Documentation for the Natural Resource Protection and Child Health Indicators, 2019 Release

June 2020

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, 2019 Release (2010–2019), 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, 2019 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 195 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 2019 release includes a consistent time series of NRPI scores for 2015-2019 and CHI scores for 2010 to 2018.

II.   Data and Methodology

Input data

Data on the Natural Resource Protection Indicator (NRPI) were calculated by CIESIN with data from the United Nations Environment Programme-World Conservation Monitoring Centre (UNEP-WCMC, 2018). Because Kosovo is not yet a UN member state, data for Kosovo protected areas boundaries were obtained from the European Environment Agency (EEA, 2018).

The 2019 CHI scores are based on data on access to improved water and sanitation on child mortality from two different sources. Data on access to improved water sources and

adequate sanitation for 2010-2017 were obtained from:
- Joint Monitoring Program (JMP) for Water Supply, Sanitation and Hygiene. Estimates on the use of water, sanitation and hygiene by country (2000-2017), updated July 2019. World Health Organization (WHO) and United Nations Children's Fund (UNICEF). https://washdata.org/data. Accessed 17 September 2019.

Definitions of service level are provided by the JMP (WHO, UNICEF, Joint Monitoring Program, 2017). 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. Access to "at least basic sanitation" includes the population using improved sanitation methods that are not shared. Improved sanitation methods comprise flush or pour-flush to piped sewer system, septic tank, or pit latrine; ventilated improved pit (VIP) latrine; pit latrine with slab; or composting toilet.

Data on child mortality (the probability of dying between age 1 and 5 (4q1)) for 2010-2018 were obtained from:
- United Nations Inter-agency Group for Child Mortality Estimation (UN IGME), last updated 19 September 2019, downloaded from https://www.childmortality.org. Accessed 19 September 2019)

To fill gaps in the time series for water and/or sanitation data, the following procedures were used for the countries below:

<u>Water</u>
All countries were missing data for 2018, so data from 2017 were carried forward (copy and pasted) to 2018.
- Missing 2017: Copied 2016 to 2017
  - Eritrea, Cayman Islands, Aruba, Central African Republic
- Missing 2016 and 2017: Copied 2015 to 2016 and 2017
  - Argentina, Dominica, Montserrat
- Missing 2014, 2015, 2016, and 2017: Copied 2013 values
  - Saint Kitts and Nevis

<u>Sanitation</u>
All countries were missing data for 2018, so data from 2017 were carried forward (copy and pasted) to 2018.
- Missing 2017: Copied 2016 to 2017
  - Eritrea, Cayman Islands, Aruba,
- Missing 2016 and 2017: Copied 2015 to 2016 and 2017
  - Argentina, Dominica, Brunei
- Missing 2014, 2015, 2016, and 2017: Copied 2013 values
  - Saint Kitts and Nevis

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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

The method for developing the proximity-to-target scores for the NRPI is 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.

By way of illustration, details on the NRPI methodology for Romania are presented in the table below. Romania has three biomes: temperate broadleaf & mixed forests, temperate coniferous forest, and temperate grasslands, savannas and shrub lands. 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 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 in a given country-year to the highest observed probability of dying for any country in the time series from 2010 to 2018, multiply that by 100, and then subtract from 100 to normalize it on the 0-100 scale. The formula for the CHI is:

100 - ((country value)/<highest probability>) * 100)

In the time series data reported by the United Nations Inter-agency Group for Child Mortality Estimation (UN IGME) between 2010 and 2018, Haiti had the highest reported mortality rate between ages 1 and 4 (4q1), at 134.6 per 1,000, owing to the exceptionally high mortality during the 2010 Earthquake. Because this was an exceptional event that killed an estimated 100,000 to 300,000 people (see

https://en.wikipedia.org/wiki/2010_Haiti_earthquake) it did not seem appropriate to use that as the highest reported mortality rate. Chad was then chosen as the next highest reported rate in 2010, since Chad's rate of 70.8 per 1,000 in 2010, was consistent with the time series of child mortality data reported for the country. Therefore, in 2010, Chad had a score of zero (0), which by 2018 had risen to 27.7, because [100 – ((51.2/70.8) * 100)] = 27.7. Afghanistan, on the other hand, has a score of 78.6, based on the following calculations: Afghanistan's observed child mortality rate for children aged 1-5 was 15.14 per 1000 in 2018, so its proximity-to-target score is calculated as [100 - ((15.14/70.8) * 100)], which equals 78.6.

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. A target of 17% was adopted for each biome protected based on the updated target established at the Convention on Biological Diversity (CBD) Conference of Parties 10 in Nagoya, Japan. Protected status is treated 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, a specific data set was chosen, accepted in both scientific and policy-making circles. The delineation of "biomes" was used 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
The June 2019 World Database on Protected Areas (WDPA) maintained by UNEP's-World Conservation Monitoring Centre (UNEP-WCMC, 2019) was used. As with prior versions of the WDPA, the 2019 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,

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a circular buffer was created 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.

A spatially accurate coastline data set was used, distributed as part of the CIESIN Gridded Population of the World, Version 4 (GPWv4) data collection (CIESIN, 2018a).

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, 14 terrestrial biomes were utilized, identified in the data set. Because the extent of terrestrial protected areas is being measured, biome 98 (water) was excluded. The WWF Terrestrial biome data was manually extended to match CIESIN's coastline data to ensure that all areas, particularly along the coast or small islands, are assigned a biome type.

Methods
In order to compute what proportion of each biome in a country is protected, a composite layer was first created consisting of country boundaries (CIESIN, 2018a and 2018b), 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.

To streamline the processing steps, geospatial processing was performed such as buffering point protected areas 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.

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 scores for 2015 to 2019 and CHI from 2010 to 2018.

Data set web page:
SEDAC URL: https://sedac.ciesin.columbia.edu/data/set/nrmi-natural-resource-protection-child-health-indicators-2019
Permanent URL: https://doi.org/10.7927/r6mv-sv82

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.

Data set download:
nrpi-chi-2019-xlsx.zip

IV.   How to Use the Data

The tabular data can be used directly for statistical analysis.

V.   Potential Use Cases

The NRPI and CHI scores are used as a component of the MCC score cards and more recently the CHI has been adopted as part of the United States Agency for International Development (USAID) Self Reliance Roadmaps (see https://selfreliance.usaid.gov/). The data can be used in statistical analyses where country-level indicators are needed.

VI.   Limitations

The NRPI and CHI scores were originally released in mid-October 2019, and those data formed the basis for country score cards released by MCC in November 2019. All data inputs have uncertainties, but no effort to quantify the uncertainties were made.

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.

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IX.   Use Constraints

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X.   Recommended Citation(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	ORCID	Contributors	Revisions
June 16, 2020	0000-0002-8875-4864	A. de Sherbinin	This document is the 1st instance of documentation.

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