Water & Sanitation – The Global Challenge / the OU (OK) Response

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School of Civil Engineering and Environmental Science

WaTER WaTER.ou.edu
Water Technologies for Emerging Regions
"Water and Sanitation for All"

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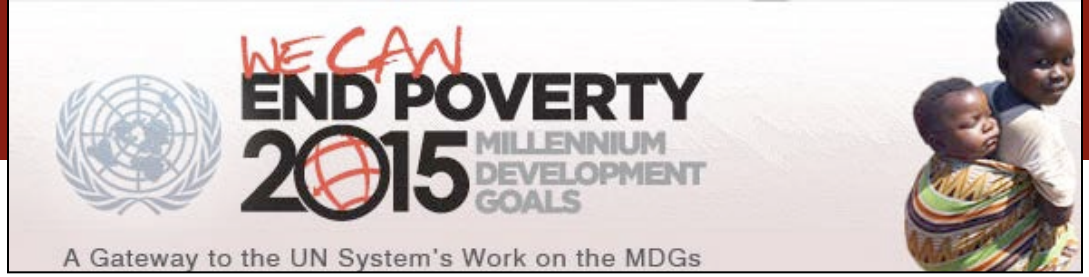


Global Water/Sanitation

- ~ 748 million people lack access to an improved source of drinking water
- ~ 2.5 billion people without improved sanitation
- ~ 2 million deaths a year (a child every 15 seconds) – comparable to AIDS/malaria
- 1.2 billion people survive on less than $1US per day; poorest pay most for safe water

On September 11, 2001

- An estimated 5000 children died from diarrheal disease

- September 12
  - An estimated
    disease
- September 13
  - An estimated
    disease
- Since Septem
  children have

Dr. Steve Luby – inaug

- Kevin Carter won the Pulitzer Prize

The Millennium Development Goals

Eight Goals for 2015

Eradicate extreme poverty and hunger

Achieve universal primary education

Promote gender equality and empower women

Reduce child mortality

Improve maternal health

Combat HIV/AIDS, malaria and other diseases

Ensure environmental sustainability

Develop a global partnership for development

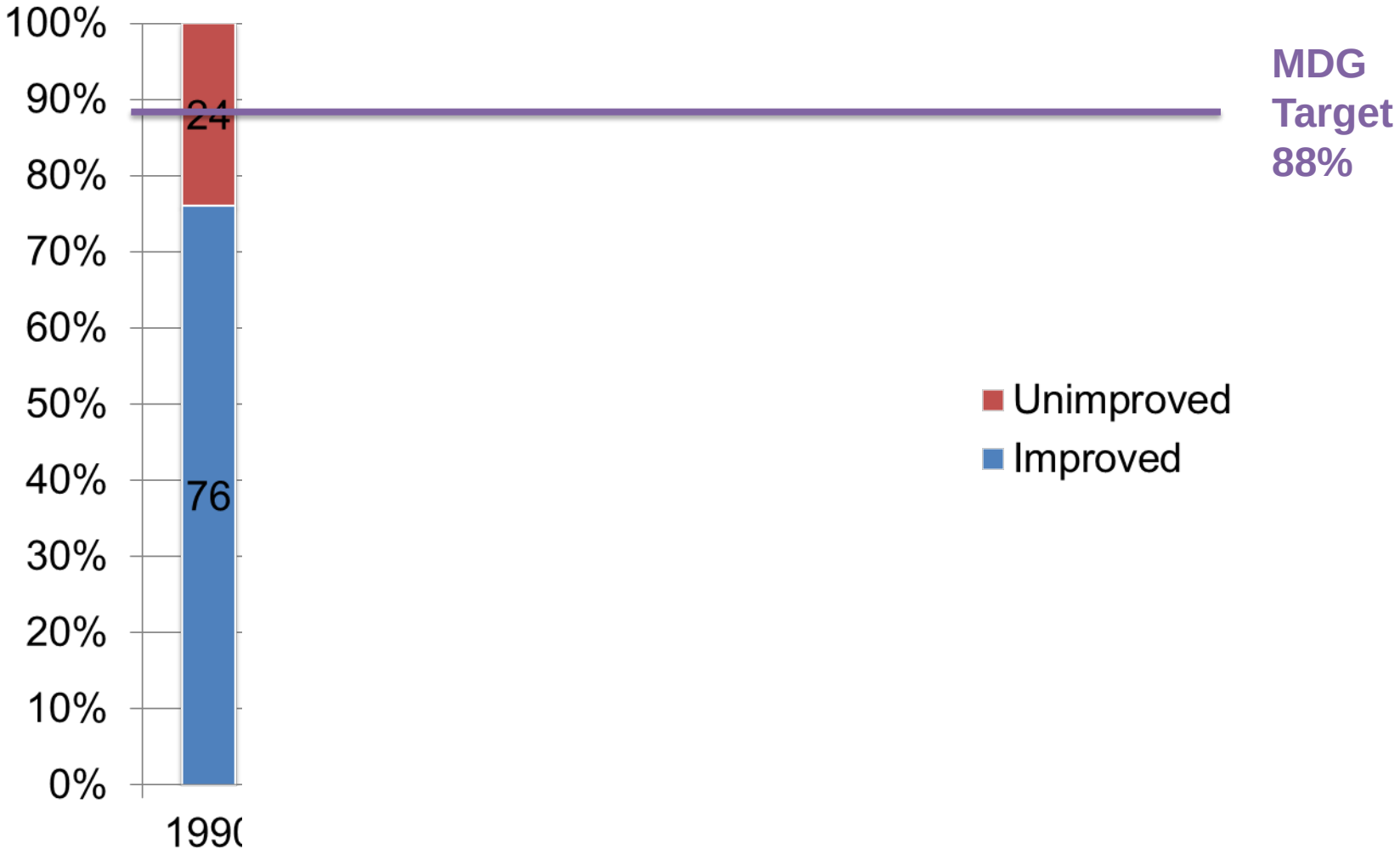
http://www.un.org/millenniumgoals/

MDG 7: Target 10

- Target 10: Halve, by 2015, the proportion of people without sustainable access to an improved drinking water source and basic sanitation

Access to an Improved Water Source

MDG Target: EXCEEDED!!!



WATER ACCESS 2012

- 89% of the global population now has access to an improved water source, but …
- 11% of the global population does not have access to an improved source
- 11% ~ **748 million** people lack access to an improved water source
- How define access? Does improved mean safe?
- Estimated that ~1 B consume unsafe water from an improved source
- Post 2015 – from MDGs to SDGs (sustainable) – from improved to **safe** water

What do we mean by “ACCESS”?

- Some possible definitions:
  - Within 20 minutes of the home
  - Within 1 kilometer of the home
  - Providing at least 20 L of water per person per day
- Based on surveys – often self reported.

Q1. What is the main source of drinking-water for members of your household?	
Piped water into dwelling	>>Q4
Piped water to yard/plot	>>Q4
Public tap/standpipe	>>Q2
Tubewell/borehole	>>Q2
Protected dug well	>>Q2
Unprotected dug well	>>Q2
Protected spring	>>Q2
Unprotected spring	>>Q2
Rainwater collection	>>Q2
Bottled water	>>Q1A
Cart with small tank/drum	>>Q2
Tanker-truck	>>Q2
Surface water (river, dam, lake, pond, stream, canal, irrigation channels)	>>Q2
Other (specify)	>>Q2

