminent extinctions. Proceedings of the National Academy of Sciences, 51, pp. 18497-18501.

Indicator Code: MPAEEZ

Objective: Ecosystem Vitality

Policy Category: Biodiversity and Habitat

Subcategory: Biodiversity and Habitat

Indicator Short Name: Marine Protected Areas

Indicator Full Name: Percentage of Exclusive Economic Zone (EEZ) Area that is Protected

Indicator Description: Home to mangroves, sea grasses, coral reefs, and other critical habitats, coastal areas are vital to marine biodiversity. There is growing recognition of the need to protect coastal and marine resources from over-fishing and other activities the damage habitat. This indicator represents a simple assessment of the percent area in each country's exclusive economic zone that is protected. The target is set to 10%, the same as for terrestrial protected areas.

Units: Percentage area

Country Coverage: 132

Reference Year: 2006

Target: 10%

Target Source: Convention on Biological

Short Source: Suzanne Mondoux and Louisa Wood, Fisheries Centre, University of British Columbia

Source: Data compiled by Suzanne Mondoux and Louisa Wood, Fisheries Centre, University of British Columbia.

Original data developed in a collaboration between the Sea Around Us Project, World Wildlife Fund (WWF), United Nations Environment Programme - World Conservation Monitoring Centre (UNEP-WCMC) and the World Conservation Union - World Commission on Protected Areas (IUCN-WCPA).

Source URL: <http://www.mpaglobal.org/>

Methodology: Protected areas were coded as marine if they principally cover the marine portion of the coastal zone. The area of marine protected areas was tallied and divided by the total area in a country's exclusive economic zone (EEZ). For countries with more than one EEZ, the MPA area and EEZ areas were summed, and then the total area protected was divided by the combined total EEZ area for the country.

Additional Citations Wood, L. J. (2007). MPA Global: A database of the world's marine protected areas. Sea Around Us Project, UNEP-WCMC & WWF. Available at <http://www.mpaglobal.org>

Indicator Code: FORGRO

Objective: Ecosystem Vitality

Policy Category: Productive Natural Resources

Subcategory: Forestry

Indicator Short Name: Change in Growing Stock

Indicator Full Name: Change in the Volume of Growing Stock

Indicator Description: Growing stock is defined as the standing tree volume of the forest resources. An increase in growing stock usually means higher quality forests, whereas a decrease in growing stock generally indicates degrading forest conditions. For simplicity in measurement and explanation of the forest resources condition, growing stock is a good choice.

Caveats: Although growing stock is important, standing tree volume alone is not sufficient for a detailed analysis. For example, future wood supply is highly dependent on the age class distribution, or the stand structures and the management system applied. Further, biodiversity requires diversity, e.g., in tree species and succession stages. Carbon storage is highly dependent on soil carbon, which may not be directly correlated to tree volume. Finally, converting primary forests to forest plantations may increase the tree volume but it generally degrades the condition (related to biodiversity and ecosystems) of the natural habitat.

Units: cubic meters/hectare

Country Coverage: 127 (deforestation data were used to increase country coverage to 230)

Reference Year: 2005:2000

Target: No Decline

Target Source: Expert Judgment

Short Source: Forestry Department, Food and Agricultural Organization of the United Nations

Source: Food and Agricultural Organization of the United Nations. (2005). Global Forests Resources Assessment 2005. Rome, FAO.

Source URL: <http://www.fao.org/forestry/site>

Methodology: Growing stock is a volumetric measure that measures the cubic meters of wood over bark of all living trees more than X cm in diameter at breast height. It includes the stem from ground level or stump height up to a top diameter of Y cm, and may also include branches to a minimum diameter of W cm. Countries indicate the three thresholds (X, Y, W in cm) and the parts of the tree that are not included in the volume. Countries must also indicate whether the reported figures refer to volume above ground or above stump. The diameter is measured at 30 cm above the end of the buttresses if these are higher than 1 meter. Growing stock includes windfallen living trees but excludes smaller branches, twigs, foliage, flowers, seeds, and roots.

