MAPPING
FOR A
SUSTAINABLE WORLD

United Nations

ICA
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Conserve and sustainably use the oceans, seas and marine resources for sustainable development

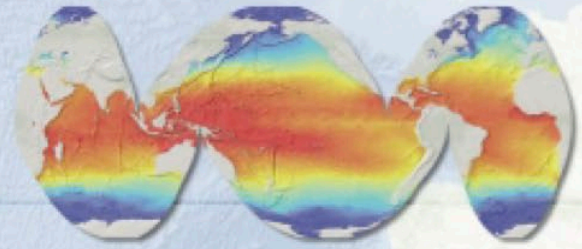
14 LIFE BELOW WATER

THE GLOBAL GOALS
For Sustainable Development

Target
Goal 14 targets include reducing marine pollution, strengthening ecosystem resilience, restoring habitats, reducing acidification, ending overfishing, conservation and improving research.

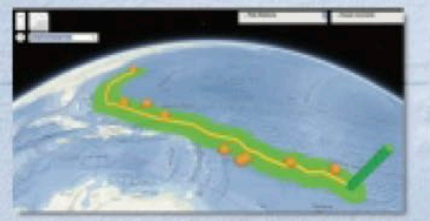
Indicator
Numerous indicators provide a way of assessing the extent to which targets are met. This poster illustrates a range of indicators and how different designs can support understanding and the overall goal.

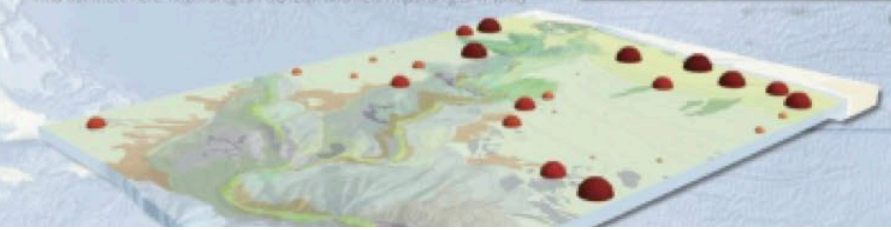
TRADITIONAL MAPPING
When we think about mapping the oceans we think of traditional hydrological charts. They contain a wealth of detail and remain important in both paper and digital form.
Mapping the oceans for sustainability requires different products, new products, immersive and interactive products as well as maps of new data and models.
This poster explores some of these cartographies of the oceans and their utility in support of the UN-GGIM Sustainability Goal for Life Below Water.



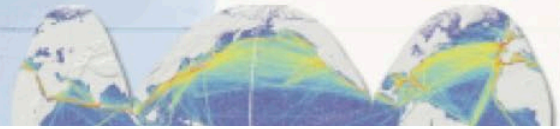
MAPPING MEASUREMENTS
Sea Surface Temperature is a key climate and weather measurement used for weather prediction, ocean forecasts, tropical cyclone forecasts, and in coastal applications such as fisheries, pollution monitoring and tourism. El Niño and La Niña are two examples of climate events which are forecast through the use of sea surface temperature maps.
Find out more here: http://arcg.is/1Pycbk

INTERACTIVE CARTOGRAPHY
Oceans are inherently three-dimensional with much of it yet to be fully explored. By creating interactive 3D cartographic representations, such as this model of sediment and geological analysis for Monterey Bay Canyon or the interactive map of ocean currents, we offer a unique, immersive and fascinating insight into the world below water.
Find out more here: http://arcg.is/1UOY2pK and here http://arcg.is/1Pycbk





MAPPING THE SCIENCE
The concentration of dissolved gases in water is of prime importance in considering the quality of water. Sufficient amounts of dissolved oxygen are required for marine-life survival.
Dissolved oxygen levels are influenced by temperature and salinity.The ability for oxygen to dissolve in water (solubility) decreases as temperature and salinity increase.
Poorly oxygenated areas are considered dead zones or hypoxic zones.
Find out more here: http://arcg.is/1SUvoqc



MAPPING THE HUMAN IMPACT
Commercial shipping activity can lead to ship strikes of large animals, noise pollution, and a risk of ship groundings or sinkings.
Ships from many countries voluntarily

ICA ACI

UN-GGIM
UNITED NATIONS INITIATIVE ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

Geospatial information for a better world **Awareness & Education on cartography**

United Nations

ICA ACI

A. Kagawa G. Le Sourd M.J. Kraak R. Roth B. Ricker

ITC UNIVERSITY OF TWENTE.

CARTOGRAPHY LAB University of Wisconsin–Madison

Universiteit Utrecht

MAPPING
FOR A
SUSTAINABLE WORLD

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Structure &

The book comprises four sections. Section 1 introduces the SDGs and their relation to geospatial data, describing SDG indicators and data transformations for mapping. Section 2 describes foundational design decisions in the cartographic workflow including projections, scale, generalization, symbolization, typography, and visual hierarchy among others. Section 3 introduces common map types (e.g., choropleth maps, proportional symbol maps, dasymetric maps, bivariate maps, cartograms) and diagrams (e.g., bar charts, scatterplots, timelines) for representing the SDG indicators. Finally, Section 4 discusses considerations for map use environments such as audiences, user interfaces and interaction operators, mobile and web media, storytelling versus exploration, and open access.

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STROKES & CORNERS

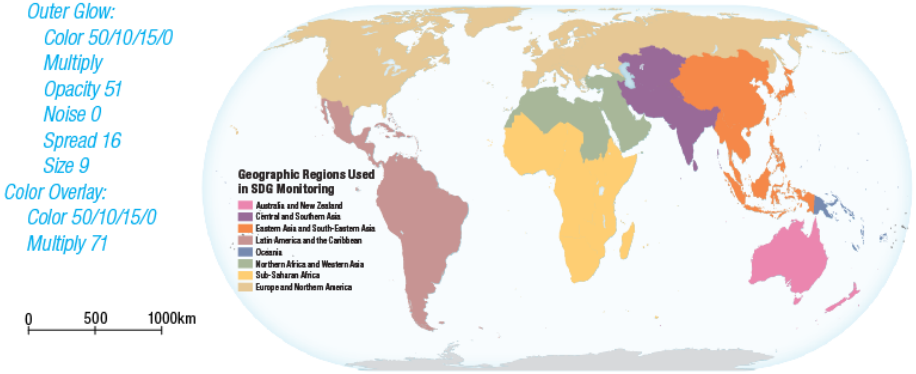
- country boundary (30K, 0.4 stroke width)
- figure arrowheads (100K, arrow 2, scale 80%, rounded cap)
- figure rounded rectangles (3pt corner radius)
- figure rounded rectangels outline (30K, 0.4 stroke width)

