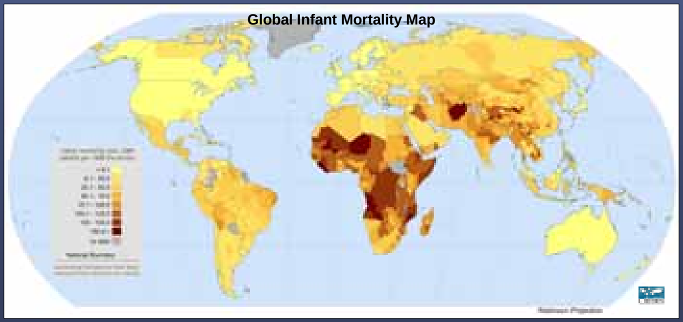
Advancing the Understanding of Human-Environment Interactions Using Fine Resolution Socioeconomic Data

Marc Levy, Alex de Sherbinin*, Deborah Balk, Bob Chen, Bridget Anderson, CIESIN, The Earth Institute, Columbia University
On the Web at **www.ciesin.columbia.edu**   *corresponding author: adesherbinin@ciesin.columbia.edu

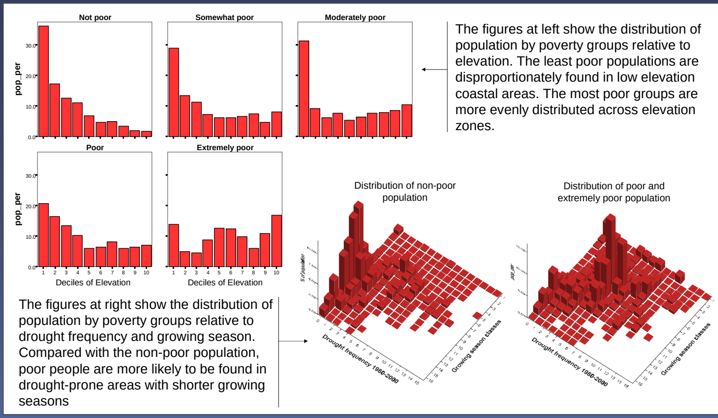
This poster describes three applications of fine resolution gridded socioeconomic data to understand human-environment interactions in the context of global assessments. These applications reveal how human population and welfare are related to a variety of environmental variables, and how future environmental change such as increased drought or sea-level rise is likely to affect wellbeing. Applications 1 and 3 uncover vulnerabilities in dryland regions, whereas Application 2 demonstrates the vulnerabilities of the coastal zone to sea-level rise.

1 *Poverty and Biophysical Constraints*

CIESIN's Global Poverty Mapping Project seeks to enhance current understanding of the global distribution of poverty and the geographic and biophysical conditions of where the poor live. The project, which was initiated as part of the UN Millennium Project, produced a Global Infant Mortality Map comprised of 10,271 subnational units.



The subnational distribution of infant mortality rates was converted to a 2.5 minute grid and then integrated with biophysical data to better understand the environmental constraints faced by the poor (see figures below).



As part of the Millennium Ecosystem Assessment, we analyzed the distribution of poor populations with respect to ecosystems. First, we calculated average IMR within each of the MA ecosystem boundaries. We also calculated another measure of well-being, the ratio of the share of world population to share of world GDP. Very clearly drylands are the most disadvantaged (below left). Using the Gridded Population of the World (GPW), we calculated rates of population growth within each ecosystem unit. Table 1 shows that drylands have the highest rate of growth.

