Presentation from

2016 World Water Week in Stockholm

www.worldwaterweek.org

African Water Security

The temptation of infrastructure and its tradeoffs

Charles J. Vörösmarty

Director, Environmental CrossRoads Initiative & Professor of Civil Engineering

City University of New York

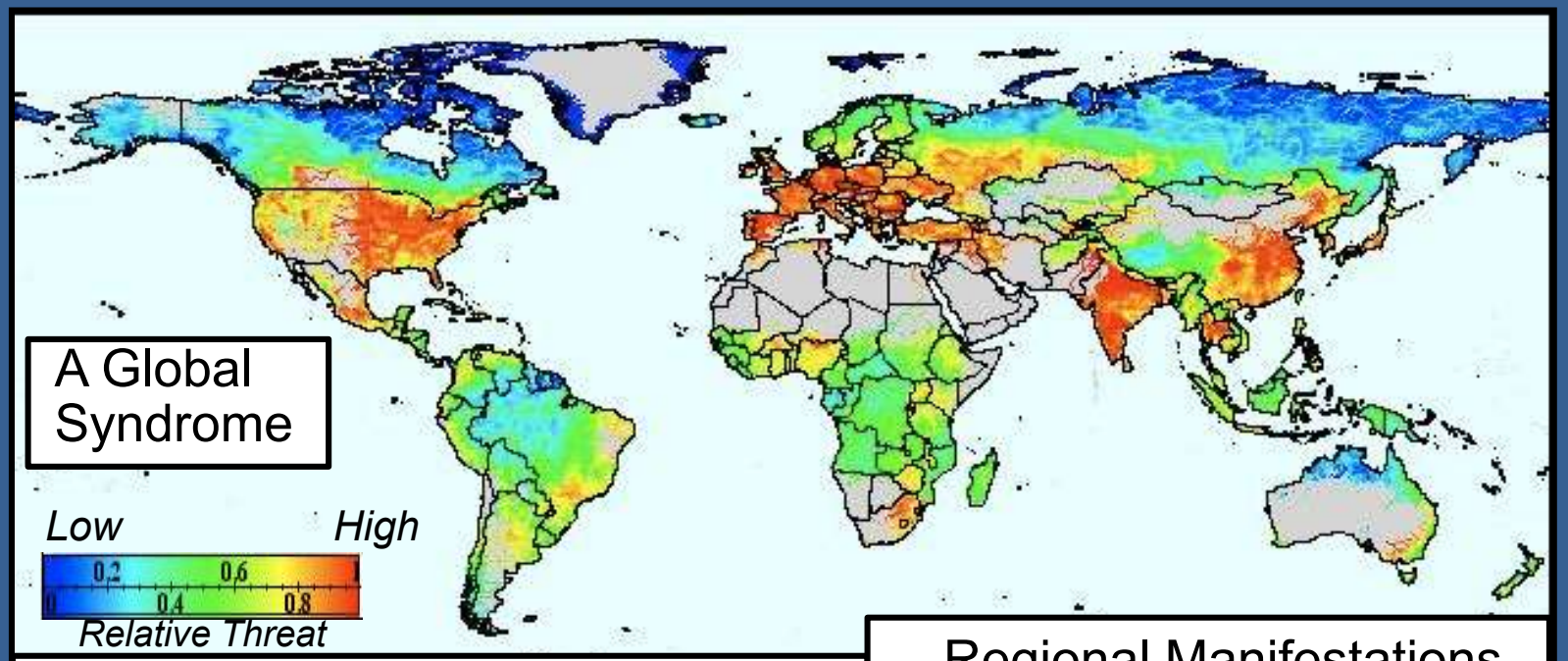
....with B. Fekete, F. Corsi, P. Green, B. Stewart-Koster and many others