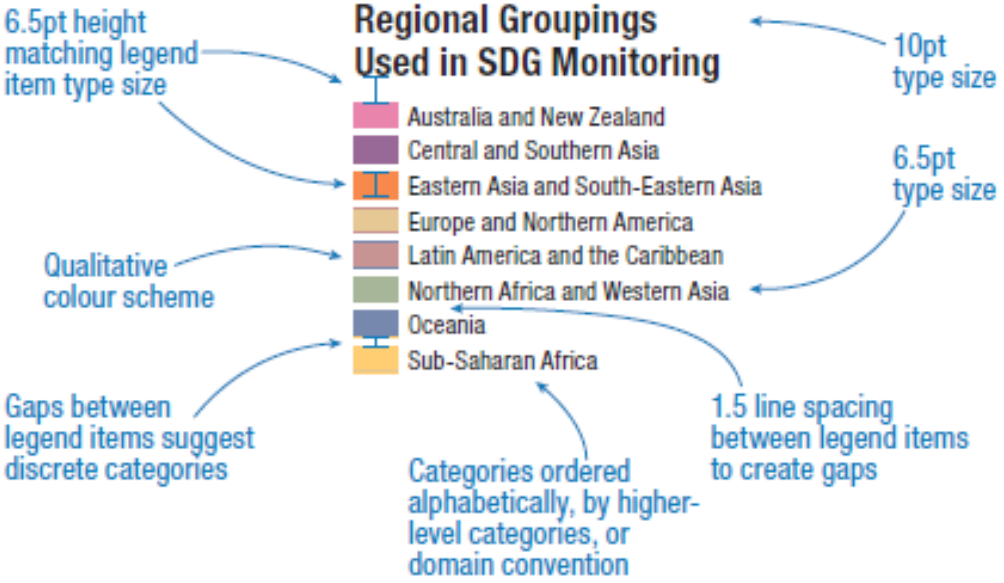
EXPORTS

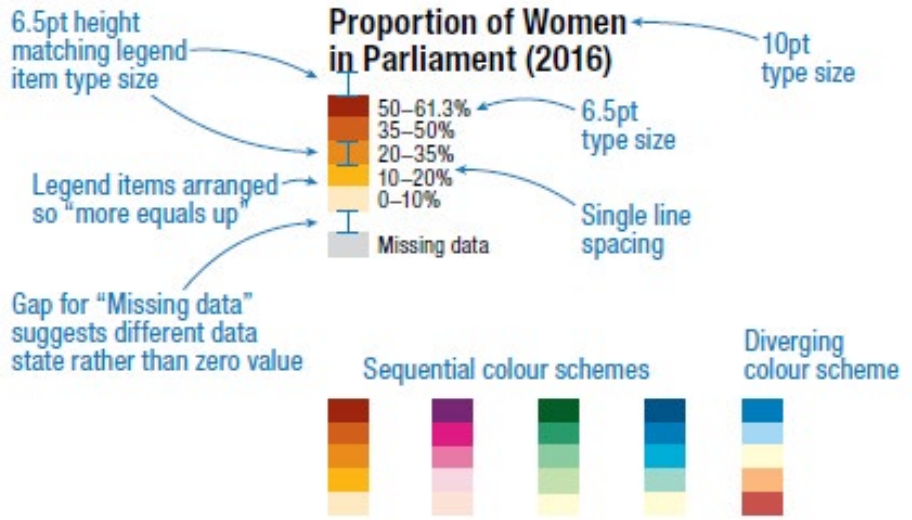
Place .AI files rather than image exports into layout
Export a copy of maps/figures as .PDF on "high quality print" setting

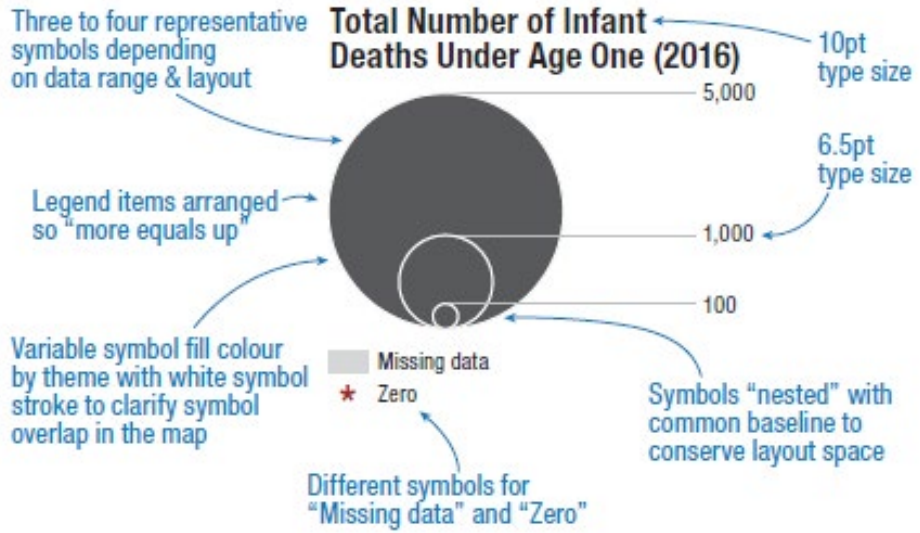
Land:
White polygon, exported to photoshop
Outer Glow:
Color 50/10/15/0
Multiply
Opacity 51
Noise 0
Spread 16
Size 9
Color Overlay:
Color 50/10/15/0
Multiply 71

Water:
White polygon, exported to photoshop
Inner Glow:
Color 18/0/3/0
Multiply
Opacity 46
Size 250
Color Overlay:
Color 30/0/6/0
Multiply 11







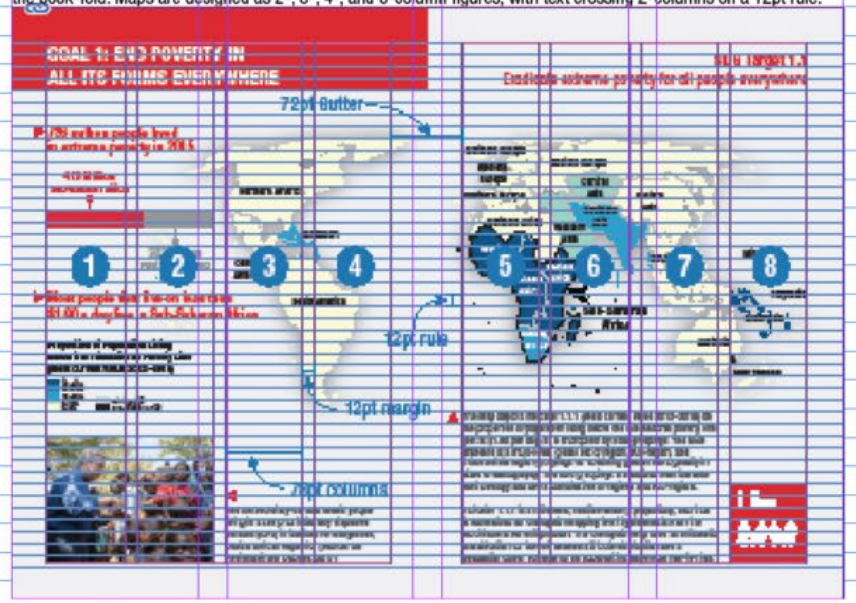


4.11 Atlases

An ***atlas*** is an intentional sequence of maps, text, and other graphic elements depicting different dimensions of geographic phenomena and processes. Many atlases focus into a specific subject, such as a particular thematic domain (*who/what*), time period (*when*), or location (*where*) (see Section 2.1). Atlases serve a variety of purposes, including general reference or geographic education as well as awareness and outreach. An atlas's editorial board contributes to its authority, especially for national atlases.

