8-27-2009

Will there be enough water to grow enough food?

David Molden
International Water Management Institute

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International Water Management Institute

Lincoln, Nebraska, August 27, 2009

Global food production has outpaced population growth since 1960, but meeting growing demand for food and water in the future will be challenging.

"There is an intimate link between food and water," said David Molden, deputy director general for research at the International Water Management Institute and an internationally known expert on water management. In his public lecture, "Will there be Enough Water to Grow Enough Food?" Aug. 27 at the University of Nebraska-Lincoln, Molden said the answer to this critical question is "no, unless we change the way we think and act on water issues."

View Molden's PowerPoint presentation here. http://research.unl.edu/events/docs/NebraskaMoldenv1.pptx

View the lecture video here : http://research.unl.edu/video/Molden%20Lecture2.mov

Accessed 11/4/2009 from http://research.unl.edu/

PDF output of the slideshow follows.

Will there be enough water to grow enough food?

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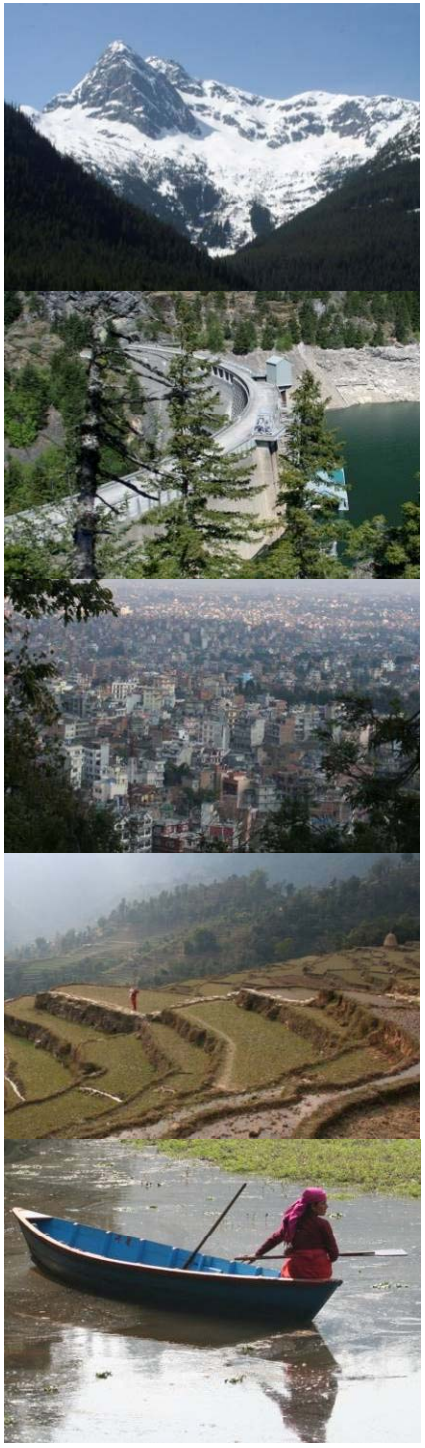
International Water Management Institute

- **Vision: Water for a Food Secure World**
- **Mission: Improve Land and Water Management for food, livelihoods and environment**
- **Offices across Asia and Africa**

www.iwmi.org

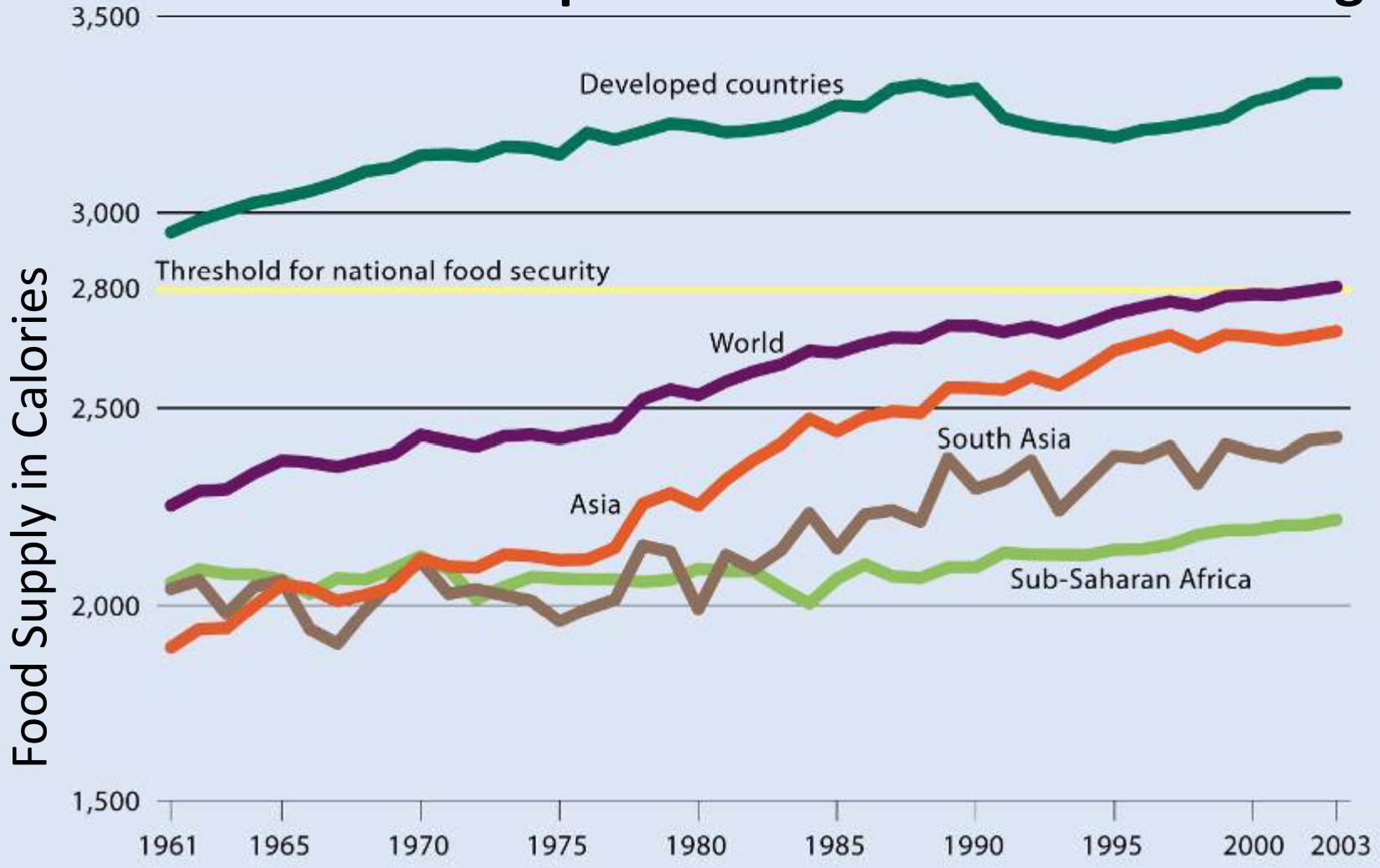
To improve the management of land and water resources for food, livelihoods and the environment.



