Documentation for the
Natural Resource Protection and Child Health Indicators, 2017 Release

August 2018

Center for International Earth Science Information Network (CIESIN), Columbia University

Abstract

This document outlines the basic methodology and data sets used to construct the Natural Resource Protection and Child Health Indicators, 2017 Release (2010–2017), along with use cases, limitations, and use constraints.

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We appreciate feedback regarding this data set, such as suggestions, discovery of errors, difficulties in using the data, and format preferences. Please contact:

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Contents

I.   Introduction

The Natural Resource Protection and Child Health Indicators, 2017 Release, is produced in support of the U.S. Millennium Challenge Corporation (MCC) as selection criteria for funding eligibility. The Natural Resource Protection Indicator (NRPI) and Child Health Indicator (CHI) are based on proximity-to-target scores ranging from 0 to 100 (at target). The NRPI covers 234 countries and is calculated based on the weighted average percentage of biomes under protected status. The CHI is a composite index for 199 countries derived from the average of three proximity-to-target scores for access to at least basic water and sanitation, along with child mortality. The 2017 release includes a consistent time series of NRPI scores for 2013-2017 and CHI scores for 2010 to 2017.

II.   Data and Methodology

Input data

Data on access to improved water sources and adequate sanitation were obtained from the Joint Monitoring Program (JMP, 2017).

Prior to 2017, the JMP used the term "access to improved water" and "access to improved sanitation". In 2017 (affecting published water and sanitation data for the year 2015 - the last reported year), the JMP revisited and incorporated linear regression methods to estimate populations with access to different levels of service for drinking water. Newly introduced levels of service for improved drinking water sources include 'at least basic

services', which refers to households using an improved water source with water collection times of no more than 30 minutes per round trip, as well as 'limited services', which refer to households using an improved water source with water collection times exceeding 30 minutes (WHO, UNICEF, Joint Monitoring Program, 2017).

An early release of the CHI included both categories; this revised release includes only the 'at least basic' category, to be more consistent with the Sustainable Development Goal (SDG) target 6.1 (see https://sustainabledevelopment.un.org/sdg6).

Similarly, the JMP revisited and incorporated similar methods to estimate populations with access to different levels of service for sanitation. Households with access to 'basic services' refer to those using adequate sanitation facilities that are not shared with other households, and, households with access to 'limited' sanitation services refer to those using adequate sanitation facilities shared with other households (WHO, UNICEF, Joint Monitoring Program, 2017).

An early release of the CHI included both categories; this revised release includes only the 'basic' category, to be more consistent with the Sustainable Development Goal (SDG) target 6.2 (see https://sustainabledevelopment.un.org/sdg6).

Gap filling for data on improved water sources and access to adequate sanitation was done using the following sources/methods:

Because Kosovo is not a UN member state, data for access to improved water sources and adequate sanitation were obtained from Kosovo's Multiple Indicator Cluster Survey (MICS) 2013-2014, Revised in May, 2015 (The Kosovo Agency of Statistics, 2014).

The data points obtained from MICS were used in 2014, and carried forward for subsequent years.

To fill gaps in the time series for water and/or sanitation data, the following procedures were used for the countries below (note: "wat_YY" represents % with access to water for year YY; "san_YY" represents % with access to sanitation for year YY):

- Saint Kitts and Nevis - wat_2013 value copied to wat_2014 through wat_2017
- Uzbekistan - wat_2012 value copied to wat_2013 through wat_2017
- Micronesia (Federated States of) - san_2014 value copied to san_2015 through san_2017
- Saint Kitts and Nevis - san_2013 value copied to san_2014 through san_2017
- Saint Pierre and Miquelon - san_2014 value copied to san_2015 through san_2017

Data on child mortality (the probability of dying between age 1 and 5 (4q1)) were obtained from the United Nations (UN, 2017).

Gap filling for data on child mortality was done using the following sources/methods:

Because Kosovo is not a UN member state, data for access to improved water sources and adequate sanitation were obtained from Kosovo's Multiple Indicator Cluster Survey (MICS) 2013-2014, Revised in May, 2015 (The Kosovo Agency of Statistics, 2014).

The data points obtained from MICS were used in 2014, and carried forward for subsequent years.

