Top down and bottom up:

Using natural capital to better understand and alleviate poverty

Carter Brandon, Global Lead Economist
World Bank, June 7, 2017

The World Bank Group's "twin goals" are to:

1. **End absolute poverty by 2030**
2. **Boost shared prosperity**
3. **In a sustainable manner**

- ***All three goals require an understanding of natural capital***

1. At the **MACRO LEVEL**, natural capital is part of the wealth of nations

2. At the **SECTOR LEVEL**, natural capital is key to sustainable development

3. At the **LOCAL LEVEL**, natural capital supports the rural poor

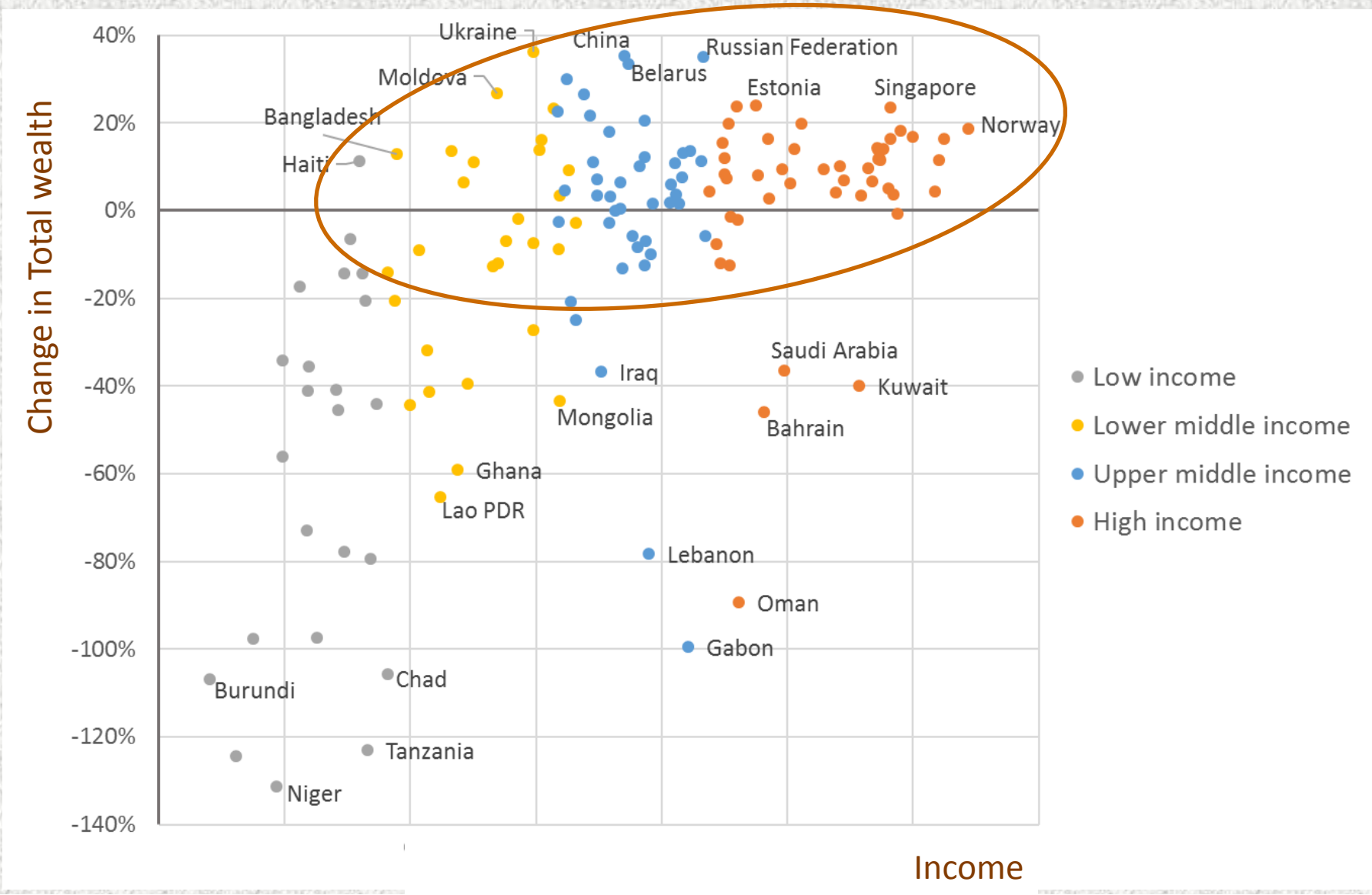
Our message to World Bank managers and counterpart countries is:

1. **You cannot achieve the twin goals by 2030 without better managing natural capital**

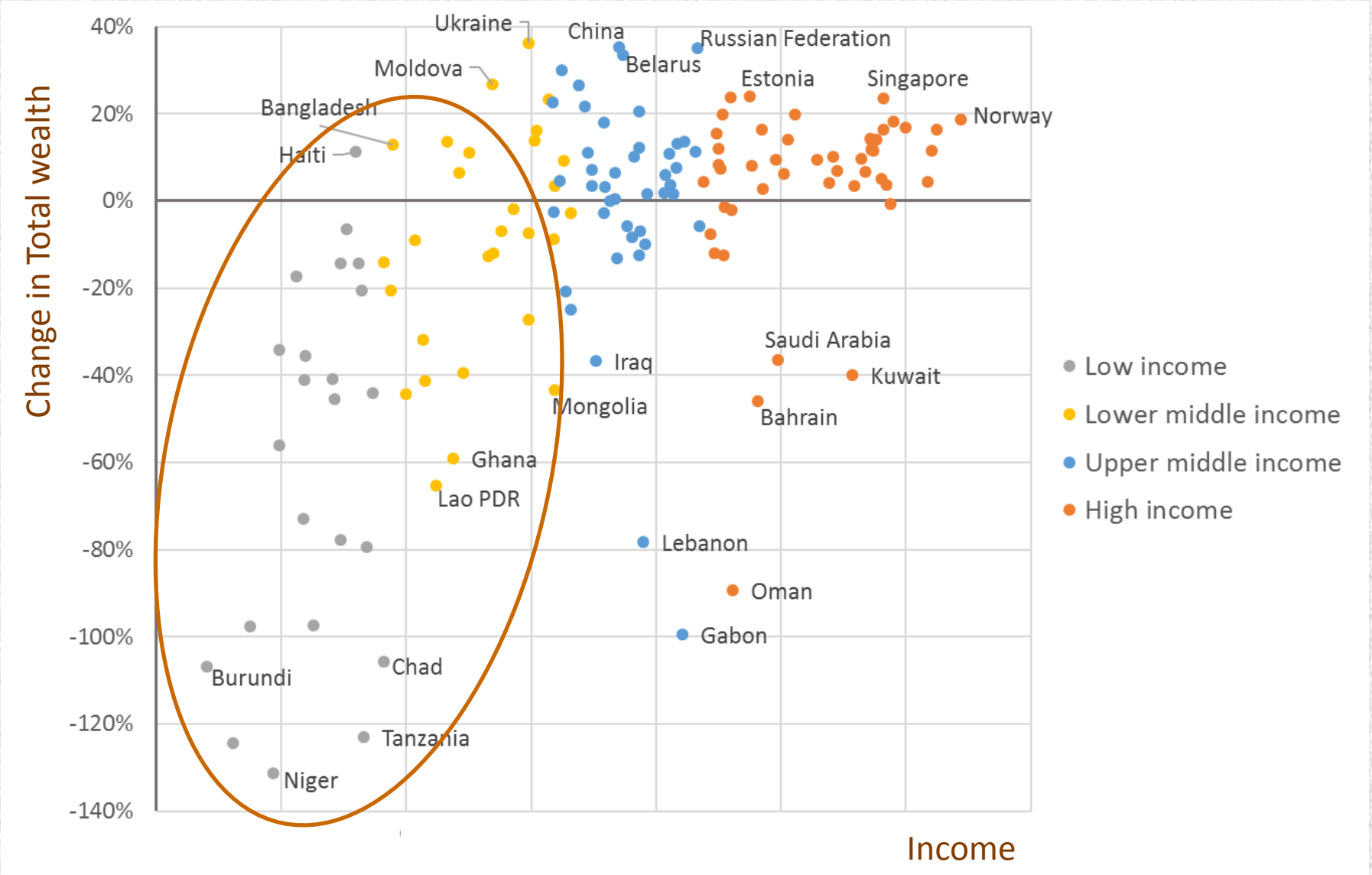
2. **Once achieved, you cannot maintain the twin goals without better managing natural capital**