Atlas design depends heavily on the presentation medium. Traditional atlases are published as printed books. Here, each map is arranged as a two-page layout for folded printing, called a ***spread***, with a vertical gap, or ***gutter***, in the centre to account for the book-fold (Figure 4.11-1). Projections should be centred so that the gutter slices the map in negative space (see Section 2.5), such as the ocean for a world map on land-based SDG indicators. The atlas spread also should be organized into a regular ***grid*** of columns and/or rows, such as the 8-column grid used in this smaller A5-size book or a 12-column grid for larger print publications and responsive design for mobile maps (see Section 4.6). Using a grid improves the layout and balance of maps, text, and negative space in more complex atlas spreads (see Section 2.13).

Figure 4.11-1: Traditional atlas spread. The 8-column grid used in this book is shown beneath the Section 1.3 two-page spread. Each column is 78pt with a 12pt margin, with a 72pt gutter expanding the Atlantic Ocean to account for the book-fold. Maps are designed as 2-, 3-, 4-, and 6-column figures, with text crossing 2-columns on a 12pt rule.



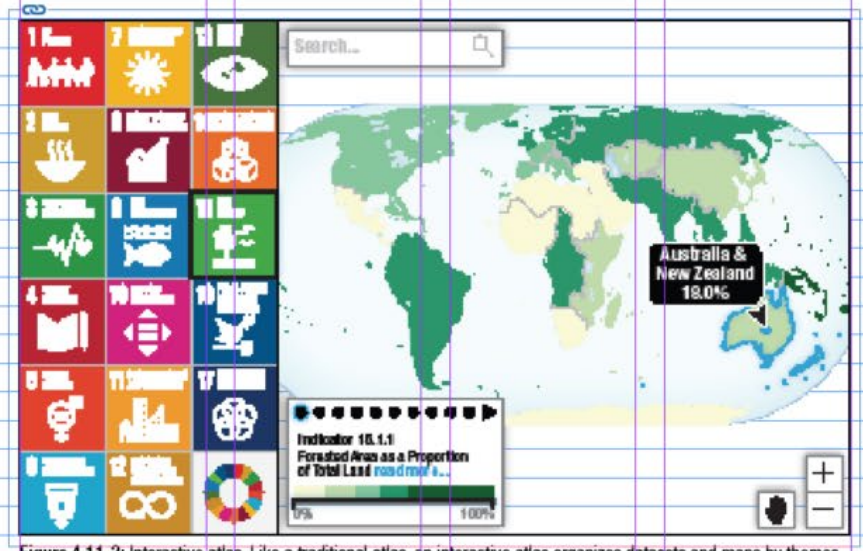


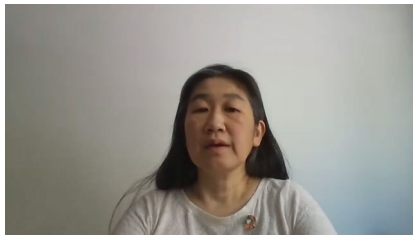
Figure 4.11-2: Interactive atlas. Like a traditional atlas, an interactive atlas organizes datasets and maps by themes, such as individual SDG indicators. The audience first selects an SDG (here, SDG 15, Life on Land) and then scrolls through a slideshow sequence of maps (here, the indicators that constitute SDG 15). Users can activate additional information about a specific indicator based on their interest. Because the atlas is interactive, users also can search for specific indicators or places as well as pan, zoom, retrieve details, and possibly perform additional operators.

Digital atlases can take a number of alternative forms, such as a series of unique web pages hyperlinked from a table of contents or a set of map layers toggled onto the same central basemap. Digital atlases typically include interactivity, particularly the overlay, search, and sequence operators in addition to the more common pan, zoom, and retrieve operators (see Section 4.4). Digital atlases also can serve as the spatial catalogue to a rich array of multimedia about mapped topics, including text, photographs, animations, and videos.

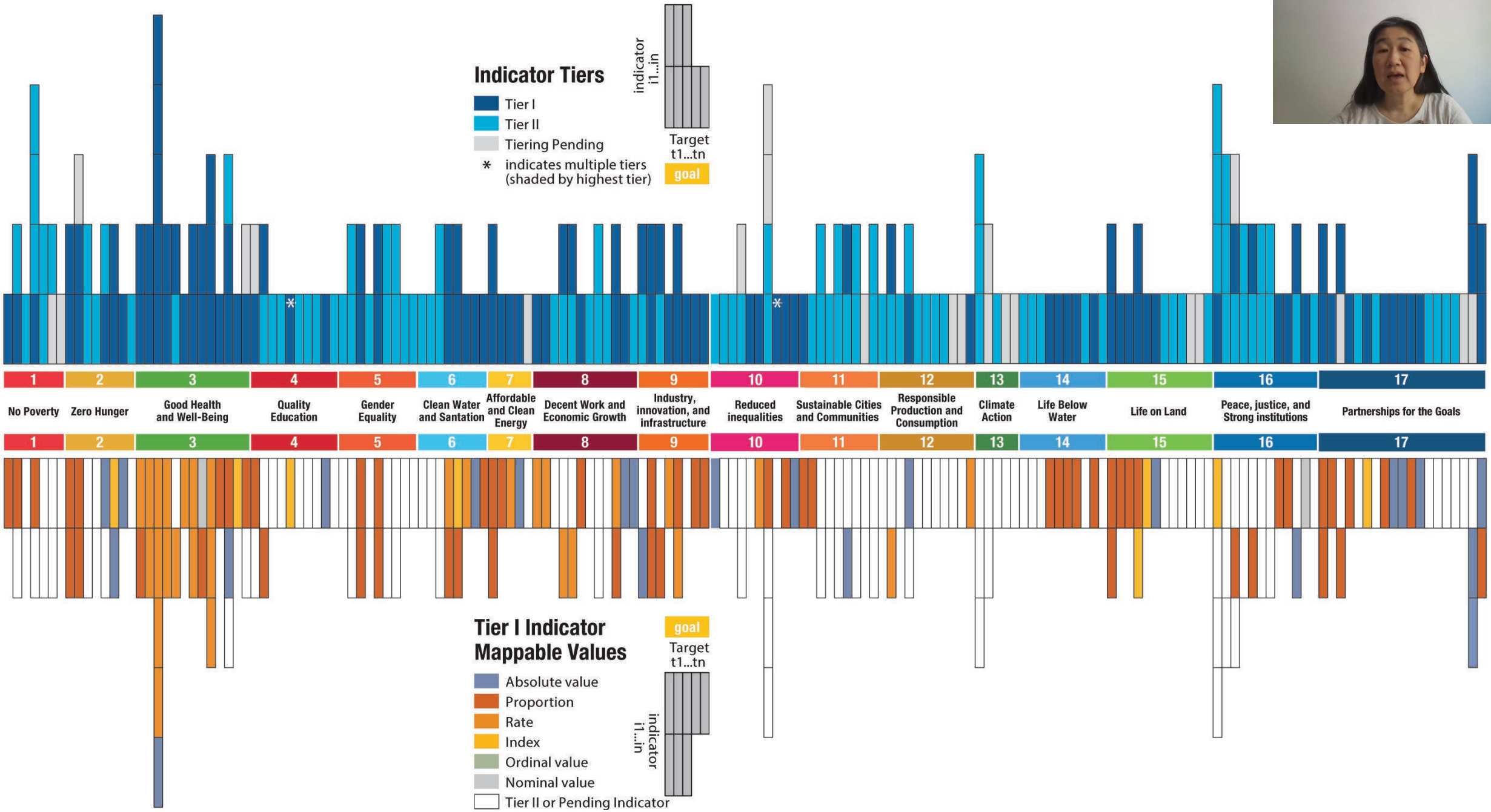
The order of the atlas pages shapes the overall atlas narrative (see Section 4.7). A paper atlas has a fixed narrative, although users often browse pages out of this order. A digital atlas provides more opportunity for breaking from a pre-defined narrative path based on audience backgrounds and interests (see Section 4.1).

