Natural Resource Management Indicators for the Least Developed Countries

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Sustainable NRM: A Three Legged Stool

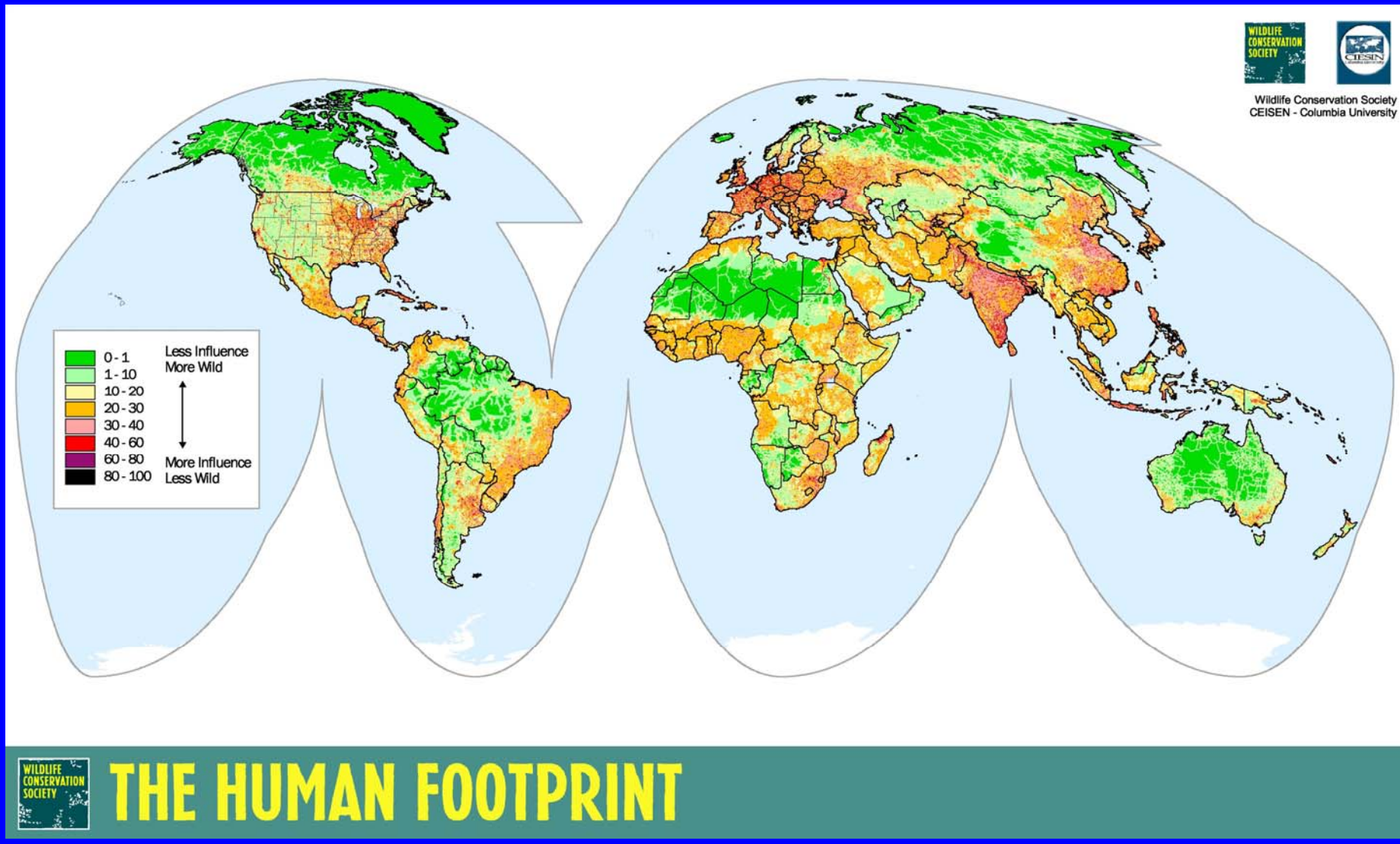
1. Biodiversity Conservation
2. Agricultural Sustainability
3. Water Use

…a focus on *outcomes* that are affected by *policies*.

Theory: For poor countries, if you get these three right, you are on the route to sustainable natural resource management.