Malin Falkenmark Symposium

A Triple Green Future for Humanity

28 August 2016 Stockholm SWEDEN

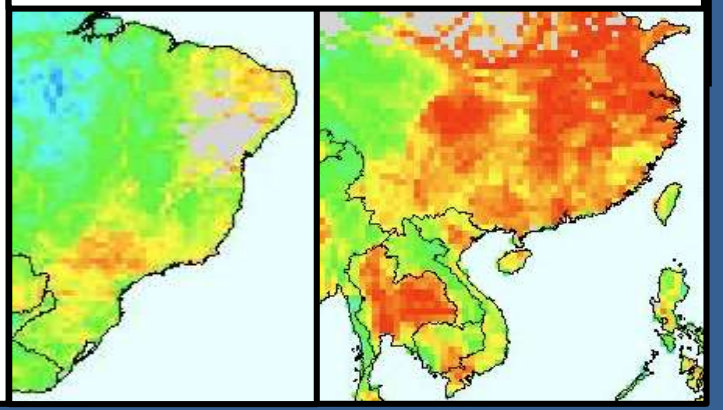
The Present: Local Threats Accumulate over Global Domain



Threat arises from a flood of unintended and unrecognized human actions

- Poor land & watershed management
- Pollution
- Maladaptive water management
- Biotic stress agents

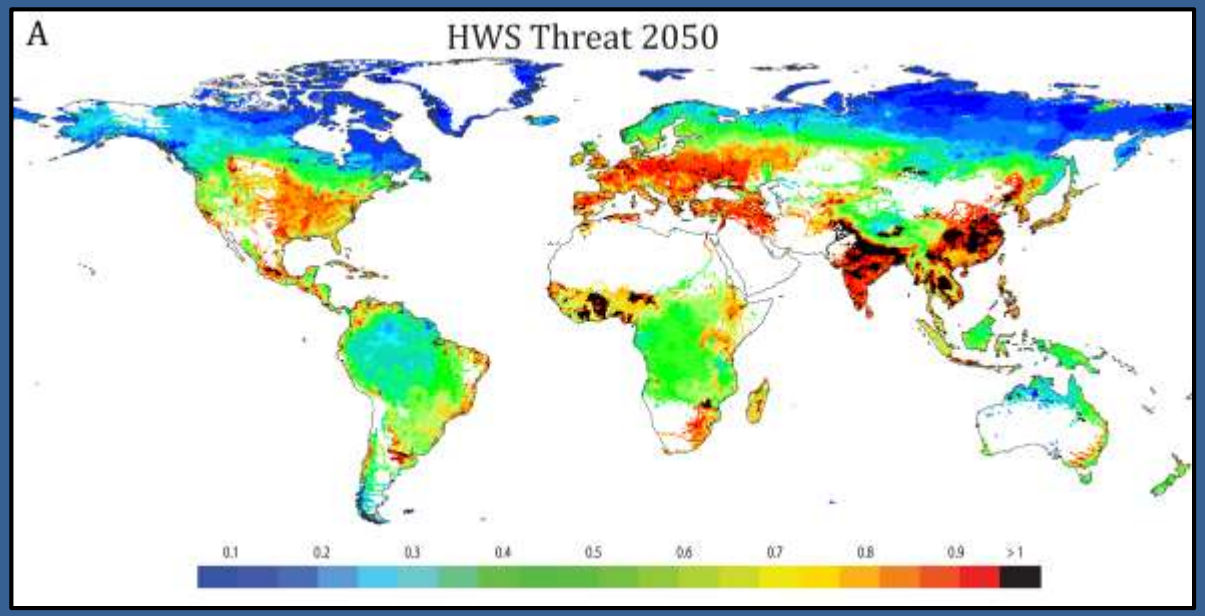
Regional Manifestations



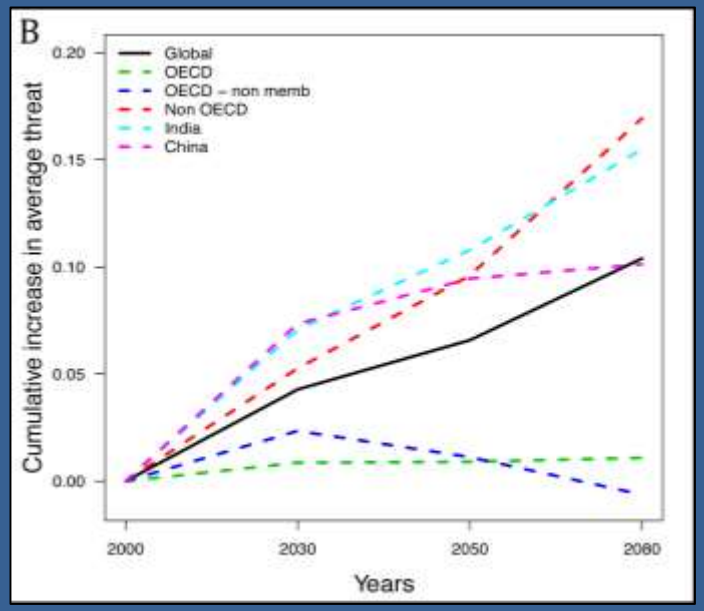
Little evidence for broad adoption of integrated water management strategies…*even in rich countries*

