UNITED NATIONS EXPERT GROUP MEETING ON STRENGTHENING THE DEMOGRAPHIC EVIDENCE BASE FOR THE POST-2015 DEVELOPMENT AGENDA

Population Division. Department of Economic and Social Affairs. United Nations Secretariat
New York, 5-6 October 2015

Session 6. Data disaggregation and utilization challenges: Prospects for the integration of multiple data sources to produce estimates for different geographical scales and time periods

CIESIN's Experience in Mapping Population and Poverty

Alex de Sherbinin and Susana B. Adamo

CIESIN - Columbia University

Center for International Earth Science Information Network
EARTH INSTITUTE | COLUMBIA UNIVERSITY

"In order to monitor the implementation of the SDGs, it will be important to improve the availability of and access to data and statistics disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts to support the monitoring of the implementation of the SDGs" - United Nations General Assembly, Report of the Open Working Group of the General Assembly on Sustainable Development Goals. A/68/970 12 August 2014.

"Mechanisms to review the implementation of goals will be needed, and the availability of and access to data would need to be improved, including the disaggregation of information by gender, age, race, ethnicity, migratory status, disability, geographic location, and other characteristics relevant to national contexts." - United Nations, The Road to Dignity by 2030: Ending Poverty, Transforming All Lives and Protecting the Planet. Synthesis Report of the Secretary General on the Post-2015 Agenda, 4 December 2014.

Introduction

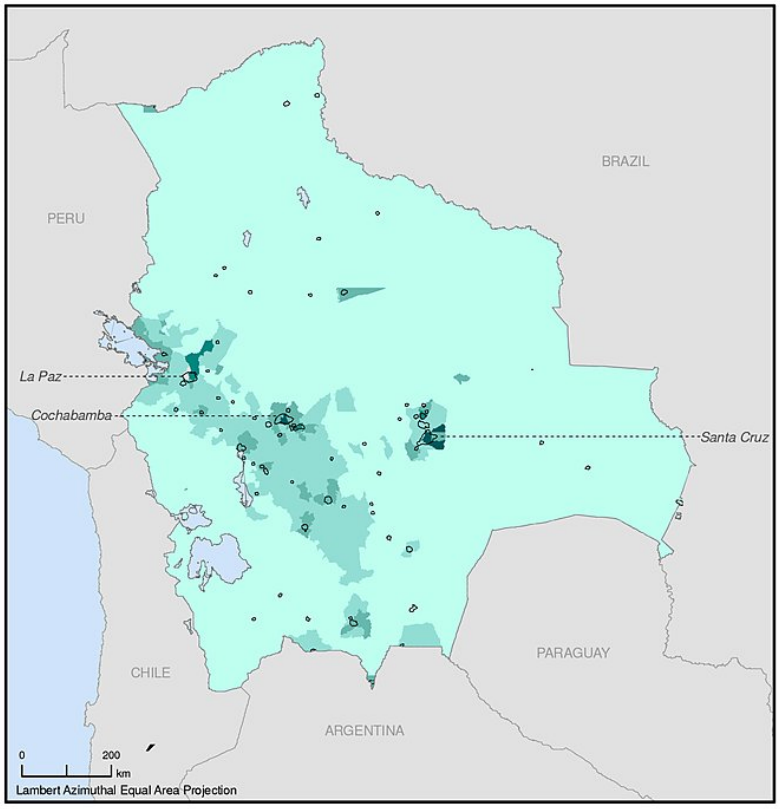
- The SDGs need to be monitored using spatially and demographically disaggregated data with high temporal resolution
- ***This is a tall order!***
- We present CIESIN experiences in compiling global subnational demographic and poverty data sets for use in measuring progress towards the Millennium Development Goals (MDGs) and now for the Sustainable Development Goals (SDGs)
- We also provide recommendations for how to strengthen the demographic evidence base needed for attainment of the SDGs

Demographic data for the MDGs

Poverty mapping

- CIESIN was the "mapping arm" of the Millennium Development Project (MDP)
- CIESIN worked most closely with the Poverty and Hunger task forces, providing maps for reports
- In collaboration with the World Bank, CIESIN developed a poverty atlas *Where the Poor Are: An Atlas of Poverty*
- Two types of data are available:
  - Small area estimates of poverty metrics for selected countries
  - Global data sets compiled with subnational resolution
- Data are available for download at http://sedac.ciesin.columbia.edu/data/collection/povmap

Small area estimate data on poverty for 26 countries (circa 2000-2005)



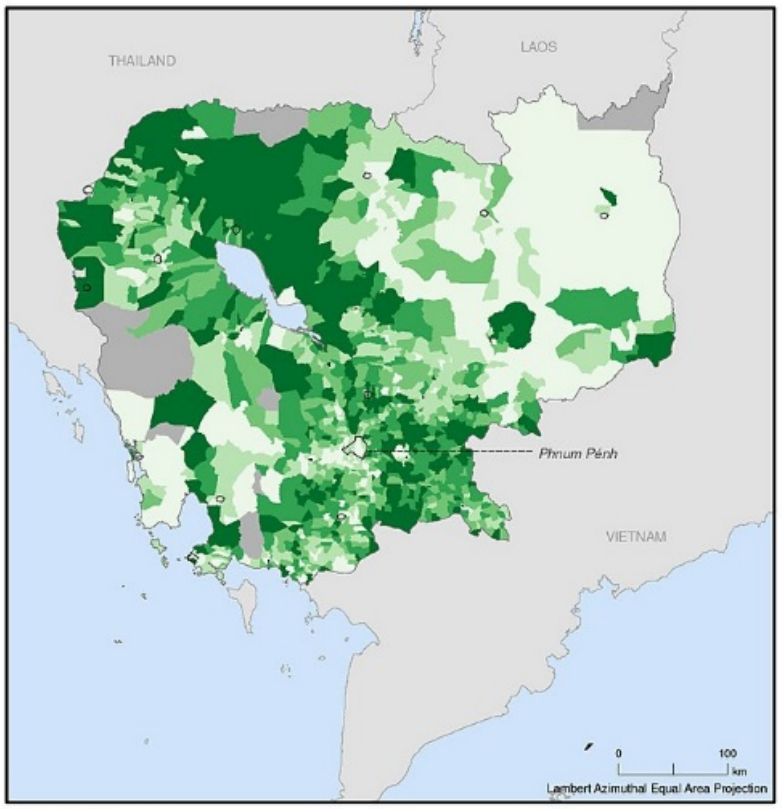
Bolivia
Administrative Level 3: Municipio

Measures of Poverty
Poverty Density
The total number of poor persons divided by the area in squared kilometers.

Each color corresponds to one - fifth of the population of the mapped country

0.04 - 6.79
6.79 - 22.75
22.75 - 91.58
91.58 - 188.04
188.04 - 1276.53
no data
Greater Urban Extent

Sixteen separate poverty lines are defined, reflecting regional differences in purchasing power. Monthly expenditure values per capita range from 185.1 and 250.3 Boliviano (in 2001 prices), or 88.14 and 119.19 PPP (in 2000 prices).



Cambodia
Administrative Level 3: Commune

Measures of Poverty
Headcount Index [FGT(0)]
FGT(0), or the Headcount Index, measures the proportion of the population whose welfare falls below the poverty line. This measure is a member of the FGT (Foster, Greer, Thorbecke) family of poverty measures.

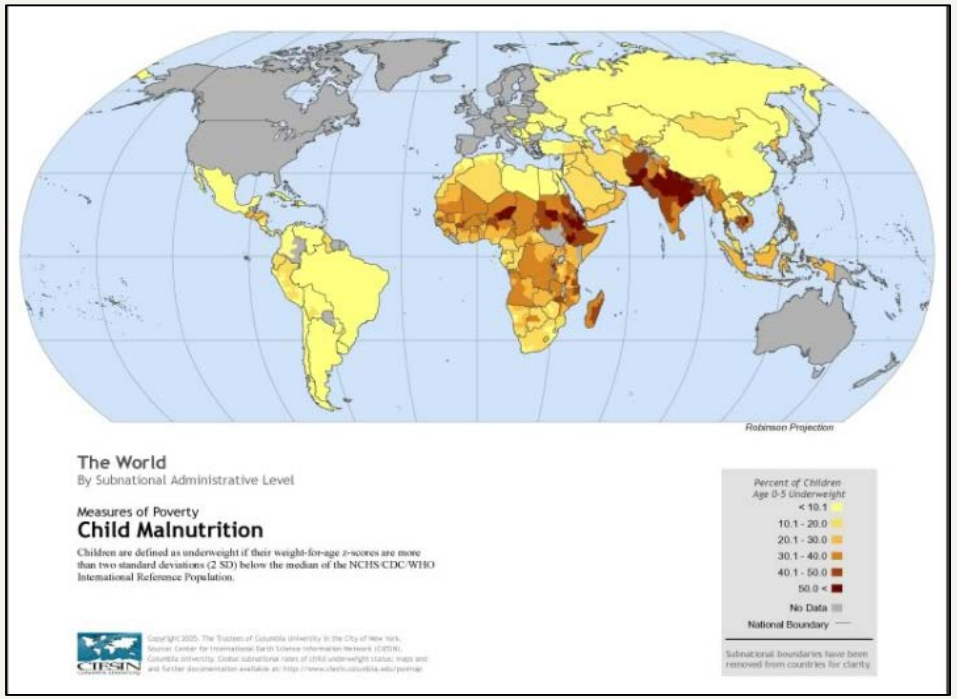
Each color corresponds to one-fifth of the population of the mapped country