Water Supply: Improved vs. Unimproved

Global Access Improved Water

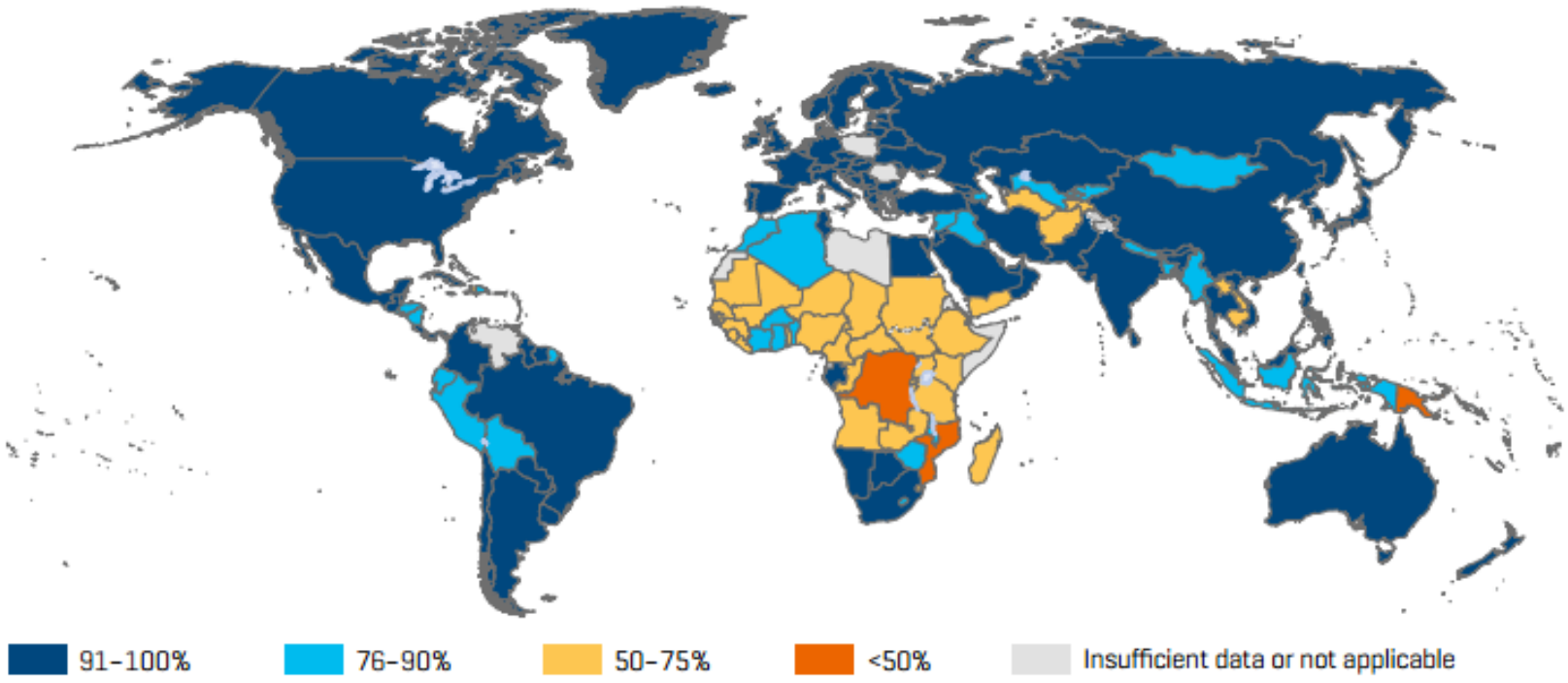
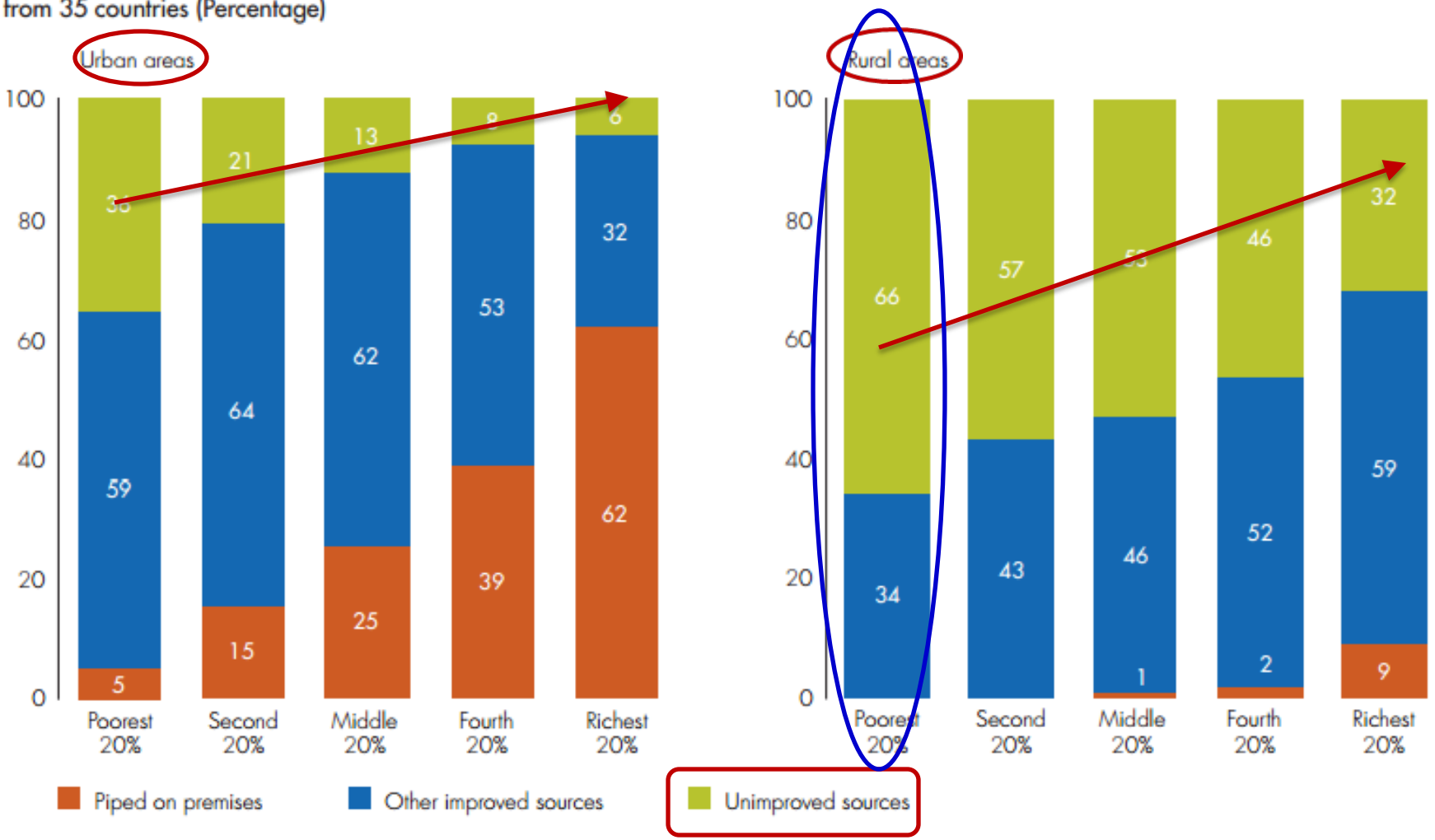


Fig. 3. Proportion of the population using improved drinking water sources in 2012

Rural Poor – Lowest Access

Poorer people in sub-Saharan Africa are at a disadvantage in access to drinking water

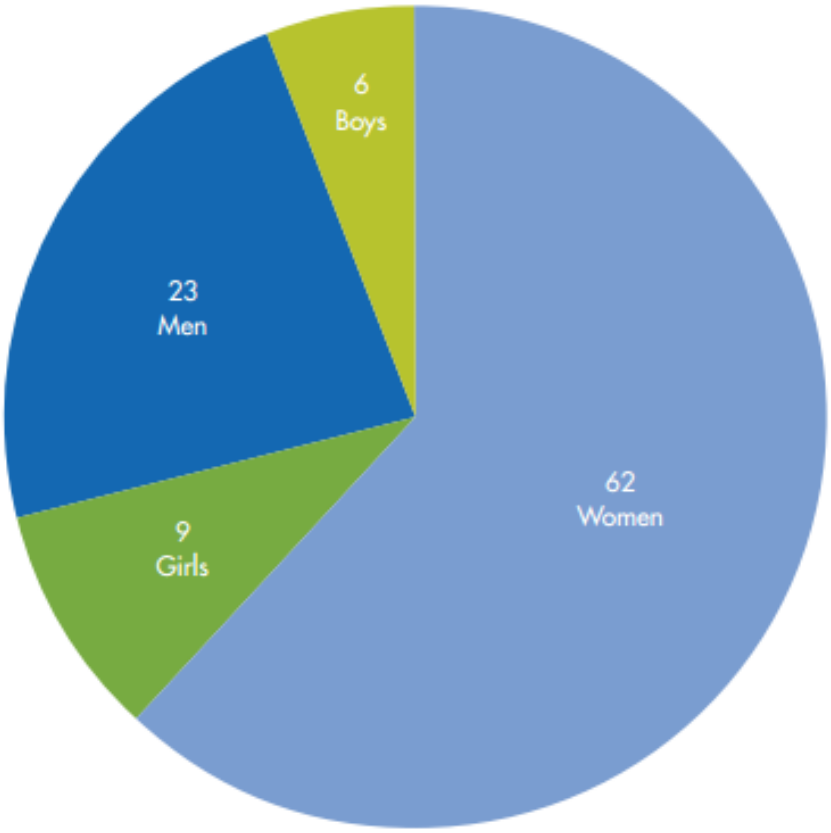
Drinking water coverage by wealth quintiles, urban and rural residence, sub-Saharan Africa, based on population-weighted averages from 35 countries (Percentage)