From: Vörösmarty et al. (2010), Nature

The Future: Threats Continue to Mount



- IPCC AR-5 Scenario SSP-2/RCP-6.0 *(middle of the road)*
- Intensification apparent over extensification



- Threat containment across OECD
- Development-linked threat rises in China, India, rapidly emerging middle class, and with least wealthy--Africa

From: Vörösmarty et al. (2016), in prep.

State of Human Water Security

People Served by Renewable Riverine Water Sources

Volumetric Water Services →

Impair

82% served by high threat resource systems

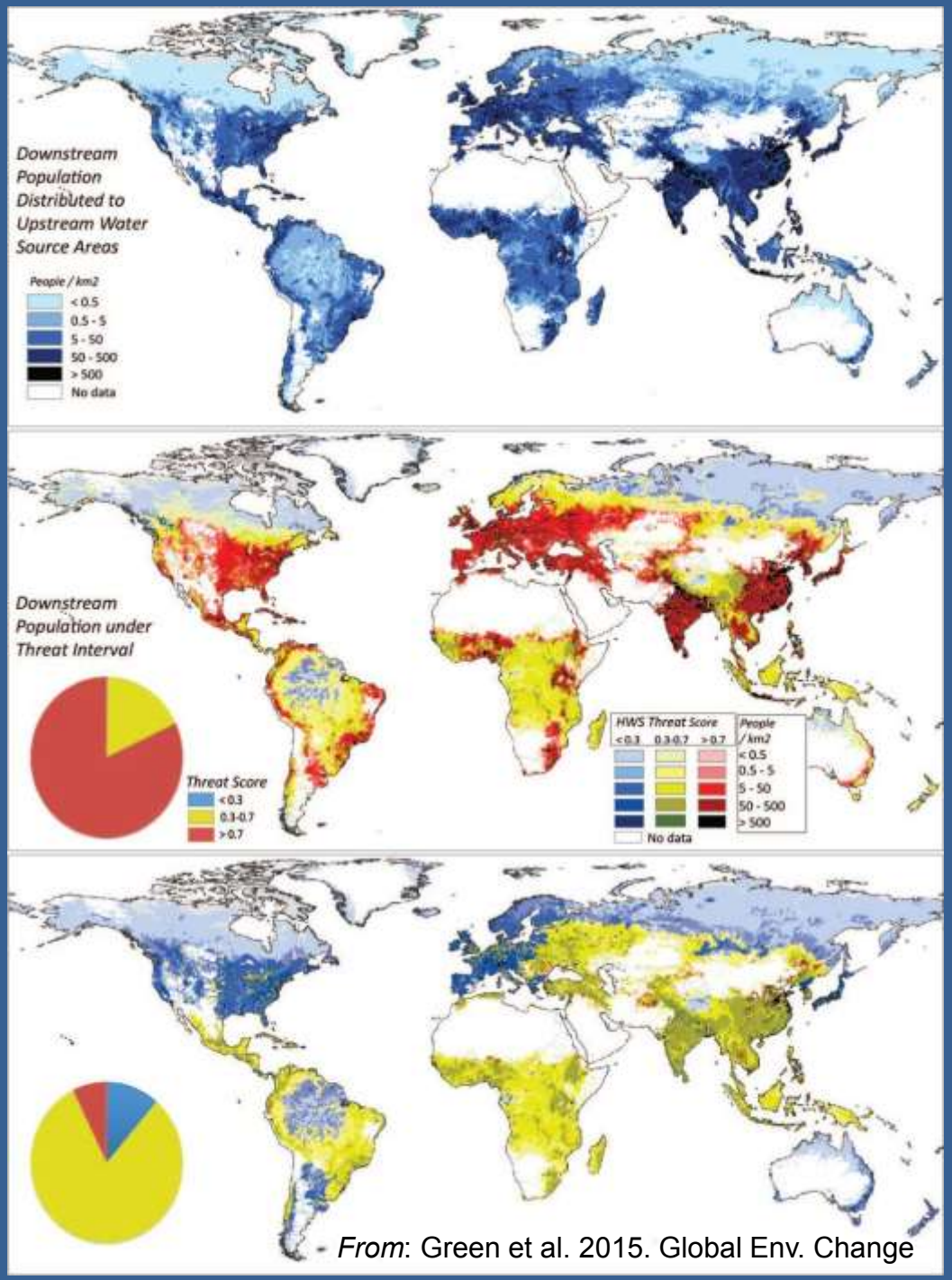
Incident Threat Condition →

$0.75 Tr per yr

Repair

Reduced Threat after Remediation at "Point-of-Serivce" →

80% live downstream of moderate threats

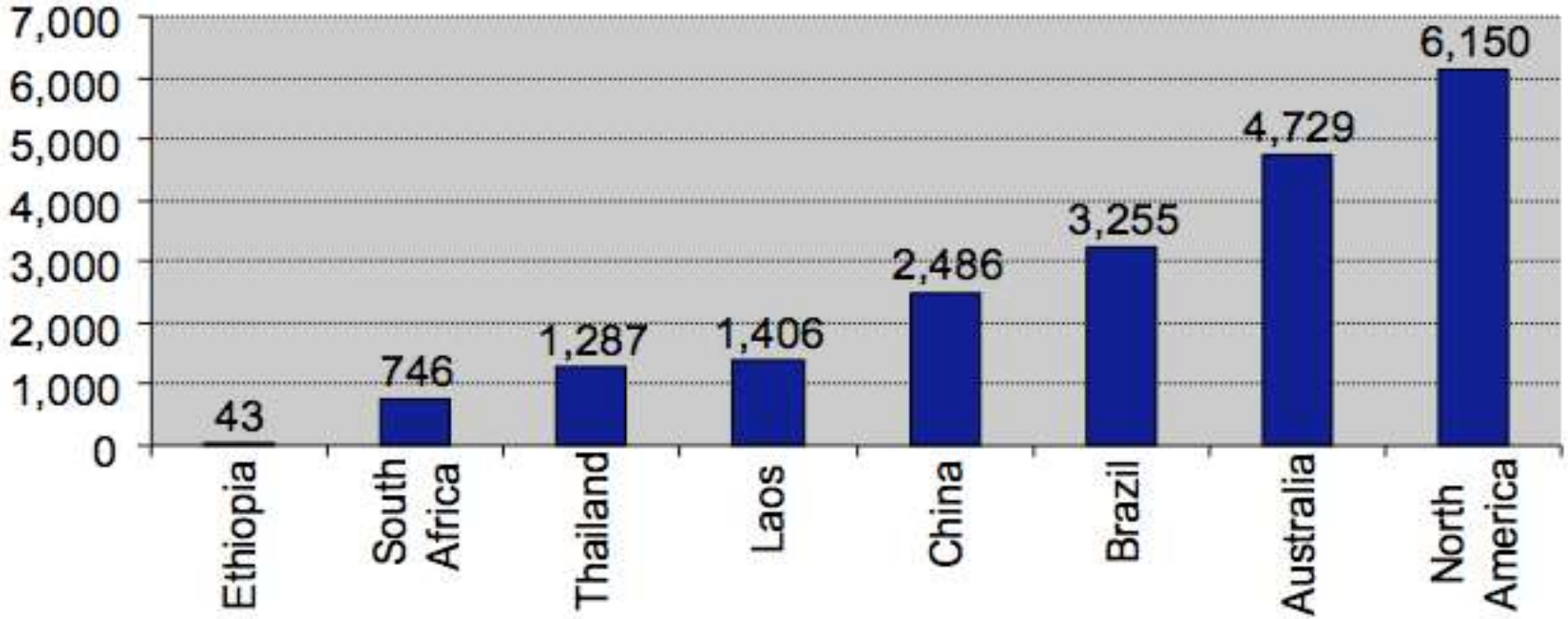


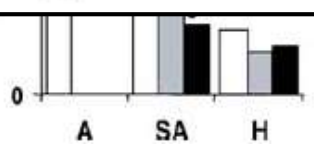
From: Green et al. 2015. Global Env. Change