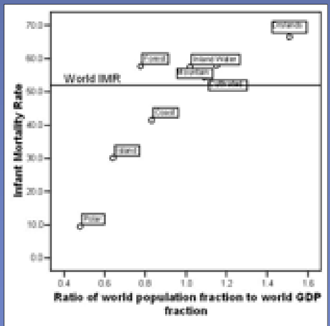


Table 1. Population Growth within Ecosystems

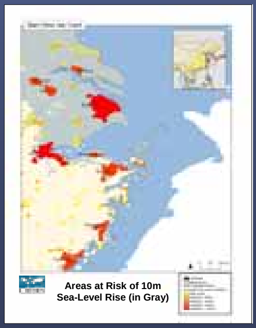
System	Change in Population (million)	Net Change in Population (percent)	Change in Population per Square Kilometer
Cultivated	505.7	14.1	14.3
Dryland	329.6	18.5	5.5
Inland Water	203.5	17.0	7.0
Mountain	171.0	16.3	5.4
Forest	142.1	13.5	3.4
Coastal	140.3	15.9	23.3
Island	67.0	12.3	9.5
Polar	–117.9	–6.5	0.0

See: http://www.ciesin.columbia.edu/povmap/

2 *Urban Areas, Ecosystems and Coastal Areas*

CIESIN's Global Rural-Urban Mapping Project (GRUMP) has produced three data products: a 1km population distribution grid, a global mask of urban areas >5,000 inhabitants, and a points database of settlements >1,000 inhabitants. As part of the Millennium Ecosystem Assessment, we superimposed the urban mask and population grid on the world's ecosystems. We found that:

- 10.2% of land in the coastal zone area is urban, and both urban and rural population densities are significantly higher in coastal ecosystems.
- 10% of the world's population is in the low elevation coastal zone, defined as coastal lands less than 10 meters above sea-level (figure bottom right).
- 6.8% of land in cultivated systems is urban, and 3.2% of land surrounding inland waters is urban.
- 2.1%, 2.0% and 1.7% of land in drylands, forests and mountains, respectively, is urban.
- Overall 2.7% of the Earth's land area is urban.



See: http://sedac.ciesin.columbia.edu/gpw/

3 *Population and Natural Hazards*

The recent World Bank publication *Natural Disaster Hotspots: A Global Risk Analysis* assessed the global distribution of cyclones, droughts, floods, earthquakes, landslides and volcanoes in relation to population and economic activities. We utilized the Gridded Population of the World (GPW) data set in two ways: first, to assess the mortality risk from various natural disasters, and second, to assess economic losses. These are represented in the two maps below.

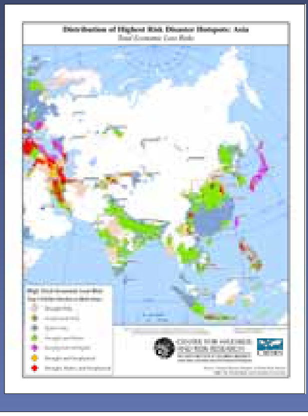


Table 2 shows that floods are the most widespread hazard, affecting 65% of the global population and areas producing 52% of global GDP. This is followed by cyclones (18% and 20%, respectively) and earthquakes (14% and 12%). Droughts impact large swaths of Africa, and globally are the second most geographically extensive hazard after floods – covering 7.5% and 11% of the global land area each.

Table 2. Characteristics of High Risk Areas by Hazard (top 3 deciles based on mortality)

Hazard	Land Area (10^6 km²)	Population (10^6)	GDP (10^9 \$)	Agricultural GDP (10^9 \$)	Road/Rail Length (10^3 km)
Cyclone	2.7	1,096	8,909	119	332
Drought	9.7	573	1,086	49	619
Flood	14.4	3,936	22,859	528	1,507
Earthquake	2.9	865	5,282	89	334
Volcano	0.1	56	166	3	12
Landslide	1.1	215	1,431	23	87
Percent of World					
Cyclone	2.1%	18.1%	20.2%	8.8%	4.2%
Drought	7.5%	9.5%	2.5%	3.6%	7.8%
Flood	11.0%	65.0%	51.7%	38.8%	19.0%
Earthquake	2.2%	14.3%	12.0%	6.5%	4.2%
Volcano	0.1%	0.9%	0.4%	0.2%	0.2%
Landslide	0.8%	3.6%	3.2%	1.7%	1.1%

See: http://www.ldeo.columbia.edu/chrr/research/hotspots/