1. At the MACRO LEVEL: capital is required to generate income… and it must be saved over time

Using this wealth accounting framework, most upper income countries are saving for the future…

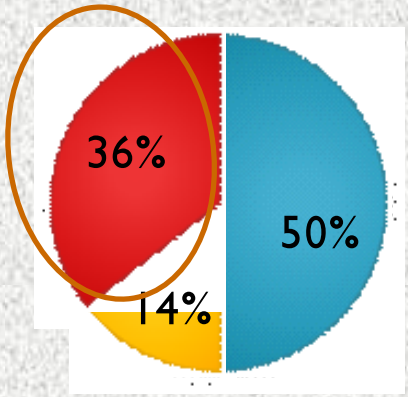


… while most lower income countries are not

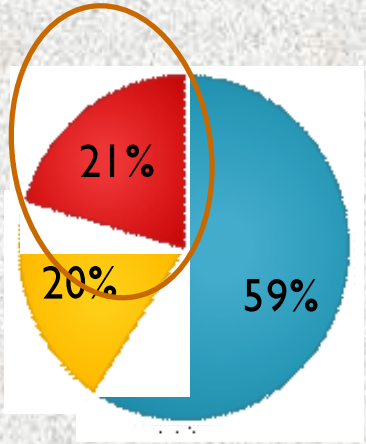


Natural Capital in low income countries: a large share of national wealth

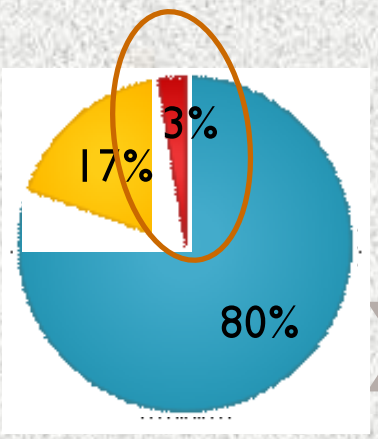
Low Income Countries



Middle Income Countries



High Income Countries



Intangible Capital Produced Capital Natural Capital

1. At the MACRO LEVEL, natural capital is part of the wealth of nations

   ∴ Lower income countries are depleting their total capital base and their economies are not sustainable over the long-term.

   ∴ This invites a better national-level asset portfolio management approach.

2. At the SECTOR LEVEL, we can value depletion of natural capital and environmental degradation

World Bank valuation of natural capital and environmental damages

Natural Capital sectors

Cropland
Pasture
Forests (timber)
Forests (non-timber)
Protected areas

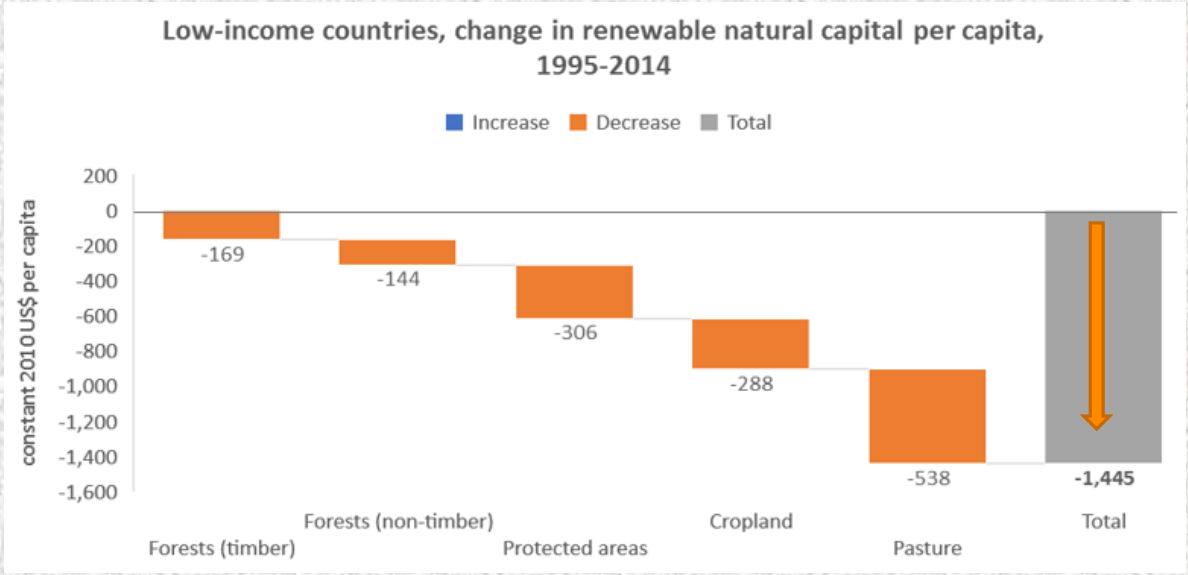
Pollution-related damages

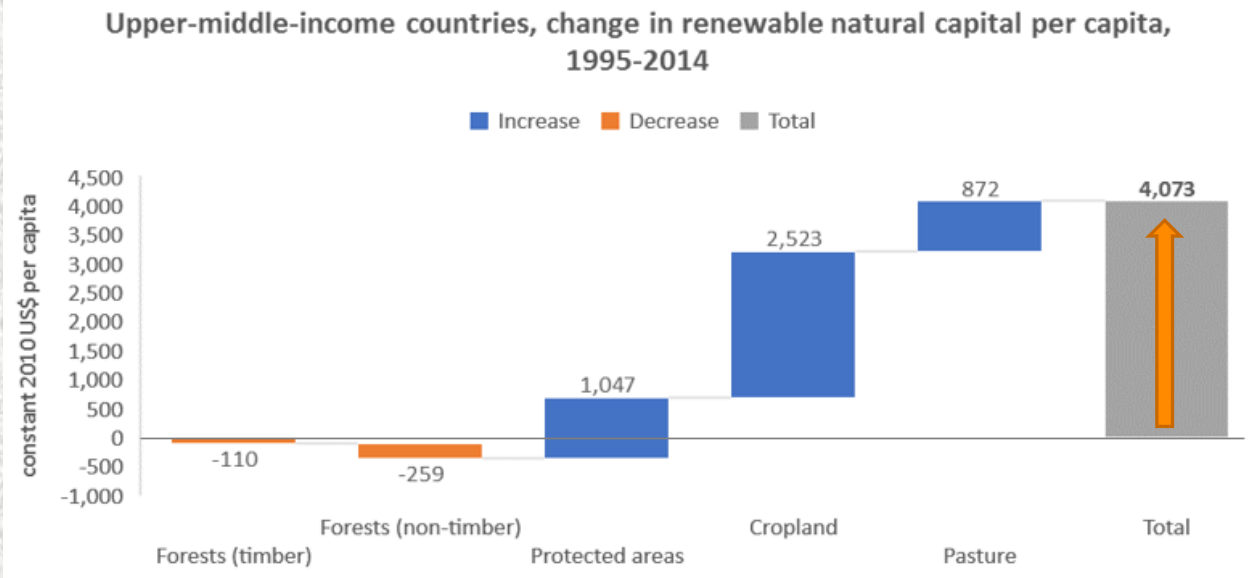
Unsafe sanitation
Unsafe water source
No handwashing with soap