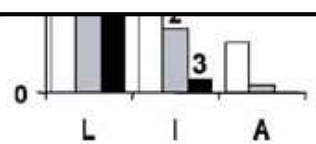
TEMPTATION WILL BE HIGH FOR FUTURE INVESTMENTS IN HARD PATH INFRASTRUCTURE

Infrastructure gap: Reservoir water storage

Haves and Have-Nots: Water storage per person (m3)





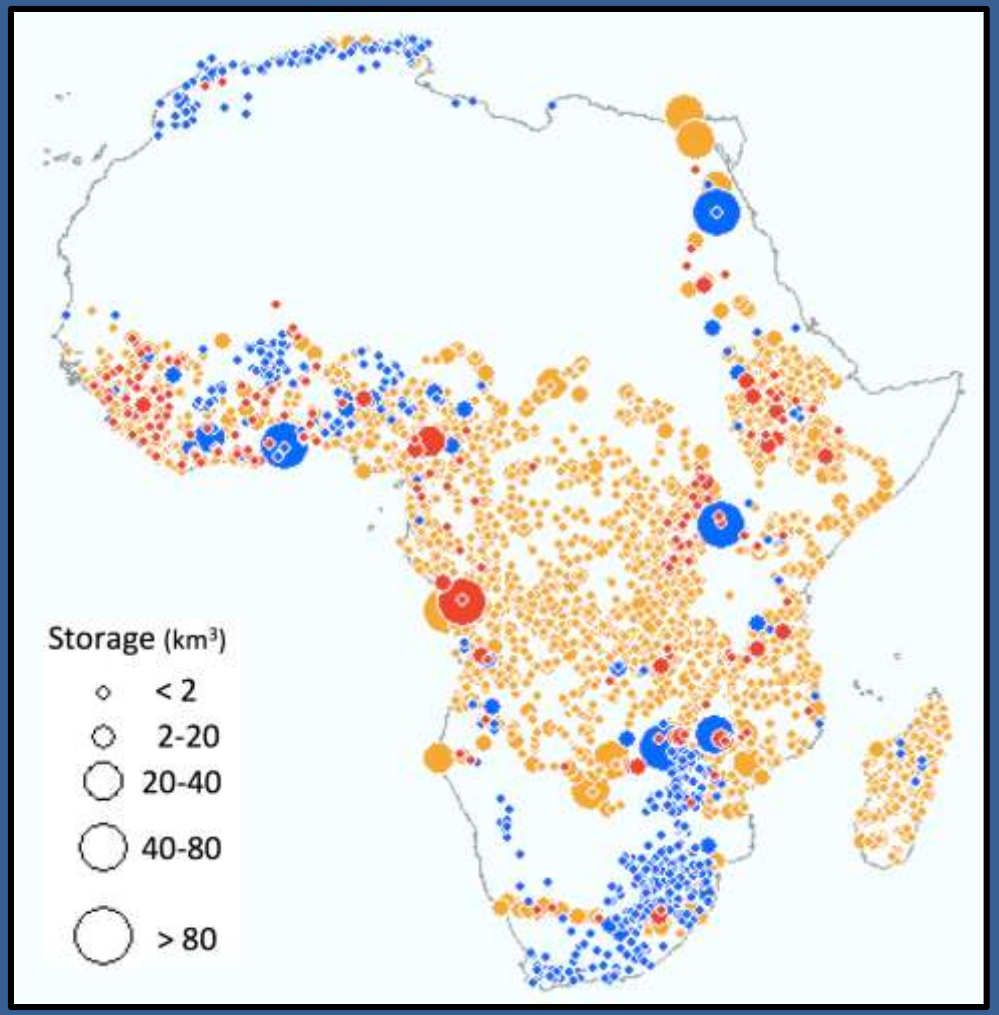


From: Vörösmarty et al. (2005) Ambio

The Temptation of Hydropower

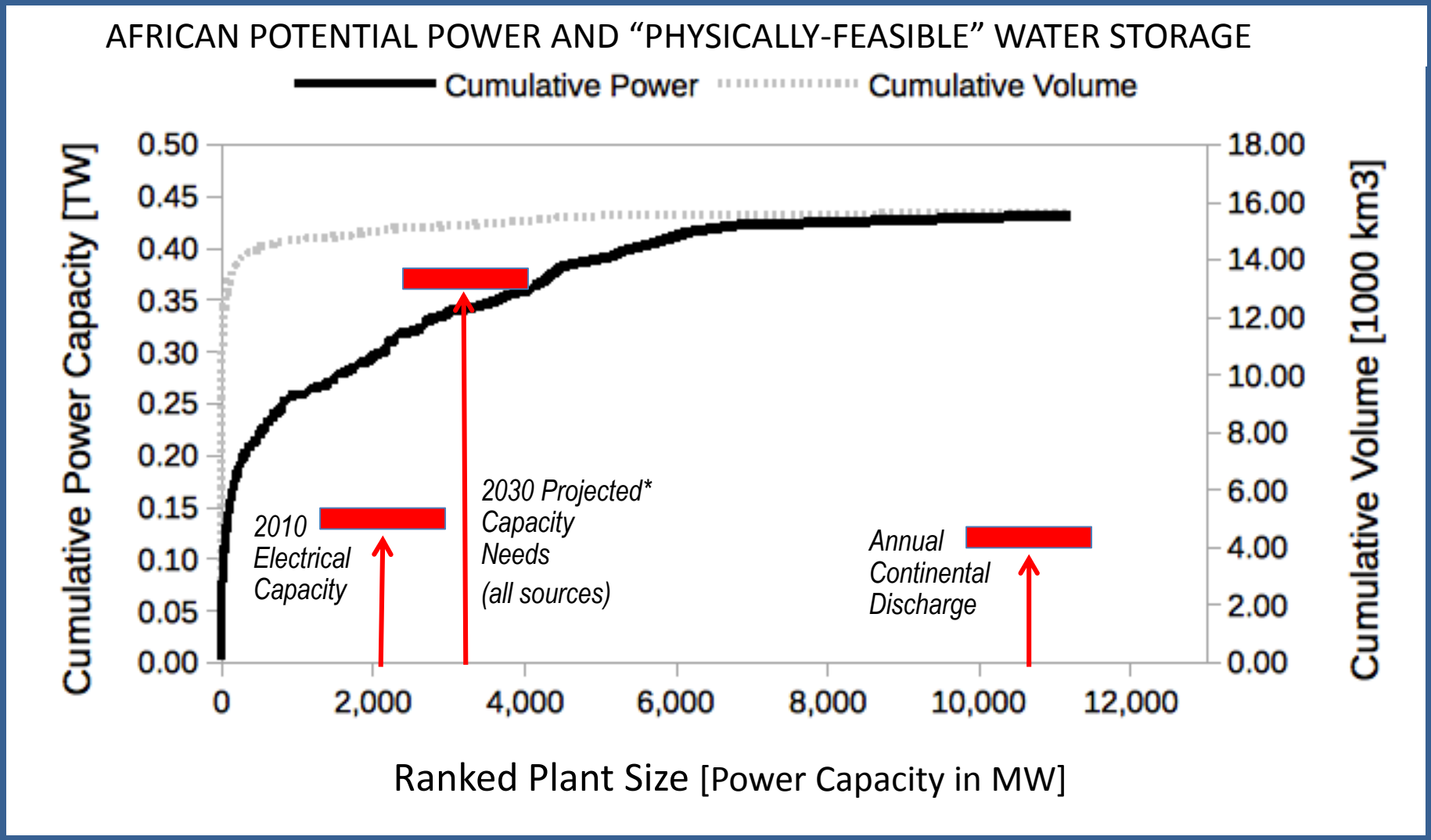
Substantial "Head-Space" for Dam & Reservoir Construction in Africa

Dams are emblematic of potential investments in hard-path water engineering works more generally



Source Zarfl et al. 2014, Lehner et al. 2011

The Temptation of Hydropower



*Africa Energy Outlook (2014) / Int'l Energy Agency

The Water Debates: Summer 2015

Particularly relevant to the SDGs and the palpable "tension" as the water targets were formulated