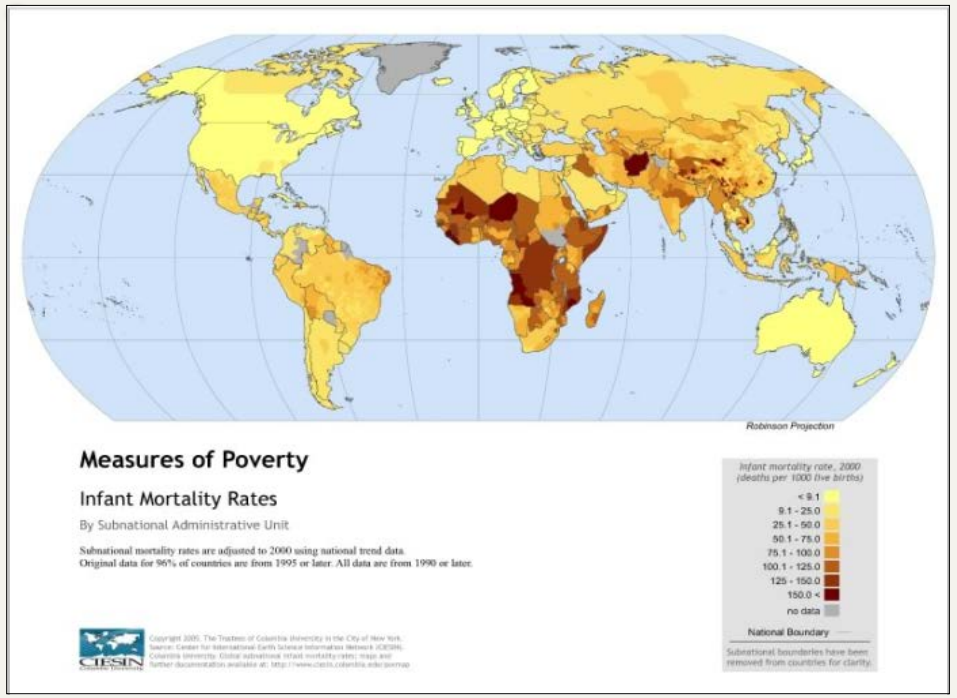
0.00 - 0.21
0.21 - 0.33
0.33 - 0.44
0.44 - 0.56
0.56 - 1.00
no data
Greater Urban Extent

Three separate poverty lines are defined, reflecting regional differences in purchasing power. Daily expenditure values per capita are 1,036, 1,214 and 1,629 Riel (in 1998 prices), or 1.46, 1.72 and 2.30 PPP.

Global data

- Global map of infant mortality rates (a measure of extreme poverty), and
- Global map of the percentage of children underweight
- The two data sets were developed by CIESIN based on statistically representative subnational regions of varying sizes from Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS), vital statistics and other country sources.
- An update of the infant mortality rate grid for circa 2015 is in preparation.



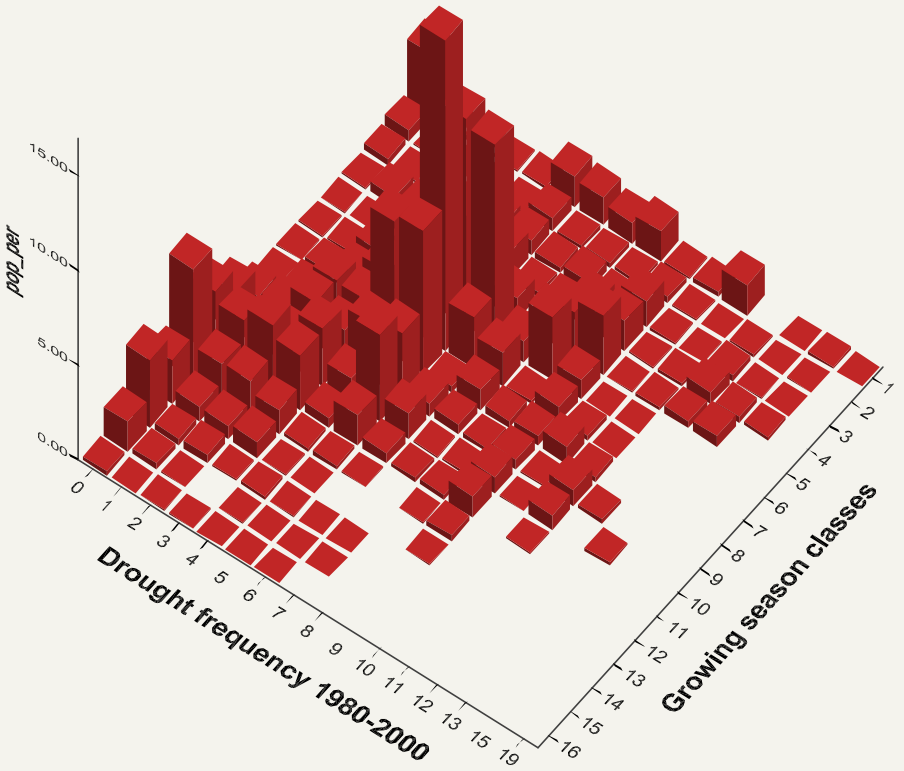


Analyses using spatial poverty data

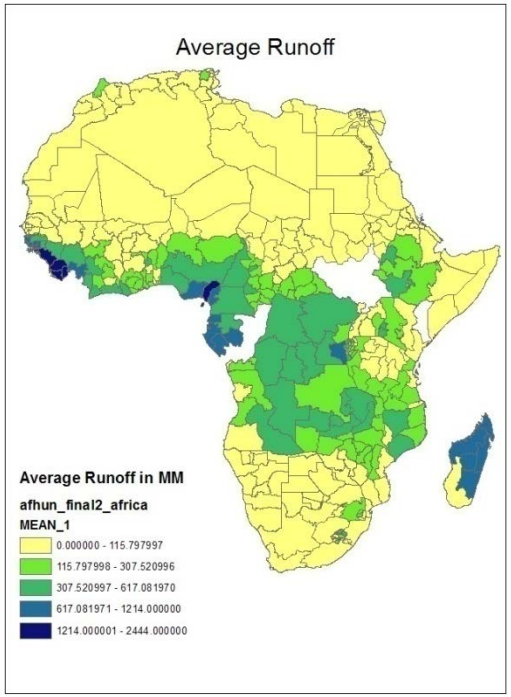
Compared with the non-poor, poor people are more likely to be found in drought-prone areas with shorter growing seasons