The ratio of growing stock in cubic meters was taken for 2005 and 2000. Ratios greater than 1 indicate that the growing stock increased over the time period, and ratios less than 1 indicate that it decreased. Countries with a growing stock of 1 or greater were taken to be "at target". Countries with declining growing stock were considered to be below target. For Germany, the ratio of 2000 to 1990 data was used instead.

For countries without growing stock data, data on percent change in forest area were used. The correlation between growing stock and deforestation data is very high (excluding three outliers, Comoros, Indonesia, and Micronesia, the $R^2 = 0.81$, $p < .001$), so this was determined to be a robust way to impute the value for change in growing stock.

Additional Citations: not available

Indicator Code: MTI

Objective: Ecosystem Vitality

Policy Category: Productive Natural Resources

Subcategory: Fisheries

Indicator Short Name: Marine Trophic Index

Indicator Full Name: Slope of Marine Trophic Index from 1950-2004

Indicator Description: The marine trophic level ranges from 1 in plants to 4 or 5 in larger predators. It expresses the relative position of fish and other animals in the hierarchical food chain that nourish them. They provide food for small fish which, have a trophic level of about 3, and the small fish are eaten by slightly larger fish that have a trophic level of 4, which, in turn, are what large predators such as sharks and marine mammal and humans typically eat (Pauly and MacLean 2003).

If the average level at which a country's fisheries is catching fish declines over time, it means that the overall trophic structure of the marine ecosystem is becoming depleted of larger fish higher up the food chain, and is resorting to smaller fish.

This indicator measures the slope of the trend line in the Marine Trophic Index (MTI) from 1950-2004. If the slope is 0 or is positive, the fishery is either stable or improving. If the slope is negative (below 0), it means the fishery is declining, and that smaller and smaller fish are being caught.

Units: Slope of Trend Line

Country Coverage: 134

Reference Year: 1950-2004

Target: No Decline

Target Source: Expert Judgment

Short Source: Sea Around Us Project and the Convention on Biological Diversity

Source: Sea Around Us Project and the Convention on Biological Diversity

Source URL: <http://www.seaaroundus.org/>

Methodology: Using the Sea Around Us website, data were gathered on the slope of the trend line in the Marine Trophic Index (MTI) from 1950 to 2004 for a country's exclusive economic zones (EEZs). For countries with more than one EEZ, a weighted average slope was calculated on the basis of the relative size of the EEZs.

Data for Albania were only available through 1970 and data for Eritrea were only available through 1978.

Additional Citations Pauly, D., and J.L. MacLean. (2003). In a Perfect Ocean: The State of Fisheries and Ecosystems in the North. Washington, DC, Island Press.

Pauly, D. and Watson, R. (2005). Background and interpretation of the 'Marine Trophic Index' as a measure of biodiversity. *Philosophical Transactions of The Royal Society: Biological Sciences* 360: 415-423.

Indicator Code: EEZTD

Objective: Ecosystem Vitality

Policy Category: Productive Natural Resources

Subcategory: Fisheries

Indicator Short Name: Trawling Intensity

Indicator Full Name: Percentage of Exclusive Economic Zone Area Trawled

Indicator Description: Benthic trawling is a fishing method that targets fish and invertebrates that inhabit ocean floor (or benthic) ecosystems. These include cod, scallops, shrimp, and flounder. Such trawling comes at a heavy environmental cost. Bottom trawling and dredging equipment has been described as the most destructive fishing gear in use today (Watson, 2004 and 2006). Benthic trawls are boats equipped with large heavy nets that are dragged across the living seafloor. The nets are held open at the front by a metal beam or by large "doors", which can weigh several tons, and which are designed to scour the bottom as the trawl is dragged along, forcing the fish and invertebrates up into the net. This process exerts a heavy toll on the natural habitats of the sea floor, breaking off brittle bottom flora and fauna such as sponges and corals. Marine species such as turtles that try to escape the gear suffer stress, injury, and quite frequently, death (FAO, 2005).

The damage can last many years and continuous trawling and dredging does not allow the time needed for habitat recovery. Deep-sea coral communities can be wiped out by a single trawl sweep and repeated trawling can change the species composition of the ecosystem toward small opportunistic species, such as sea stars and small short-lived clams, and diminishes the abundance of commercially valuable species.