Data on Natural Resource Protection Indicator (NRPI) were calculated by CIESIN with data from the UNEP World Conservation Monitoring Centre (UNEP-WCMC, 2017).

Gap filling for data on Natural Resource Protection Indicator (NRPI) was done using the following sources/methods:

Because Kosovo is not yet a UN member state, data for Kosovo protected areas boundaries were obtained from European Environment Agency (EEA, 2017).

Methods

General Methods
All indicators are computed as a standardized proximity-to-target ranging from 0 (worst performance) to 100 (at target or best performance).

Natural Resource Protection Indicator
Here we present the method for developing the proximity-to-target scores for the NRPI derived from processing spatial data on protected areas, biomes, and country boundaries. Additional details on the spatial data processing are included at the bottom of this page.

For the Natural Resource Protection Indicator (NRPI), all scores by biome are capped at 17%, which is the target established at the 10th Conference of the Parties of the Convention on Biological Diversity (Nagoya, Japan). The scores are capped so that protection levels greater than 17% in a given biome do not offset less than 17% protection in another biome. Since the range of protection levels across all countries is from 0-17%, the proximity-to-target scores are calculated as the ratio of the weighted biome protection percentage to 17%, multiplied by 100. Thus, a country with 5% weighted biome protection would be calculated as follows: $5/17 = 0.29411$; $0.29411 * 100 = 29.41$.

Details on the NRPI methodology for Romania are presented in the table below. Romania has three biomes. First, the biome protected area (Column E) is divided by the total biome area (Column D) and the result is a percentage area protected (Column F). As stated, where there is greater than 17% protection (e.g. for Biome 5 and Biome 8), this is capped at 17% (Column G). Next, the proportion of Romania's land area in each biome class is calculated to weight the three scores (Column H). The final column represents the

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result of the score weighting for the three biomes (Column I). These are then summed, and the total is divided by 17 (bottom left) to produce an overall score of 95.1.

A	B	C	D	E	F	G	H	I
Country	Biome	Biome Description	Biome Area (sq km)	Biome Protected Area	Percentage area Protected = (Biome Protected Area/Biome Area) x 100	Indicator Percent Protected Capped at 17%	Biome Weighted = (Biome Area/ Country Biome Area)	Protected Ecoregion Indicator = (Biome Weighted x Indicator % Capped)
Romania	Biome 4	Temperate Broadleaf & Mixed Forests	159,254.58	25,098.91	(25,098.91/159,254.58) x 100 = 15.76	15.76	25,098.91/ 237,389.09 = 0.67	15.76 x 0.67 = 10.57
Romania	Biome 5	Temperate Coniferous Forests	53,542.95	22,129.37	(22,129.37/53,542.56) x 100 = 41.33	17.00	22,129.37/ 237,389.09 = 0.23	17 x 0.23 = 3.83
Romania	Biome 8	Temperate Grasslands, Savannas & Shrublands	24,591.95	10,428.33	(10,428.33/24,591.95) x 100 = 42.41	17.00	10,428.33/ 237,389.09 = 0.10	17 x 0.10 = 1.76
		Country Biome Area	159,254.58 + 53,542.56 + 24,591.95 = 237,389.09				Country Ecoregion Indicator	10.57 + 3.83 + 1.76 = 16.17

Country	ISO3	Prox to 17% = (Country Ecoregion Indicator/17) x 100
Romania	ROU	(16.17/17) x 100 = 95.1

Additional details on the geospatial methods used to calculate the NRPI are found below.

Child Health Indicator

The Child Health Indicator (CHI) is a simple average of the three proximity-to-target scores for access to adequate sanitation, access to improved water, and child mortality. For access to adequate sanitation and access to improved water, the proximity-to-target measure is equal to the reported percentage. For example, if a country has 84% of its population with access to adequate sanitation, it is considered to have a proximity-to-target score of 84. For child mortality, we compute the ratio of the measured probability of dying to the highest observed probability of dying in a given year, multiply that by 100, and then subtract from 100 to normalize it on the 0-100 scale (the formula is 100 - ((country value)/<highest probability>) * 100). In 2017, the highest child mortality rates in the world occurred in Chad, where children aged 1-5 had a probability of dying of 5.546 per 100 children. Therefore, Chad has a score of zero (0). Afghanistan, on the other hand, has a score of 70.9, based on the following calculations: Afghanistan's observed child mortality rate for children aged 1-5 was 1.614 per 100 in 2015, so its proximity-to-target score is calculated as [100 - ((1.614/5.546) * 100)], which equals 70.9.