Ambient PM2.5 particulates
Household air pollution from solid fuels
Ambient ozone
Residential radon

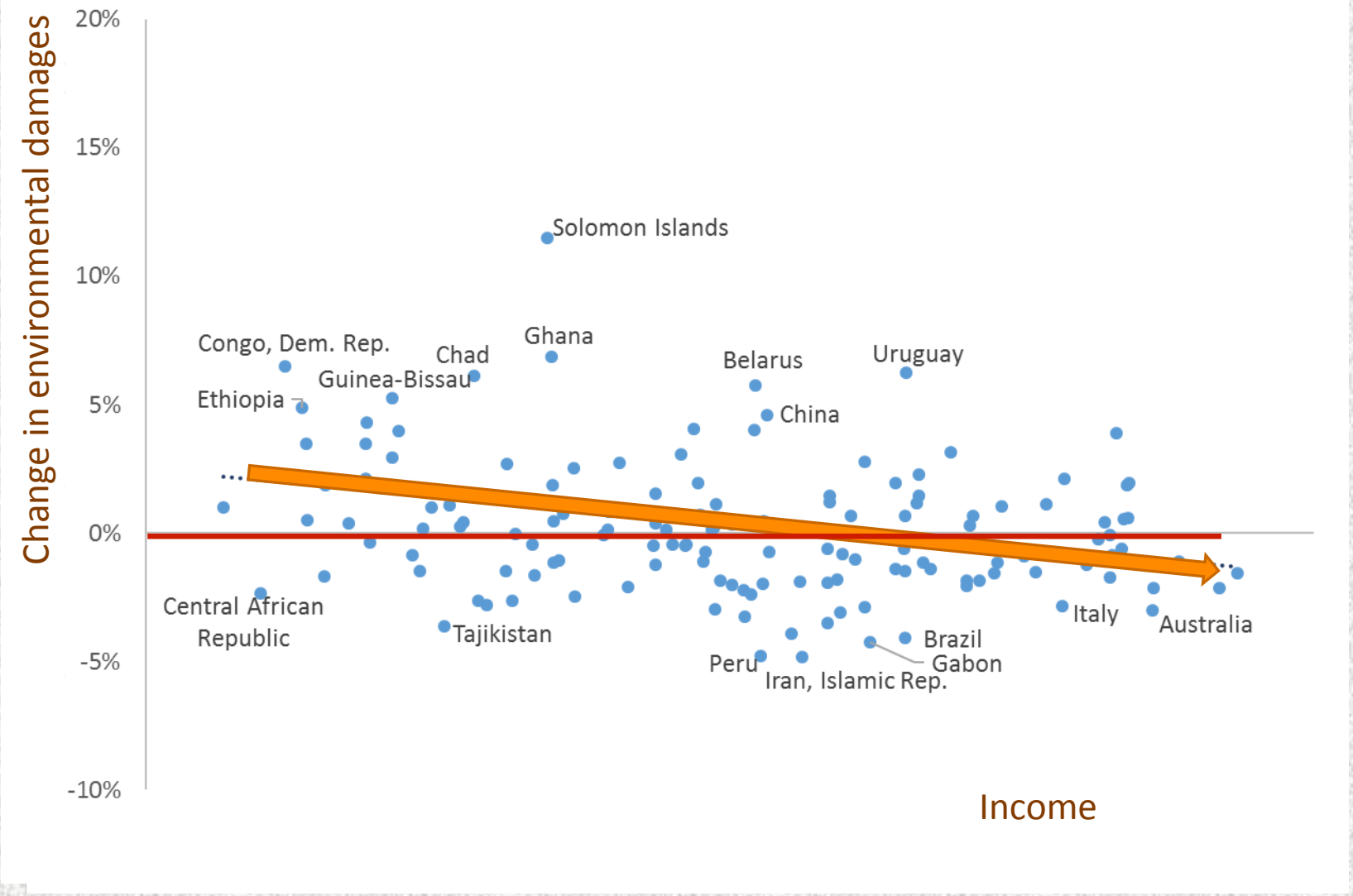
Lead exposure
Workplace environmental hazards

Lower income countries deplete their natural capital faster than higher income countries





Overall depletion and degradation is increasing in lower income countries



2. At the SECTOR LEVEL, natural capital is key to sustainable development

   ∴ Current trends are not sustainable

   ∴ Natural Capital valuation guides sectoral investment priorities in water, agriculture, forestry, fisheries, energy…

3. At the LOCAL LEVEL, rural communities depend on natural capital

Extreme poverty is increasingly rural → 81% of the total poor are rural, up from 66% twenty years ago

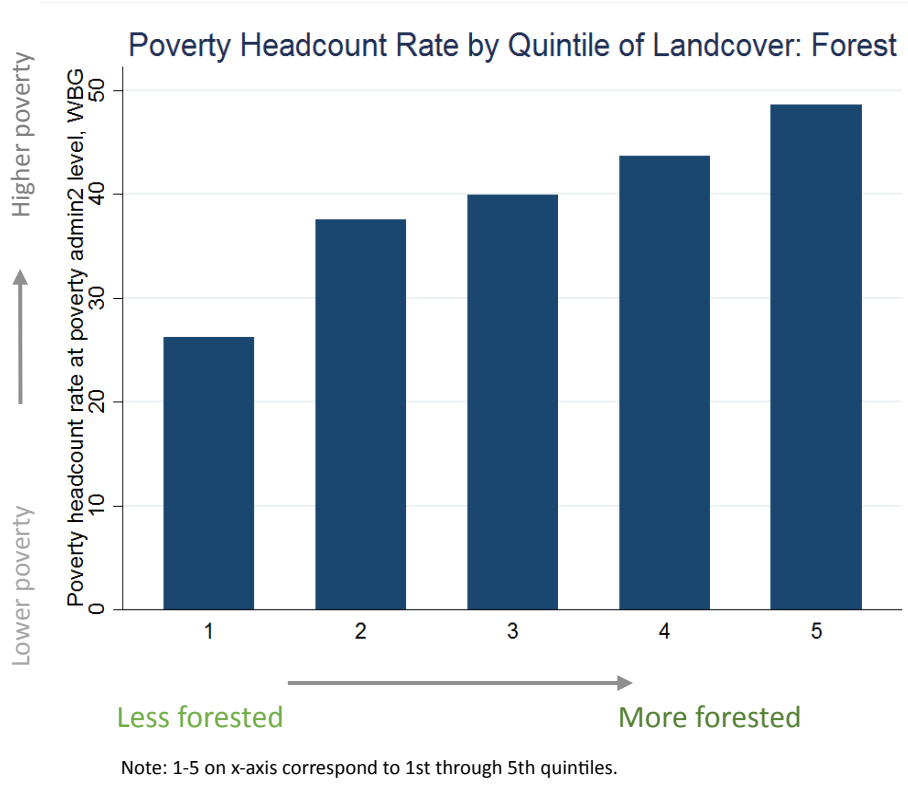
So we asked ourselves:

- Where exactly do the rural poor live?
- How resource-dependent are they?
- Can they lift themselves out of poverty using natural resources?
- Where and how can we invest in degraded natural capital?
- What are choices between short-term growth and long-term sustainability?