Gender Inequality

Women bear the main burden for collecting water in sub-Saharan Africa

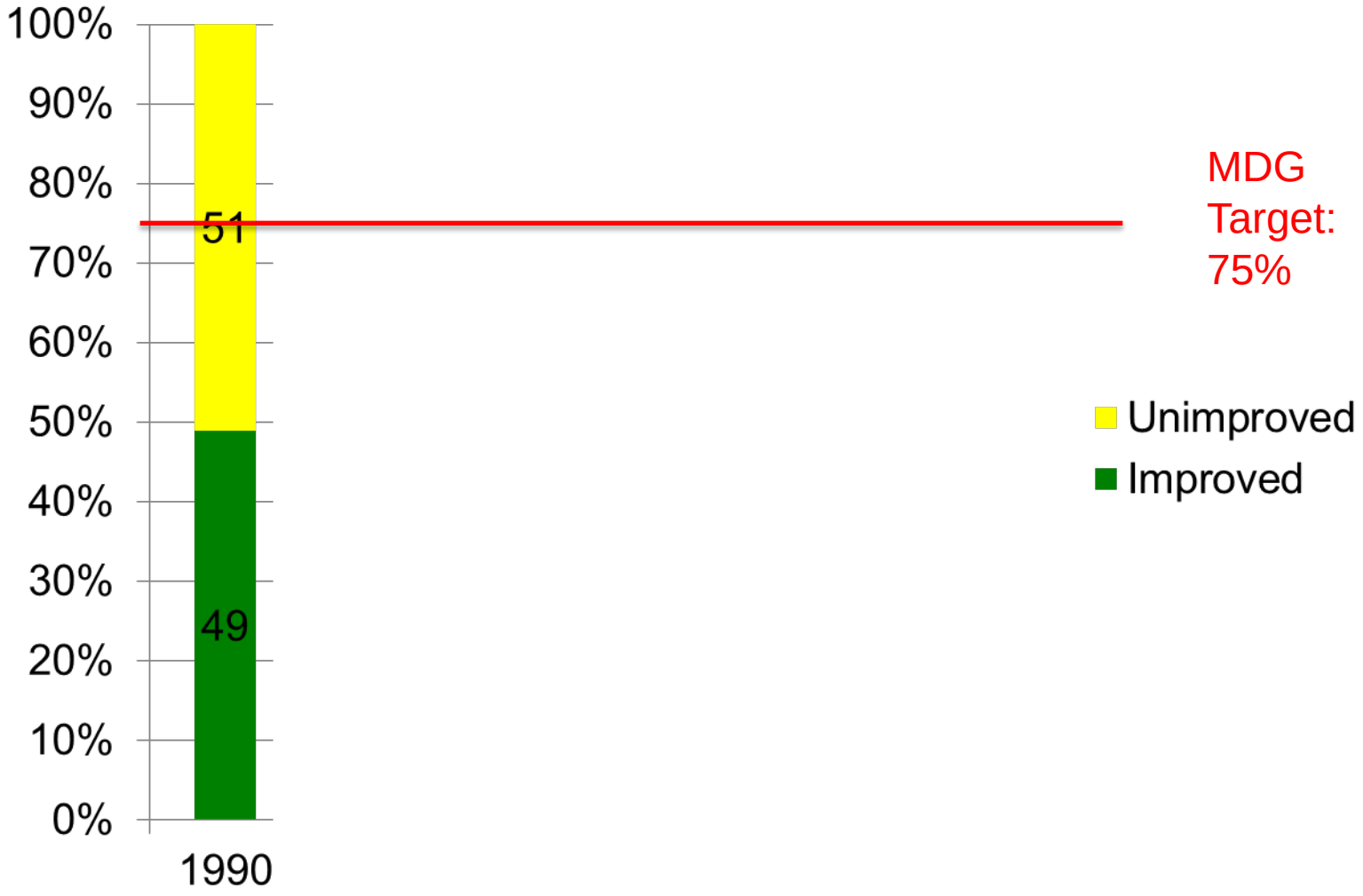
Distribution of the water collection burden among women, children under age 15 and men, in households without piped water on premises, sub-Saharan Africa, based on population-weighted averages from 25 countries, 2006/2009 (Percentage)



- > 70% by females
- 26 M hours per day

Sanitation Access

MDG Target: Missed by 8%!!!



Sanitation: Improved vs. Unimproved

SANITATION COVERAGE 2011

- 64% of the world's population uses improved sanitation
- 36% uses unimproved sanitation and/or practices open defecation
- 36% = **2.5 BILLION** people

Global Sanitation Coverage

There are 46 countries where less than half the population has access to an improved sanitation facility

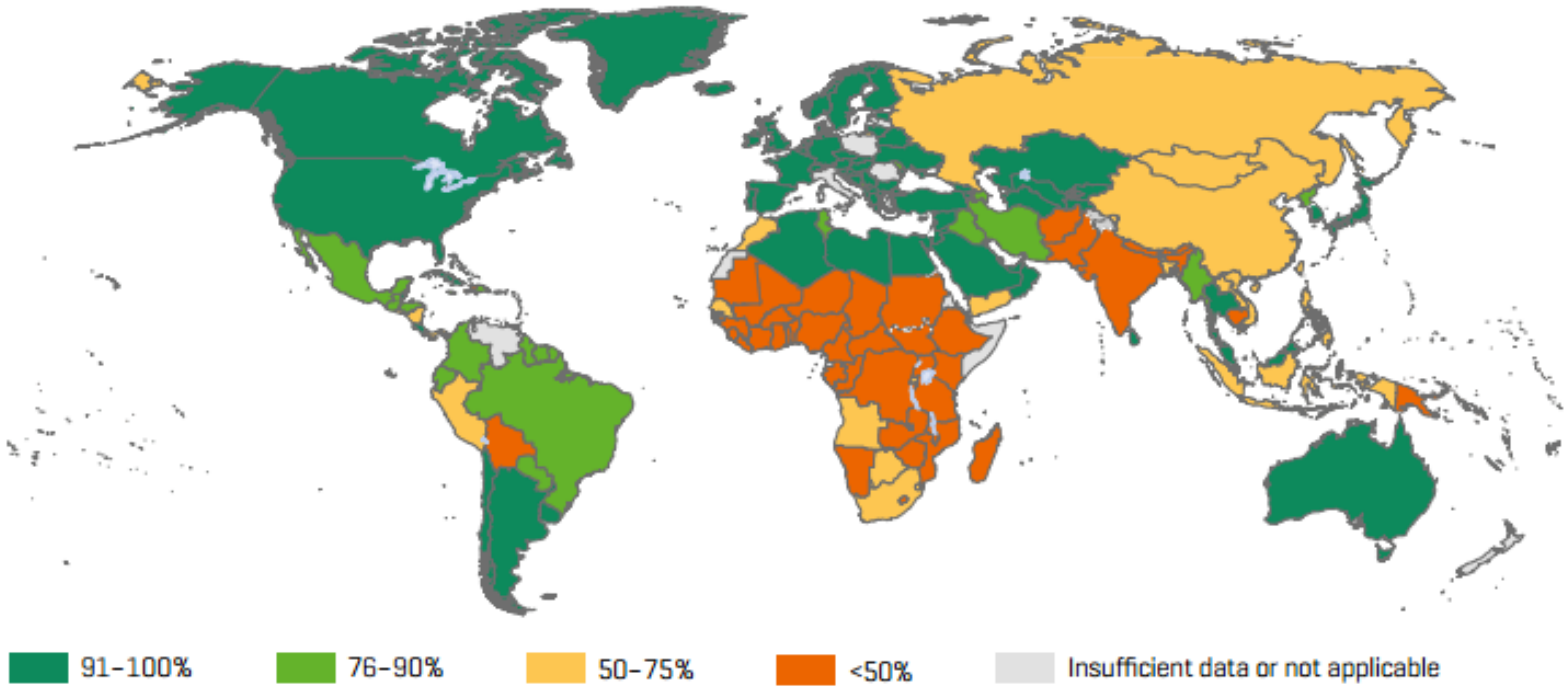
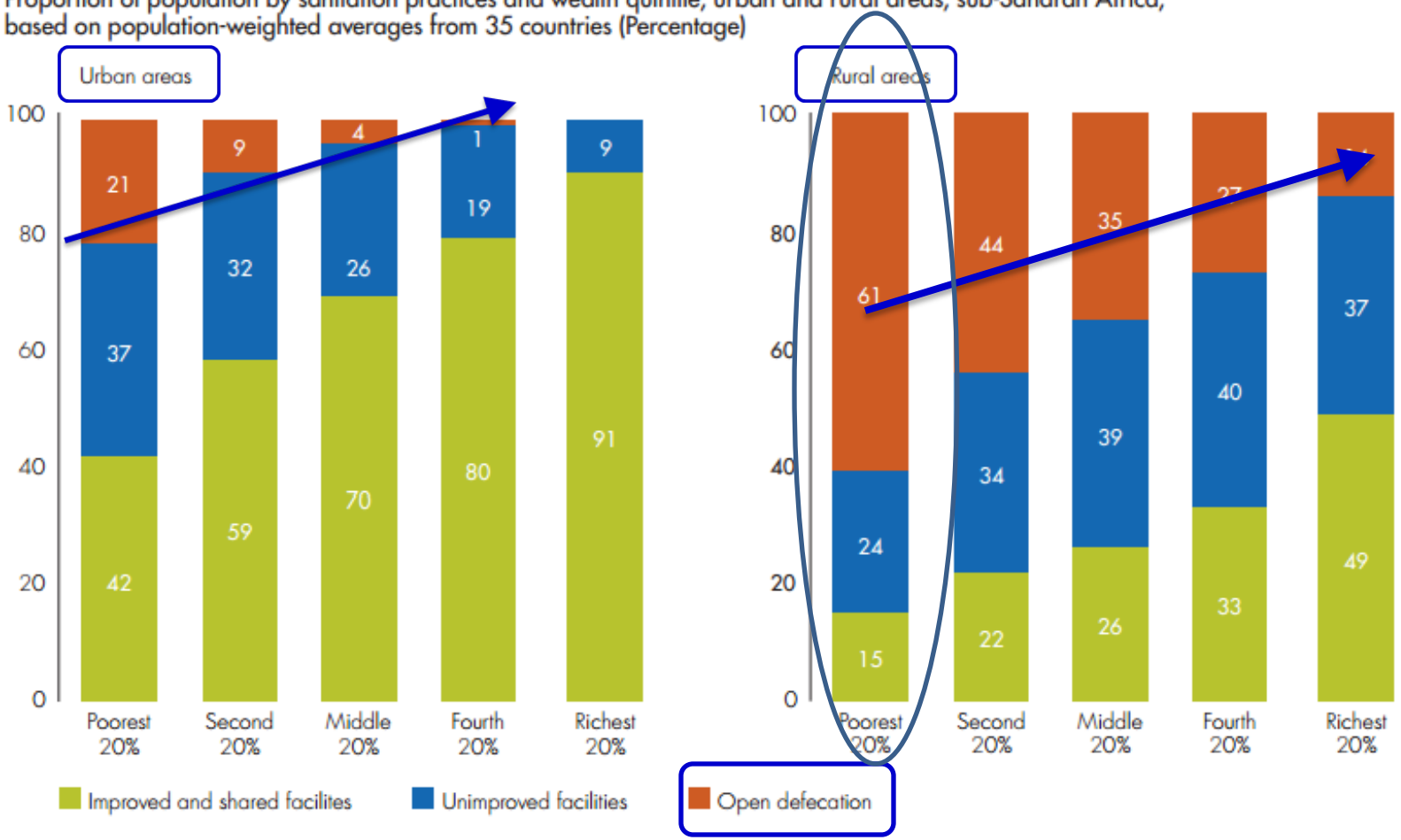