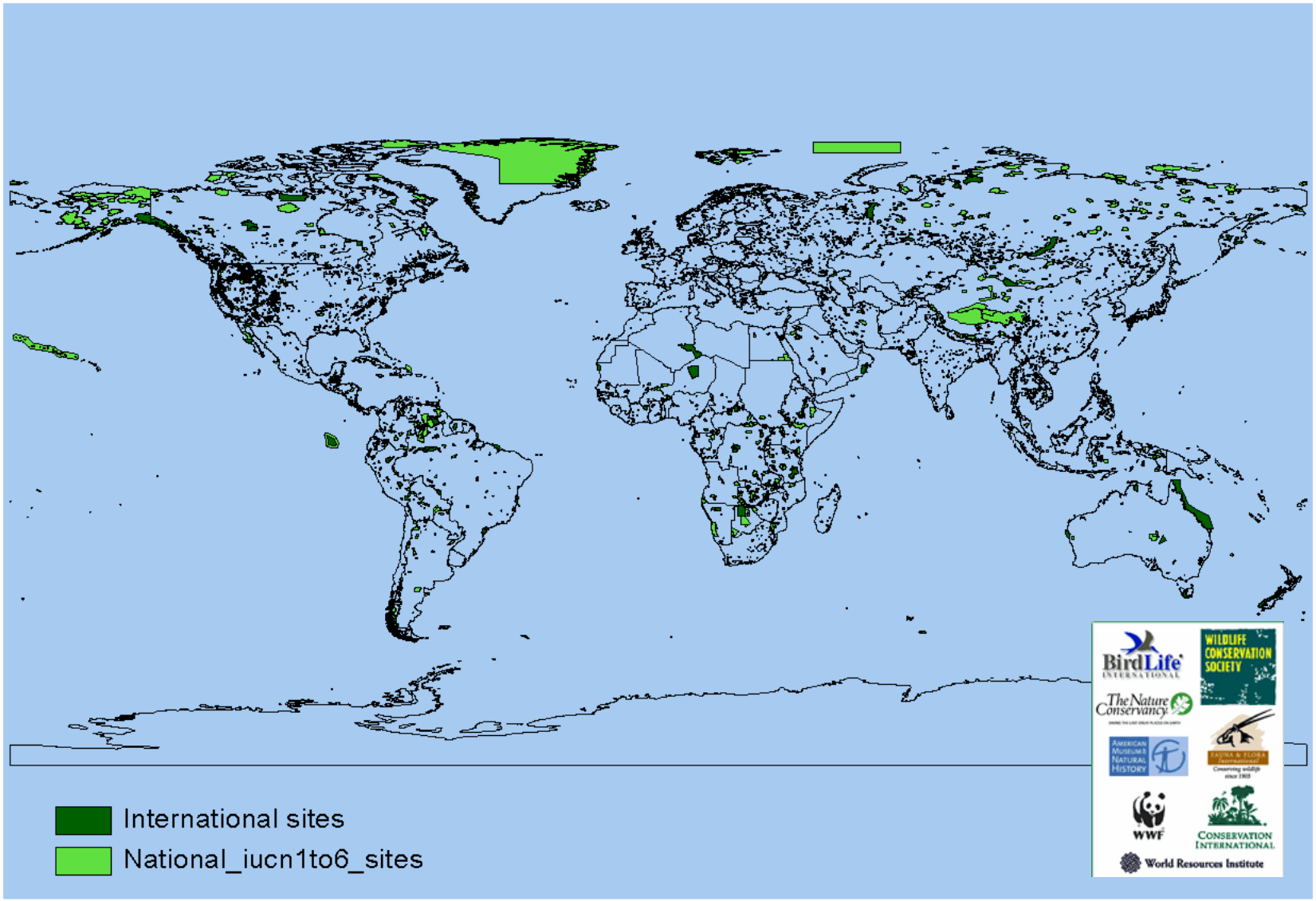
Indicator #1: Biodiversity Conservation

- **Indicator:**
  - Percentage of wilderness protected per country
- **Input data:**
  - Human Footprint Wildness Map
  - World Database of Protected Areas Map
- **Method:**
  - Overlay the WPDA on the Human Footprint Wildness
  - Measure the areas protected and unprotected
  - Calculate the percentage of wilderness protected
- **Rationale:**
  - There is a large and growing list of biodiversity indicators, but few have any direct connection to policy. Concentrating PAs in the most wild areas maximizes conservation effectiveness.