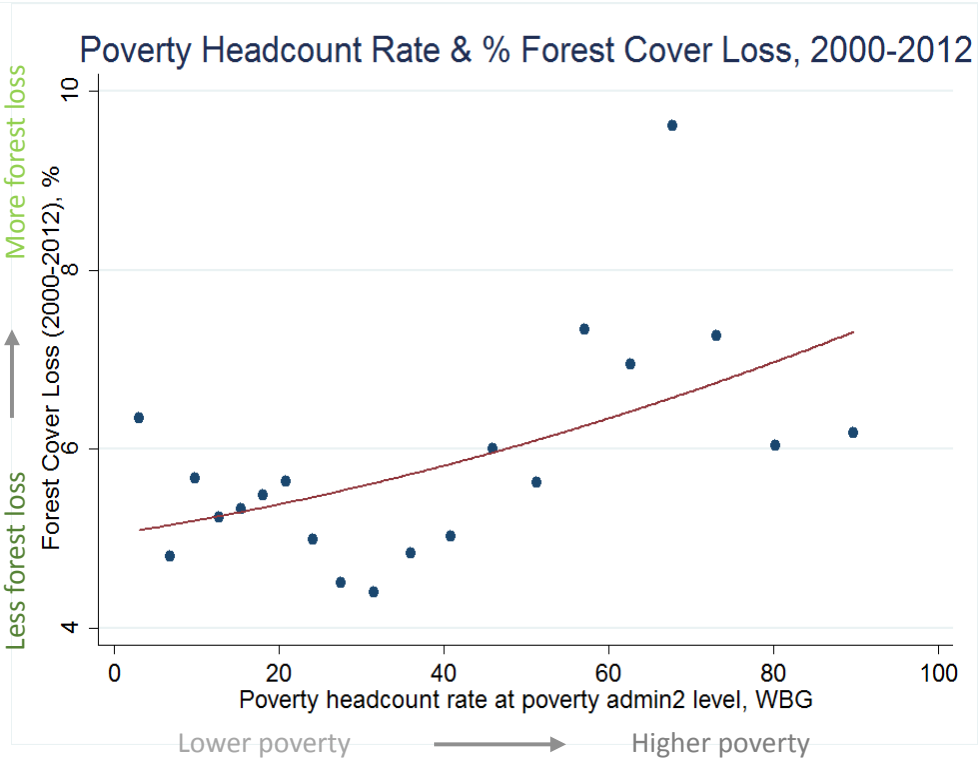
"The Hidden Dimensions of Poverty": new World Bank global research on poverty-environment linkages

- **First global spatial poverty dataset at subnational level**
  - Both monetary poverty and 50 other subnational poverty proxies.
- **75 spatial environment databases including Green (natural resources), Blue (oceans and coastal zones) and Brown (pollution) indicators**
  - For 125-150 countries

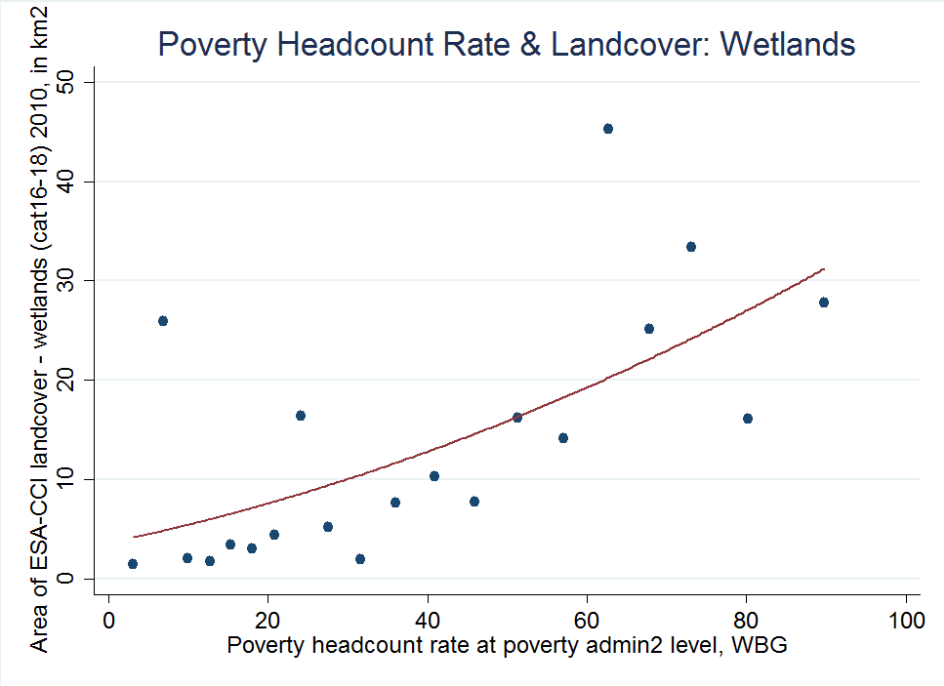
Global Scale: Both more forested districts and more deforested districts have higher rates of poverty



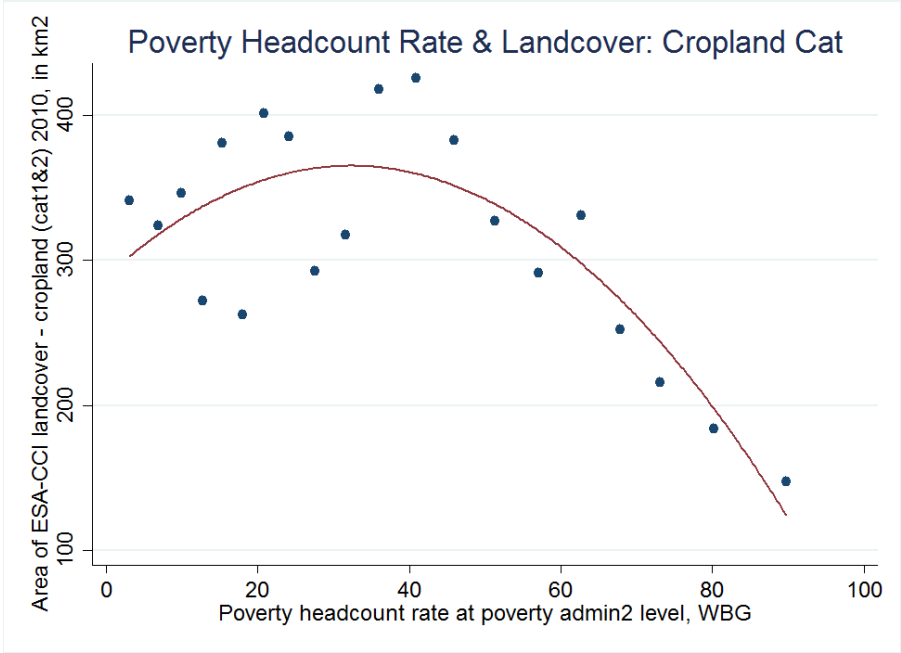
Note: 1-5 on x-axis correspond to 1st through 5th quintiles.