In addition to disrupting the living seafloor, trawling kills a large number of animals as "by catch," the accidental harvest of untargeted species, such as other fish and invertebrate species, marine mammals, seabirds, and turtles. Some of this by catch is retained for sale, but a portion of it is returned to the sea, usually dead or dying. These animals returned to sea are known as discards. Bottom trawled fisheries have the highest discard rates of all fisheries. By catch is a contributor to the depletion of fish stocks, and can have a significant impact on endangered species of fish, mammals, turtles and seabirds.

The habitat destruction caused by trawling and dredging directly affects the human communities that depend on marine resources for food and income. Key nursery habitats such as seagrass are essential for sustaining a range of commercially important species. When these nursery habitats are destroyed, the entire local environment is impacted and the productivity of local fisheries, including those employing sustainable fishing methods, decreases.

The 2008 EPI uses a simple calculation of the percentage of the shelf area in each country's EEZ that is fished by trawlers. There are no direct data available for the area trawled on a country-by-country basis. However, there are good data available describing fish landings and the gear used to catch these fish, and acceptable data on the composition of each country's fishing fleet.

Units: Percentage Area

Country Coverage: 175

Reference Year: 2004

Target: 0%

Target Source: Expert Judgment

Short Source: Watson et al. 2004; 2006

Source: Watson, R., Hoshino, E., Beblow, J., Revenga, C., Kura, Y., & Kitchingman, A. (2004). Fishing gear associated with global marine catches. Fisheries Centre Research Reports 12(6), 32p.

Watson, R., Revenga, C., & Kura, Y. (2006). Fishing gear associated with global marine catches: II Trends in trawling and dredging. Fisheries Research 79, 103-111.

Source URL: <http://www.seaaroundus.org/>

Methodology: This indicator is calculated based on the amount of catch that is trawled per one-half degree (30 arc-minute) grid cells. This results in a metric of the area (sq km) associated with combined bottom trawl or dredge catch (supergears 8 or 9) rates >0.05 tonnes/sq km/year within declared EEZ areas. The marine area of the cells are added up to find the total area trawled and then divided by total EEZ. Cells that have a minimal catch are not included in the analysis.

Additional Citations: FAO. (2005). Mortality of fish escaping trawl gears (No. 478). Rome:Food and Agriculture Organization of the United Nations.

Indicator Code: IRRSTR

Objective: Ecosystem Vitality

Policy Category: Productive Natural Resources

Subcategory Agriculture

Indicator Short Name: Irrigation Stress

Indicator Full NamePercentage of Irrigated Area that is in Water Stressed Areas

Indicator Description: Agriculture is by far the largest user of "blue water" (freshwater in streams, lakes, from groundwater aquifers, etc) globally, with irrigation accounting for 70% of freshwater extraction globally and as much as 80-90% in some developing countries. When water is abstracted for irrigation in water stressed areas (catchments in which consumption exceeds 40% of available water supplies) , it can contribute to seasonal low-flows, and to excessive concentration of agrochemicals from agricultural runoff. This indicator simply measures the percentage of irrigated agriculture that falls in areas of water stress within a country.

Units: Percentage Area

Country Coverage: 159

Reference Year: circa 2000

Target: 0%

Target Source: Expert Judgment

Short Source: CIESIN calculation based on global irrigation map by Johann Wolfgang Goethe University and Food and Agriculture Organization of the UN, and water stressed area map by University of New Hampshire Water Systems Analysis Group.