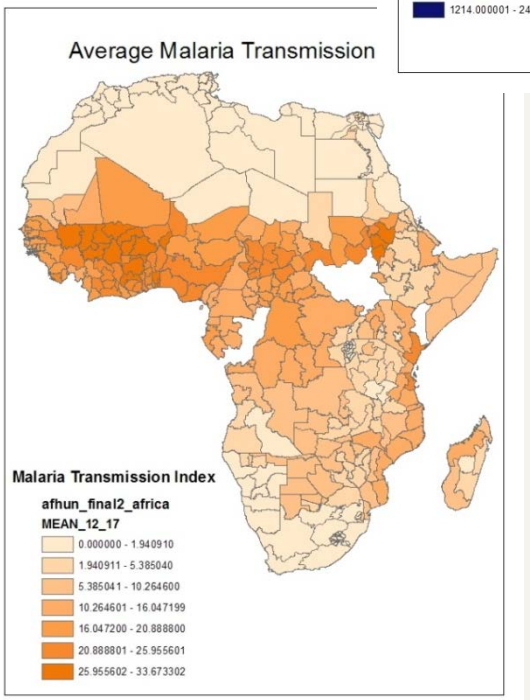
Non-poor

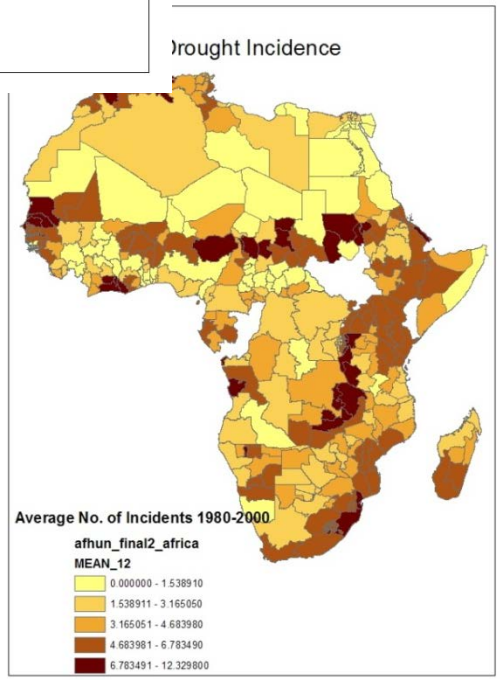
Poor

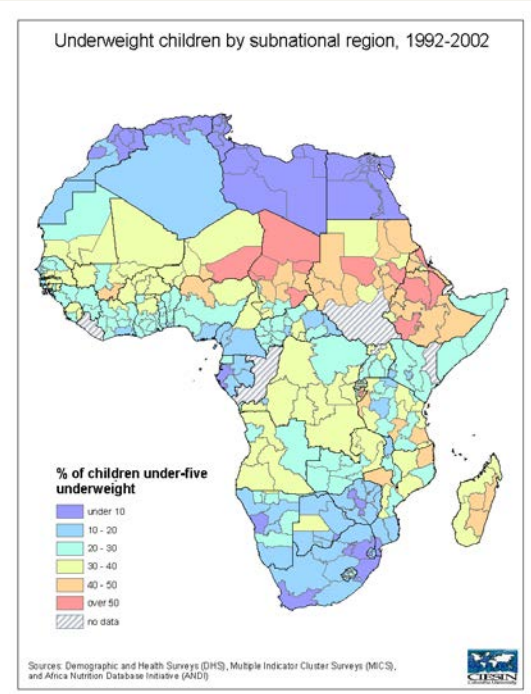


Climate Change Health Impacts



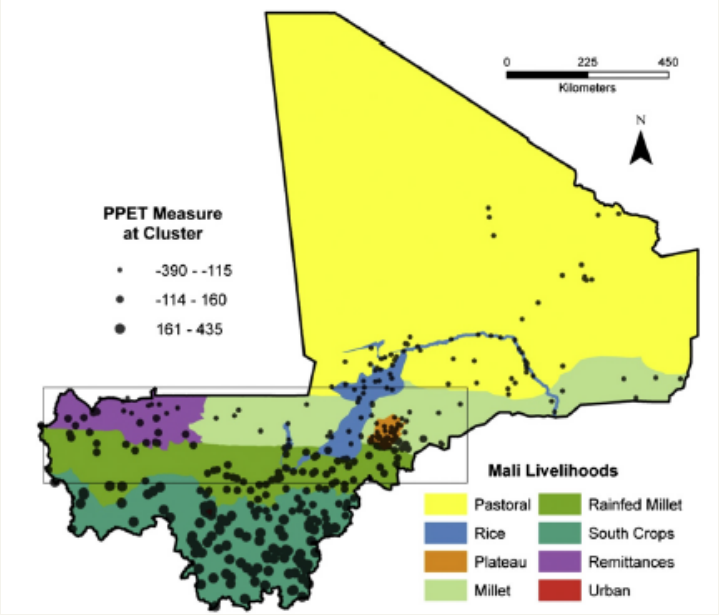






Source: de Sherbinin. (2009) "Covariates of Malnutrition in Africa," *Pop., Space & Place*

From clusters to surfaces

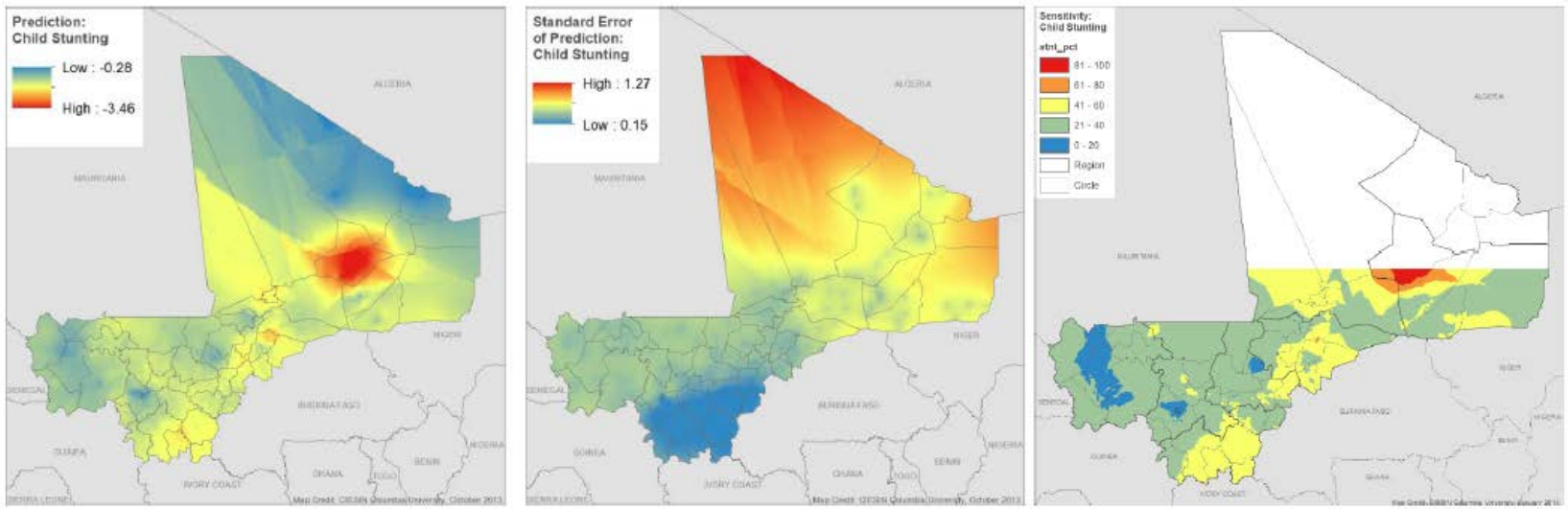


Source: Jankowska, M., D. Lopez-Carr, C. Funk, G.J. Husak, Z.A. Chafe. (2012). Climate change and human health: Spatial modeling of water availability, malnutrition, and livelihoods in Mali, Africa. *Applied Geography*, 33:4-15.

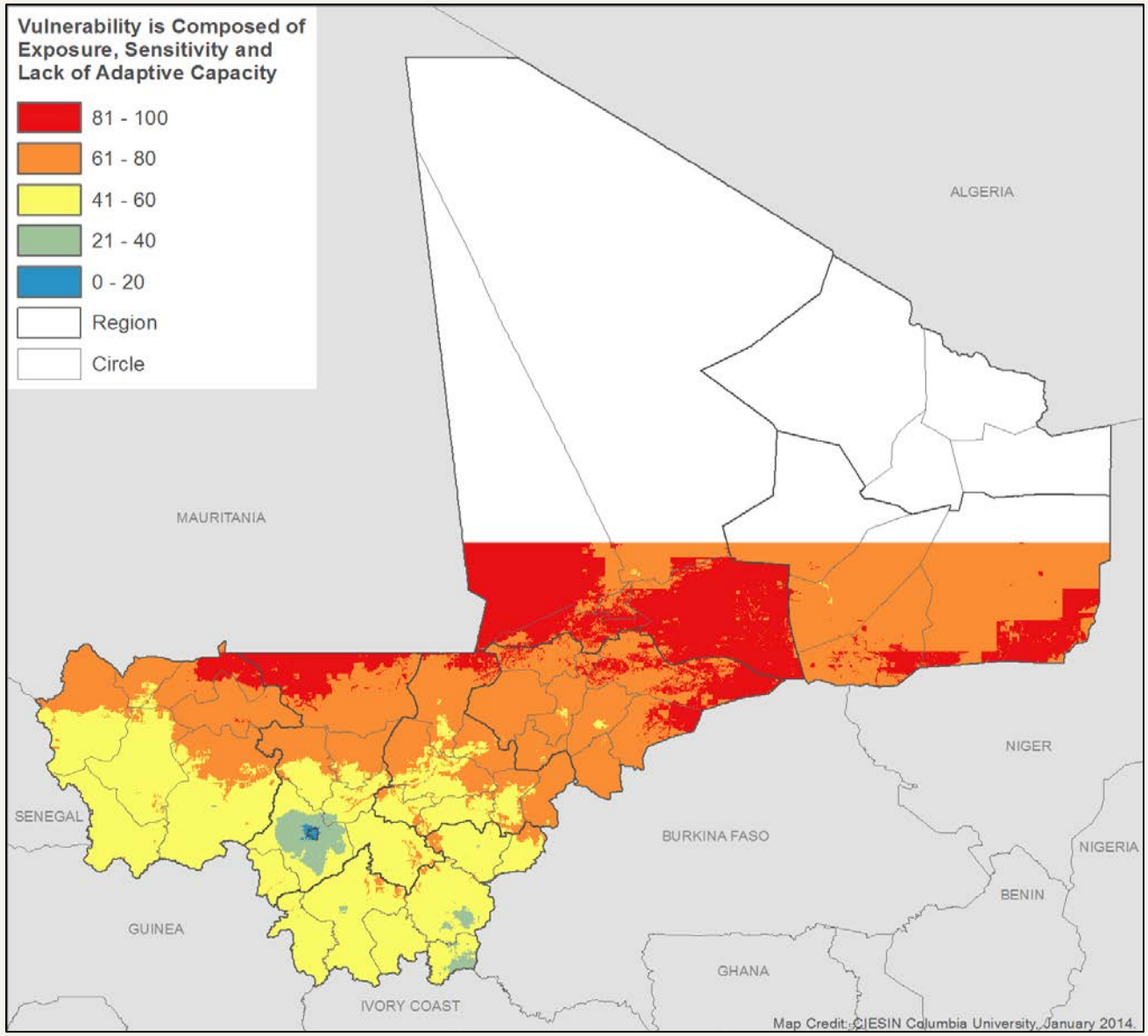
Three indicators derived from Demographic and Health Survey (DHS) cluster-level data: household wealth, child stunting, and education level of the mother.