Fig. 9. Proportion of the population using improved sanitation in 2012

Rural Poor – Lowest Access

In sub-Saharan Africa, access to sanitation is highly correlated with wealth and residence

Proportion of population by sanitation practices and wealth quintile, urban and rural areas, sub-Saharan Africa, based on population-weighted averages from 35 countries (Percentage)



Open Defecation – 1 B Globally

Eighty-two per cent of the one billion people practising open defecation in the world live in 10 countries

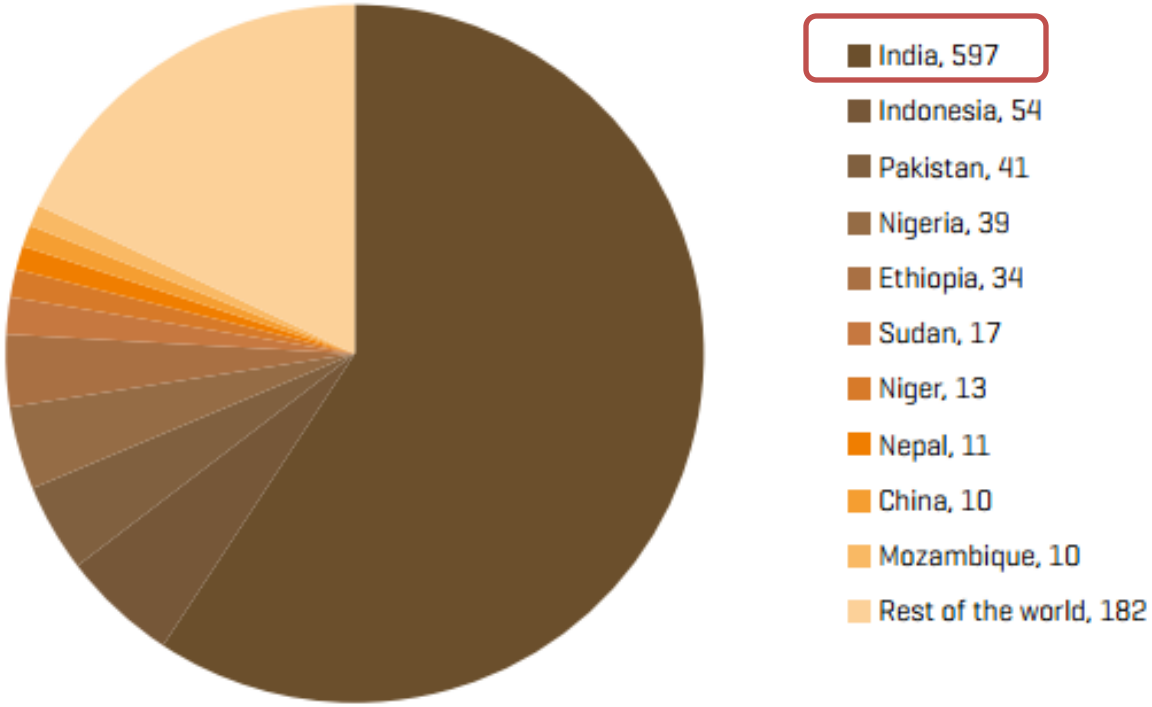


Fig. 17. Top 10 countries with the highest numbers of people (in millions) practising open defecation

References

- All data above were taken from the “Joint Monitoring Programme (JMP) for Water Supply and Sanitation” report (www.wssinfo.org) or from the UN “Millennium Development Goals Report (2012 or 2014)

College of Engineering

The WaTER (Water Technologies for Emerging Regions) Center

The WaTER Center aims to promote peace by advancing health, education and economic development through sustainable water and sanitation solutions for impoverished regions.

Education:

- Two core courses:
  - Water Technologies for Emerging Regions
  - WaTER Field Methods
- *NEW* U/G minor in "Water and Sanitation For Emerging Regions" – all majors

Service Learning:

- Sooners Without Borders (SWB)
  - International / domestic projects
  - Open to all majors

- Biennial Prize / International Conference

Directors:
David Sabatini
Yang Hong
Robert Knox
Randy Kolar
Bob Nairn

WaTER Directors with 2011 Water Prize winner (above)
Students in Field Methods course (below)

Sooners Without Borders builds an eco-latrine for the 2011 WaTER Conference

Sooners Without Borders
El Salvador – November 2013

Sooners Without Borders
El Salvador – November 2013

- The team
  - 3 adults and 10 OU students
  - Mangle Association
  - Eco Viva
  - Iowa City Engineers Without Borders
- Objectives
  - Solar irrigation pump demonstration
  - Tidal Study and community water supply – Isla Montecristo
  - Geological study – site for Mangrove Restoration Center

Tidal Study and Community Water Supply- Isle of Montecristo

- High tidal waters enclose this area
- Salt water infiltration
- Safety of wells
- Overcomplicated and expensive community well

Solar Irrigation Pump Demo

- Goal:
  - Cheaper alternative to irrigation with diesel engine
  - Prove that gravity can force water through the system
- Future Plans
  - Install systems at schools with Rotary International
  - Teach students how the system works
  - Aid in school gardens

And then….the tortugas

Water and Sanitation for Health and Sustainable Development

The WaTER Minor is designed for engineering and non-engineering majors interested in development work in emerging regions.

The WaTER Minor will:

- Prepare students for international development in groups such as: Peace Corps, USAID, State Department, NGOs, service organizations, and faith-based organizations.
- Increase the awareness of tomorrow's societal leaders on challenges and opportunities facing developing countries, building a global ethic for development and peace.

WaTER Minor

"Water and Sanitation for Health and Sustainable Development"

For all majors:

CEES 4243G WaTER Technologies for Emerging Regions (3)

CEES 4273G WaTER Technical Field Methods (3)

CEES 3422 Intercultural Immersion Experience in an Emerging Region (2)

CEES 3251 WaTER Center Integrated Seminar (1)

CORE (9) + TRACK ELECTIVES (9)
= 18 total credit hours

* = recommended courses by area of competency

ENGINEERING AND TECHNOLOGY NATURAL AND PHYSICAL SCIENCES:

* CEES 5020 Research Methods in Global Health

Other examples:
CEES G5363 Ecological Engineering Science
ENGR 4513 Introduction to Sustainable Engineering
GEOG 4293 Hydrologic Science
BSE 5113 Principles of Epidemiology (OUHSC)

POLICY, ECONOMICS, AND BUSINESS:

* ENT 3193 Fundamentals of Social Entrepreneurship

Other examples:
IAS 3063 Politics of Developing Countries
IAS 3323 The Political Economy of Development

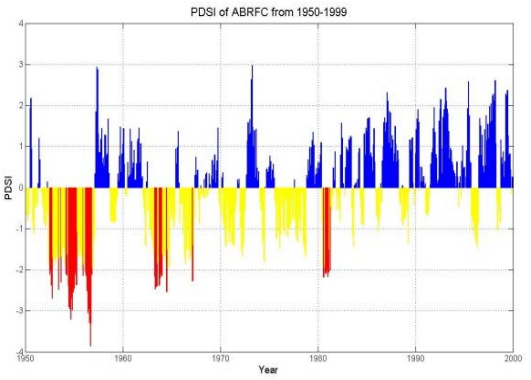
SOCIAL / CULTURAL / BEHAVIORAL SCIENCES:

* ANTH 4303 Women and Development in Africa

Other examples:
ANTH 3953 - Water and Health in Emerging Regions I
IAS 2003 Understanding the Global Community
GEOG 3443 Environment and Society
ANTH 3423 Anthropology of Religion