Source: CIESIN calculation based on three data sets:

Johann Wolfgang Goethe University and Food and Agriculture Organization of the UN, Global Map of Irrigation Areas version 4.0.1, available at: <http://www.fao.org/nr/water/aquastat/irrigationmap/index10.stm>

University of New Hampshire Water Systems Analysis Group, Mean annual relative water stress index (unitless ratio per grid cell),available at <http://wwdrii.sr.unh.edu/>

Country Grid (CIESIN 2006): Country grid with cell size of 0.083333. Grid values are UNSD codes

Source URL: <http://www.fao.org/nr/water/aquastat/irrigationmap/index10.stm>; <http://wwdrii.sr.unh.edu/>

Methodology: The Global Map of Irrigation Areas version 4.0.1, with a spatial resolution of 5 arc-minutes, was overlaid on the global map of mean annual relative water stress index, with a spatial resolution of 30 arc-minutes. The irrigated area that fell in water stressed grid cells was summed and divided by the total irrigated area for the country in order to calculate the percentage of irrigated area that is in water stressed areas. The specific processing steps were as follows:

1. Resampled the UNH Relative Water Stress data at 0.083333 grid cell size to match that of the Global Map of Irrigated Areas
2. Reclassify the Relative Water Stress data into the following classes
 - a. 1: grid value < 40%
 - b. 2:grid value >= 40%
3. Calculate Irrigation area within each class
- 4.Summary area irrigated in each country using Zonal Statistics

Additional Citations: Siebert, S., P. Döll, S. Feick, J. Hoogeveen and K. Frenken. (2007). Global Map of Irrigation Areas version 4.0.1. Johann Wolfgang Goethe University, Frankfurt am Main, Germany / Food and Agriculture Organization of the United Nations, Rome, Italy.

Indicator Code: AGSUB

Objective: Ecosystem Vitality

Policy Category: Productive Natural Resources

Subcategory: Agriculture

Indicator Short Name: Agricultural Subsidies

Indicator Full Name: Agricultural Subsidies represented by Nominal Rates of Assistance(NRA) by country

Indicator Description: According to a report by the OECD (2004), agricultural subsidies exacerbate environmental pressures through the intensification of chemical use and the expansion of land into sensitive areas. This indicator seeks to assess the magnitude of subsidies in order to assess the degree of environmental pressure they exert. The NRA is defined as the price of their product in the domestic market (plus any direct output subsidy) less its price at the border, expressed as a percentage of the border price (adjusting for transport costs and quality differences).

Units: Proximity-to-Target, with 100 being the target, and 0 being the worst performer

Country Coverage: 238

Reference Year: 2005

Target: 100

Target Source: Expert Judgment

Short Source: YCELP calculation based on OECD Producer Support Estimates Data, WDR 2008 and the Pilot 2006 EPI

Source: World Development Report Selected Indicators 2008, OECD Producer Support Estimates database 2007, Pilot 2006 EPI

Source URL: <http://siteresources.worldbank.org>.

Methodology: Where available, we used data on the Nominal Rate of Assistance (NRA) from the World Development Report 2008. NRA is defined as the price of a product in the domestic market, less its price at a country's border, expressed as a percentage of the border price, and adjusted for transport costs and quality differences (WDR 2008). These were converted to the standard EPI proximity-to-target indicator.

NRA data were unavailable for a number of countries for which we had data when we compiled the Pilot 2006 EPI (Costa Rica, Israel, Jordan, Peru, Tunisia, Uruguay, and Venezuela). For these, the indicator was computed by subtracting greenbox subsidies from total agricultural subsidies, which was then divided by the total value of agriculture.

Low and middle-income countries without agricultural subsidies data were imputed a proximity to target score of 0 on the basis that most non-OECD countries do not subsidize their agricultural sector.

Caveats: Combining the 2008 EPI data with the AGSUB indicator data from the 2006 EPI represented a less than perfect solution, yet we were uncomfortable assigning a score of 100 to countries that subsidize their agriculture, and unwilling to estimate subsidy levels for countries that are engaged in agriculture of dubious environmental sustainability. This methodology makes use of the best data available, and we hope to include a more accurate measure in future editions of the EPI, as improved data sources arise.

Additional Citations Agriculture's "multifunctionality" and the WTO; Kym Anderson; The Australian Journal of Agricultural and Resource Economics, 44:3, pp 475-494

Indicator Code: AGINT

Objective: Ecosystem Vitality

Policy Category: Productive Natural Resources

Subcategory: Agriculture

Indicator Short Name: Intensive Cropland

Indicator Full Name: Percentage of Cropland Area that is in Agriculture-dominated Landscapes

Indicator Description: As a rough rule of thumb, ecologists agree that if more than 30% of the area of a given landscape is under intensive use for agricultural production, then major ecosystem functions will likely be compromised, and if this level reaches 60%, then special attention is needed to conserve ecosystem functions (Wood et al., 2000). The 2008 EPI sets a target of 40% uncultivated land in areas of crop production, although this figure includes grazing land and settlements, so is quite conservative.