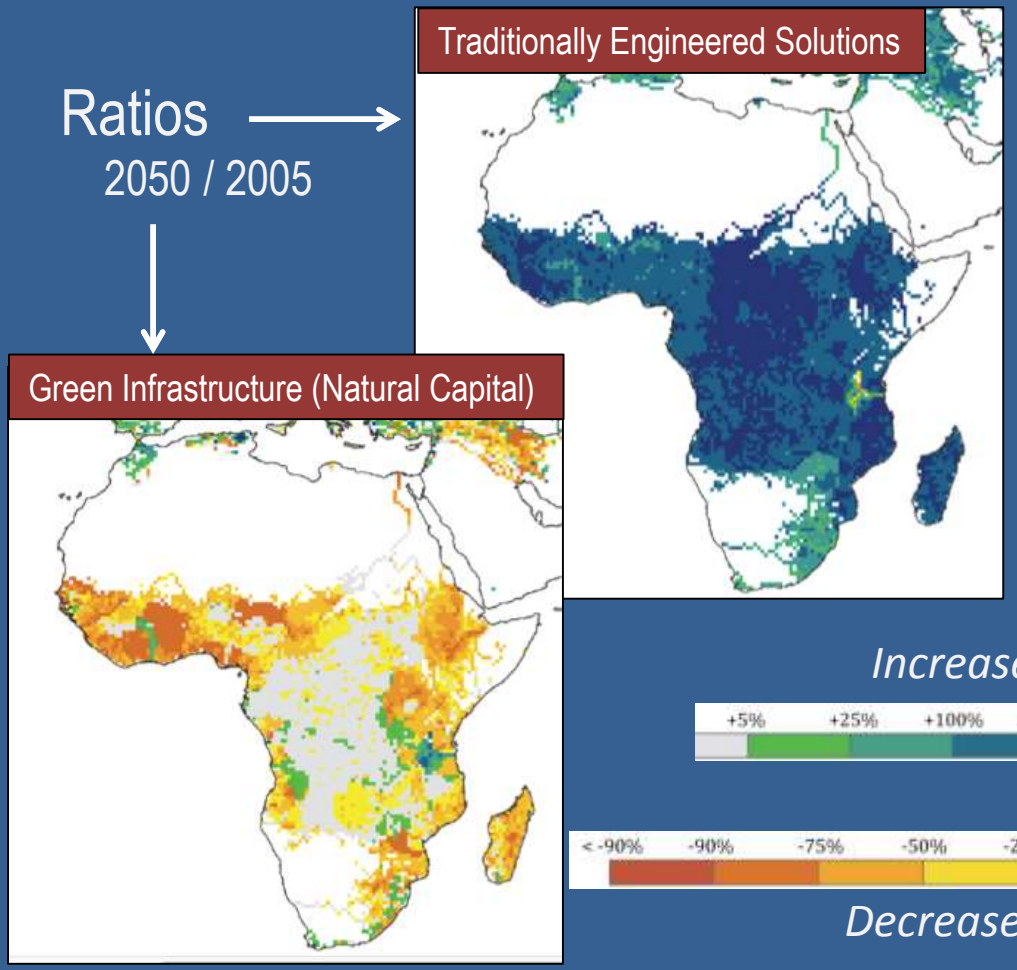
WATER

Water security: Gray or green?