An interactive atlas of the SDGs is increasingly possible as more SDGs indicators attain Tier I status (Figure 4.11-2). The World Bank published an initial compendium on the SDGs using their world development indicators as proxies to the indicators. Creation of an atlas of the SDG indicators has many challenges, such as global distribution, multilingual translation, and regular updates. However, it could be a centerpiece for supporting local and national decision-making as well as public education and advocacy.

The boundaries and names shown and the designations used in this book do not imply official endorsement or acceptance by the United Nations.

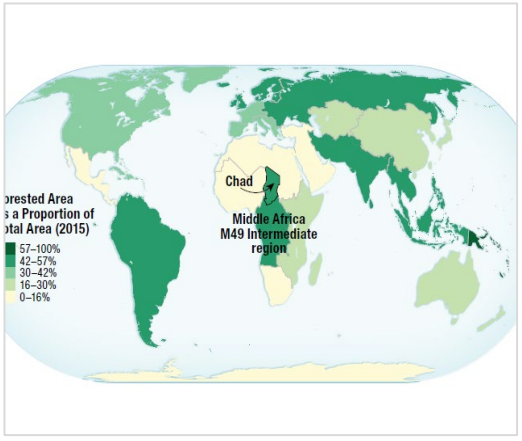


SUSTAINABLE DEVELOPMENT GOALS


Indicator Tiers
Tier I
Tier II
Tiering Pending
* indicates multiple tiers (shaded by highest tier)
indicator i1...in
Target t1...tn
goal
1 No Poverty
2 Zero Hunger
3 Good Health and Well-Being
4 Quality Education
5 Gender Equality
6 Clean Water and Santation
7 Affordable and Clean Energy
8 Decent Work and Economic Growth
9 Industry, innovation, and infrastructure
10 Reduced inequalities
11 Sustainable Cities and Communities
12 Responsible Production and Consumption
13 Climate Action
14 Life Below Water
15 Life on Land
16 Peace, justice, and Strong institutions
17 Partnerships for the Goals
Tier I Indicator Mappable Values
Absolute value
Proportion
Rate
Index
Ordinal value
Nominal value
Tier II or Pending Indicator
goal
Target t1...tn
indicator i1...in

Sustainable Development Goals

How can you measure and monitor sustainable development…



…without geography, place, and location

UN Global SDG database

SDG indicators
United Nations Global SDG Database

https://unstats.un.org/sdgs/indicators/database/

Data Series **(selected 0 of 531)** | Geographic Areas | Years | **0 observations**

Select from all series
Search and select indicators Type here... Search

All

- **GOAL 1** End poverty in all its forms everywhere
  - **TARGET 1.1** By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than
    - **INDICATOR 1.1.1** Proportion of the population living below the international poverty line by sex, age, employment stat
      - Employed population below international poverty line, by sex and age (%) **SI_POV_EMP1**
      - Proportion of population below international poverty line (%) **SI_POV_DAY1**
  - **TARGET 1.2** By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its