To create a surface from the cluster points, we followed the proceeding steps. We created 30 arc-second (0.00833 degrees; ~1km) *prediction* and *prediction standard error* surfaces from the cluster point data using ArcGIS's Empirical Bayesian Kriging tool. The rasters were subset to the Mali national boundary extent using ArcGIS Extract by Mask tool and a 30 arc-second raster mask generated from a 30 arc-second fishnet. Raster values were extracted using ArcGIS Extract Values to Points tool and the 30 arc-second fishnet centroids. The outputs were exported to .csv tables for re-coding and statistical analysis.

Maps of Child Stunting



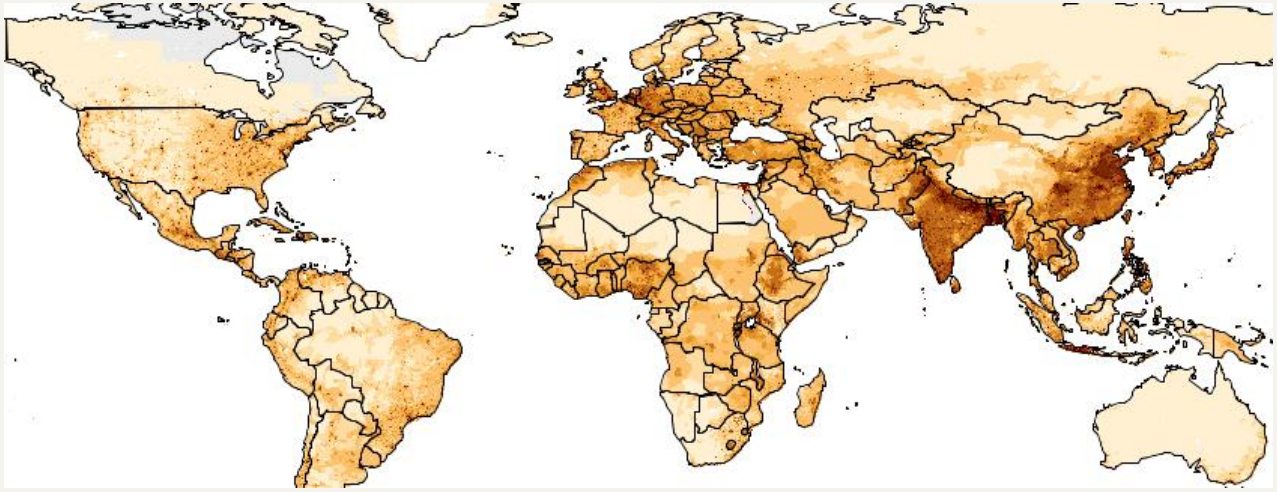
Mali: Overall Climate Vulnerability Index



Demographic data for the SDGs

Gridded Population of the World

- Raster data product developed to provide a spatially-disaggregated population surface that is compatible with data sets from social, economic, and Earth science fields
- Census population data are transformed from their native spatial units to a global grid of quadrilateral latitude-longitude cells (Balk et al. 2010)
- Free and openly available

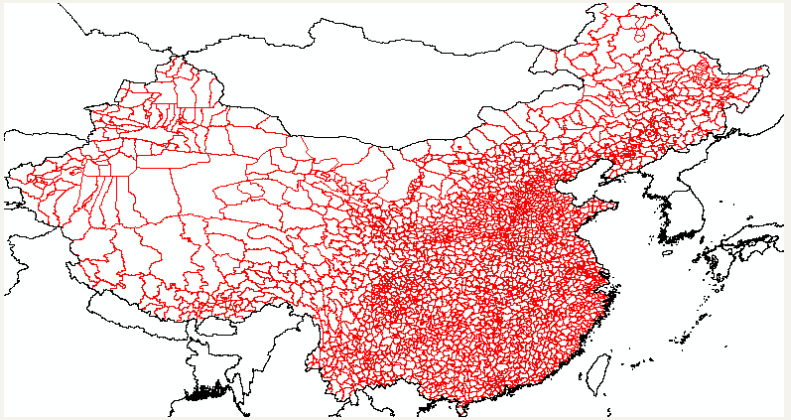


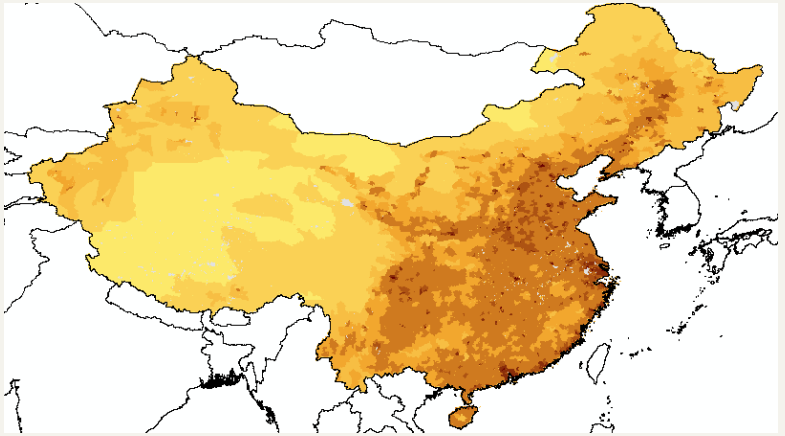
GPW version 3, 2000 population density

Transforming census units to a grid

GPW is minimally-modeled

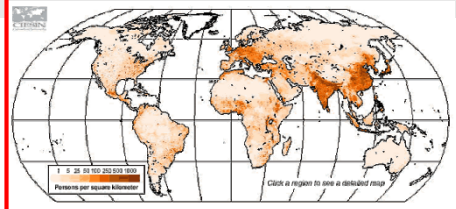
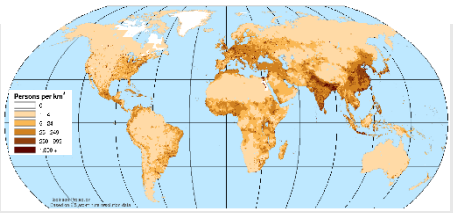
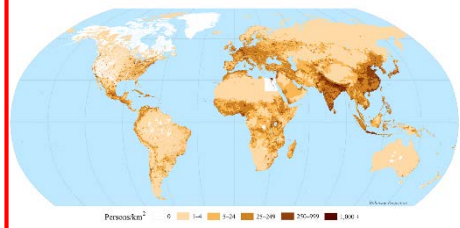
- GPW uses the areal-weighting method
  - Uniformly distributes population based on land area
  - Does not incorporate ancillary data (e.g. land use/land cover, transportation networks, elevation, etc.)
- Maintains fidelity to input data
- The accuracy of GPW pixel estimates is directly related to the size of the input census units
  - Average input unit resolution for very high development regions is 944 sq. km
  - Average input unit resolution for very low human development countries is 3,518 sq. km