Presentation

- Drivers of water use and their consequences
- Future Water Needs
- Adaptive Responses

One liter of water produces one calorie on average



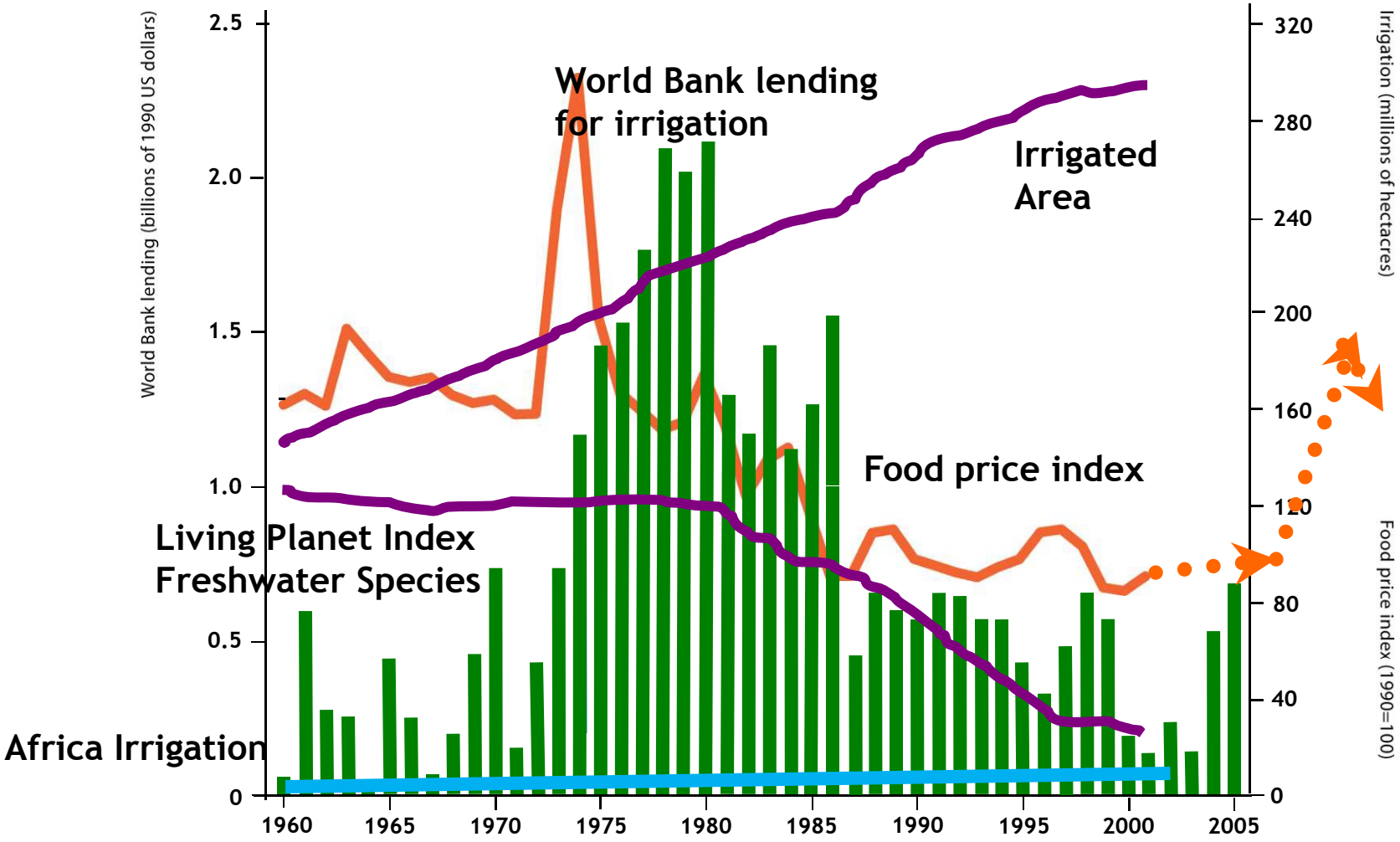
Source: FAO 2006b.

International Water Management Institute

Comprehensive assessment of water management in agriculture

Diets and water

Between 2,000 and 5,000 liters per person per day – depending on type and amount of food eaten and how it is produced



Source: Based on World Bank and Food and Agriculture Organization data.

Investing in Irrigation

Drivers of Water Use

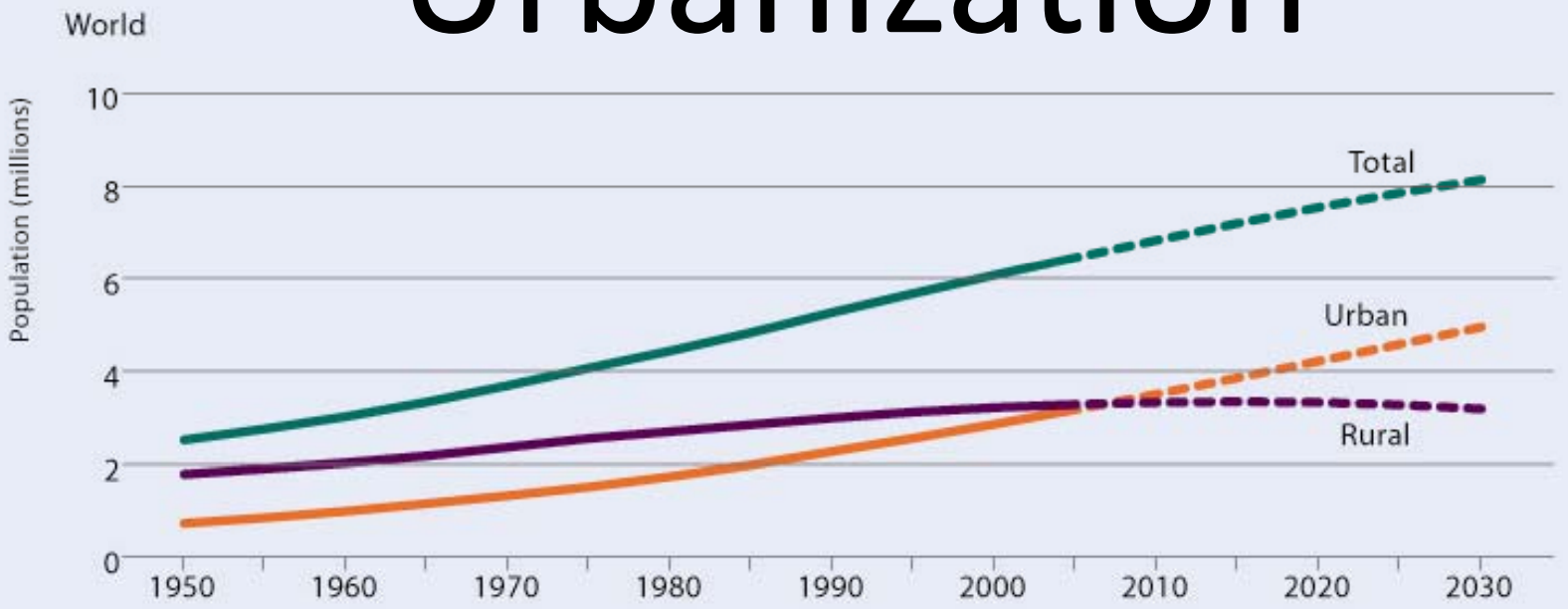
Urbanization - Cities are projected to use 150% more water in 2025