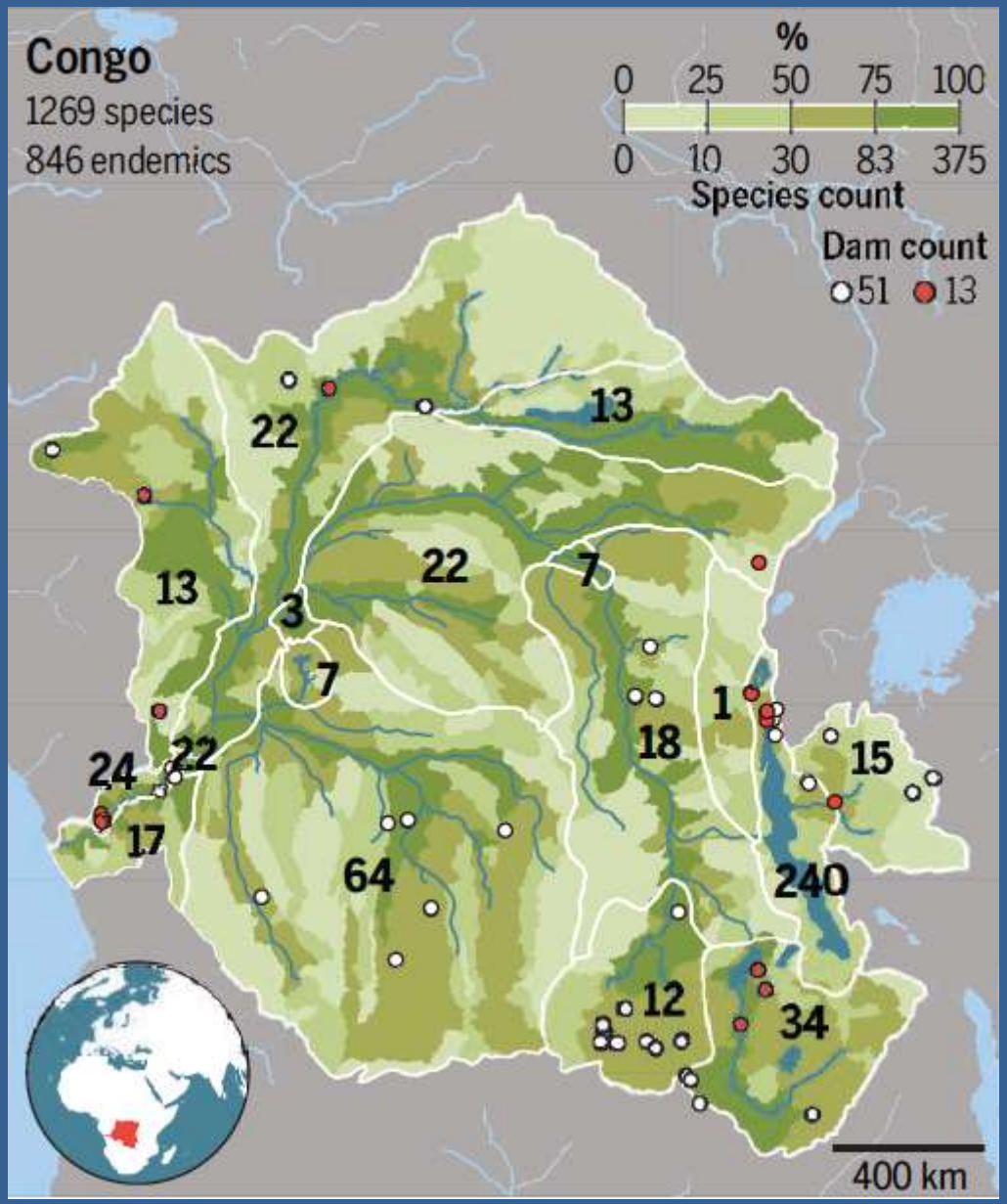
Attaining Human Water Security under SSP-2 Trajectories

- Continued, heavy reliance on hard path *(costly but effective)* w/ losses of natural capital
- Value of traditional engineering & natural capital comparable (~$85B vs $70B per yr in 2050)
- Loss of NC will increase costs of attaining human water security

Ratios
2050 / 2005



From: Vörösmarty et al. (2016), in prep.



ONE IMPORTANT TRADEOFF

Biodiversity Loss

- *Freshwater ecosystems are a BD Hotspot*
- *BD loss likely the greatest breach of any safe operating space for the planet*
- *Hard path engineering unequivocally stresses aquatic ecosystems & BD*
- *Losses of associated environmental services > benefits of energy?*

From: Winemiller et al. (2016) Science; Mace et al. (2014) Global Env. Change

CONCLUSONS

- Africa already “ground-zero” for human water security
- Economic growth will create threats to inland waters-- pressure to invest in traditional engineering high
- Hard-path engineering in sub-Saharan Africa: undeniable benefits, but (a) is costly & a pathway to indebtedness and (b) compromises ecosystems & is a lost opportunity for cost-effective natural capital-based management
- Africa has large untapped potential of natural capital to manage its water stress, but strategies to use this resource need to be developed, tested and incentivized

Additional information at:

- *www.water-future.org*
- *asrc.cuny.edu*
- *www.gwsp.org*

The Water Debates: 31 July, 7 August, 14 August 2015 issues of Science

River Threat/Impair-then-Repair: Vörösmarty et al. and Palmer (Sept. 30, 2010 issue of Nature) and Vörösmarty et al. (July 2015 issue of Daedalus)

Human and Ecosystem Security Mapping: Green, P.A., C.J. Vörösmarty, et al. 2015, Global Environmental Change; Harrison et al. 2016, Aquatic Conservation: Marine and Freshwater Ecosystems