The indicator considers whether each 10km x 10km grid cell where cropping occurs has at least 40% land uncultivated, thereby "making space" for other ecosystem functions. If agriculture makes up more than 60% of the grid cell, the agricultural land in that grid cell is considered to be intensive. The indicator seeks to address the problem of over-clearing, excessive "in-filling" of agricultural landscapes.

Units: Percentage Area

Country Coverage: 158

Reference Year: 2000

Target: 0%

Target Source: Expert Judgment

Short Source: CIESIN calculation based on global cropland grid by Ramankutty et al. (forthcoming).

Source: CIESIN calculation based on global cropland grid from Ramankutty et al. (forthcoming).

Source URL: not available

Methodology: Global cropland grids by Ramankutty et al. (forthcoming) representing the proportion of land that is in cropland per 5 arc-minute grid cell were processed to calculate two figures, the total cropland area per country, and the total cropland area per country in grid cells in which cropland represents more than 60% of land use types in that grid cell. The latter was divided by the former and multiplied by 100 to calculate the percentage of cropland area that is in agriculture dominated landscapes.

Countries with less than 3,000 sq. km of cropland were considered not to have sufficient cropland for this indicator, and were considered therefore to have no data.

Additional Citations Ramankutty, N., A.T. Evan, C. Monfreda, J.A. Foley. (forthcoming). Farming the Planet. Part 1: The Geographical Distribution of Global Agricultural Lands in the Year 2000. Global Biogeochemical Cycles, in press.

Wood, S., K. Sebastian, and S. Scherr. 2000. Pilot Analysis of Global Ecosystems: Agroecosystems. IFPRI and WRI, Washington, DC.

Indicator Code: PEST

Objective: Ecosystem Vitality

Policy Category: Productive Natural Resources

Subcategory: Agriculture

Indicator Short Name: Pesticide Regulation

Indicator Full Name: Degree of Regulation of Toxic Pesticides

Indicator Description: Pesticides are a significant source of pollution in the environment, affecting both human and ecosystem health. Pesticides damage ecosystem health by killing beneficial insects, pollinators, and fauna they support. Human exposure to pesticides has been linked to increases in headaches, fatigue, insomnia, dizziness, hand tremors, and other neurological symptoms. Furthermore, many of the pesticides included in this index are persistent organic pollutants (POPs), endocrine disruptors, or carcinogens.

Our indicator of pesticide use examines the legislative status of countries on two landmark agreements on pesticide usage, the Rotterdam and Stockholm conventions, and also rates the degree to which these countries have followed through on the objectives of the conventions by limiting or outlawing the use of certain toxic chemicals. While the Rotterdam convention focuses on trade restrictions and proper labeling of toxic substances, the Stockholm convention seeks to limit or ban the use of the 12 most toxic persistent organic pollutants which bioaccumulate and move long distances in the environment.

While ideally, we would use an output measure rather than a legislative measure for this indicator, we concluded after extensive research that the robust data on pesticide usage - especially for banned pesticides for which official data may be scant - were simply not available. While legislative controls do not always match the situation on the ground, this indicator sends a clear message to countries that setting standards for pesticides use is an essential first step in controlling the degree to which toxics are used at a national scale.

Units: 22 Point Scale, with 0 representing the lowest score, and 22 the highest

Country Coverage: 238

Reference Year: 2003

Target: 22 points

Target Source: Expert Judgment

Short Source: YCELP calculation based on data from the Rotterdam Convention and the Stockholm Convention.

Source: YCELP calculation based on data from the Rotterdam Convention and the Stockholm Convention.

Source URL: Rotterdam Convention. Available at <http://www.pic.int/home.php?type=t&id=5&sid=16>.

Stockholm Convention on Persistent Organic Pollutants (POPs). Available at <http://www.pops.int/>.