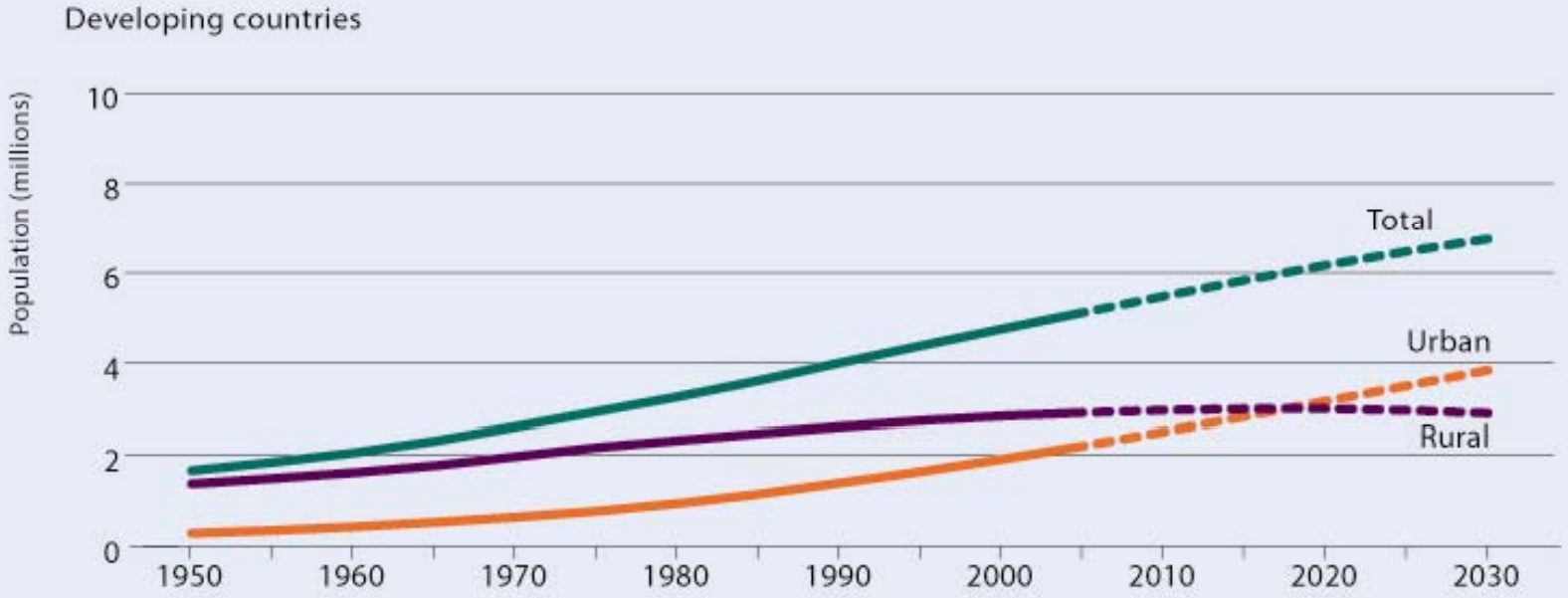
Land Degradation – limits further productivity increases

Climate Change – Shifting patterns of water availability – potential yields decline in Africa

Energy – Production and use by agriculture is in competition with hydropower

Urbanization





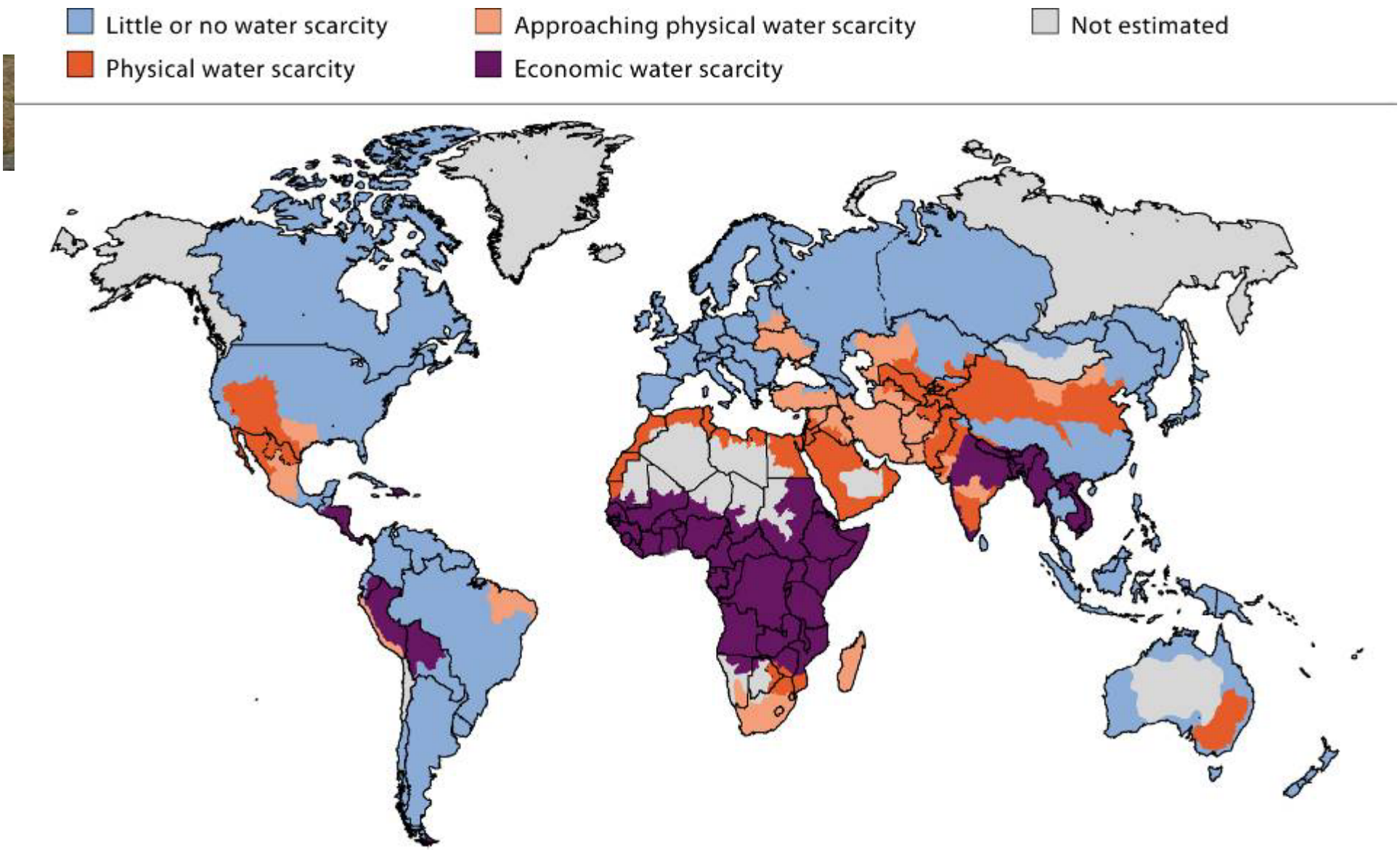
Urbanization

- Increased demand for water for cities
- Reallocation from irrigation to cities
- Cities generate more wastewater – an important source of agricultural supplies
- Changes in dietary preferences – farmers respond to different demands
- Voting dynamics shift
- Cities offer jobs – competition for rural employment

Limits – reached or breached

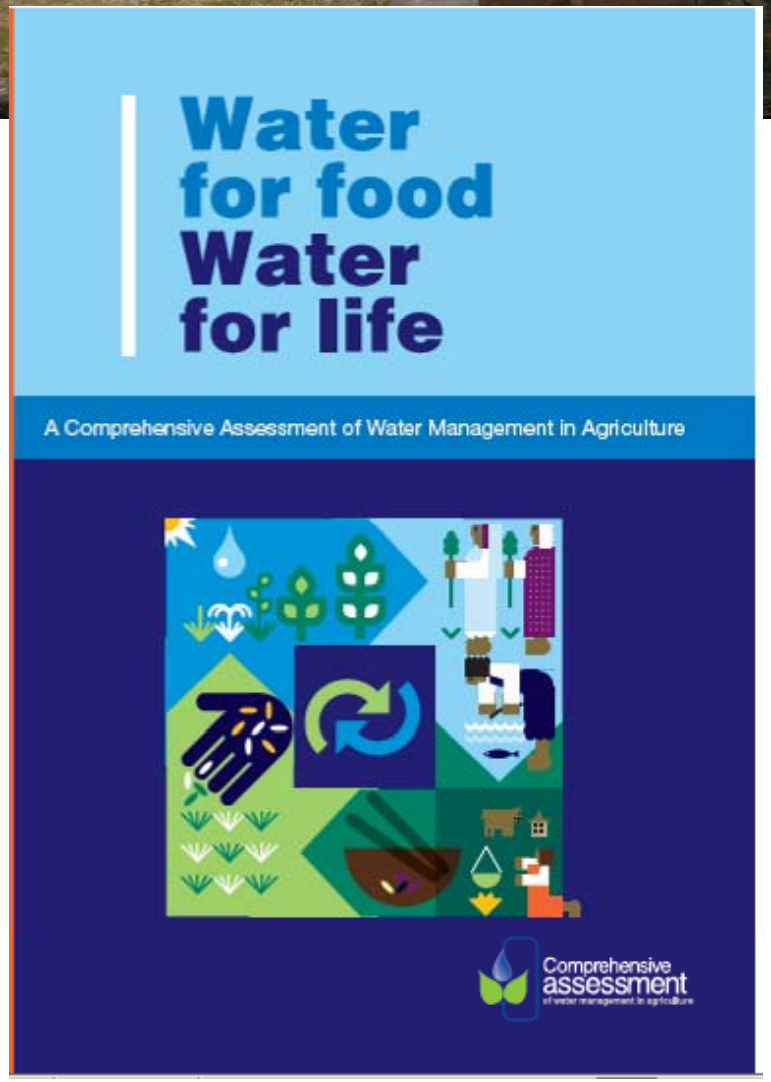
- River basins closed – Colorado, Murray Darling, Yellow, Indus, Amu Darya …… no additional water left
- Groundwater overdraft – in agricultural breadbaskets
- Fisheries – ocean and freshwater at a limit, aquaculture will become more prevalent
- Livestock – limit on extent of grazing land, more will come from mixed and industrialized production