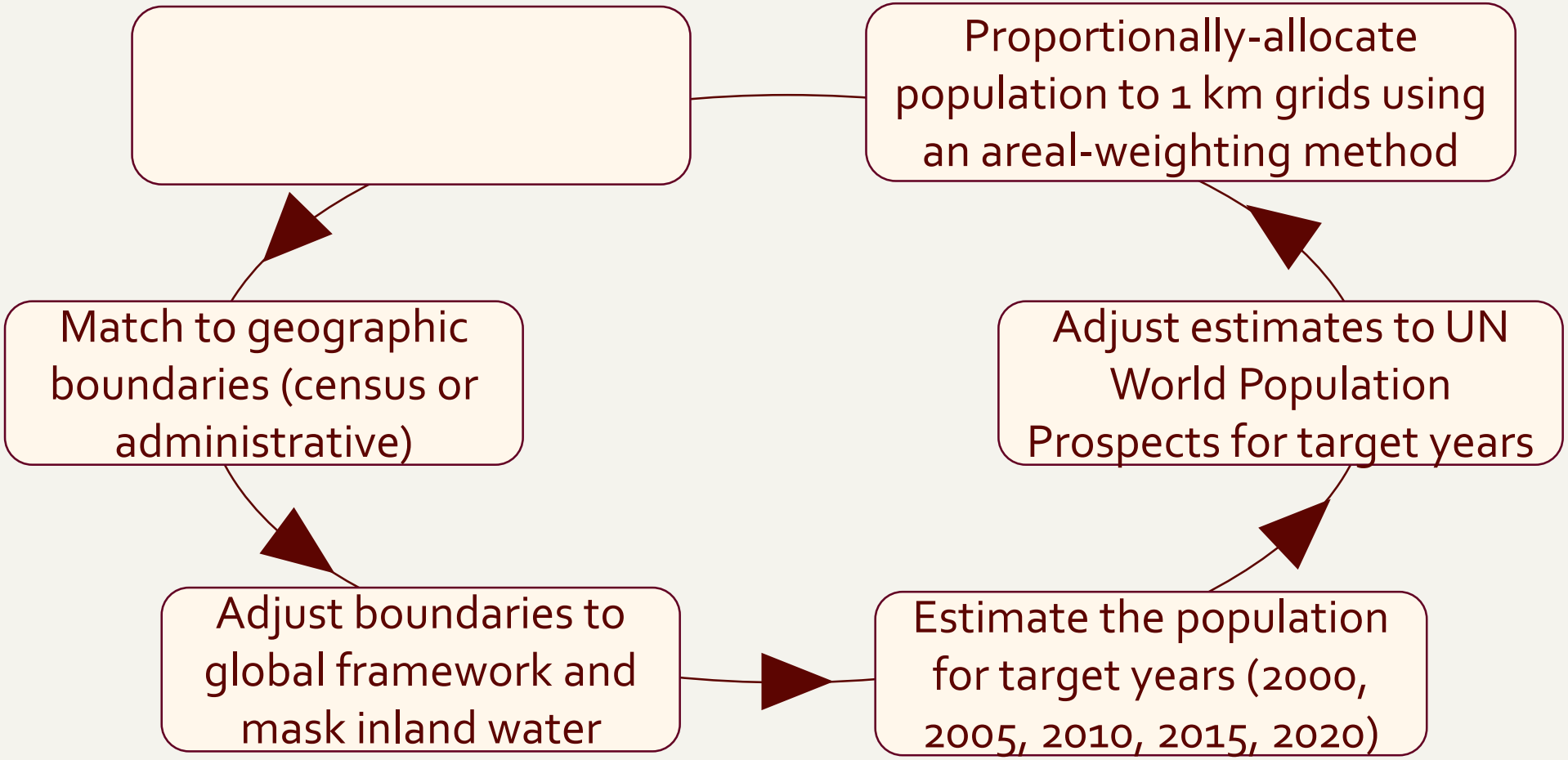
Higher resolution boundaries in eastern China lead to more accurate population distributions

Development of GPW

	Publication Year	Years of Estimation	Grid Resolution	Number of Input Units (subnational geographic units)	Census variables	Population Density Grid
GPWv1	1995	1994	5 arc-minute (10 km)	19,000	Total Population	 1994
GPWv2	2000	1990, 1995	2.5 arc-minute (5 km)	127,000	Total Population	 1995
GPWv3	2005	1990, 1995, 2000	2.5 arc-minute (5 km)	~ 400,000	Total Population	 2000
GPWv4	2015	2000, 2005, 2010, 2015, 2020	30 arc-second (1 km)	~ 12,500,000	Total Population, Sex, Age, Urban/Rural status	 2010