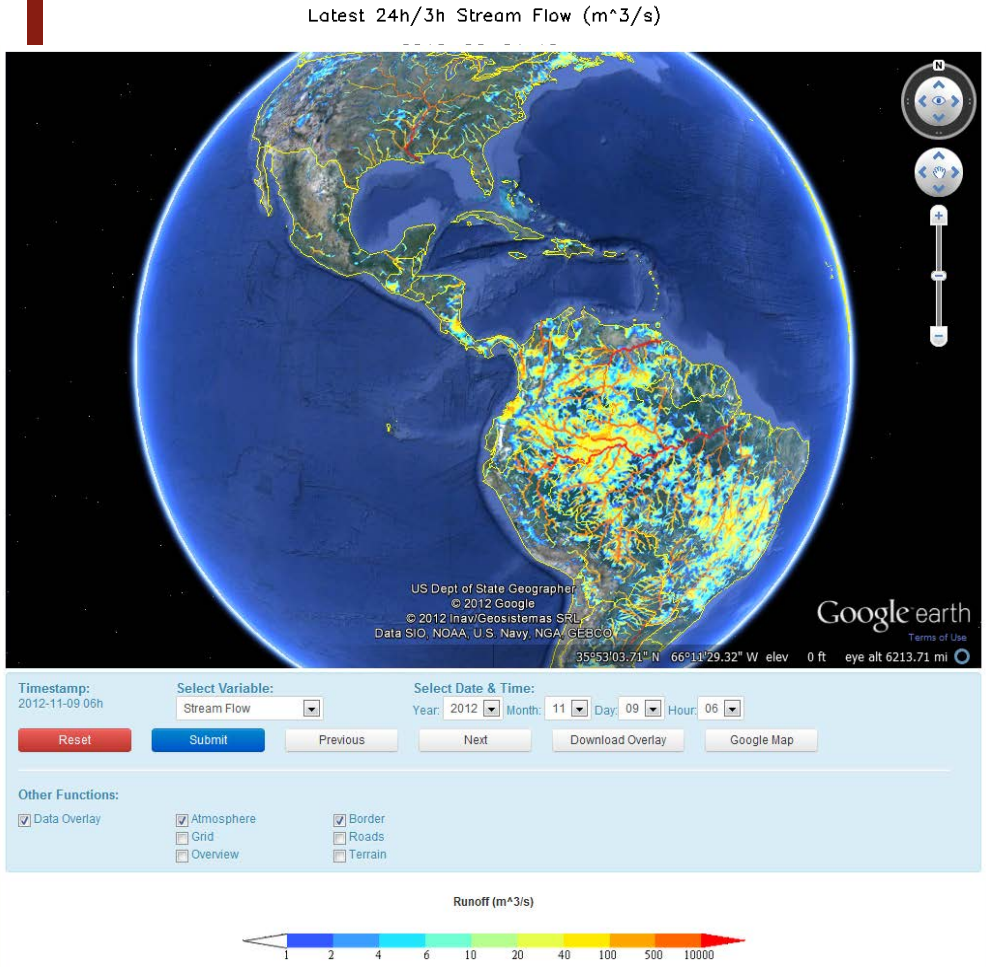
Research Areas

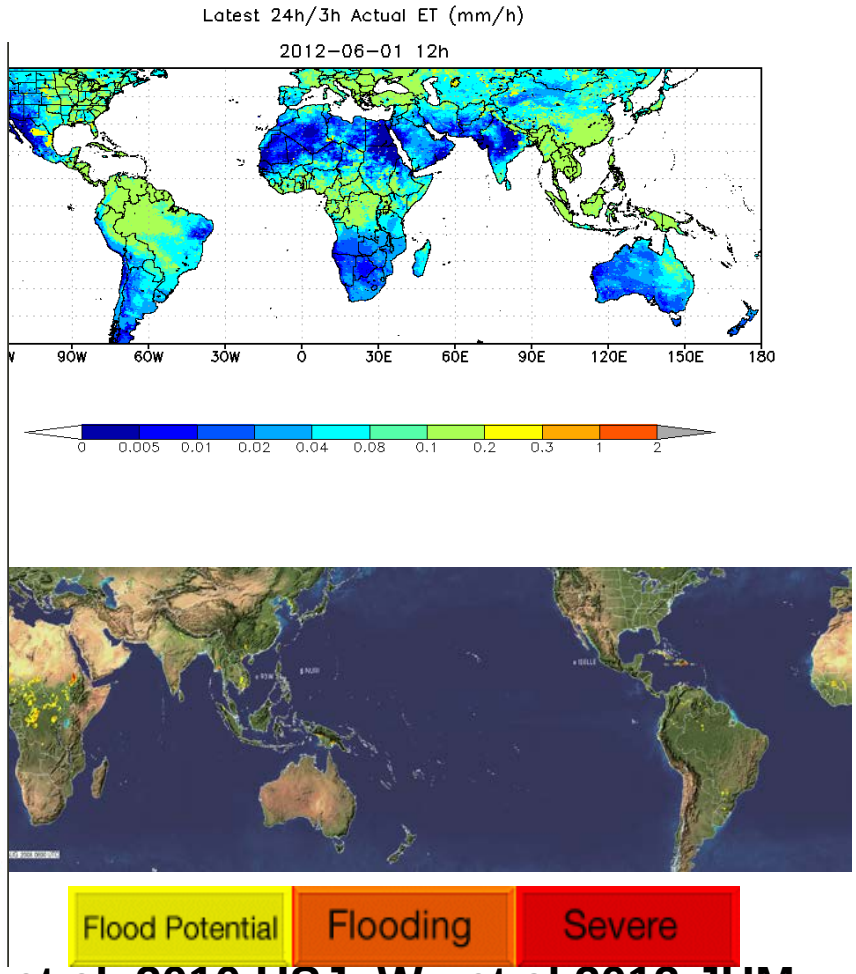
- OU strengths, Oklahoma history, importance of topics to developing countries and rural OK / US
- Sustainable solutions – integrate human, economic/business, and technical factors – **sustainable systems**
- Four research focus areas
  - Water resources / climate change – dust bowl
  - Passive wetlands treatment – mine drainage (Tar Creek) and wastewater / sanitation
  - Drinking water treatment – arsenic & fluoride
  - Sustainable sanitation – ½ time CE & Anthro



OU-NASA Global Hydrologic Prediction

Real-time Virtual Water System: http://eos.ou.edu





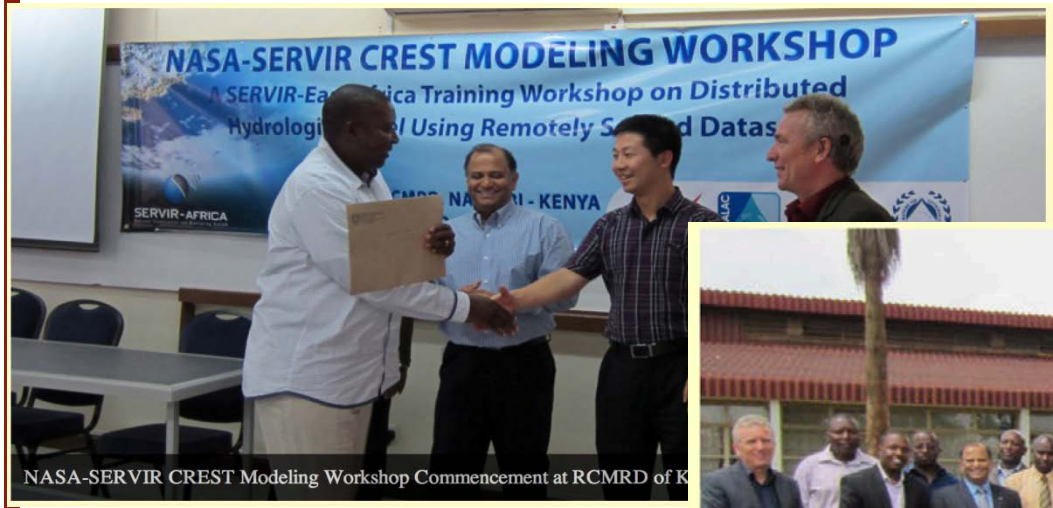
Hong et al. 2007 WRR; Wang and Hong et al. 2010 HSJ; Wu et al 2012 JHM

Dr. Yang Hong

Capacity Building, Workshop and Training

Researchers and graduate students have transferred our technology and systems to build local capacity by providing remote assistance, on-site workshops, and hands-on training in:

- Africa (Kenya, Namibia, Rwanda)
- South Asia (Pakistan, Nepal, Bhutan)
- Central/South America (Panama, Colombia)