Water Scarcity 2000



1/3 of the world's population live in basins that have to deal with water scarcity

Will there be enough water to end hunger, and sustain ecosystems?



A question posed to 700 researchers and practitioners who put together the Comprehensive Assessment of Water Management in Agriculture.

CGIAR CBD Ramsar

Answer from the Comprehensive Assessment –

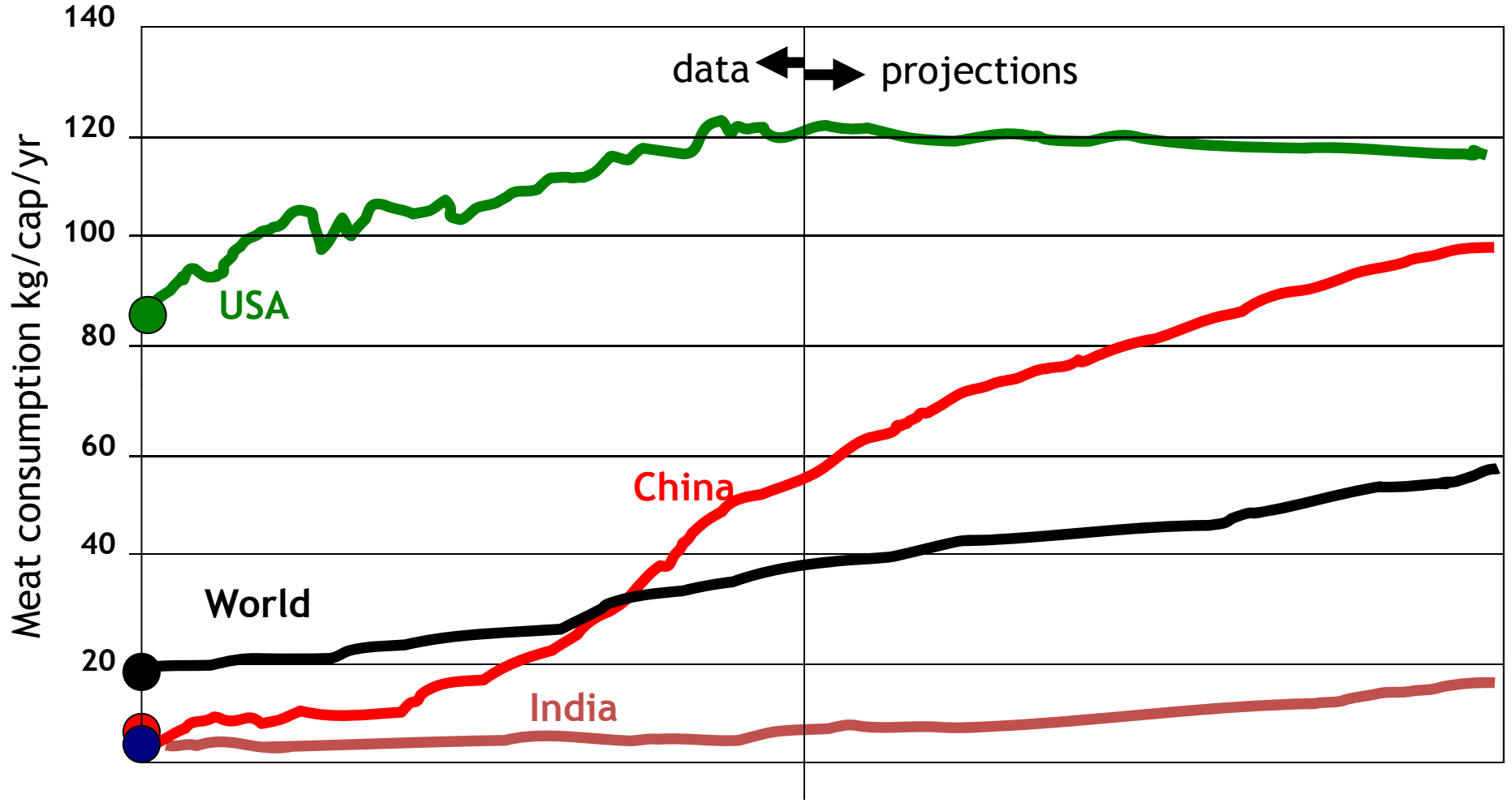
Will there be enough water to grow enough food, reduce poverty and support ecosystems?

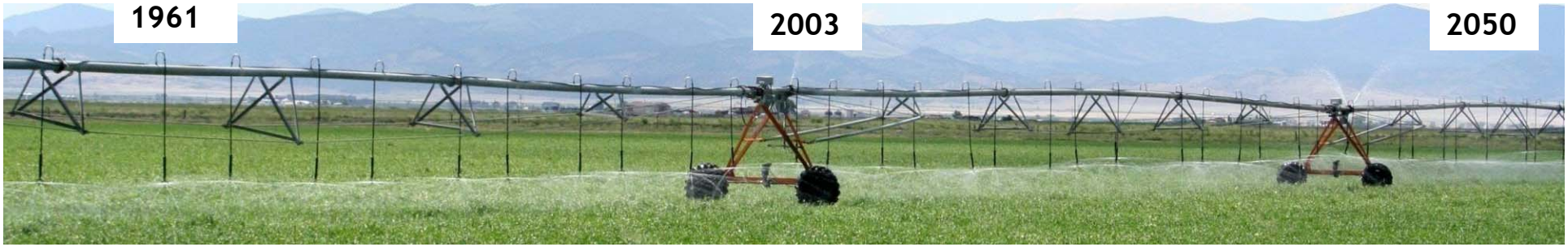
No, unless ….

We change the way we think and act on water issues.

WHAT OF THE FUTURE?