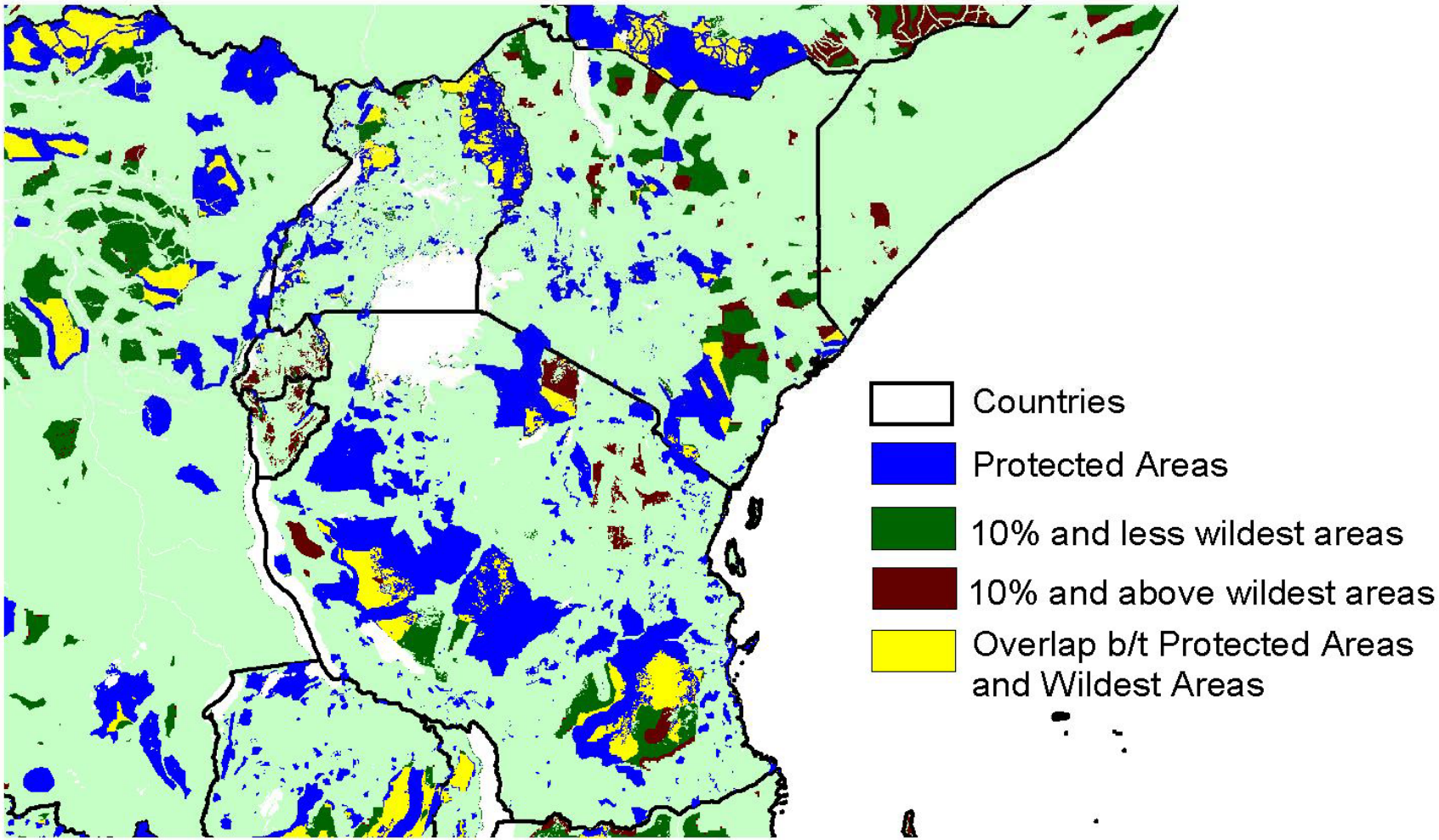


THE HUMAN FOOTPRINT

WDPA Data layers



Human Footprint - normalized by biome
The 10% and above of wildest area per country