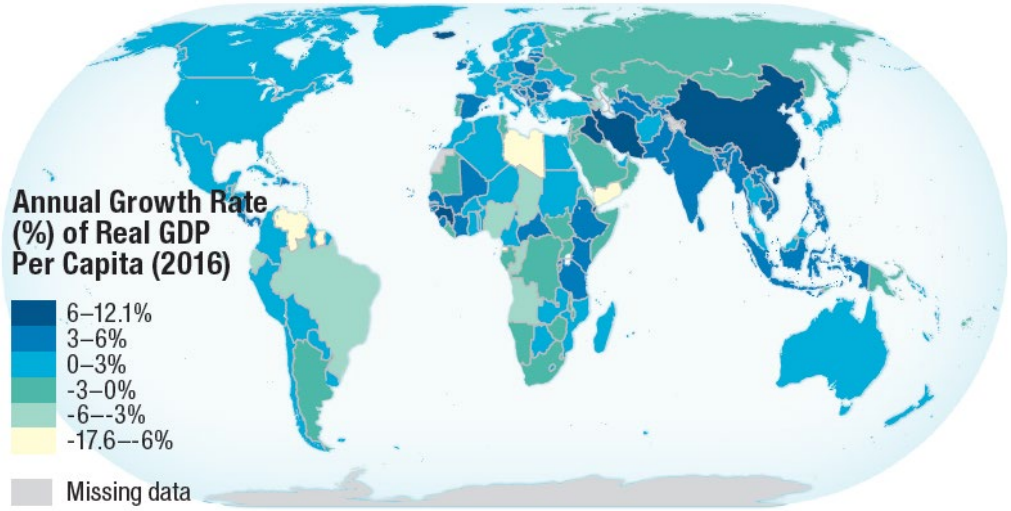
SDG indicator data

Goal	Target	Indicator	SeriesCode	SeriesDescription	GeoAre	GeoAreaName	Nature	Reporting Type	Units	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	1.1	1.1.1	SI_POV_DAY1	Proportion of population	2	Africa	G	G	PERCENT			47			43			41		39	38
1	1.1	1.1.1	SI_POV_DAY1	Proportion of population	8	Albania	G	G	PERCENT			2			1			0			
1	1.1	1.1.1	SI_POV_DAY1	Proportion of population	12	Algeria	G	G	PERCENT												1
1	1.1	1.1.1	SI_POV_DAY1	Proportion of population	19	Americas	G	G	PERCENT			8			7			5		4	4
1	1.1	1.1.1	SI_POV_DAY1	Proportion of population	24	Angola	G	G	PERCENT	32								30			
1	1.1	1.1.1	SI_POV_DAY1	Proportion of population	32	Argentina	G	G	PERCENT	6	9	14	7	5	4	3	3	3	3	2	1
1	1.1	1.1.1	SI_POV_DAY1	Proportion of population	51	Armenia	G	G	PERCENT		19	15	11	8	5	3	3	1	2	2	2
1	1.1	1.1.1	SI_POV_DAY1	Proportion of population	142	Asia	G	G	PERCENT			30			23			19		15	12
1	1.1	1.1.1	SI_POV_DAY1	Proportion of population	36	Australia	G	G	PERCENT		1		1	1				0		0	
1	1.1	1.1.1	SI_POV_DAY1	Proportion of population	53	Australia and New	G	G	PERCENT			1			1			0		0	0
1	1.1	1.1.1	SI_POV_DAY1	Proportion of population	40	Austria	G	G	PERCENT	0			0	0	0	0	0	1	1	1	0

SDG regional groupings

M49 regions & sub-regions

Country mapping



Intermediary regions mapping

GOAL 1: END POVERTY IN ALL ITS FORMS EVERYWHERE

SDG Target 1.1
Eradicate extreme poverty for all people everywhere

72pt Gutter

► 736 million people lived in extreme poverty in 2015

413 Million
Sub-Saharan Africa

1 2 3 4 5 6 7 8

► Most people that live on less than $1.90 a day live in Sub-Saharan Africa

Northern America
Caribbean
South America
Northern Europe
Western Europe
Eastern Europe
Southern Europe
Central Asia
Eastern Asia
Southern Asia
Northern Africa
Western Asia
Middle Africa
Eastern Africa
Sub-Saharan Africa
Southern Africa
Australia & New Zealand
Polynesia
Melanesia

12pt rule

12pt margin

Proportion of Population Living Below the International Poverty Line (most current value 2012–2018)

30–53%
20–30%
10–20%
5–10%
0–5%
Missing data
Sub-Saharan Africa

78pt columns

The UN Secretary-General meets people living in a camp for internally displaced persons (IDPs) in the town of Bangassou, Central African Republic. (Source: UN Photo/Eskinder Debebe, 2017)

▲ The map depicts Indicator 1.1.1 (most current value 2012–2018) on the proportion of population living below the international poverty line (set at $1.90 per day) as a choropleth by SDG groupings. The M49 standard is a multi-level, global set of region, sub-region, and intermediate region groupings for obtaining greater homogeneity in sizes of demography. The SDG groupings are derived from the M49 methodology and use a combination of regions and sub-regions.

Indicator 1.1.1 is a ratio level, relative value (a proportion), and thus is normalized for choropleth mapping to mitigate effects from the modifiable areal unit problem. The choropleth map uses an arithmetic classification for the left-skewed attribute distribution and a sequential colour scheme for an apparent increase from low-to-high.

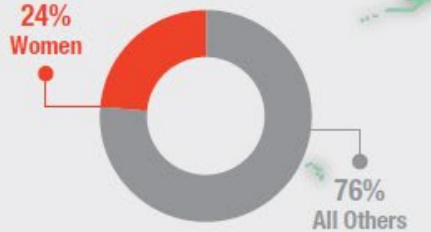
1 NO POVERTY

GOAL 5: ACHIEVE GENDER EQUALITY AND EMPOWER ALL WOMEN AND GIRLS

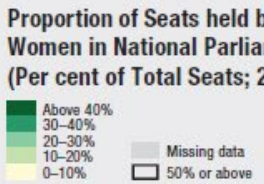
SDG Target 5.5

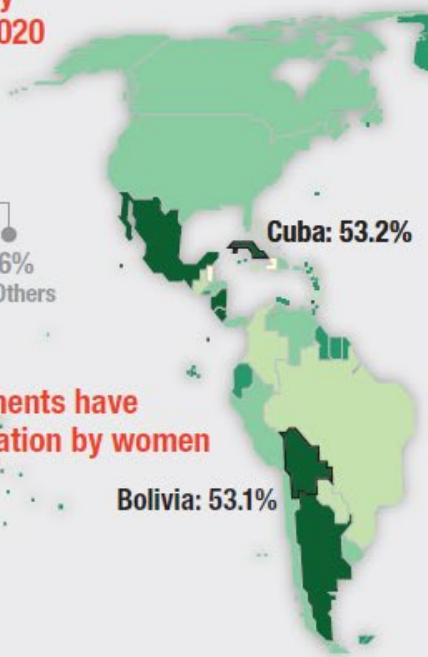
Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making