Additional Details on the NRPI

What it measures
This indicator measures the degree to which a country achieves the target of protecting at least 17% of each terrestrial biome within its borders. We adopted a target of 17% of each biome protected based on the updated target established at the Convention on Biological Diversity (CBD) Conference of Parties 10 in Nagoya, Japan. We treat protected status as a necessary but not sufficient condition for an ecological region to be "effectively conserved." How well protected areas are managed, the strength of the legal protections extended to them, and the actual outcomes on the ground, are all vital elements of a comprehensive assessment of effective conservation. Such measures are not available on a widespread basis, though there are efforts underway to fill critical gaps (Chape et al., 2005, 452).

The target as expressed by the CBD and the conservation community more generally refers to "ecological regions." To make this metric concrete, we had to choose a specific data set accepted in both scientific and policy-making circles. We used the delineation of "biomes" for this purpose (Olson et al., 2001). Biomes are broad terrestrial ecological regions. Nested within the biomes are what the authors call "ecoregions," which are finer-scale areas sensitive to more specific ecological patterns. These ecoregions are probably more appropriate as policy targets, because they identify areas based on factors that affect biodiversity on the ground more precisely than biomes. However, given the scale of the present analysis (global 1 km grids) and the processing time requirements, it was determined that using ecoregions as the unit of analysis would not be possible (see Caveats section below).

Data Set Preparation
We used the March 2017 World Database on Protected Areas (WDPA) maintained by UNEP's World Conservation Monitoring Centre (WDPA, 2017). As with prior versions of the WDPA, the 2017 release includes both points and polygon layers. The protected areas represented by polygons, which provide the actual boundaries, are a subset of the protected areas represented by points.

We excluded protected areas that were listed as proposed but not yet designated. For protected areas that had point and area information but not an explicit polygon identified, we created a circular buffer around the point with a total area equivalent to the area listed in the database. However, where protected areas are near a country's border, the buffered point is arbitrarily clipped to the border (so as not to spill over into neighboring countries), thereby losing a certain percentage of the total area. (Countries are encouraged to provide protected area boundary data to the WCMC WDPA team.). Marine protected areas whose points were located offshore were excluded from this step. To avoid over-counting overlapping protected areas, the "dissolve" command in ArcMap was used to create a consolidated set of polygons that distinguished areas that were under protected status from those that were not.

We used a high resolution and spatially accurate coastline data set developed by ISciences, L.L.C. (ISciences, 2009). The ISciences coastline data has higher resolution (3 arc-second, or approximately 90 m).

The biome data were obtained from The World Wildlife Fund (WWF) Terrestrial Ecoregions of the World (Olson et al., 2001). Rather than utilize the 200 ecoregions, many of which are quite small, we utilized 14 terrestrial biomes identified in the data set. Because we are measuring the extent of terrestrial protected areas, biome 98 (water) was excluded. We manually extended the WWF Terrestrial biome data to match ISciences coastline data to ensure that all areas particularly along the coast or small islands are assigned a biome type.

We did not include protected areas that are listed as "International" in the WDPA. The vast majority of such internationally designated protected areas, which include World Heritage, Ramsar, and Biosphere Reserve sites, are contained in either the IUCN I-VI or the "no category" national protected area databases of the WDPA, meaning that they have some national legal status. Where they have no national legal status, such protected areas cannot be considered to be adequately protected. This decision is supported by the common practice of many studies that utilize the WDPA to assess the protected status of a nation's territory.

Methods
In order to compute what proportion of each biome in a country is protected, we first created a composite layer consisting of country boundaries (ISciences, 2009), WWF's terrestrial biomes layer, and the consolidated country protected area polygon layer for each year. The area for each unique polygon in the composite layer was computed in square kilometers. The attribute table of the layer was exported into an Excel spreadsheet for final tabulation. The tabular data set quantifies, for each country, the total area of each biome and the total area of each biome that is protected. The percentage of each biome that is protected is calculated. The percentage was capped at 17%, so that additional "credit" does not accrue where protection exceeds 17%. The country's overall score is a weighted average of the protection score for each biome. The weights are derived by calculating the biome area as a fraction of a country's overall area. Greater weights are applied to larger biomes.