15

GPWv4 Workflow

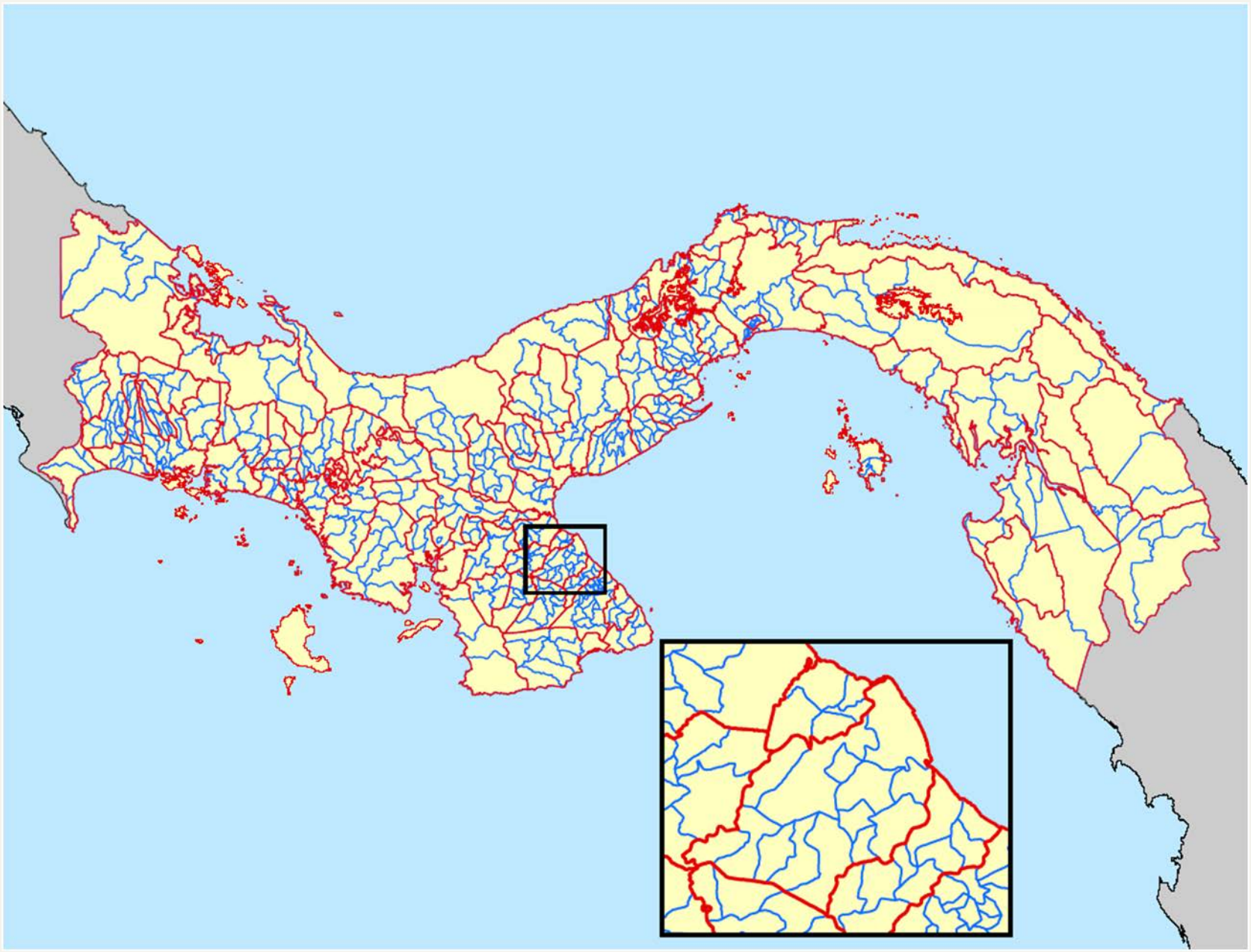


16

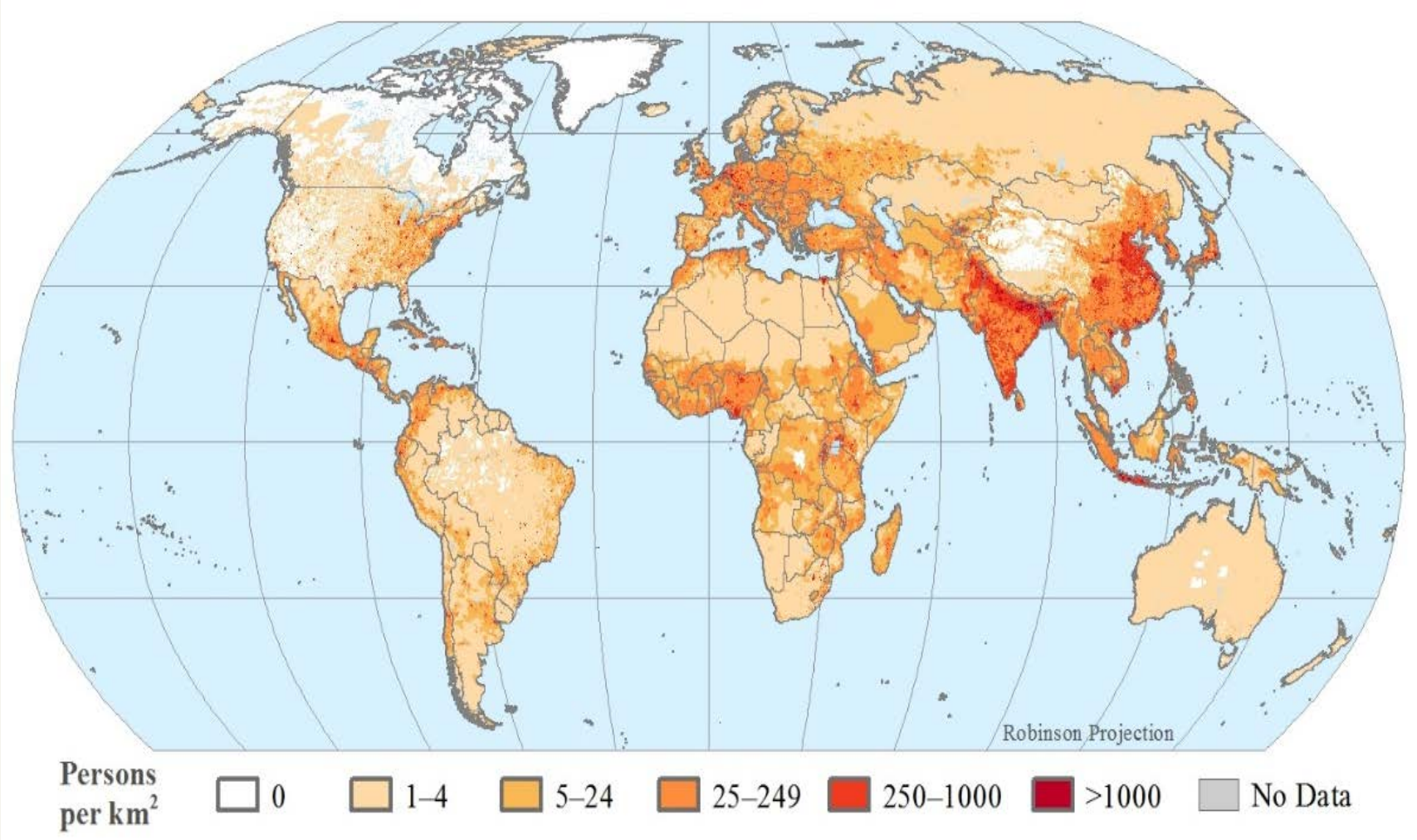
GPW v4 highlights

- Basic inputs:
  - 2010 round of population censuses or latest available census data
  - Geographic boundaries matching census cartography
- Large, significant improvements in accessibility to higher resolution population and boundary data (although some issues remain)
- Variables: population counts, density, **urban/rural status (as defined by the country), age and gender structures**
- Higher resolution: **30 arc seconds (approximately 1 km at the equator),** down from 2.5 arc minutes in GPW v3 (approximately 4km at the equator)
- Expected: changes in the access to the data: from pre-packaged to "on the fly" datasets

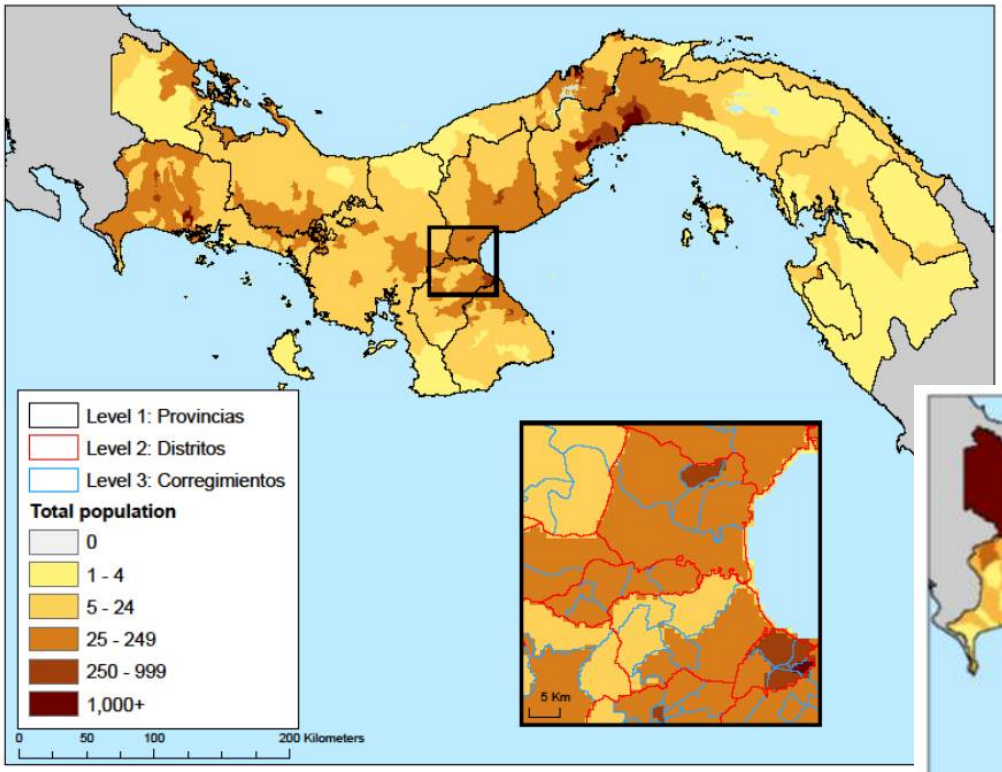
Panama, GPWv3 vs GPWv4 boundaries



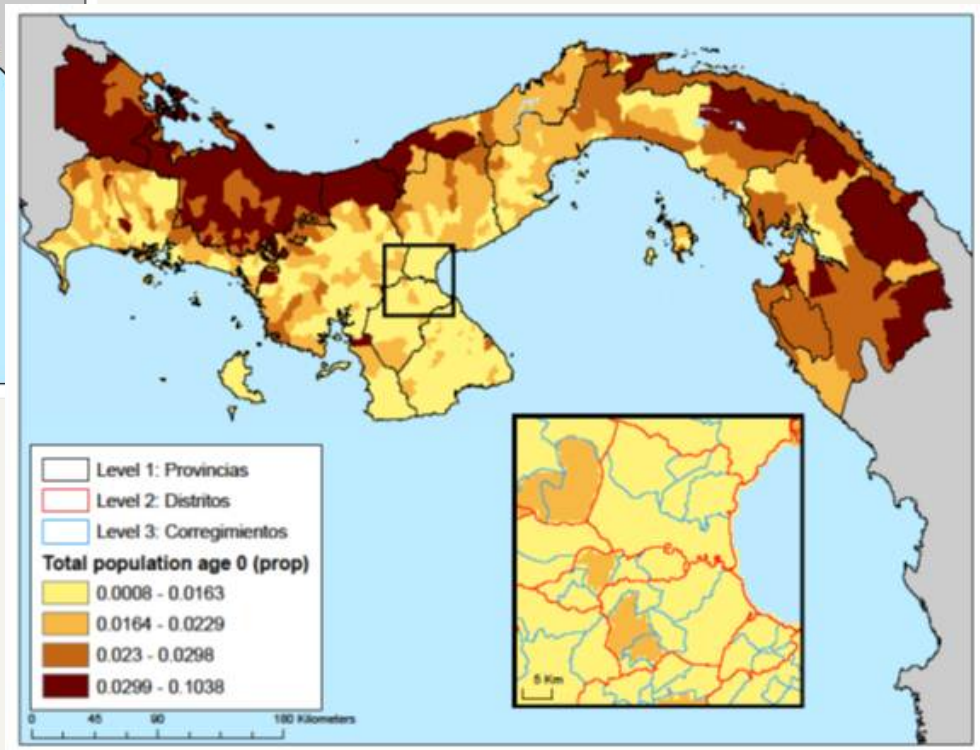
Gridded Population of the World version 4 (GPWv4), 2010 population density