► **Only 24% of parliamentary leaders were women in 2020**

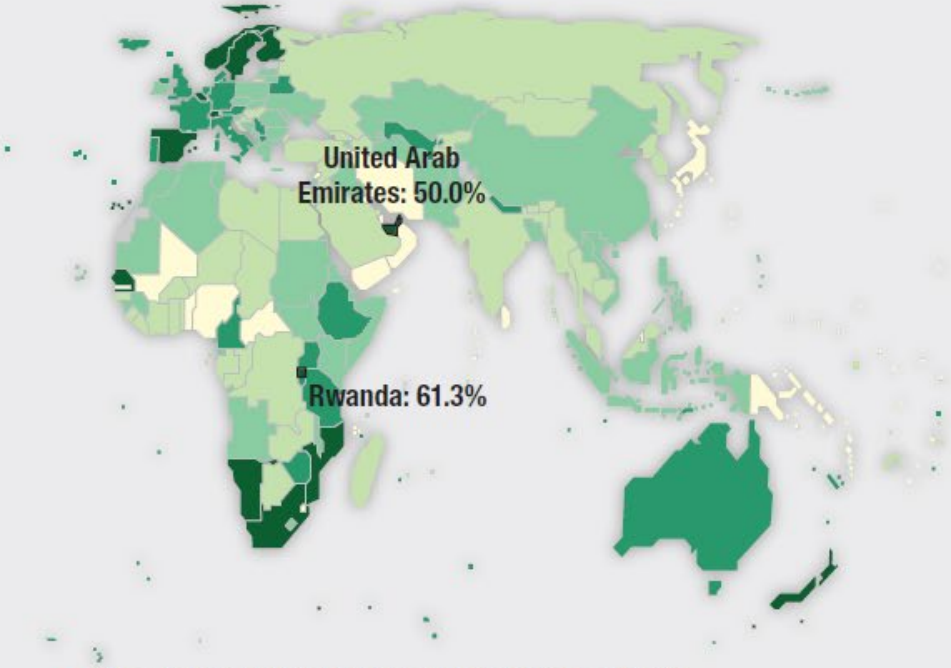


► **Only four national parliaments have 50% or greater representation by women**





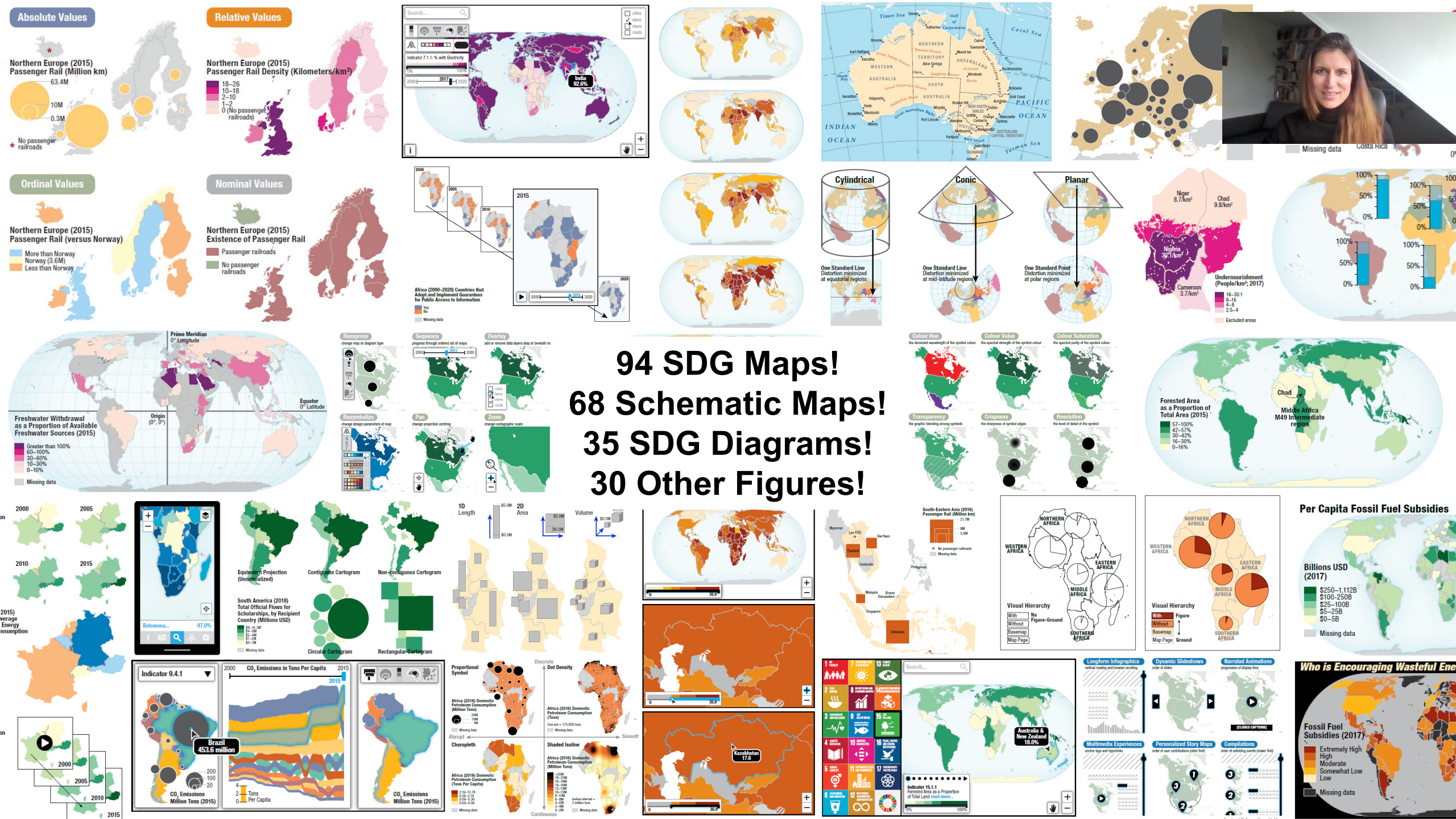
◄ Wide view of the opening meeting of the sixty-fourth session of the Commission on the Status of Women (CSW). Member States adopted a political declaration in which they pledged to step up action to fully implement the landmark Beijing Declaration and Platform for Action on gender equality, agreed to 25 years ago. (Source: UN Photo/Loey Felipe, 2020)



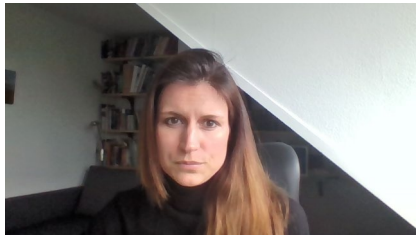
▲ The map depicts Indicator 5.5.1 (2020) on the proportion of seats held by women in national parliaments as a choropleth map. Countries for the choropleth map are highly generalized to show only the overall thematic patterns, simplifying the message. This style also increases the visual weight of smaller nations. UN Women promotes this basemap for its publication on "Women in Politics."

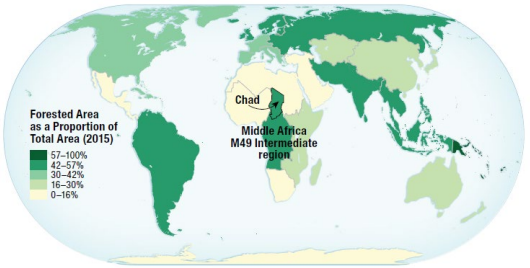
Although simplified, the map remains projected in the Eckert IV equivalent projection used throughout the book, allowing for comparison of areas in the choropleth. The choropleth map uses an equal interval classification for the uniform attribute distribution and a sequential colour scheme that crosses yellow to green colour hues but primarily relies on the ordered visual variable colour value.