FY04 Eligible and Threshold Nations

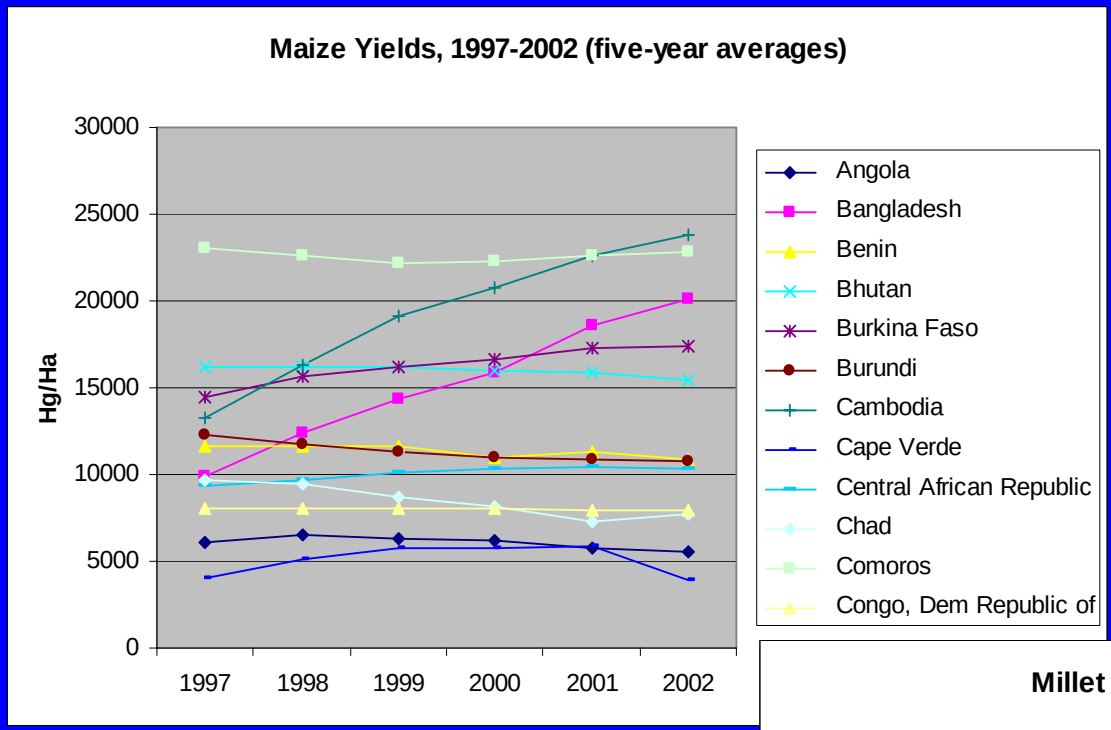
CNTRY_NAME	%10 > WILDperCNTRY	Percent Most Wild in PAs
FY2004		
ELIGIBLE		
Mongolia	14.07	45.67
Georgia	39.47	7.40
Armenia	24.42	4.11
Mali	32.24	0.00
Cape Verde	9.29	0.00
Honduras	11.89	0.99
Senegal	12.20	25.94
Nicaragua	11.07	40.79
Benin	30.30	100.64
Ghana	30.44	72.70
Sri Lanka	12.02	42.90
Mozambique	13.08	30.72
Bolivia	11.94	31.70
Madagascar	10.47	3.85
Vanuatu	9.63	0.28
Lesotho	19.29	0.53
THRESHOLD		
Albania	19.35	0.26
Yemen	12.00	0.00
Uganda	11.32	78.14
Kenya	12.24	11.82
Sao Tome & Principe	48.50	0.00
Tanzania	10.31	47.19

FY05 Eligible and Threshold Nations

CNTRY_NAME	%10 > WILDperCNTRY	Percent Most Wild in PAs
FY2005		
ELIGIBLE		
Mongolia	14.07	45.67
Georgia	39.47	7.40
Armenia	24.42	4.11
Morocco	11.71	0.00
Mali	32.24	0.00
Honduras	11.89	0.99
Senegal	12.20	25.94
Nicaragua	11.07	40.79
Benin	30.30	100.64
Ghana	30.44	72.70
Sri Lanka	12.02	42.90
Mozambique	13.08	30.72
Bolivia	11.94	31.70
Madagascar	10.47	3.85
Vanuatu	9.63	0.28
Lesotho	19.29	0.53
THRESHOLD		
Philippines	18.15	42.68
Yemen	12.00	0.00
Burkina Faso	21.81	83.14
Guyana	12.60	0.00
Uganda	11.32	78.14
Kenya	12.24	11.82
Sao Tome & Princip	48.50	0.00
Tanzania	10.31	47.19
Zambia	12.38	70.04
Malawi	9.98	80.24
Paraguay	26.98	16.99