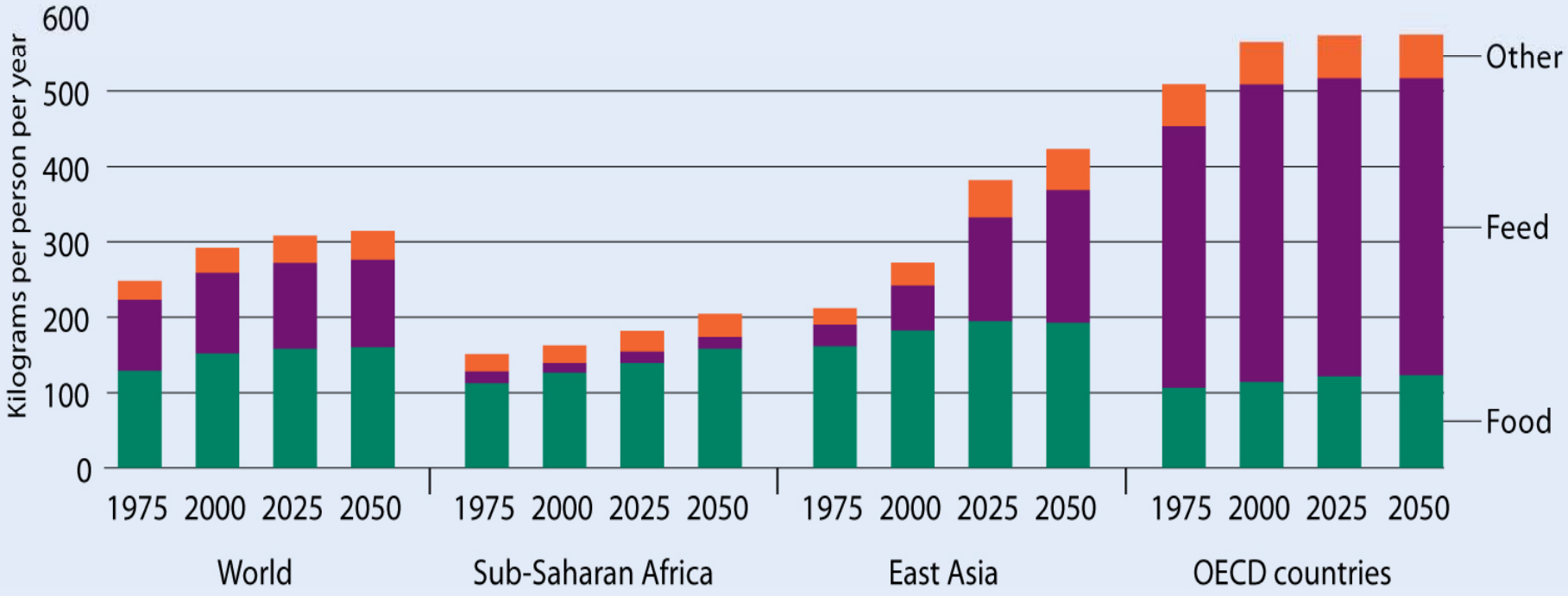
Per capita meat demand (kg/cap/yr)





Food demand doubles over the next 50 years because of diet and population growth

Water Needs (ET) will double – without water productivity gains

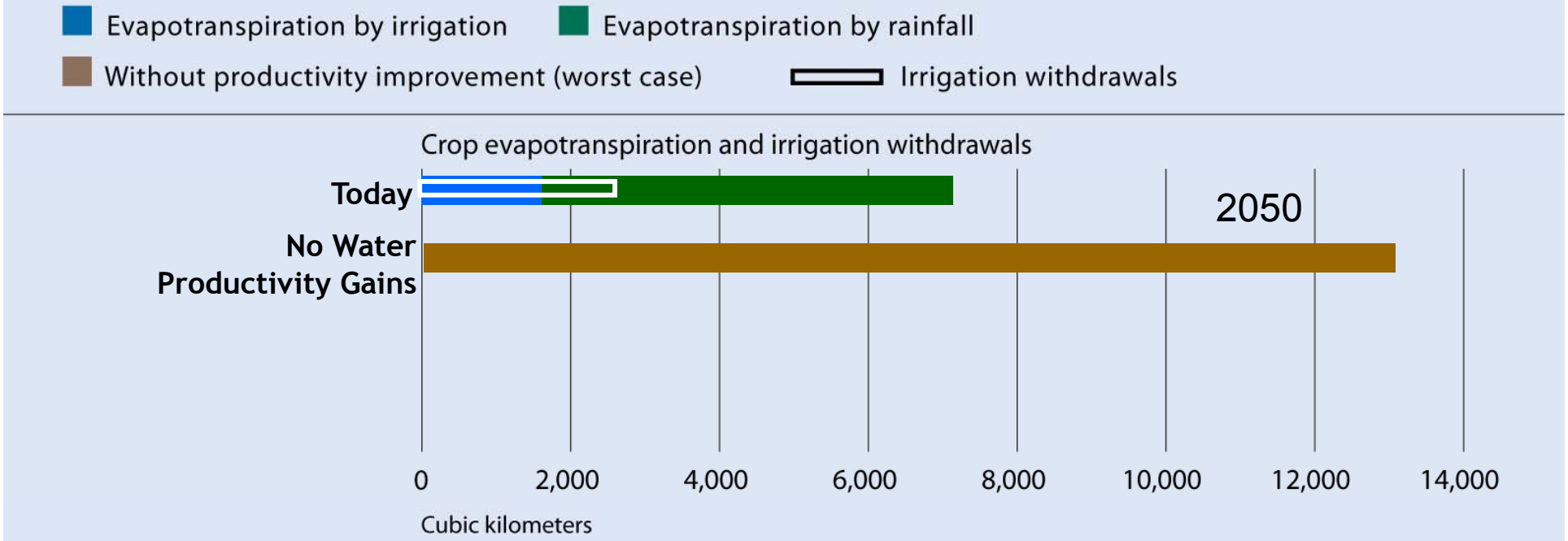


Source: For 1975 and 2000, FAOSTAT 2006; for 2025 and 2050, International Water Management Institute analysis done for the Comprehensive Assessment of Water Management in Agriculture using the Watersim model.