Global Scale: Coastal districts with high poverty rates have less cropland and more wetlands



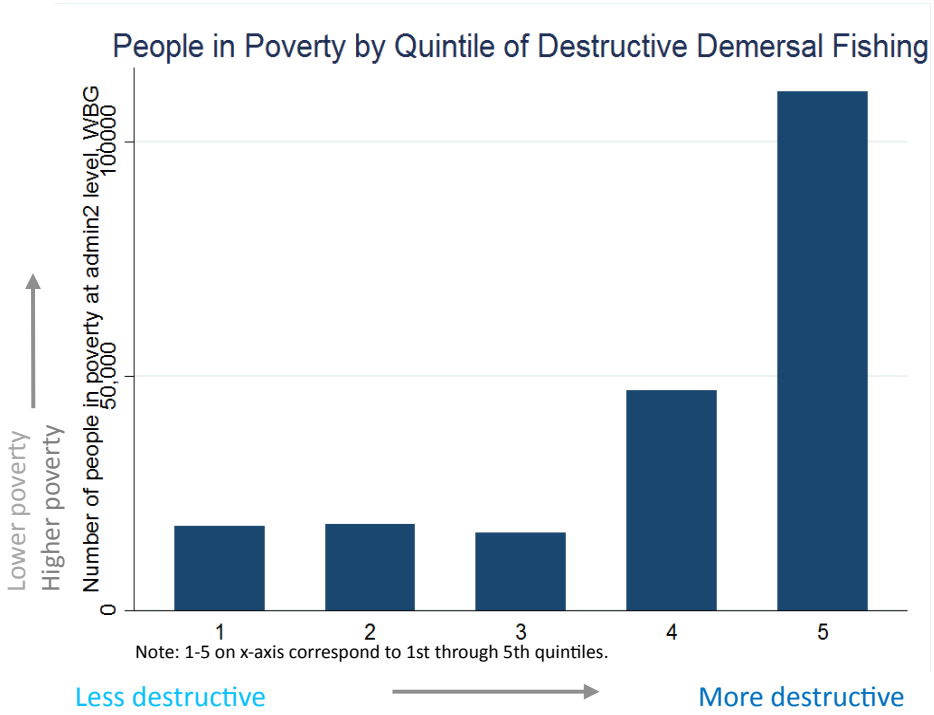
Lower poverty → Higher poverty

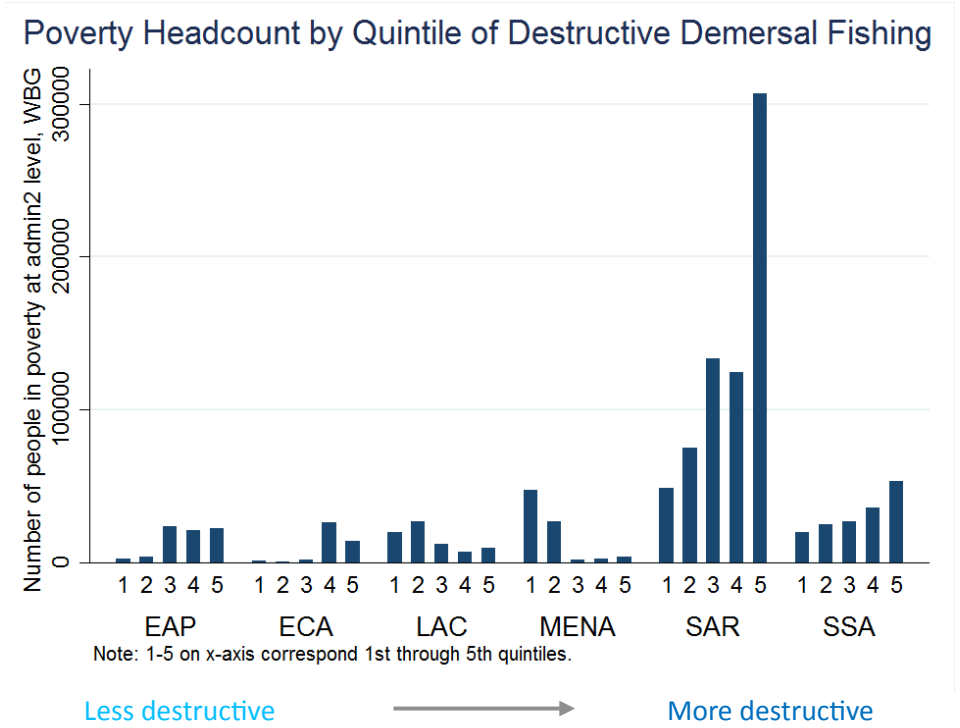


Lower poverty → Higher poverty

Data sources: World Bank staff (2017) using World Bank poverty data (various years), and ESA-CCI (2012) data.

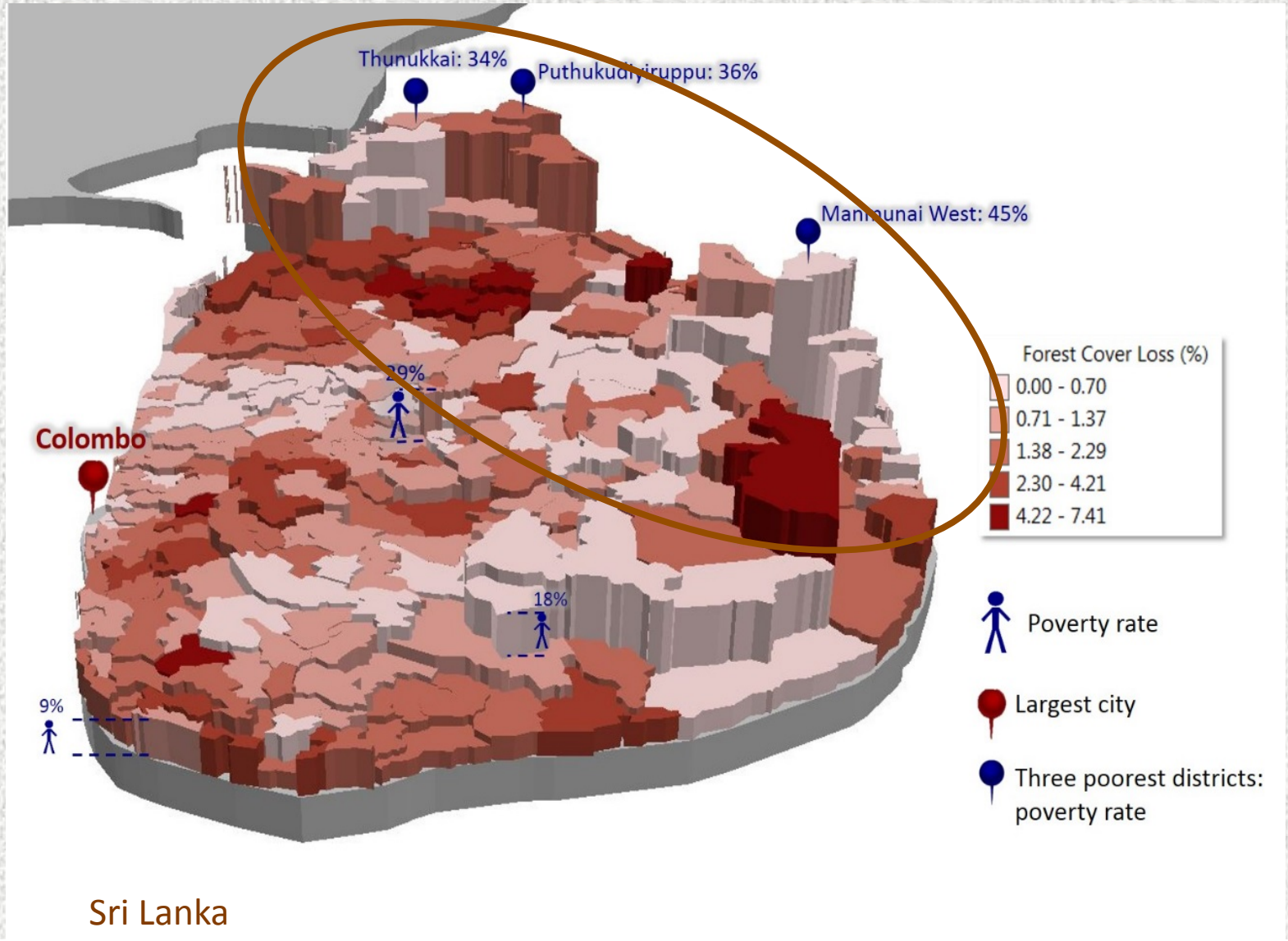
Global Scale: The most destructive demersal fishing is in districts with the highest rates of poverty