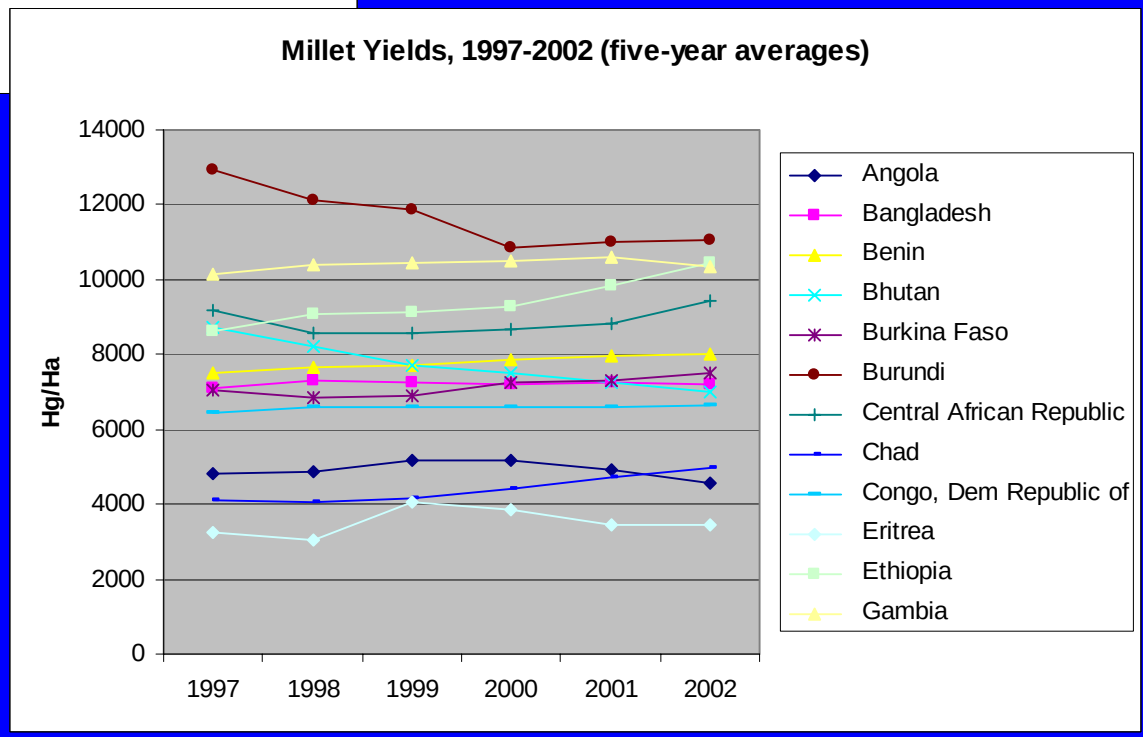
Indicator #2: Agricultural Sustainability

- **Indicator:**
  - Yield changes for subsistence crops
- **Input data:**
  - FAO's FAOSTAT
- **Method:**
  - Create an index based on changes in the five-year moving average of yields for a "basket" of subsistence crops such as millet, sorghum, and maize
- **Rationale:**
  - Agricultural experts agree that what matters most for small holder agriculturalists is yield changes. A five-year moving average smooths some of the effect of rainfall and can help to identify a secular trend in soil fertility.



Maize: Cambodia and Bangladesh have dramatically improved; Benin, Burundi and Chad have declined slightly