Methodology: The indicator encompasses 11 criteria, each of which have a maximum of two possible points. The first two criteria measure whether, and to what degree countries have participated in the conventions. Under the Rotterdam Convention, countries receive 2 points if they are a party and have designated a national authority for its implementation, 1 point if they are a party but have no national authority, and 0 points if they are not a party. Under the Stockholm Convention on Persistent Organic Pollutants, countries receive 2 points if they are a party and have created a national implementation plan (NIP), 1 point if they are a party but have no NIP, and 0 points if they are not a party. These data are available via the respective convention secretariats.

The next nine criteria indicate whether countries have banned (for a score of 2), restricted (for a score of 1), or taken no action (for a score of 0) on regulating the nine of the "dirty dozen" persistent organic pollutants. These include aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, and toxaphene. Data for these criteria were collected from the United Nations Environment Programme Chemicals.

Country performance is a simple sum of the scores across the 11 criteria for a maximum possible score of 22.

Additional Citations United Nations Environment Programme, Chemicals. Master List of Actions on the Reduction and/or Releases of Persistent Organic Pollutants. June 2003

Indicator Code: BURNED

Objective: Ecosystem Vitality

Policy Category: Productive Natural Resources

Subcategory: Agriculture

Indicator Short Name: Burned Area

Indicator Full Name: Percentage of Country Area Burned

Indicator Description: Biomass burning has long been recognized as a significant source of carbon emissions that contribute to climate change, and as an important source of airborne particulates, especially in developing countries. Thus, from atmospheric perspective, it is unambiguously negative. From a land management perspective, however, the role of biomass burning in soil fertility management and ecosystem processes is more difficult to assess. For example, controlled biomass burning in the agricultural sector, on a limited scale, can have positive functions as a means of clearing and rotating individual plots for crop production, and in some ecosystems, as a healthy means of weed control and soil fertility improvement. In a number of natural ecosystems, such as savannah and scrub forests, wild fires can help maintain biotic functions. However, in tropical forest ecosystems, fires are mostly human induced and environmentally harmful, killing wildlife, reducing habitat, and setting the stage for more fires by reducing moisture content and increasing combustible materials. Even where fire can be beneficial from an agricultural perspective, fires can inadvertently spread to natural ecosystems, setting the stage for further agricultural colonization. Hence, we have chosen to assess fires as, on balance, a negative phenomenon from an agricultural natural resource management perspective.

Units: Percentage

Country Coverage: 160

Reference Year: 2005-2006

Target: 0

Target Source: Expert Judgment

Short Source: L3JRC 2000-2007, CIESIN, 2007

Source: Joint Research Centre's Global Burnt Areas 2000-2007 (L3JRC)

CIESIN Global Rural-Urban Mapping Project (GRUMP) land area and country grids.

Source URL: not available

Methodology: The EPI team assessed the extent of burn scars by downloading and processing data for 2000 (representing April 2000-March 2001) and 2005 (representing April 2005-March 2006) from the Joint Research Centre's Global Burnt Areas 2000-2007 (L3JRC) product, which identifies burnt areas using the SPOT VEGETATION sensor at 1km resolution. These data were simplified to a boolean surface of burnt (1) and non-burnt (0) areas and subsampled from 0.009 degree resolution to 0.008 degrees to match the Global Rural-Urban Mapping Project (GRUMP) land area and country grids. The total burnt area was calculated by multiplying the boolean burnt area grid by the GRUMP land area grid (land area in ha) and summing the results. The country totals were generated by calculating the unique combination of countries (from GRUMP) and burnt areas, then summing the land area grid for the country-burnt area zones.

We calculated total land area burnt for the 12 months from April 2000-March 2001 and April 2005-May 2006 in order to assess land burning during two years under different climate regimes: for the winter of 2000-01 there was a strong La Niña signal in the Pacific Ocean, and for the winter of 2005-06 neither El Niño or La Niña played a role in global climate patterns. We calculated the land area burned as a percentage of total land area in both years, then averaged the percentages.