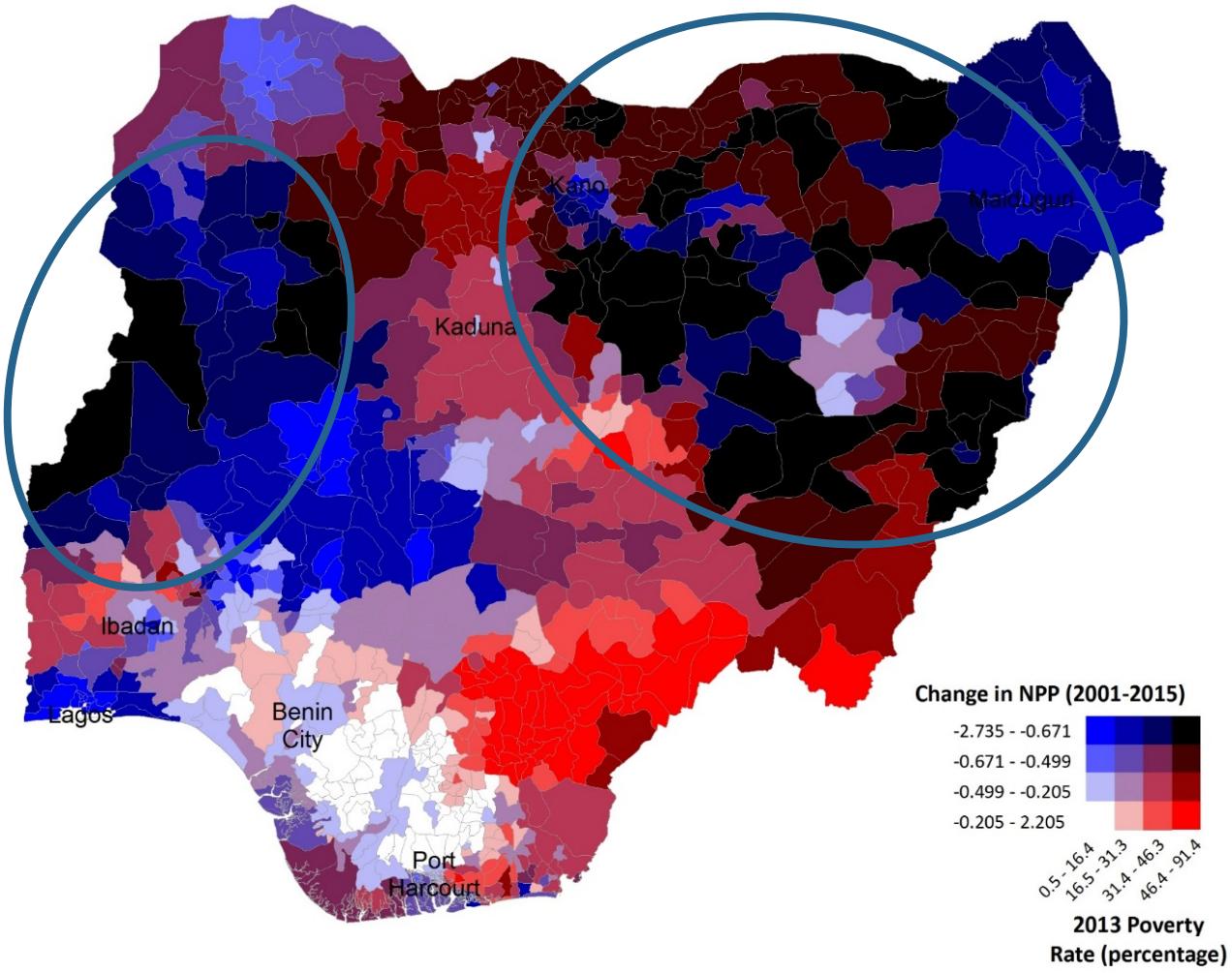
Data sources: World Bank staff (2017) using World Bank poverty data (various years), and Halpern et al (2015) data.

Sri Lanka (national scale): Identifying hotspot areas of high poverty and high natural resource degradation



Sri Lanka

Nigeria: Poverty-land degradation nexus



Hotspots with high trends in land degradation (2001-2015) and high poverty rates (2013) are in northern Nigeria.

Poverty-environment hotspots guide investments

Data sources: World Bank staff (2017) using World Bank poverty maps (2012-3) and NASA Earth Observatory (2015).

National scorecards (Vietnam): correlation of environmental issues with poverty deciles

		Poverty Rate rank (10=most poor)									
Measure	Indicator	1	2	3	4	5	6	7	8	9	10
Green	Forest Cover %	8	15	16	15	20	27	32	47	71	65
	Forest Loss %	1.9	1.8	1.1	2.0	2.5	2.6	4.5	4.2	3.7	3.6
	NDVI mean	163	167	165	175	158	171	163	168	183	208
	NPP mean	82	82	76	81	87	92	99	112	125	128
	Protected Areas %	4	4	7	11	5	17	18	14	12	12
Brown	Soil degradation mean	12	10	7	13	16	17	25	16	23	35
	NOAA PM2.5 All years max	18.4	15.3	18.3	17.5	17.6	17.0	14.0	17.6	22.9	23.6
	NOAA PM2.5 2010 max	21.6	18.4	20.9	19.7	19.4	19.9	16.1	20.8	28.2	28.5
	NOAA PM2.5 2010 mean	20.8	17.7	20.1	18.7	18.2	18.1	14.5	17.8	23.4	22.1
	Brauer PM2.5 max	30.0	26.5	28.9	28.2	27.3	24.8	21.1	23.5	36.3	39.8
Blue	Degradation of Marine Ecosystems	6.0	6.0	4.9	4.2	4.8	4.4	3.7	4.3	4.1	4.1
	Ocean Pollution	0.5	0.4	0.3	0.2	0.3	0.2	0.1	0.2	0.2	0.2
	Demersal Destructive Fishing	0.7	0.6	0.6	0.7	0.7	0.7	0.6	0.5	0.5	0.5
	Ocean acidification	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.4
Geography	Ruggedness mean	31861	34590	38199	44253	60784	73742	89761	166619	262397	422494

Natural capital degradation (based on many different indicators) is highly correlated with poverty

Rwanda: Natural capital, poverty and job growth

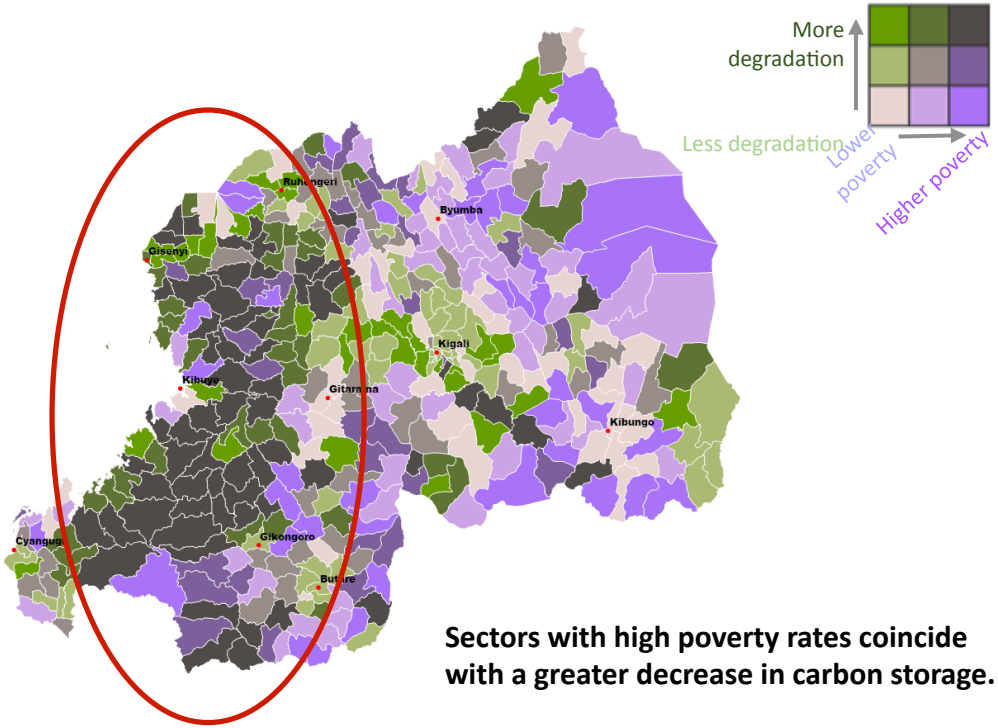
Highly disaggregated data on poverty, job growth, and ecosystem services

Preliminary findings:

In poorer sub-districts, there is relatively more ecosystem services degradation.