NASA-SERVIR CREST Modeling Workshop Commencement at RCMRD of K


NASA-SERVIR CREST Modeling Workshop at RCMRD of Kenya

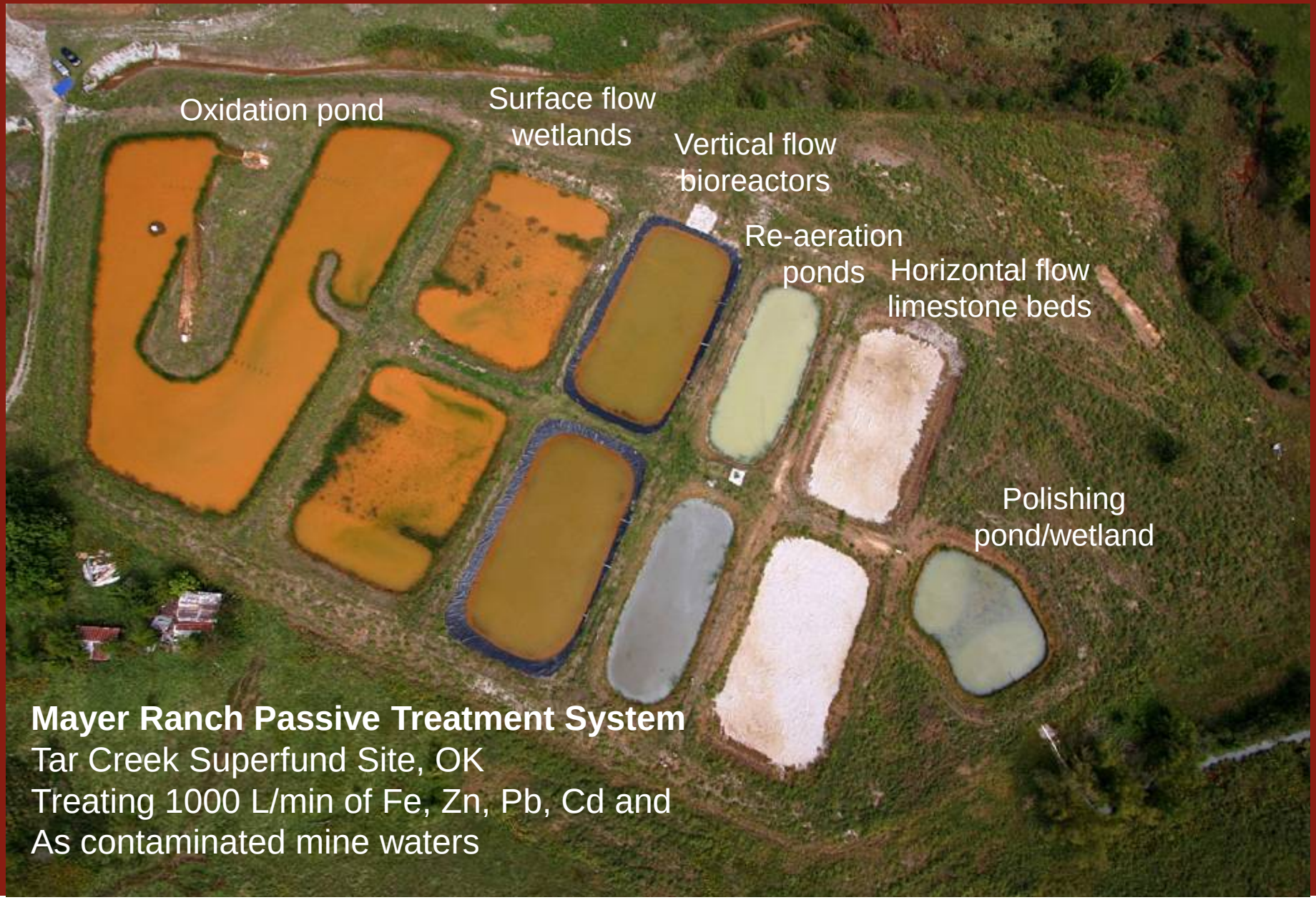
USAID FROM THE AMERICAN PEOPLE

(2) Passive Treatment of Mine Waste

- Naturally-occurring ecological, biogeochemical, and microbiological processes
  - Limestone dissolution
  - Metal oxidation / hydrolysis
  - Bacterial sulfate reduction
- Driven by renewable energies
- Natural unprocessed materials
- Lower O&M / larger land areas

Dr. Bob Nairn

Research



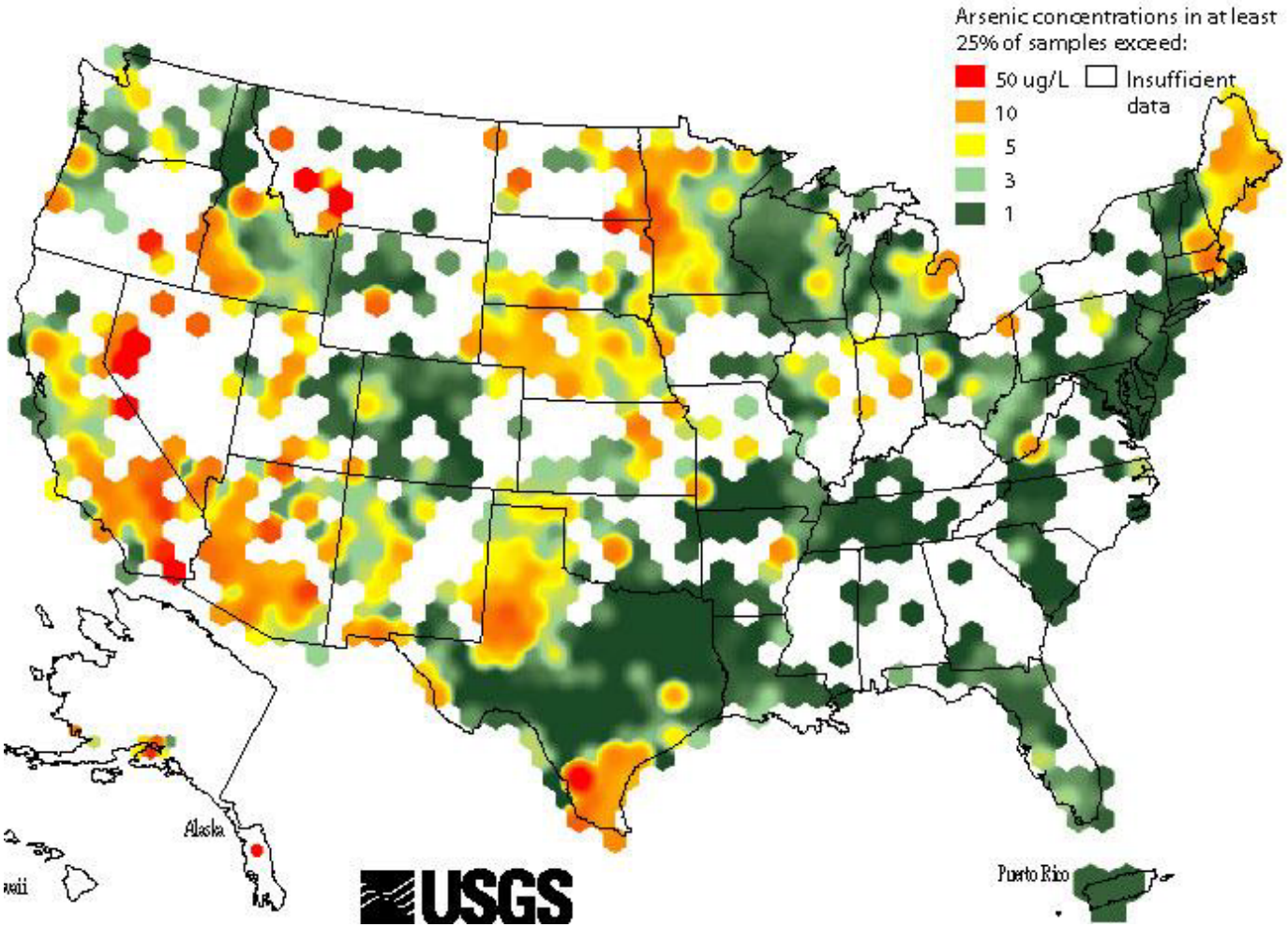
Mayer Ranch Passive Treatment System
Tar Creek Superfund Site, OK
Treating 1000 L/min of Fe, Zn, Pb, Cd and As contaminated mine waters

Research

Potosi, Bolivia

- Mineral extraction for centuries
- Currently *camposinos* irrigating with metal contaminated waters
- Passive treatment will provide clean water
- Multiple partners both in Bolivia and the US