IWMI International Water Management Institute

Comprehensive assessment of water management in agriculture

Water Use – Today and 2050



Based on IWMI WaterSim analysis for the CA

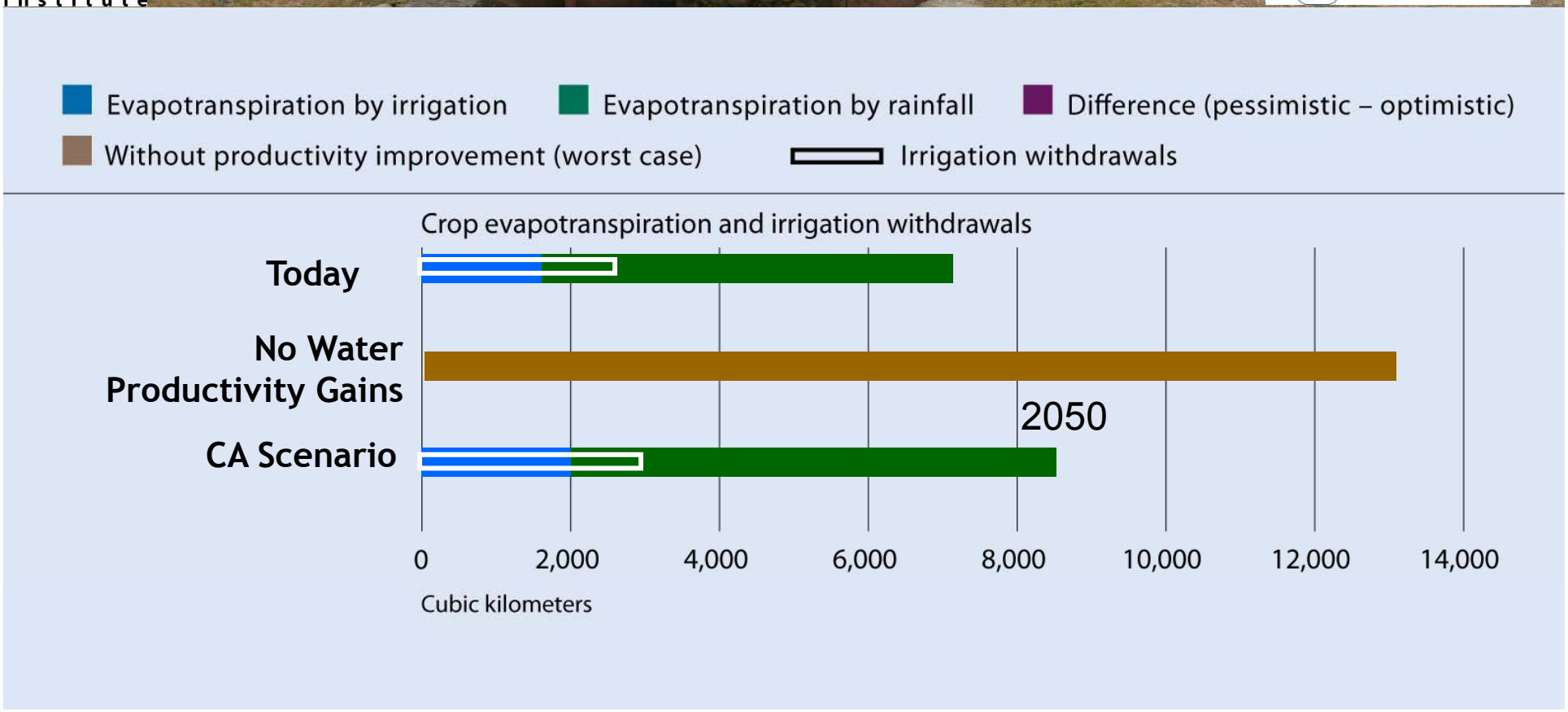
Without Water Productivity Gains,

Crop ET doubles by 2050

IWMI International Water Management Institute

Comprehensive assessment of water management in agriculture

Water Use – Today and 2050



CA Scenario: Policies for productivity gains, upgrading rainfed, revitalized irrigation, trade

Based on WaterSim analysis for the CA

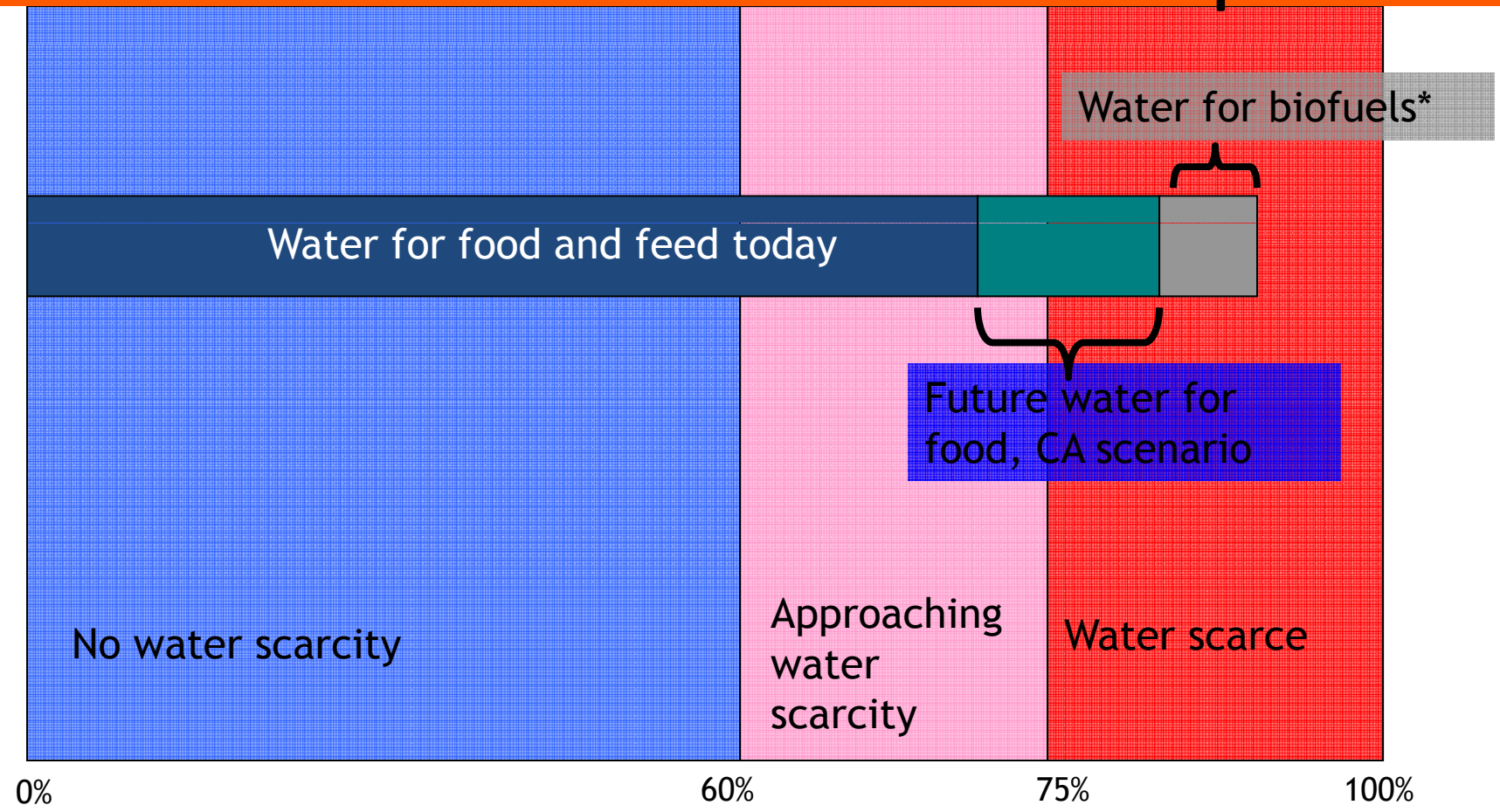
Water for Biofuels

Water use per liter of biofuel production

	Litres of ET	Litres of Irrigation water
China	3800	2500
India	4100	3500
US	1750	300
Brazil	2250	200

Biofuels: India: and in 2030 (WaterSim analysis by IWMI).