Millet: Ethiopia and Chad have improved; Burundi and Bhutan have declined

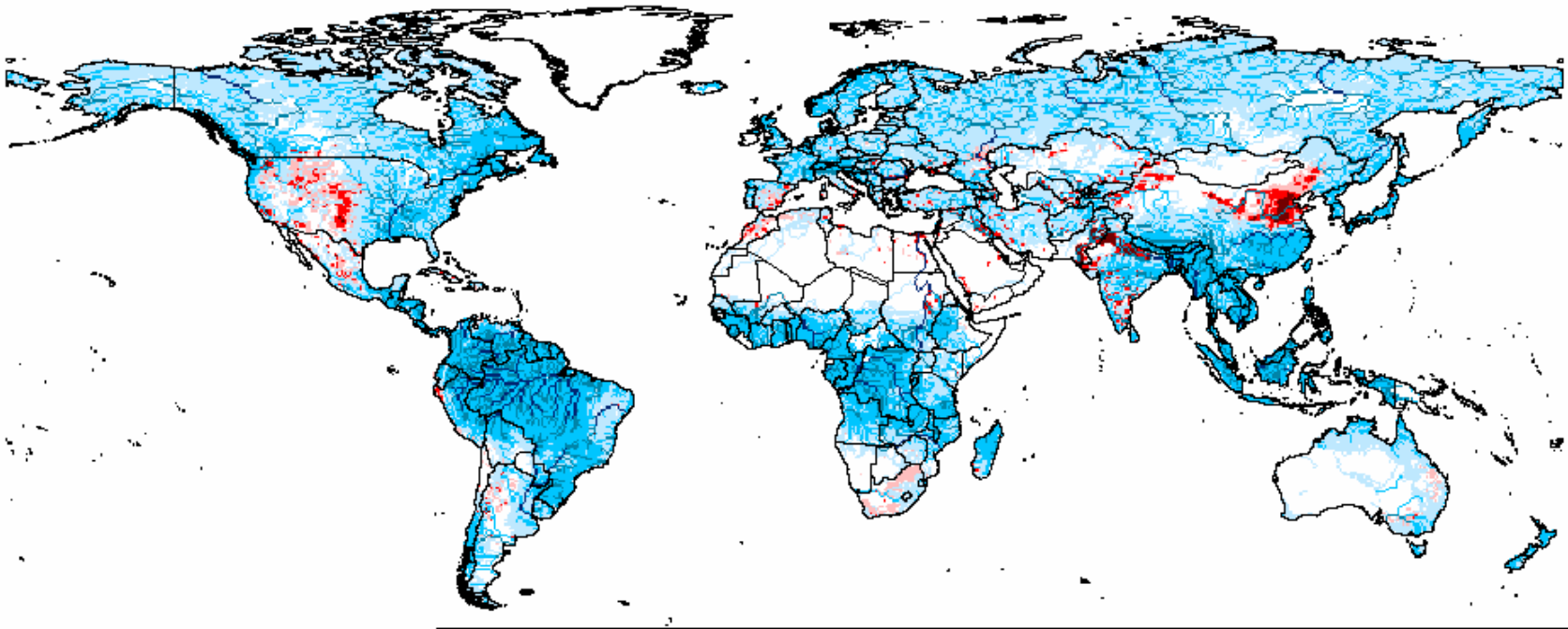


Indicator #3: Water Use

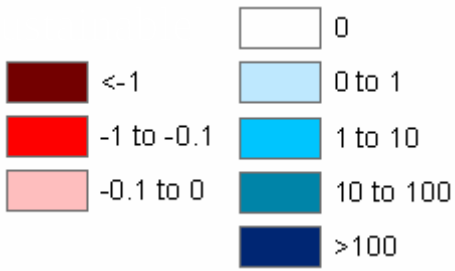
- **Indicator:**
  - Percent of irrigation based on non-renewable water resources
- **Input data:**
  - University of New Hampshire discharge fields (Q)
  - FAO irrigation withdrawals (AG)