In poorer sub-districts, there is less job growth in sectors that are resource-dependent.

It is not clear which way causality is occurring. More research is needed.



Sectors with high poverty rates coincide with a greater decrease in carbon storage.

3. At the LOCAL LEVEL, natural capital supports the rural poor

∴ We cannot eliminate extreme poverty by 2030 without better managing natural capital.

∴ Natural capital and poverty hotspots guide local-level interventions

Top-down and bottom up: Using natural capital to better understand and alleviate poverty

1. Macro-economic Sustainability	2. Sectoral Sustainability	3. Poverty - Environment Hotspots
Conserving natural capital is key to the wealth of nations, especially low-income countries	Conserving natural capital is key to sustainable development across many sectors	Conserving natural capital is pro-poor

Appendix: the "Hidden Dimensions" dataset

- Dataset will grow -- to include (ideally) climate risks, land tenure, ethnicity, water quality, land contamination
- Will be public as soon as country's give clearance for new poverty data (estimated in September, 2017)

HDD Indicators- Natural Resources - Green

Indicator	Indicator definitions	Unit of Analysis Admin 1 = province Admin 2 = district	Country Coverage	Spatial Resolution	Year	Source
Forest coverage and loss (FOR)	Total area of district	Admin 1 & 2	Global	30m x 30m	2000 - 2012	Hansen et al., 2013
	Forest Cover (2000) Area					
	Forest Cover Loss (2000-2012) Area					
	Forest Cover Loss Area, Average Annual (2000-2012)					
	Forest Cover Percentage (2000)					
	Forest Cover Loss Percentage (2000-2012)					
	Forest Cover Loss Percentage, Average Annual (2000-2012)					
Soil degradation (SOIL)	Global yearly erosion rates according to the RUSLE model	Admin 1 & 2	Global	5 arcmin	Modeled based on data from various years	Naipal
Vegetation Index (NDVI)	NDVI Normalized Difference Vegetation Index	Admin 1 & 2	Global	0.1 degrees	2001 (2000-2002), 2005 (2003-2007), 2010 (2008-2012), 2015 (2013-2016)	NEO (MODIS/Terra)
Net Primary Productivity (NPP)	NPP Net Primary Productivity	Admin 1 & 2	Global	0.1 degrees	2001 (2000-2002), 2005 (2003-2007), 2010 (2008-2012), 2015 (2013-2016)	NEO (MODIS/Terra)
Biodiversity (BIODIV)	Area of biodiversity hotspot	Admin 1 & 2	Global	shapefile	2011	Biodiversity Hot Spots (2011): IBAT and Conservation International
	Share of area that is a biodiversity hotspot					
Bird areas (EBA)	Endemic bird area size	Admin 1 & 2	Global	shapefile	1998	Endemics Bird Areas (1987-1998): IBAT
	Share of area that is an endemic bird area					
Protected areas (PA)	Protected area size	Admin 1 & 2	70 countries	shapefile	2014	Protected Areas (2014): World Database on Protected Areas (WDPA) (April 2014)
	Share of area that is a protected area					

HDD Indicators- Geography and Climate

Indicator	Indicator definitions	Unit of Analysis Admin 1 = province Admin 2 = district	Country Coverage	Spatial Resolution	Year	Source
Land cover	Land cover types: cropland, rainfed; cropland, irrigated; mosaic cropland/vegetation; mosaic vegetation/ cropland; tree broadleaved evergreen; tree broadleaved deciduous; tree needleleaved evergreen; tree needleleaved deciduous; tree mixed leaved type; mosaic tree, shrub/hc; mosaic hc/tree, shrub; shrubland; grassland; lichens and mosses; sparse vegetation; tree flooded, fresh water; tree flooded, saline water; shrub or herbaceous flooded; urban areas; bare areas; water bodies; permanent snow and ice	Admin 1 & 2	Global	300m x 300m	2000 (1998-2002), 2005 (2003-2007), 2010 (2008-2012)	CCI
	Land Cover Total Area					
Grid cell ruggedness	Ruggedness index	Admin 1 & 2	Global	30 x 30 arcsecond grid	1999	Nunn and Puga, 2012
Less Favored Agricultural Land (LFAL)	LFAL % of total area	Admin 1 & 2	Global	0.1 degree	2000/2005	Barbier & Hochard (2014); Ramankutty et al. (2008); Siebert et al. (2006); FAO Global Agro-Ecological Zones Data Portal version 3; Sebastian (2007)
	LFAL % of Agricultural Land in area					
	MFAL % of total area					
	MFAL % of Agricultural Land in area					
	Agricultural extent % of total area					
Area size	Size of the administrative boundary	Admin 1 & 2	Global	NA	NA	GADM
Market Access	Travel time to major city	Admin 1 & 2	Global	0.01 degree	2000	Nelson & Uchida, 2008
Road density	Road Density, total	Admin 1 & 2	Global	10km	2013	PBL
	Road Density, highways					
	Road Density, primary					
	Road Density, secondary					
	Road Density, tertiary					
	Road Density, urban/residential					
Built-up area	Built-up area %			2.8 arc seconds (75-84m)	2011	Global Urban Footprint (GUF); DLR 2016
Temperature	Temperature mean (of decade)	Admin 1 & 2	Global	0.5 degree	1901-2015	CRU Climate Research Unit
Rainfall	Precipitation total (of decade)					

HDD Indicators- Pollution - Brown

Indicator	Indicator definitions	Unit of Analysis Admin 1 = province Admin 2 = district	Country Coverage	Spatial Resolution	Year	Source
Air pollution (AP)	PM2.5 air pollution, 2010, satellite	Admin 1 & 2	Global	0.1 degrees x 0.1 degrees	2000 - 2013	CIESIN, 2015
	PM2.5 air pollution, all years, satellite			0.1 degrees x 0.1 degrees	2000 - 2013	
	PM2.5 air pollution, 2013			0.1 degrees x 0.1 degrees	2013	Brauer et al., 2016
	PM2.5 air pollution, all composition, 2013			0.01 degrees x 0.01 degrees	2013	van Donkelaar et al., 2016
	PM2.5 air pollution, all composition, pov. year			0.01 degrees x 0.01 degrees	2000-2013	
	PM2.5 air pollution, dust- and salt-removed, 2013			0.01 degrees x 0.01 degrees	2013	
	PM2.5 air pollution, dust- and salt-removed, pov. year			0.01 degrees x 0.01 degrees	2000-2013	
	PM2.5 air pollution, emissions			0.5 decimal degrees x 0.5 decimal degrees	2010	ECCAD
	PM10 air pollution			0.5 decimal degrees x 0.5 decimal degrees	2010	
	Black Carbon			0.5 decimal degrees x 0.5 decimal degrees	2010	
	NO x			0.5 decimal degrees x 0.5 decimal degrees	2010	
	Mercury			0.5 decimal degrees x 0.5 decimal degrees	2000	