Additional Citations Tansey, K., Grégoire, J.M.C., Defourny, P., Leigh, R., Pekel, van Bogaert, E., Bartholomé, E., Bontemps, S. 2008. A new, global, multi-annual (2000-2007) burned area product at 1 km resolution and daily intervals. *Geophysical Research Letters*, Vol. 35, L01401, doi:10.1029/2007GL031567

Indicator Code: GHGCAP

Objective: Ecosystem Vitality

Policy Category: Climate Change

Subcategory: Climate Change

Indicator Short Name: Emissions Per Capita

Indicator Full Name: Greenhouse Gas Emissions Per Capita

Indicator Description: Sum of emissions of six greenhouse gases, in CO2 equivalents, and emissions attributable to land use, divided by total population.

Units: Metric Tons CO2 Equivalent Per Person

Country Coverage: 169

Reference Year: 2005:2000

Target: 2.24 Metric Tons CO2 Equivalent

Target Source: Calculated by calculating 50%

Short Source: IAE, 2007, Houghton 2003, IMF 2005

Source: International Energy Agency. CO2 Emissions from Fuel Combustion (2004 edition).

International Monetary Fund, World Economic Outlook Database, October 2007 Population year 2005

Houghton, R.A. 2003. Revised estimates of the annual net flux of carbon to the atmosphere from changes in land use and land management 1850-2000. Tellus 55B:378- 390.

Source URL: <http://wds.iea.org/WDS/TableViewer/dimView.aspx?ReportId=949>

Methodology: For countries missing GHG emission data, values were imputed using a regression model predicting GHG emissions from CDIAC CO2 emissions. For countries missing land-use emissions, values were imputed based on the regional average of land-use emissions were square kilometer.

GHG emissions and land-use emissions were summed and divided by 2005 population.

Additional Citations: not available

Indicator Code: CO2KWH

Objective: Ecosystem Vitality

Policy Category: Climate Change

Subcategory: Climate Change

Indicator Short Name: CO2 from Electricity Production

Indicator Full Name: Emissions per Kilowatt Hour of Energy Produced

Indicator Description Sum of emissions from combustion of all fossil fuel types used for public electricity generation, public combined heat and power generation, and public heat plants.

Units: g CO2 per kWh

Country Coverage: 213

Reference Year: 2005

Target: 0

Target Source: Expert Judgment

Short Source: IAE, 2007

Source: International Energy Agency. CO2 Emissions from Fuel Combustion (2004 edition).

Source URL: <http://wds.iea.org/WDS/TableView/dimView.aspx?ReportId=949>

Methodology: This data includes emissions from public elec. and heat producers. Carbon dioxide emissions from public electricity and heat production include the sum of emissions from combustion of all fossil fuel types used for public electricity generation, public combined heat and power generation, and public heat plants. Public utilities are defined as those undertakings whose primary activity is to supply the public. Emissions from electricity and heat production for use by the producer (autoproduction) are not included in this variable, as those emissions are attributed to industry, transport or "other" sectors. CO2 from public electricity and heat production corresponds to International Panel on Climate Change (IPCC) Source/Sink Category 1 A 1 a

Additional Citations: not available

Indicator Code: CO2IND

Objective: Ecosystem Vitality

Policy Category: Climate Change

Subcategory: Climate Change

Indicator Short Name: Industrial Carbon Intensity

Indicator Full Name: Carbon Emissions from Industry per Industrial GDP

Indicator Description: Total emissions from industry sector, divided by industrial GDP.

Units: CO2 per \$1000, USD 1995 PPP

Country Coverage: 170

Reference Year: 2005

Target: .85

Target Source: 27% of current, reduction that

Short Source: IAE, WDI, 2007

Source: International Energy Agency. CO2 Emissions from Fuel Combustion (2004 edition).

World Development Indicators, Percentage of GDP from Industry, 2005

Source URL: <http://wds.iea.org/WDS/Report>

Methodology: For countries with missing data, values were imputed based on regression model predicting CO2IND using CO2_GDP (CO2 emissions per GDP).

Industrial GDP were calculated based on the percentage of GDP from industry, and total GDP. IAE industrial CO2 emissions were divided by industrial GDP to create the indicator.

Additional Citations: not available