Panama, population distribution grid, 2010



Panama, proportion population below age 1, 2010

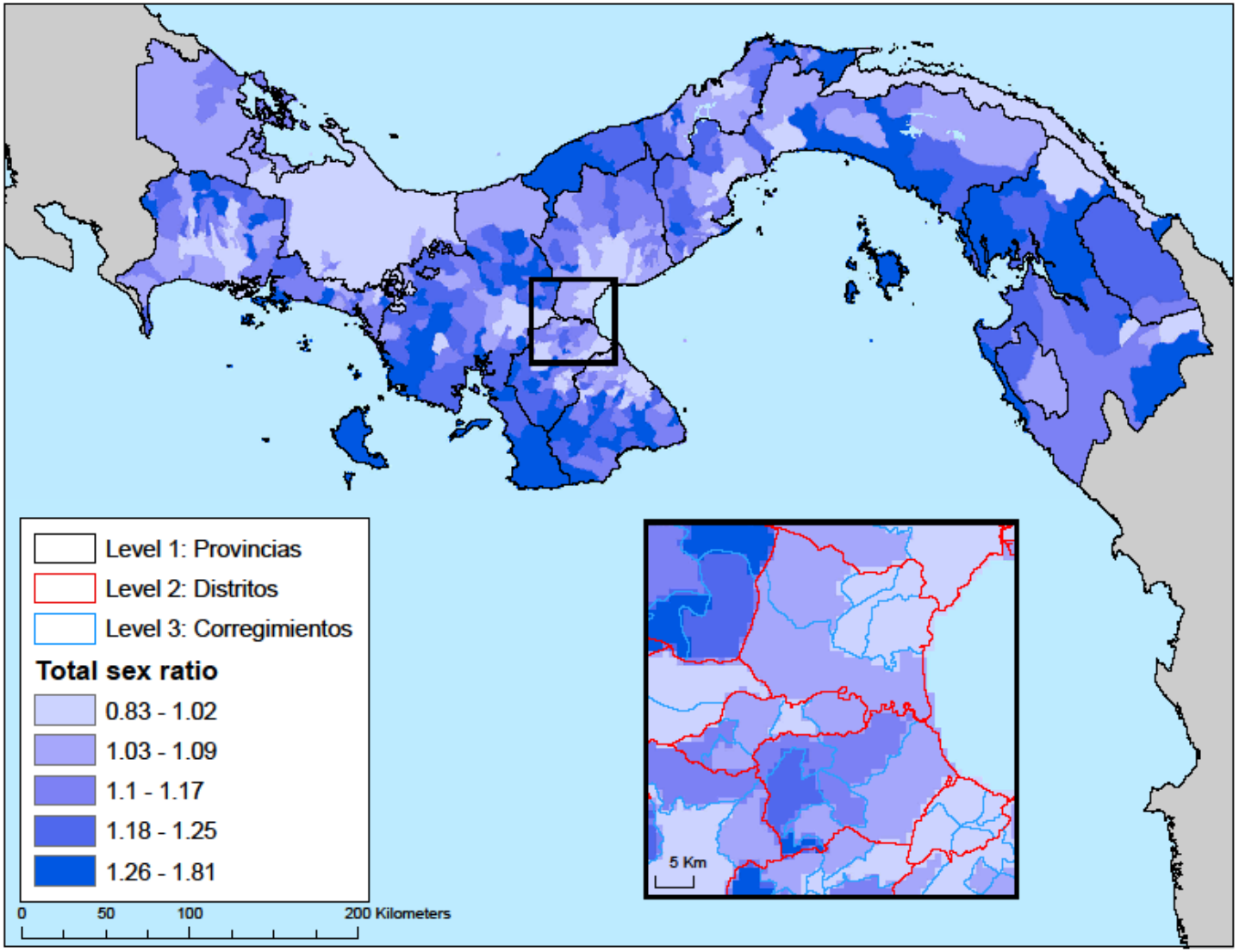


The proportion of the population <1 is highest in the rural areas and lowest in urban areas

Panama, gender structure grid, 2010

Urban areas are more heavily female

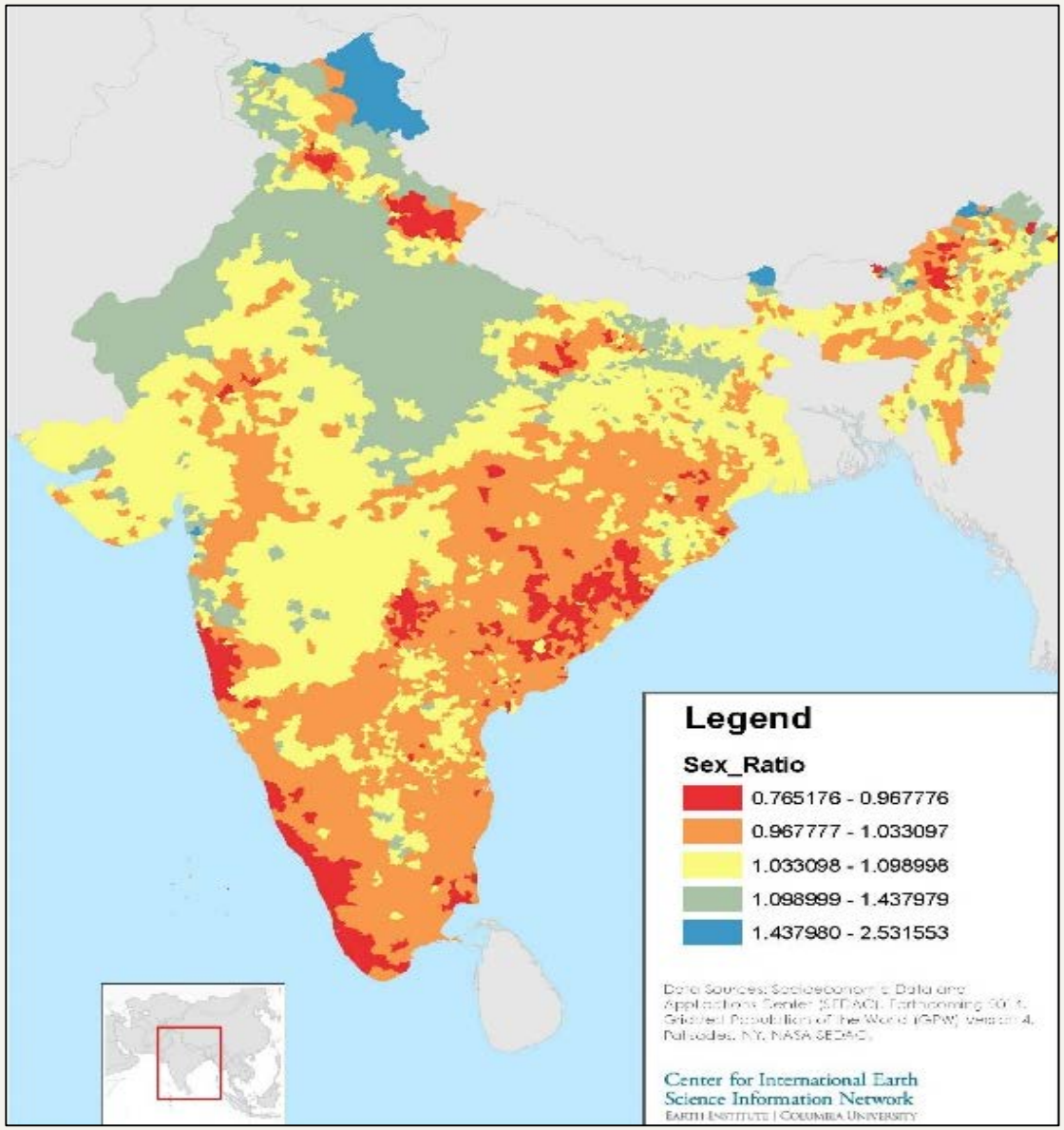
Rural areas are more heavily male

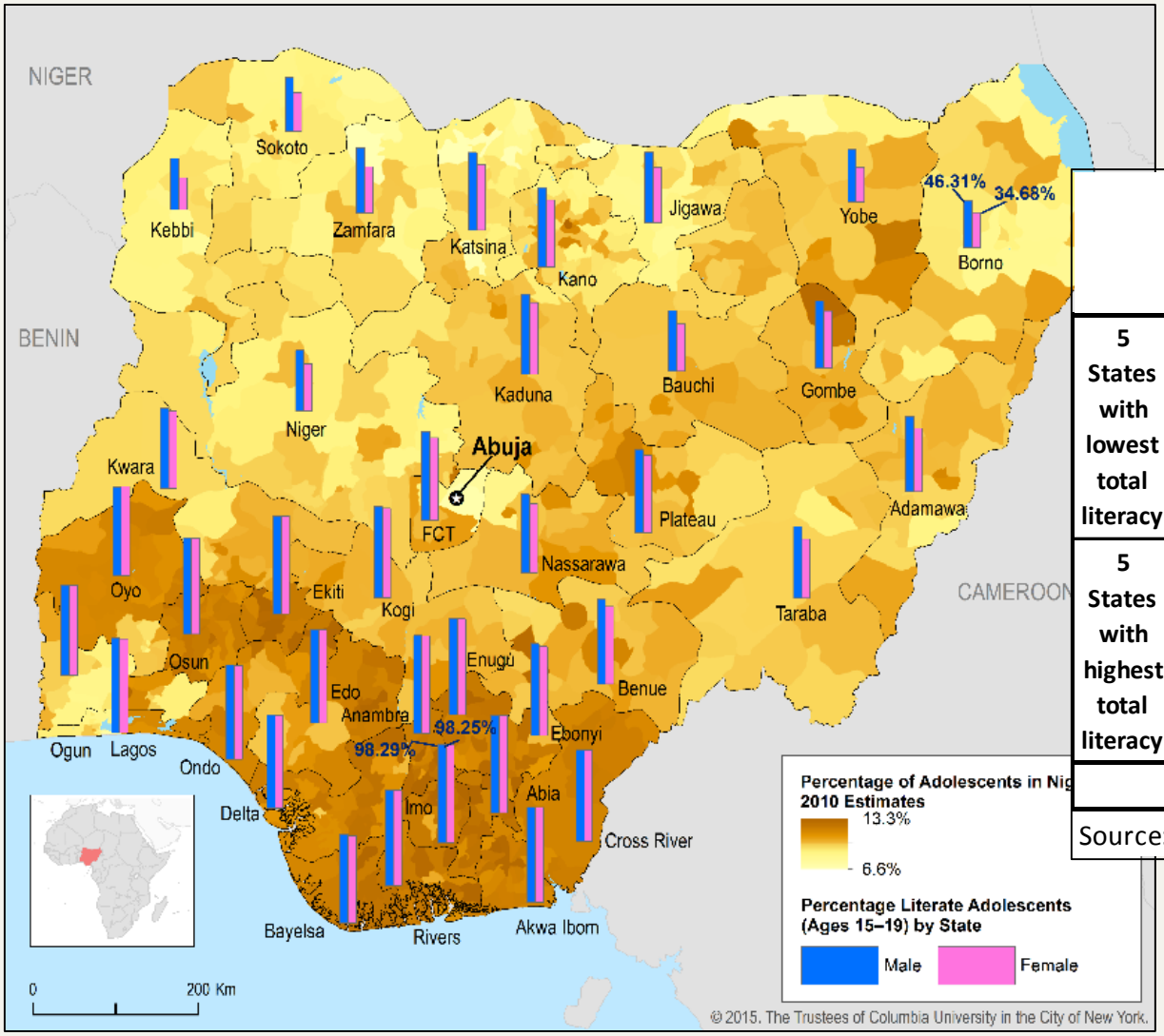


Estimated sex ratio in India (2010)