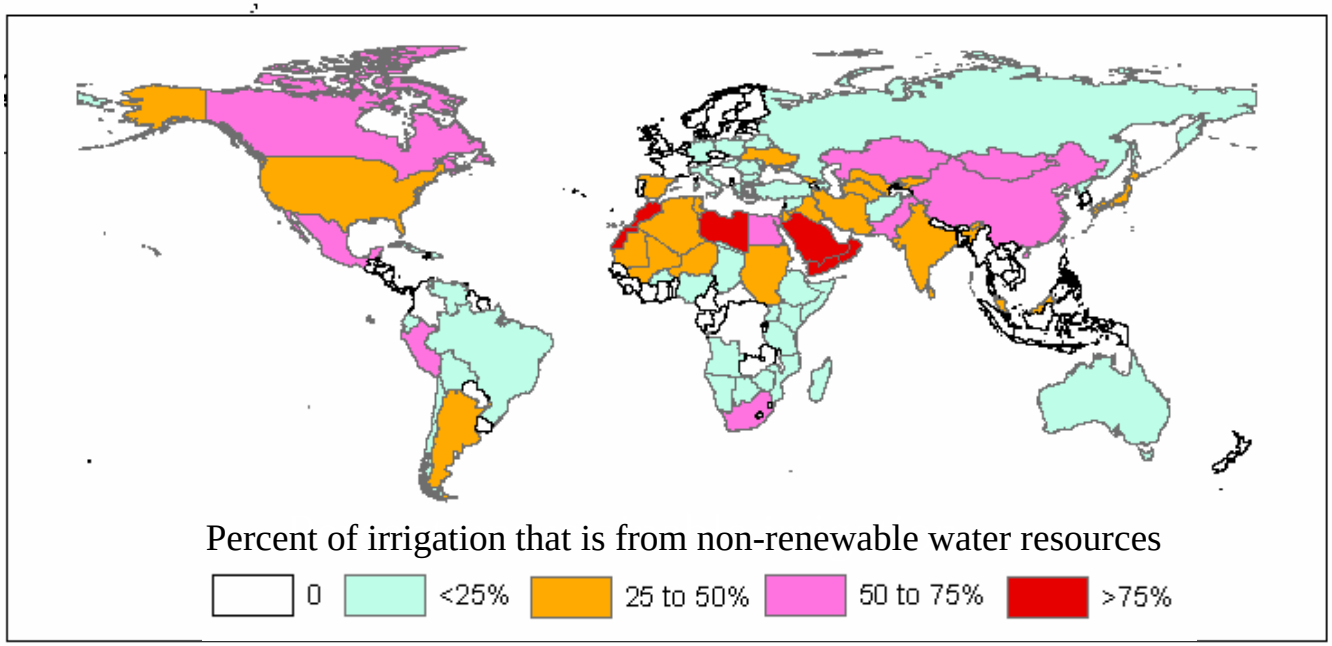
Indicator #3: Water Use

- **Method:**
  - Country-level irrigation withdrawals are geospatially-distributed over irrigated areas (Siebert and Döll, 2001) based on irrigation need
  - Irrigation need = Potential ET (representing crop water demand) – actual ET (limited by available soil moisture)
  - Non-sustainable Irrigation Use = Mean annual discharge (Q) minus irrigation water withdrawals (Ag)
- **Rationale:**
  - The agricultural sector is the single largest water user. Non-renewable irrigation undermines the future ability to meet water needs for all sectors.



Non-renewable Irrigation (km^3)





Country	Percent
Saudi Arabia	99.94
Yemen	99.94
Oman	95.38
Libyan Arab Jamahiriya	83.25
Morocco	80.54
China	70.53
Canada	63.34
Mexico	60.03
Mongolia	55.26
Peru	54.99
Pakistan	54.21
South Africa	53.07
Egypt	52.04
Kazakhstan	50.51
Ukraine	47.46
Mauritania	45.60
United States of America	45.33
Sudan	45.14
India	40.05
Gaza Strip (Palestine)	38.18
Uzbekistan	36.97
Jordan	35.34
Turkmenistan	34.15
Argentina	32.72
Kyrgyzstan	32.48
Mali	32.42
Niger	31.76
Japan	30.53
Iran, Islamic Rep of	30.25
Iraq	28.39
Georgia	28.28
Algeria	27.45
Tunisia	27.23
Spain	27.08
Sri Lanka	26.40
Malaysia	25.54
Italy	24.98
Chad	24.93
Syrian Arab Republic	23.13
Afghanistan	21.00
Turkey	20.81
Azerbaijan, Republic of	20.72
Botswana	18.38
Russian Federation	17.06
Poland	16.45
Somalia	16.37
Namibia	15.39
Australia	14.97
Angola	14.72
Bolivia	14.64
Cuba	14.13
Romania	13.30
Kenya	12.74
Hungary	11.35
Madagascar	11.02
Bulgaria	10.65
Korea, Dem People's Rep	9.60
Brazil	8.13
Venezuela, Boliv Rep of	7.07
Belarus	5.27
Chile	4.93
Ecuador	4.58
Germany	4.41
Mozambique	4.14
Dominican Republic	4.12
Ethiopia	4.12
Greece	3.29
Tanzania, United Rep of	2.57
Burkina Faso	2.51
Zimbabwe	1.64
Uganda	1.07
Nigeria	0.67
Moldova, Republic of	0.49

Countries below zero not included in this table.

Conclusions

- Data availability on NRM for the least developed countries is a real challenge
- Geospatial data sets based on simple models are perhaps the best bet for getting broader country coverage
- All proposed indicators have time series data – though the non-renewable irrigation data are under development
- All the measures proposed here are policy mutable and highly relevant to the NRM issues confronting the least developed countries