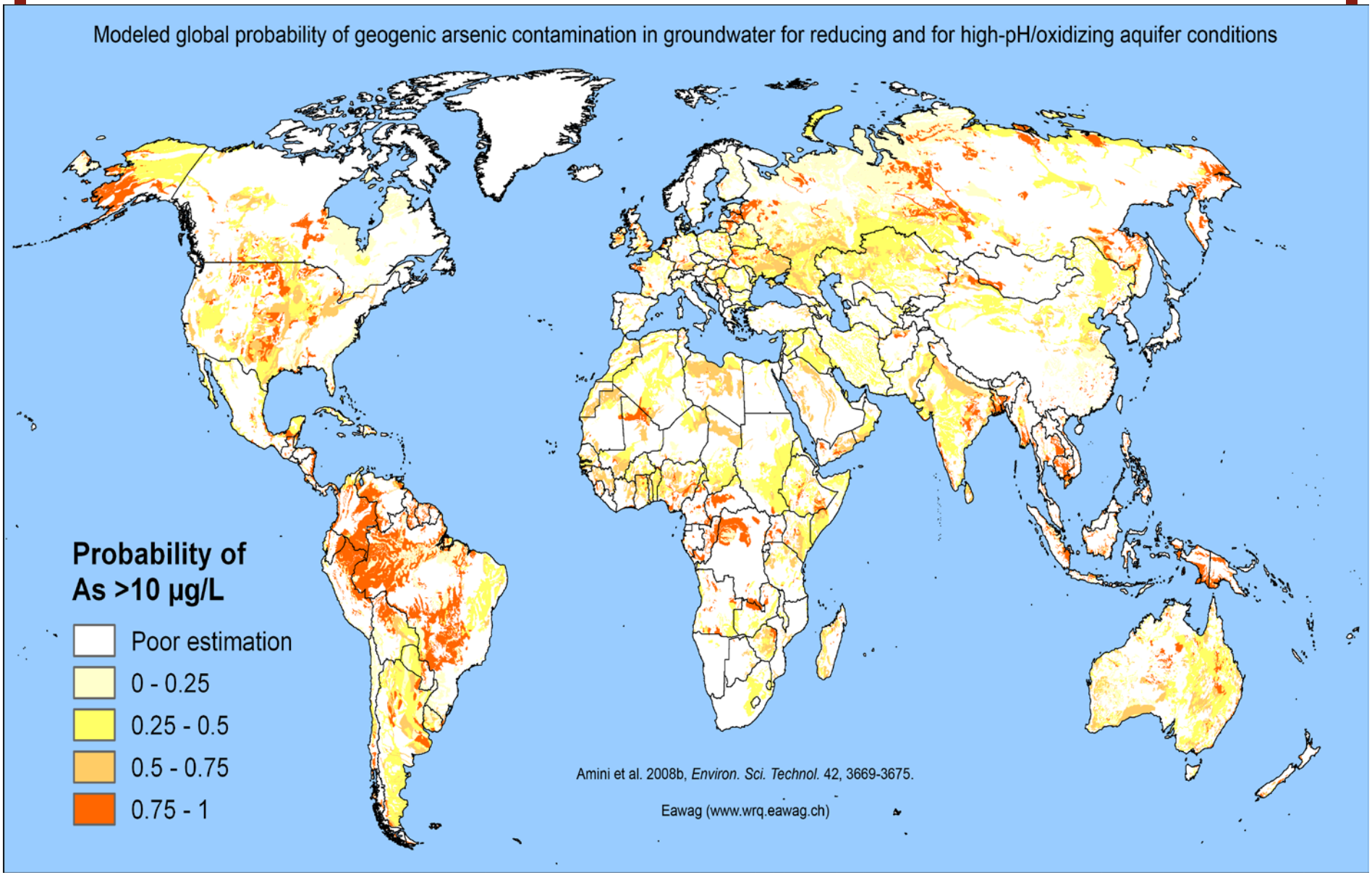
Arsenic in U.S. (OK)



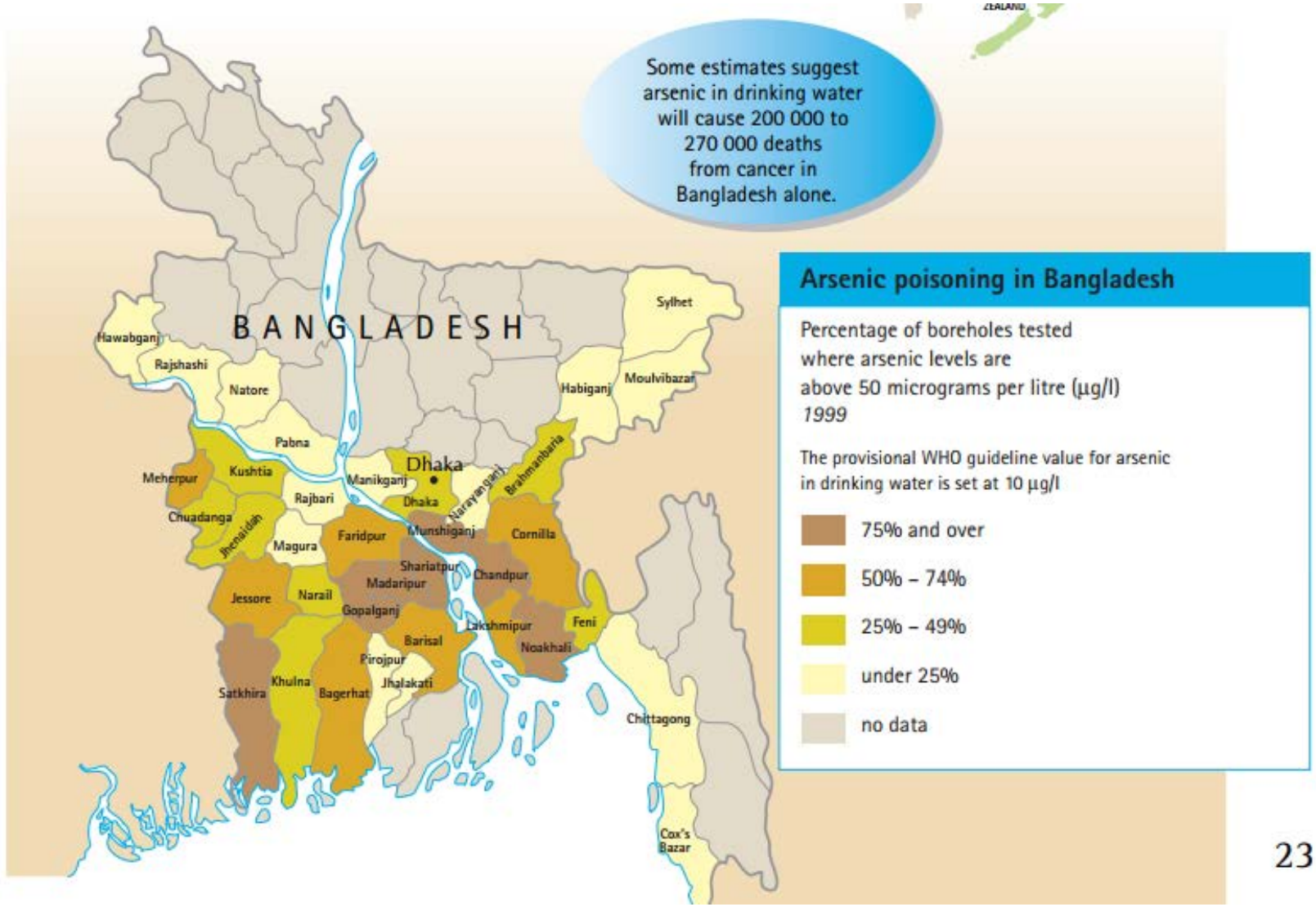
Norman, OK Arsenic

- Impacted ~ ½ of gw supply – treatment vs other water
- Alternate water $$ - pilot test of Bayoxide (granular ferric oxide) – technically viable / cost competitive

Naturally Occurring Arsenic



Bangladesh


Some estimates suggest arsenic in drinking water will cause 200 000 to 270 000 deaths from cancer in Bangladesh alone.
BANGLADESH
Sylhet
Hawabganj
Rajshahi
Natore
Habiganj
Moulvibazar
Pabna
Dhaka
Meherpur
Kushtia
Manikganj
Brahmanbaria
Rajbari
Dhaka
Narayanganj
Chuadanga
Jhenaidah
Munshiganj
Cornilla
Magura
Faridpur
Shariatpur
Chandpur
Madaripur
Jessore
Narail
Gopalganj
Lakshmipur
Feni
Barisal
Noakhali
Pirojpur
Satkhira
Khulna
Bagerhat
Jhalakati
Chittagong
Cox's Bazar
Arsenic poisoning in Bangladesh
Percentage of boreholes tested where arsenic levels are above 50 micrograms per litre (µg/l)
1999
The provisional WHO guideline value for arsenic in drinking water is set at 10 µg/l
75% and over
50% – 74%
25% – 49%
under 25%
no data