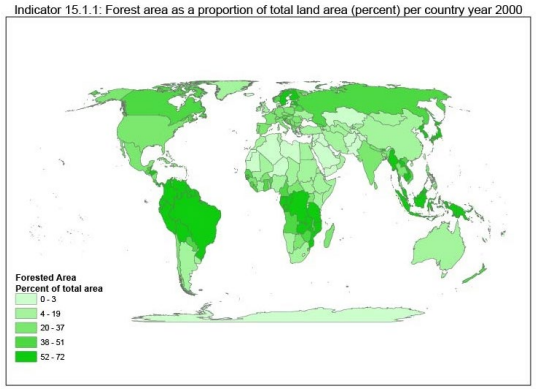
5 GENDER EQUALITY

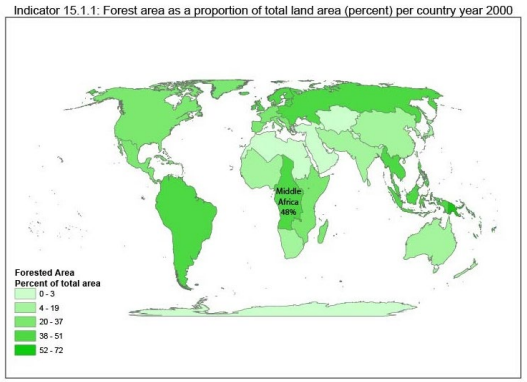

Absolute Values
Northern Europe (2015)
Passenger Rail (Million km)
63.4M
10M
0.3M
No passenger railroads
Relative Values
Northern Europe (2015)
Passenger Rail Density (Kilometers/km²)
18–26
10–18
2–10
1–2
0 (No passenger railroads)
Ordinal Values
Northern Europe (2015)
Passenger Rail (versus Norway)
More than Norway
Norway (3.6M)
Less than Norway
Nominal Values
Northern Europe (2015)
Existence of Passenger Rail
Passenger railroads
No passenger railroads
India
92.6%
Cylindrical
One Standard Line
Distortion minimized
at equatorial regions
Conic
One Standard Line
Distortion minimized
at mid-latitude regions
Planar
One Standard Point
Distortion minimized
at polar regions
Niger
8.7/km²
Chad
9.8/km²
Nigeria
30.1/km²
Cameroon
3.7/km²
Undernourishment
(People/km²; 2017)
16–30.1
8–16
4–8
2.5–4
Excluded areas
Missing data
Costa Rica
Africa (2000–2020) Countries that
Adopt and Implement Guarantees
for Public Access to Information
Yes
No
Missing data
Prime Meridian
0° Longitude
Equator
0° Latitude
Origin
(0°, 0°)
Freshwater Withdrawal
as a Proportion of Available
Freshwater Sources (2015)
Greater than 100%
60–100%
30–60%
10–30%
0–10%
Missing data
Reexpress
change map or diagram type
Sequence
progress through ordered set of maps
Overlay
add or remove data layers atop or beneath m
Resymbolize
change design parameters of map
Pan
change projection centring
Zoom
change cartographic scale
Colour Hue
the dominant wavelength of the symbol colour
Colour Value
the spectral strength of the symbol colour
Colour Saturation
the spectral purity of the symbol colour
Transparency
the graphic blending among symbols
Crispness
the sharpness of symbol edges
Resolution
the level of detail of the symbol
Forested Area
as a Proportion of
Total Area (2015)
57–100%
42–57%
30–42%
16–30%
0–16%
Chad
Middle Africa
M49 Intermediate
region
94 SDG Maps!
68 Schematic Maps!
35 SDG Diagrams!
30 Other Figures!
Botswana...
97.0%
Equivalent Projection
(Unnormalized)
Contiguous Cartogram
Non-contiguous Cartogram
South America (2018)
Total Official Flows for
Scholarships, by Recipient
Country (Millions USD)
Missing data
Circular Cartogram
Rectangular Cartogram
1D
Length
2D
Area
Volume
South-Eastern Asia (2016)
Passenger Rail (Million km)
21.7M
8M
3.4M
No passenger railroads
Missing data
NORTHERN AFRICA
WESTERN AFRICA
EASTERN AFRICA
MIDDLE AFRICA
SOUTHERN AFRICA
Visual Hierarchy
With
Without
Basemap
Map Page
No Figure-Ground
Figure
Ground
Per Capita Fossil Fuel Subsidies
Billions USD
(2017)
$250–1,112B
$100–250B
$25–100B
$5–25B
$0–5B
Missing data
Indicator 9.4.1
Brazil
453.6 million
CO₂ Emissions
Million Tons (2015)
CO₂ Emissions in Tons Per Capita
Tons
Per Capita
Proportional
Symbol
Dot Density
Choropleth
Shaded Isoline
Discrete
Continuous
Abrupt
Smooth
Kazakhstan
17.6
Australia &
New Zealand
18.0%
Indicator 15.1.1
Forested Area as a Proportion
of Total Land read more...
Longform Infographics
vertical reading and browser scrolling
Dynamic Slideshows
order of slides
Narrated Animations
progression of display time
[CLOSED CAPTIONS]
Multimedia Experiences
anchor tags and hyperlinks
Personalized Story Maps
order of user contributions (older first)
Compilations
order of unfolding events (newer first)
Who is Encouraging Wasteful Ene
Fossil Fuel
Subsidies (2017)
Extremely High
High
Moderate
Somewhat Low
Low
Missing data

Modifiable Aerial Unit Problem









- **Indicator 15,1,1 Forested area as a proportion % of total land area**
- **Patterns change at different administrative or aggregational units**
  - https://arcg.is/1ju1fW

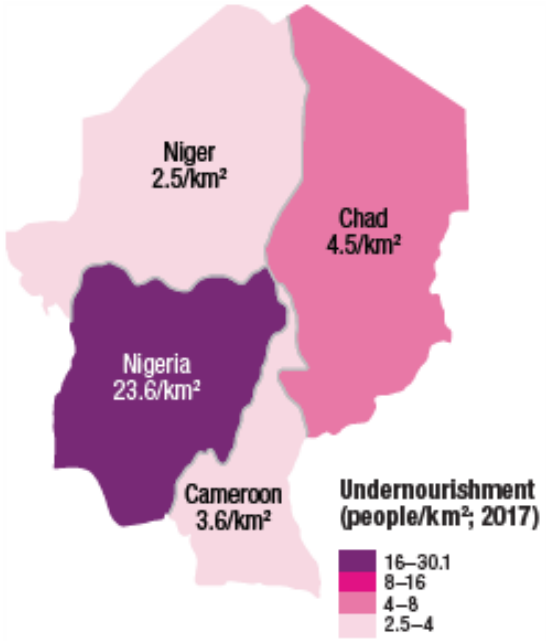


Figure 3.5-1: Original choropleth map. Indicator 2.1.1 (2017) on the number of undernourished people per km² is mapped for four countries in Sub-Saharan Africa.

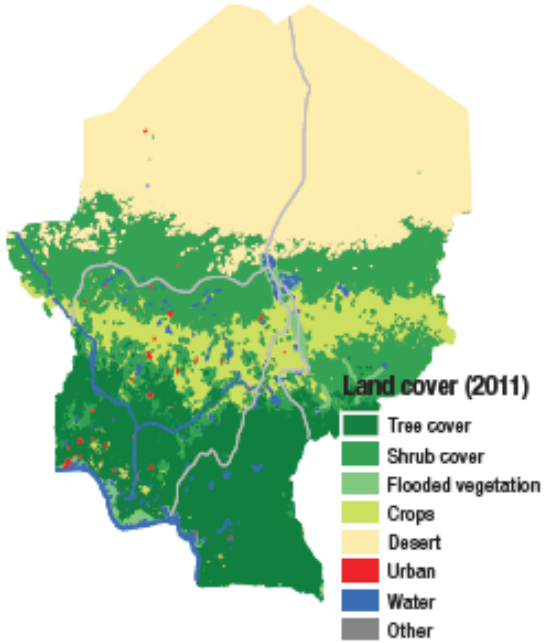


Figure 3.5-2: Exclusionary data. Classified land cover (2011) processed from satellite imagery is used to identify areas where people do not live: desert and water.