Caveats
Spatial errors are always a possibility when combining multiple global, 1:1m scale data sets for analytical purposes. Uncertainty about the exact location of boundaries of some protected areas, especially those represented by creating circles around points, and the potential spatial mismatch between the protected areas layer and the biome-country layer represent potential sources of error. Also worth mentioning is that the WDPA database has been a work in progress since 2006. Over the years, as relatively accurate boundary data has become available, point protected areas are replaced with boundary delineations that often result in changes to the total area under protection.

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To streamline the processing steps we performed geospatial processing such as point protected areas buffering and country-biome- protected areas separately for each country before importing areas into the ecoregion protection indicator calculator. A major benefit of this change is eliminating over-estimation of protected areas as a result of point buffers in adjacent countries from spilling over into neighboring countries thereby inflating the overall ecoregion protection score.

Notes on Updates
The NRPI is equivalent to the "ecoregion protection indicator" of the Natural Resource Management Index (NRMI). Note that until 2011, the protection target was 10% of each biome. From 2012 onward, the target was moved to a weighted average of 17% of biome area protected, which is based on a revised target established by the CBD in Nagoya, Japan, October 2010.

Until the 2012 release, we relied on annual releases of the UNEP-World Conservation Monitoring Centre World Database on Protected Areas (WDPA) to establish our time series, such that the 2006 ecoregion protection indicator would have been based on the 2006 release of the WDPA, the 2007 ecoregion protection indicator on the 2007 release, and so on. From 2012 onward, we have used the most recent monthly release of the WDPA, and the time series is developed based on the date of establishment of the protected area. Thus, if better boundary data becomes available for a given protected area, it will be reflected across the entire series from the date of its establishment onward. The goal is to ensure that any changes in percent of biomes protected in a given release will be due to actual changes in protected status and not due to improvements to the database.

III.   Data Set Description(s)

Data set description:
The NRPI and CHI data consist of country-level estimates in a Microsoft Excel spreadsheet. This spreadsheet includes the NRPI for 2013 to 2017 and CHI from 2010 to 2017.

Data set web page:

SEDAC URL:
http://sedac.ciesin.columbia.edu/data/set/nrmi-natural-resource-protection-child-health-indicators-2017
Permanent URL: https://doi.org/10.7927/H4SQ8XGT

Data set format:
The data are available in Microsoft Excel (XLSX) format as a downloadable zip file. The downloadable is a compressed zip file, containing: 1) Workbook with country-level values for the NRPI and CHI, and 2) PDF documentation.

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Data set download:
nrpi-chi-2017-xlsx.zip

IV.   How to Use the Data

The tabular data can be used directly for statistical analysis.

V.   Potential Use Cases

The data set is used as a component of the MCC score cards, and could be used in statistical analyses where country-level indicators are needed.

VI.   Limitations

The NRPI and CHI scores were originally released in late September 2017, and those data formed the basis for country score cards released by MCC in October 2017. As of December 2017, we revised the CHI so that definitions of access to water and sanitation are consistent with those used by the Sustainable Development Goals (see "about and methods" tab). This resulted in only modest changes to relative country performance.

This data set was formerly known as the Natural Resource Management Index (NRMI), and was distributed under that name until 2011. In 2012, the Millennium Challenge Corporation decided to repackage the NRMI into two separate indicators, the NRPI and CHI.

VII.   Acknowledgments

CIESIN calculated the NRPI and CHI with data provided by other sources, and CIESIN acknowledges the data providers. Funding for development and dissemination of this data set was provided under the U.S. National Aeronautics and Space Administration (NASA) contract NNG13HQ04C for the continued operation of the Socioeconomic Data and Applications Center (SEDAC), which is operated by the Center for International Earth Science Information Network (CIESIN) of Columbia University.

VIII.   Disclaimer

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IX.   Use Constraints

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X.   Recommended Citation(s)

Data set(s):

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XI.   Source Code

No source code is provided.

XII.   References

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XIII. Documentation Copyright and License

Appendix 1. Data Revision History

No revisions have been made to this data set.

Appendix 2. Contributing Authors & Documentation Revision History

Revision Date	Contributors	Revisions
August 2, 2018	Alex de Sherbinin	This document is the 1st instance of documentation