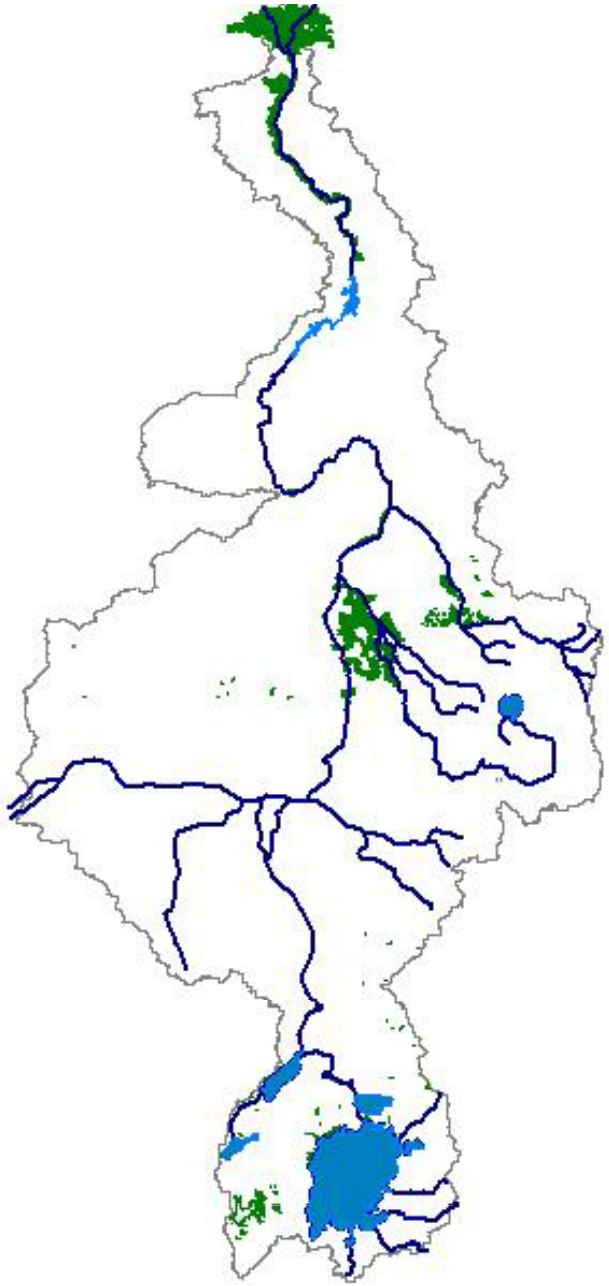
Green solution with blue impacts



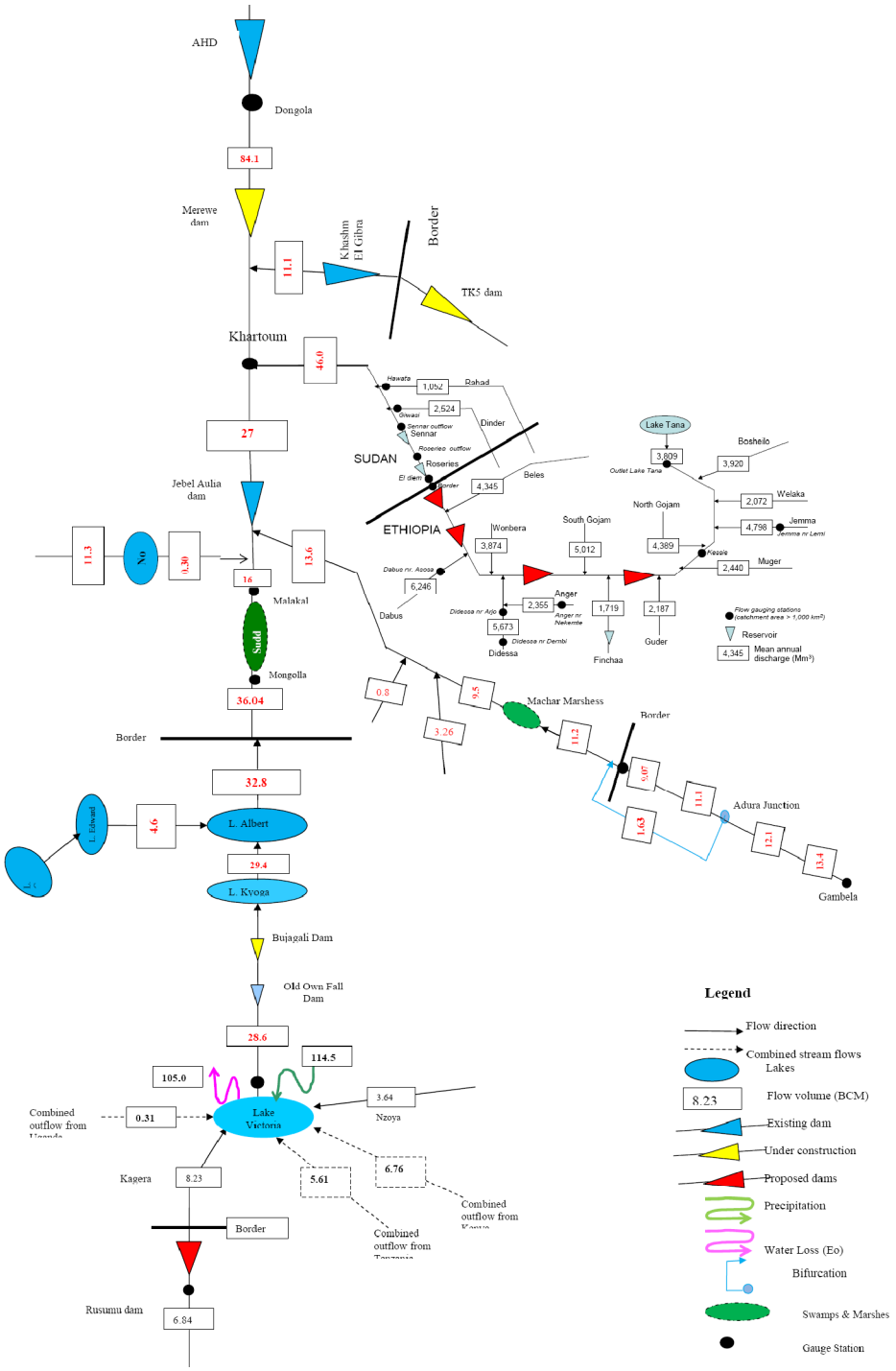
% of potentially utilizable water withdrawn for human purposes →

*Assumes that 10% of gasoline demand is met by biofuels by 2030

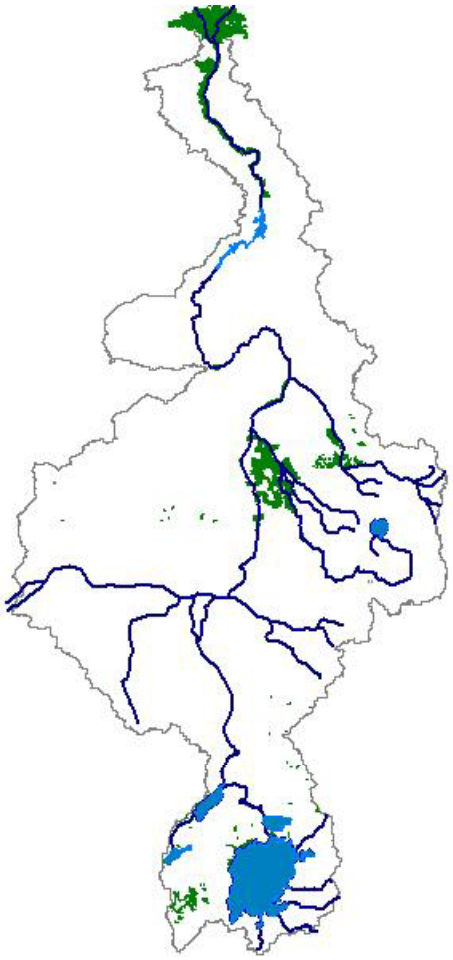

The Nile Basin
More irrigation?
More rainfed?