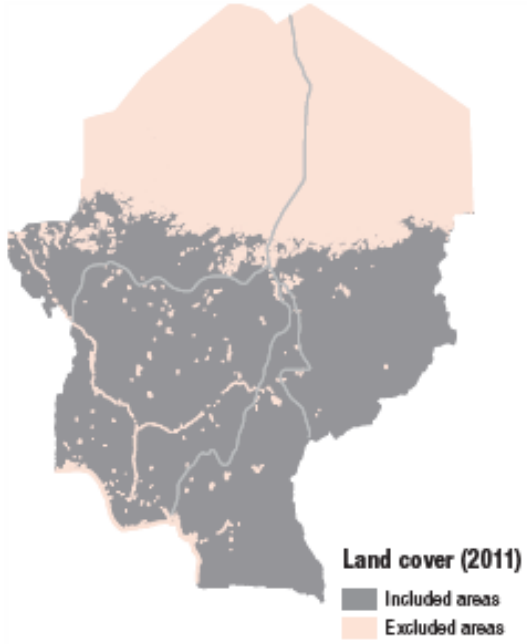


Figure 3.5-3: Vector math. Vector math is applied to remove the desert and water classes from the enumeration unit. Large areas in the north are removed due to the location of the Sahara Desert as well as smaller water bodies such as Lake Chad and the Niger River.

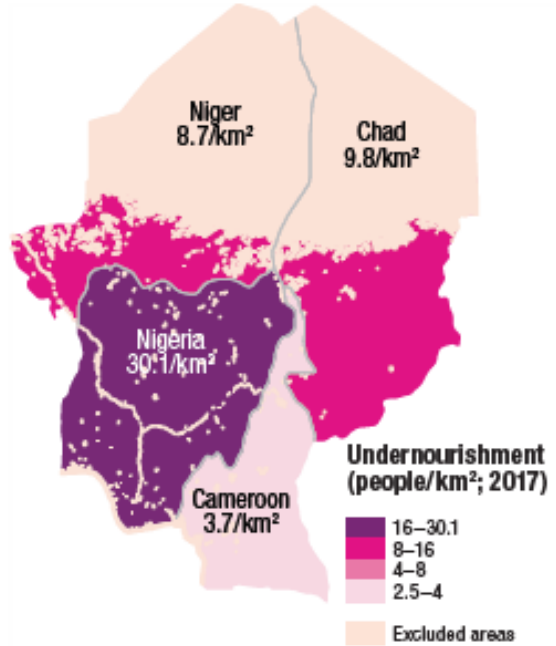
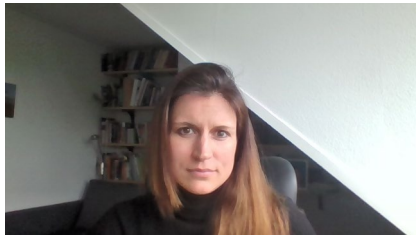
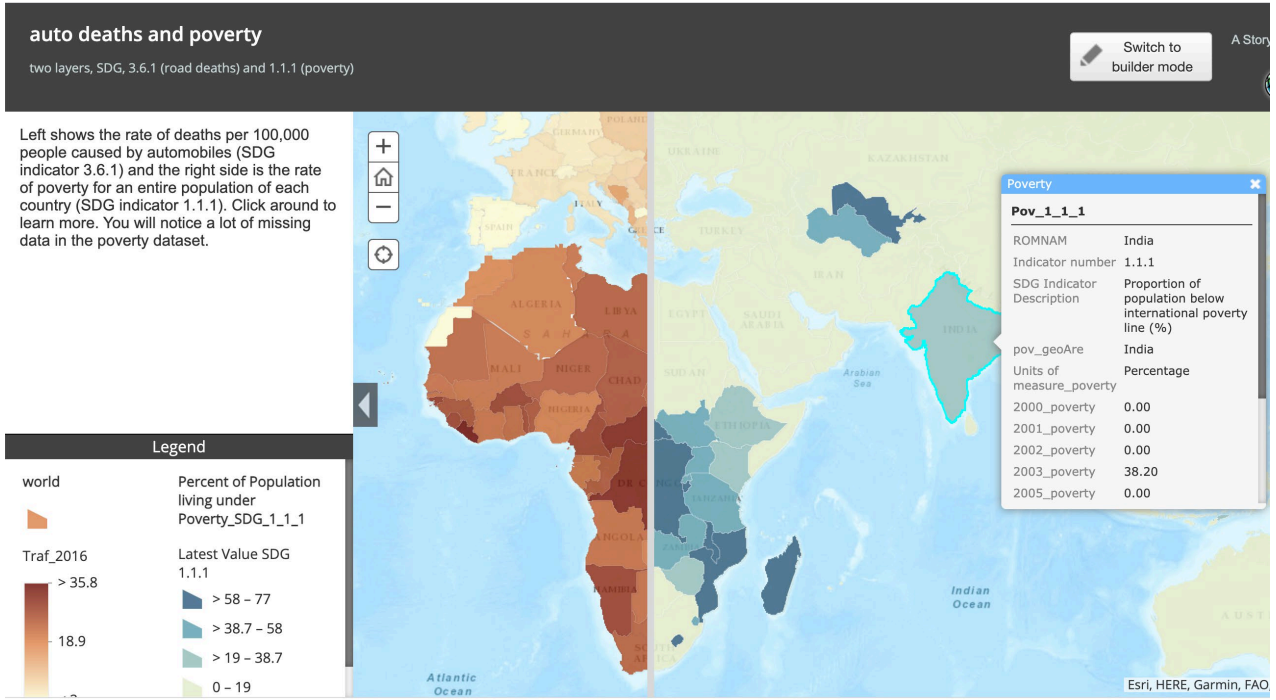


Figure 3.5-4: Resulting dasymetric map. Indicator 2.1.1 (2017) on the number of undernourished people per km² is remapped with a new area denominator. As a result, Niger and Chad have a much greater density, pushing them into higher choropleth classes.



How to make your own choropleth map with SDG indicator data – and make an Esri online web viewer!

https://github.com/bricker0/choropleth_map



SDG indicator data considerations

- Data formatting
- Missing Data
- Data Provenance

MAPPING
FOR A
SUSTAINABLE WORLD

United Nations

ICA
ACI