Arsenicosis

Remote Village – Bangladesh

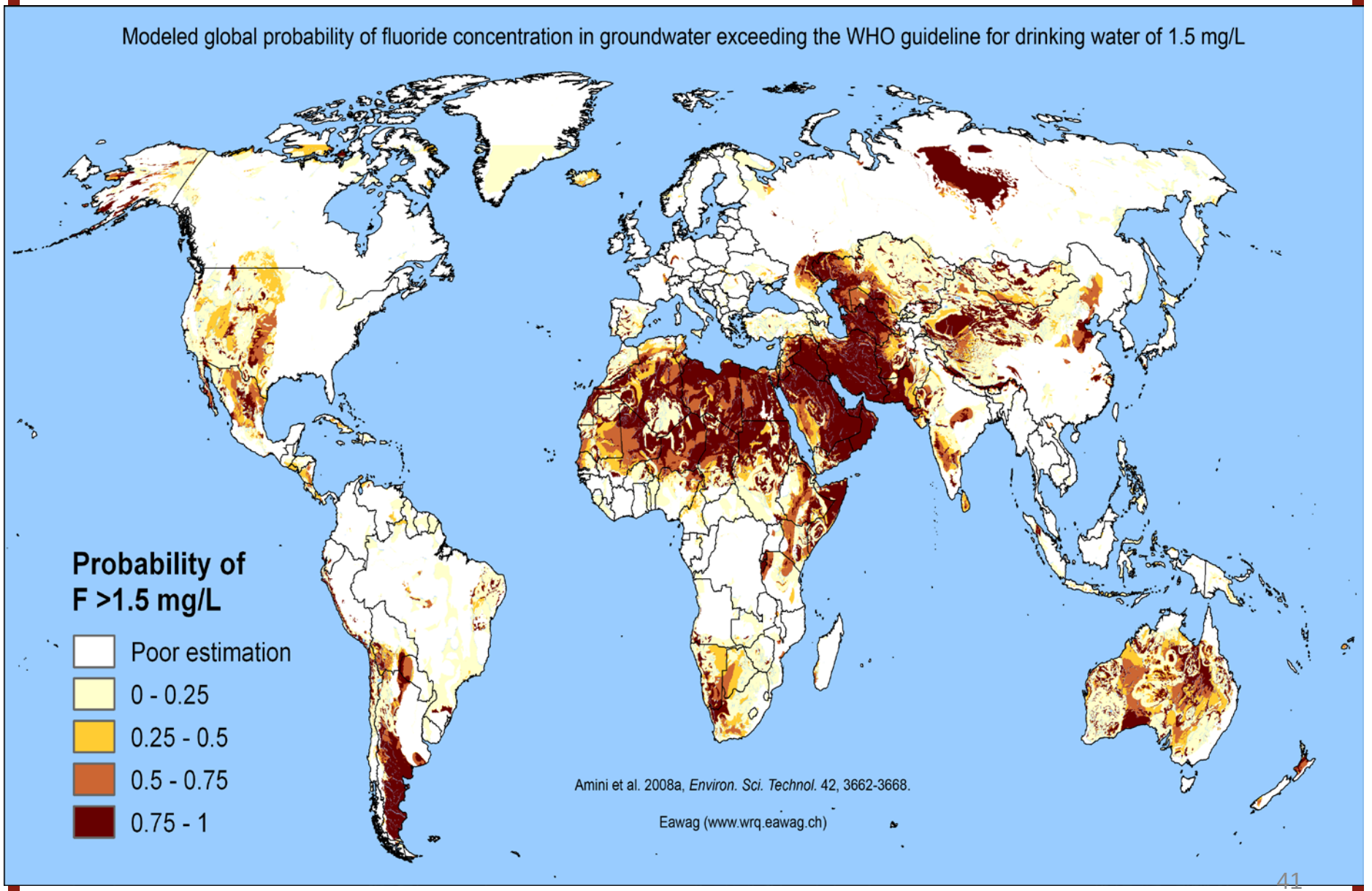
Rice Husk Char- Cambodia

- OU Research: Iron oxide amended rice husk char

VS

Proprietary

Naturally Occurring Fluoride



Fluorosis

Dental Fluorosis
(2 to 4 ppm)

Skeletal Fluorosis
(4 to 10 ppm)

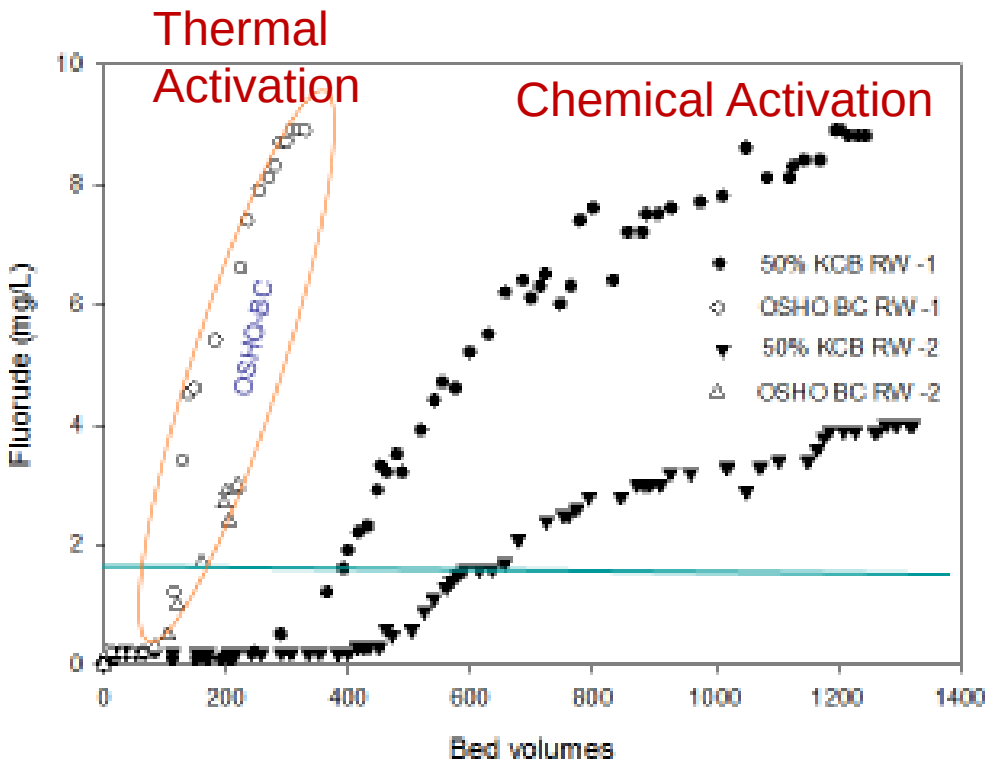
Fluoride - Ethiopia

Simple Solution -Bone Char

- Bone Char: crush / heat bones; charring temperature critical
- Works for various types of bones
- Locally available material / technology
- OU research – chemical activated bone – superior to thermal char

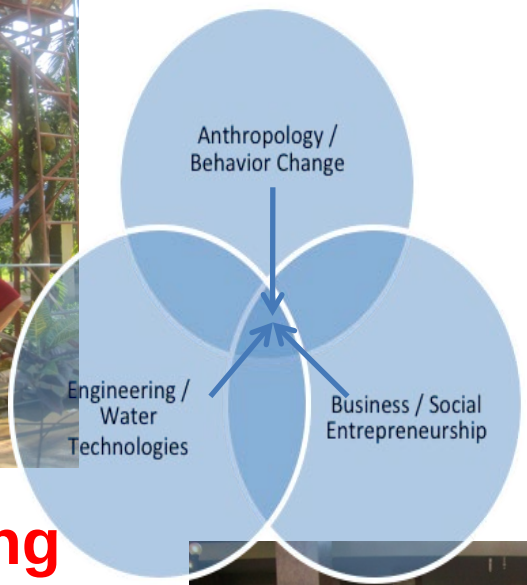
Fluoride - Ethiopia

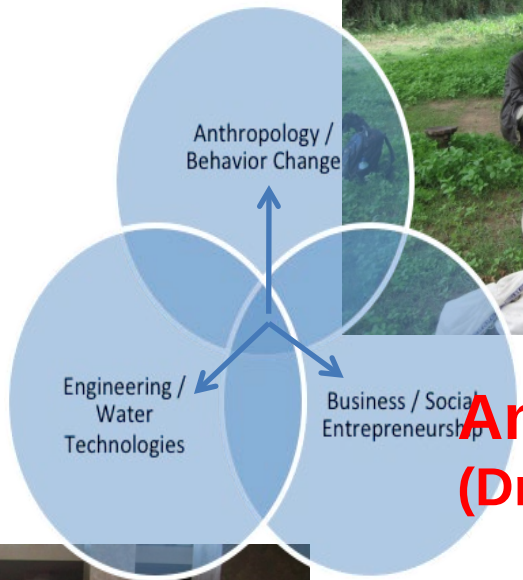
Chemical vs Thermal Activation



Chemically Activated Bone: (i) four times as effective as bone char,
(ii) much higher yield (lower loss) of product than during charring process.

Sustainable Solutions





Anthropology
(Dr. Paul Spicer)

Engineering

Business
(Dr. Lowell Busenitz)

Brunson, L. R., Busenitz, L. W., Sabatini, D. A. and Spicer, P. "In Pursuit of Sustainable Water Solutions in Emerging Regions." *Journal of Water, Sanitation and Hygiene for Development*. 2013, 3(4), 489-499.

Oklahoma NGOs

ENGINEERS IN ACTION

PROS FOR AFRICA

water4

WATERisLIFE

Makes me proud to be an Oklahoman!

My First Water Project

In China – with Dick Greenly

The University of Oklahoma

International *WaTER Conference*

and

International Water Prize Award Ceremony

Sept. 21-23, 2015; Norman, OK

200+ people / 25+ countries / 5+ continents

Fourth Water Prize Winner

Mr. Peter Lochery

- Leads CARE's global relief / development efforts in water and sanitation for developing countries
- Three decades of experience in the water sector
- Will deliver plenary lecture at banquet

WaTER WaTER.ou.edu
Water Technologies for Emerging Regions
"Water and Sanitation for All"

Thanks:

- OU CEES, CoE, VPR, President's Office
- NSF, USAID, CRS, Rotary, donors
- OU Colleagues: Drs. Butler, Busenitz, Chamberlain, Dreibelbis, Hong, Knox, Kolar, Nairn, Spicer

Questions?