There are more males than females in the north, perhaps indicating gender preferences among parents

There are more females than males in the south

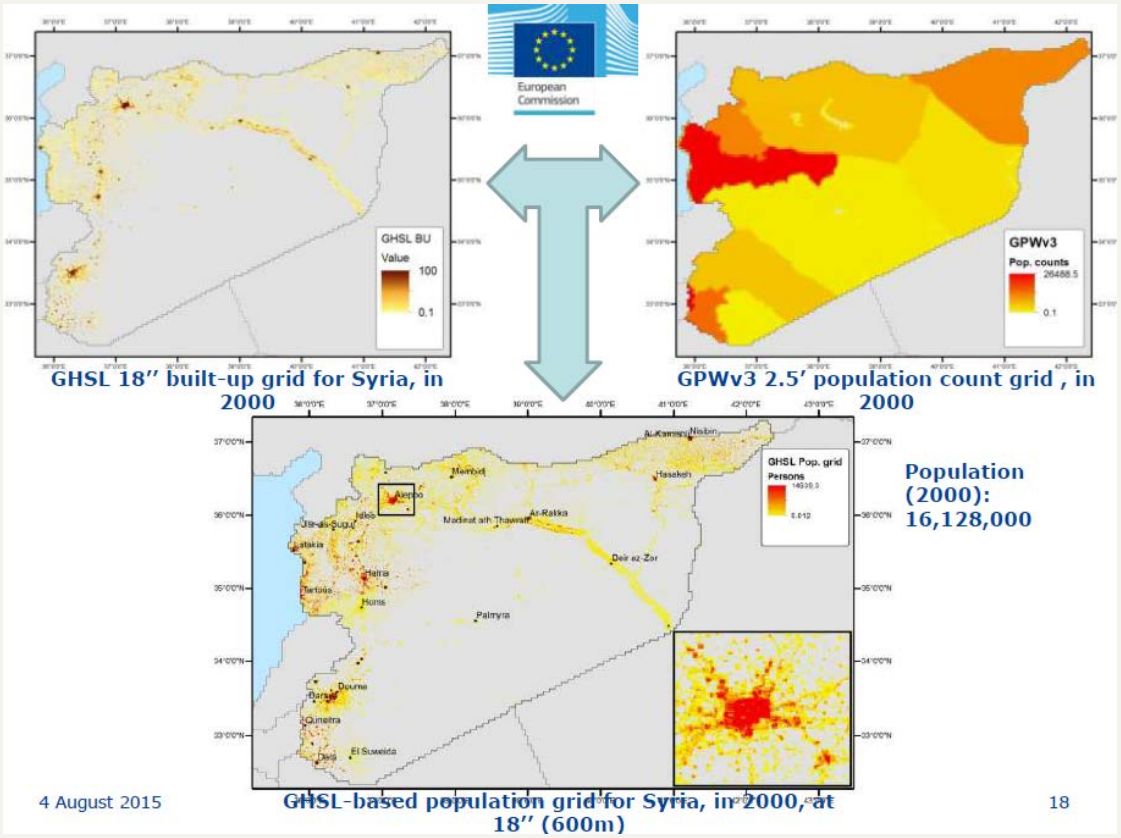




	State	% Literate, Male Adolescents	% Literate, Female Adolescents	Male/Female Ratio of Literate Adolescents
5 States with lowest total literacy	Borno	46.3	34.7	1.3
	Kebbi	51.1	31.8	1.6
	Yobe	52.2	34.7	1.5
	Sokoto	54.5	39.4	1.4
	Niger	60.6	47.2	1.3
5 States with highest total literacy	Osun	96.6	96.1	1.0
	Ekiti	97.6	97.8	1.0
	Anambra	97.8	97.6	1.0
	Abia	97.7	97.9	1.0
	Imo	98.3	98.3	1.0
	NIGERIA	82.8	76.7	1.1

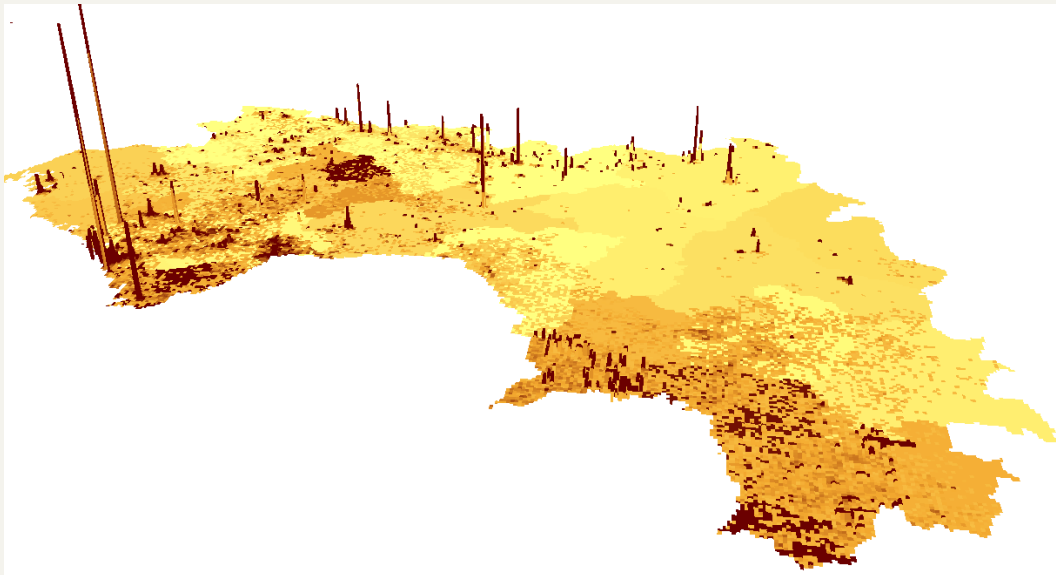
Source: National Population Commission of Nigeria. 2009

There proportion of the population that are adolescents is greater in the south, where literacy rates are also higher in this sub-population



GPW has served as an input to population reallocations using Landsat (left) and VIIRS night-time lights (below)

Source: Sergio Freire, 2015. IGARSS.



Recommendations

Recommendations

1. Disseminate data freely for at most the cost of reproduction:
   - this supports research, discovery, and information flows that can promote policies that reduce poverty
2. Report population and household counts at enumeration area level and all other census variables at census tract or smaller census geographies:
   - this facilitates a whole range of population-based analyses important to the SDGs
3. Include common identifying codes for the tabular population counts and census geographies to allow for seamless and accurate data integration:
   - this would reduce the time needed to compile spatial population data and increase the time for analysis
4. Make the census geography available to the public in a digital format:
   - too many countries do not disseminate spatial data files associated with their census results

Recommendations (2)

5. Document changes in administrative areas from one census round to the next:
   - this is vital for tracking progress towards SDGs over time
6. Report all ages in 1-year age groups:
   - having 1-year age groups would allow for grouping the age data as needed, for example as denominators for education statistics or for calculation of infant and child mortality and malnutrition rates
7. Do not truncate age reporting over a certain age:
   - many countries group everyone over age 60 or 70 rather than reporting all age groups in one or five year intervals up to age 100; with increasing longevity and heterogeneity across the elderly populations over age 60 it is important to disaggregate
8. Report infant and child mortality disaggregated by sex at the highest resolution reporting units possible:
   - this facilitates tracking of sex-differentiated development across space

Recommendations (3)

9. Encourage DHS and MICS to disseminate interpolated grids of their cluster-level data (along with uncertainty grids) using Bayesian kriging:
   - many analysts need these data and have to do it themselves
   - it promotes wider use of the data for a variety of spatial analyses

These are not "rocket science" and even these simple steps could move us lightyears towards having the tools at hand to achieve the SDGs!