HDD Indicators- Fisheries and Oceans - Blue

Indicator	Indicator definitions	Unit of Analysis Admin 1 = province Admin 2 = district	Country Coverage	Spatial Resolution	Year	Source
Reefs at Risk (REEF)	Area of district's shoreline classified as low, medium, high & very high threat Share of district's shoreline classified as very high threat level Share of district's shoreline classified as very high & high threat level	Admin 1 & 2	70 countries	500m	2011	World Resources Institute (WRI), Reefs at Risk Revisited, 2011
Degradation of Marine Ecosystems (COAST)	CI: Ocean Health Index/Cumulative Impact Score	Admin 1 & 2	Global	1km²	Based on data from various years	Halpern et al (2015)
	Land-based Fertilization			modeled 1km²	2007-2010	
	Land-based Pesticides			modeled 1km²	2007-2010	
	Land-based Inorganic Pollution			modeled 1km²	2000-2001	
	Land-based Human Pollution			modeled 1km²	2011	
	Land-based Night Lights			1km²	2007-2009	
	Fishing (Demersal Destructive)			half-degree	2011	
	Fishing (Demersal Nondestructive High Bycatch)			half-degree	2011	
	Fishing (Demersal Nondestructive Low Bycatch)			half-degree	2011	
	Fishing (Pelagic High Bycatch)			half-degree	2011	
	Fishing (Pelagic Low Bycatch)			half-degree	2011	
	Fishing (Artisinal)			modeled 1km²	2006	
	Climate Change Sea Surface Temperature (SST)			~21km²	2005-2010	
	Climate Change UV			1 degree	2008-2012	
	Climate Change ocean Acidification			1 degree	1870 vs. 2000-2009	
	Climate Change Sea Level Rise (SLR)			modeled 0.25 degree	1992-2012	
	Ocean Shipping			0.1 degree	2003-2011	
	Ocean Invasive Species			modeled 1km²	2011	
	OPOLL: Ocean Pollution (pressure)-combination of commercial shipping & invasive species			modeled 1km²	2003-2011	
	Ocean Oil Rigs			1km²	2007-2010	
	Climate Change Sea Level Trend (SLT)			0.25 degree	1993-2016	Nicholls and Cazenave

HDD Indicators- Poverty

Indicator Category	Indicator definitions	Unit of Analysis Admin 1 = province Admin 2 = district Admin 4 = village	Country Coverage	Source
Monetary Poverty	Share of people below the national poverty line	Admin 1, 2, 4	70 countries (Admin 1), 32 countries (Admin 2)	WBG
	Number of persons below the national poverty line			
Multidimensional Poverty	Multidimensional Poverty Index = headcount ratio * intensity of deprivation, 0 to 1	Admin 1	66 countries	OPHI
	% population in multidimensional poverty			
	Intensity of deprivation among the poor, average % of weighted deprivations			
Vulnerability	% population that are destitute			
	% of MPI poor who are destitute, % of population			
	Inequality among the poor, 0 to 1			
	% population vulnerable to poverty (intensity between 20-33%)			
	% population in severe poverty (intensity > 50%)			
	Number of MPI poor people, thousands			
Health	Child mortality			
	Nutrition deprivation			
Education	Schooling deprivation			
	Child school attendance deprivation			
Living standards	Electricity deprivation			
	Improved sanitation deprivation			
	Drinking water deprivation			
	Flooring deprivation			
	Cooking fuel deprivation			
	Asset ownership deprivation			
World Pop Poverty	Percentage of poor people below $1.25	Admin 1 & 2	7 countries	World Pop
	Percentage of poor people below $2.00			
	Percentage of poor people that are MPI poor			
Harvest choice	Percentage of poor people below $1.90	Admin 1 & 2	25 countries (Africa only)	IFPRI
	Percentage of poor people below $3.10			

HDD Indicators- Economics and Population

Indicator Category	Indicator definitions	Unit of Analysis Admin 1 = province Admin 2 = district	Country Coverage	Source
GDP	Estimate of gross domestic product (gridded)	Admin 1 & 2	Global	UNEP GRID
Population	Estimate of number of people per grid cell	Admin 1 & 2	Global	LandScan
Health	Infant mortality rate	Admin 1 & 2		CIESIN
	Total fertility rate for the three years preceding the survey	Admin 1	81 countries	DHS
	% currently married/in union women currently using any method of contraception			
	% currently married/in union women currently using any modern method of contraception			
	Median age at first marriage among women age 25-49			
	Median age at first sexual intercourse among women age 25-49			
	% HIV positive among adult men who were tested			
	% HIV positive among adult women who were tested			
	% HIV positive among adult respondents who were tested			
	% men aged 15-49 receiving an HIV test and receiving the test results in the last 12 months			
	% women aged 15-49 receiving an HIV test and receiving the test results in the last 12 months			
	Infant mortality rate: Probability of dying before the first birthday per 1,000 live births			
	Under-five mortality rate: Probability of dying before the fifth birthday per 1,000 live births			
	% live births in the three/five years preceding the survey delivered at a health facility			
	% children 12-23 months who had received all vaccinations			
	% children born three/five years preceding the survey with diarrhea in the two weeks preceding the survey who received either ORS or RHS			
	Median duration of exclusive breastfeeding (months)			
	% children under 5 who slept under an insecticide treated net (ITN) the night before the survey			
	% children stunted (-2 SD) [WHO standard]			
	% children underweight (-2 SD) [WHO standard]			
	% children wasted (-2 SD) [WHO standard]			
	% currently married/in union women with an unmet need for family planning			
Education	% women who are literate	Admin 1	81 countries	DHS
	% women with secondary or higher education			
Standard of Living	% households with electricity	Admin 1	81 countries	DHS

Regional coverage of the monetary poverty data

AFR		EAP	ECA	LAC	MENA	SAR
Angola	Liberia	Fiji	Albania	Bolivia	Egypt	Afghanistan
Benin	Madagascar	Indonesia	Armenia	Chile	Iraq	Bangladesh
Botswana	Malawi	Lao PDR	Belarus	Colombia	Jordan	Bhutan
Burkina Faso	Mali	Philippines	Bosnia and Herzeg	Costa Rica	Lebanon	India
Burundi	Mauritania	Timor-Leste	Bulgaria	Dominican Republ	Morocco	Nepal
Cameroon	Mauritius	Vanuatu	Estonia	Ecuador	Palestina	Sri Lanka
Cape Verde	Mozambique	Vietnam	Georgia	El Salvador	Syria	
Central African Repub	Namibia		Hungary	Guatemala	Tunisia	
Chad	Niger		Kazakhstan	Haiti	Yemen	
Comoros	Nigeria		Kyrgyzstan	Honduras		
Congo	Rwanda		Latvia	Mexico		
Cote D'Ivoire	Senegal		Moldova	Panama		
Democratic Republic of Congo	Seychelles		Montenegro	Peru		
Djibouti	Sierra Leone		Poland	Venezuela		
Equatorial Guinea	Somalia		Romania			
Eritrea	South Africa		Russia			
Ethiopia	South Sudan		Slovakia			
Gabon	Sudan		Slovenia			
Gambia	Swaziland		Tajikistan			
Ghana	Tanzania					
Guinea	Togo					
Guinea-Bissau	Uganda					
Kenya	Zambia					
Lesotho	Zimbabwe					
Total	48	7	19	14	9	6

Admin-1 and admin-2

Admin-1 only