A blue water view of the Nile

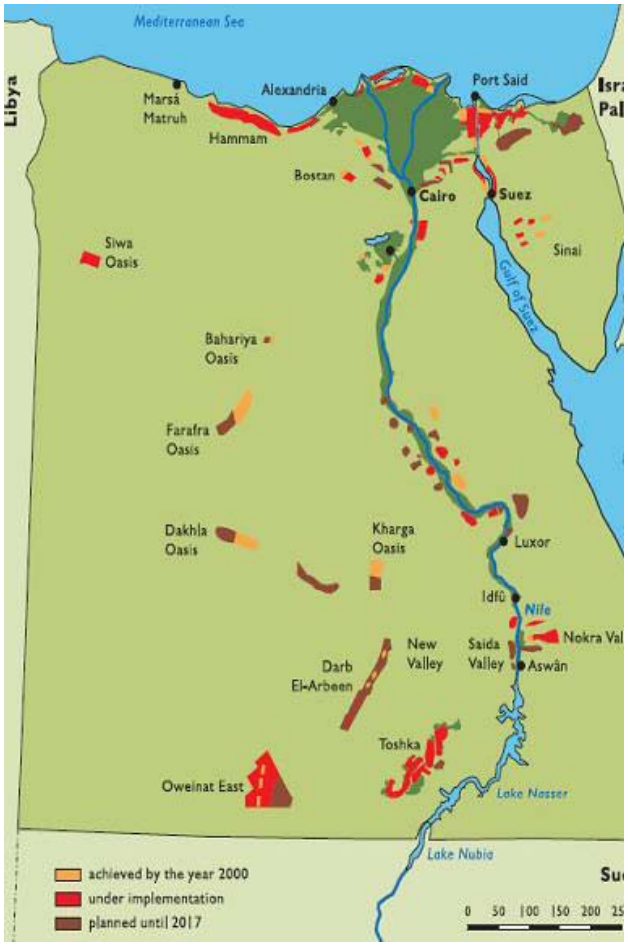


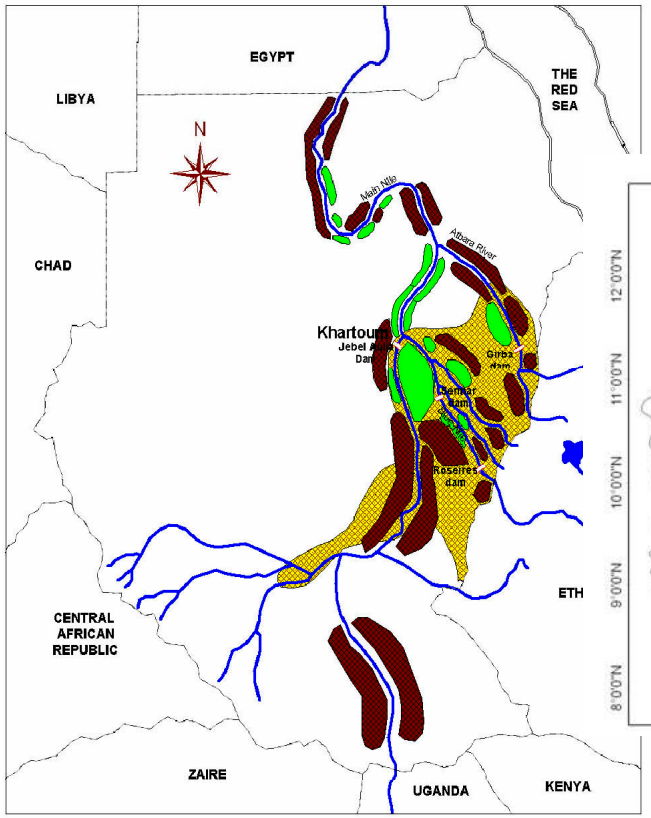
Irrigation Schemes

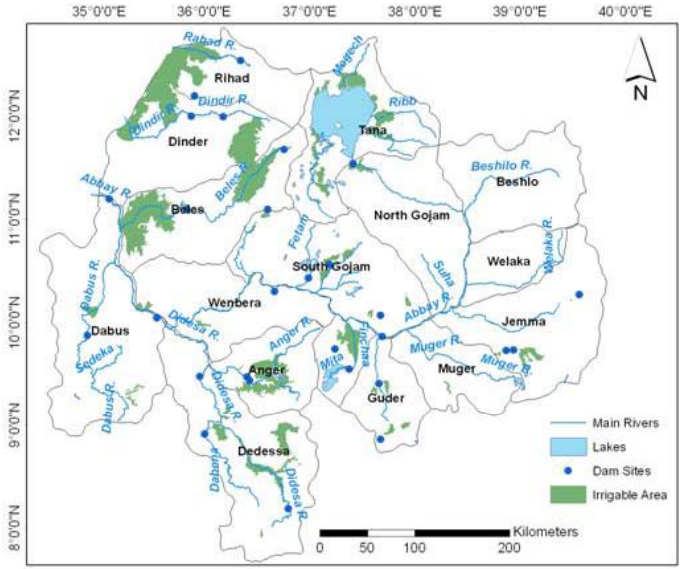


Country	Irrig. Water Requirement, m3/ha/yr	Irrigation Potential, ha	Irrigated Area, ha
Burundi	13,000	80,000	0
DRC	10,000	10,000	0
Egypt	13,000	4,420,000	3,078,000
Eritrea	11,000	150,000	15,124
Ethiopia	9,000	2,220,000	23,160
Kenya	8,500	180,000	0
Rwanda	12,500	150,000	2,000
Sudan	14,000	2,750,000	1,935,200
Tanzania	11,000	30,000	10,000
Uganda	8,000	202,000	9,120

Irrigation Schemes, current & future …







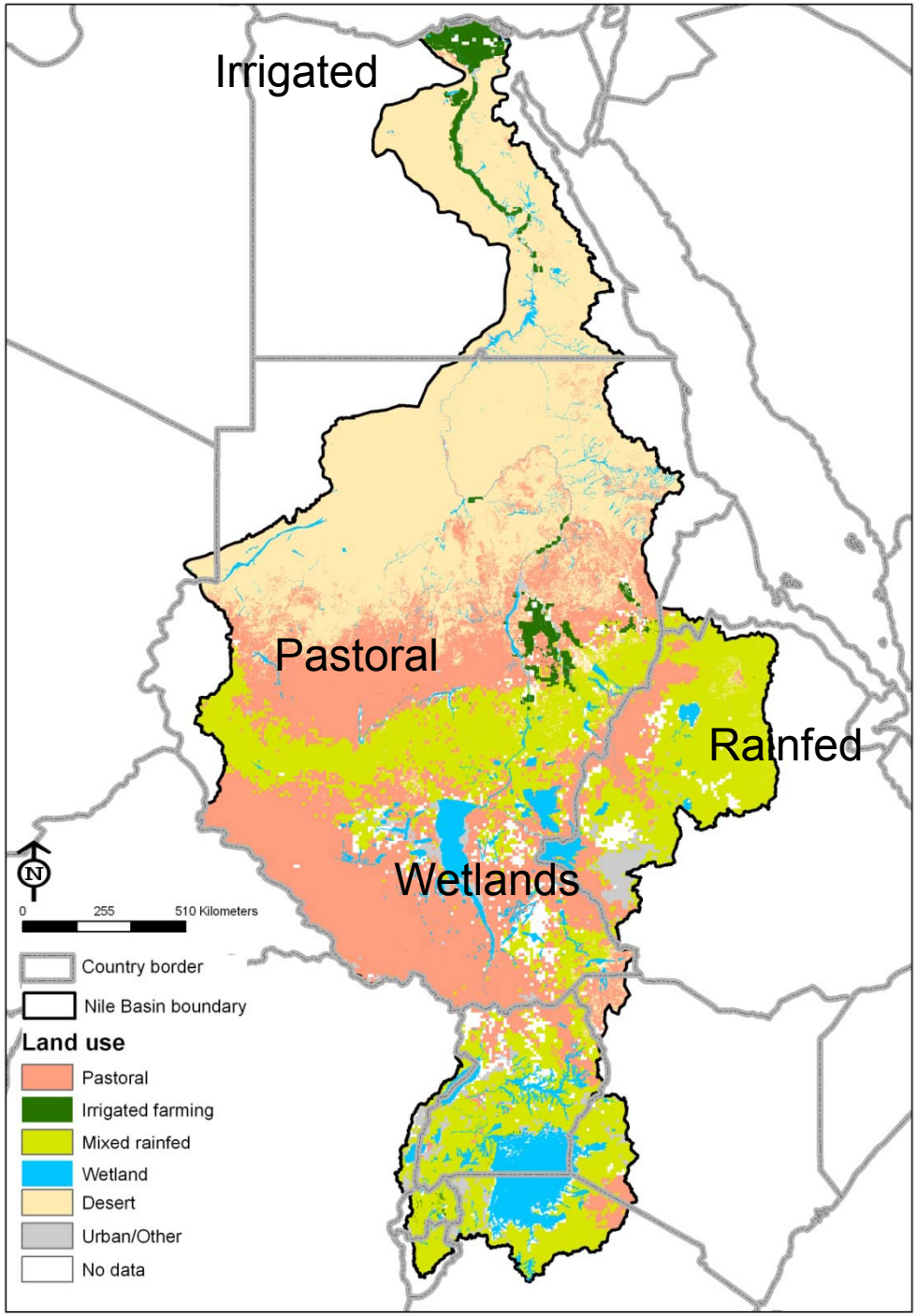
CGIAR Challenge Program on WATER & FOOD

A green-blue view

Rain = 1745 km^3
Rainfed ET - 190 km^3
Irrigated ET - 67 km^3
Outflow - 10 to 30 km^3

Limited options to expand irrigation - but gets attention

Ample options to upgrade agriculture on rainfed lands - gets little attention



IWMI International Water Management Institute

CGIAR Challenge Program on WATER & FOOD


Unlocking the potential
Olivia Maldon

Get water to poor people

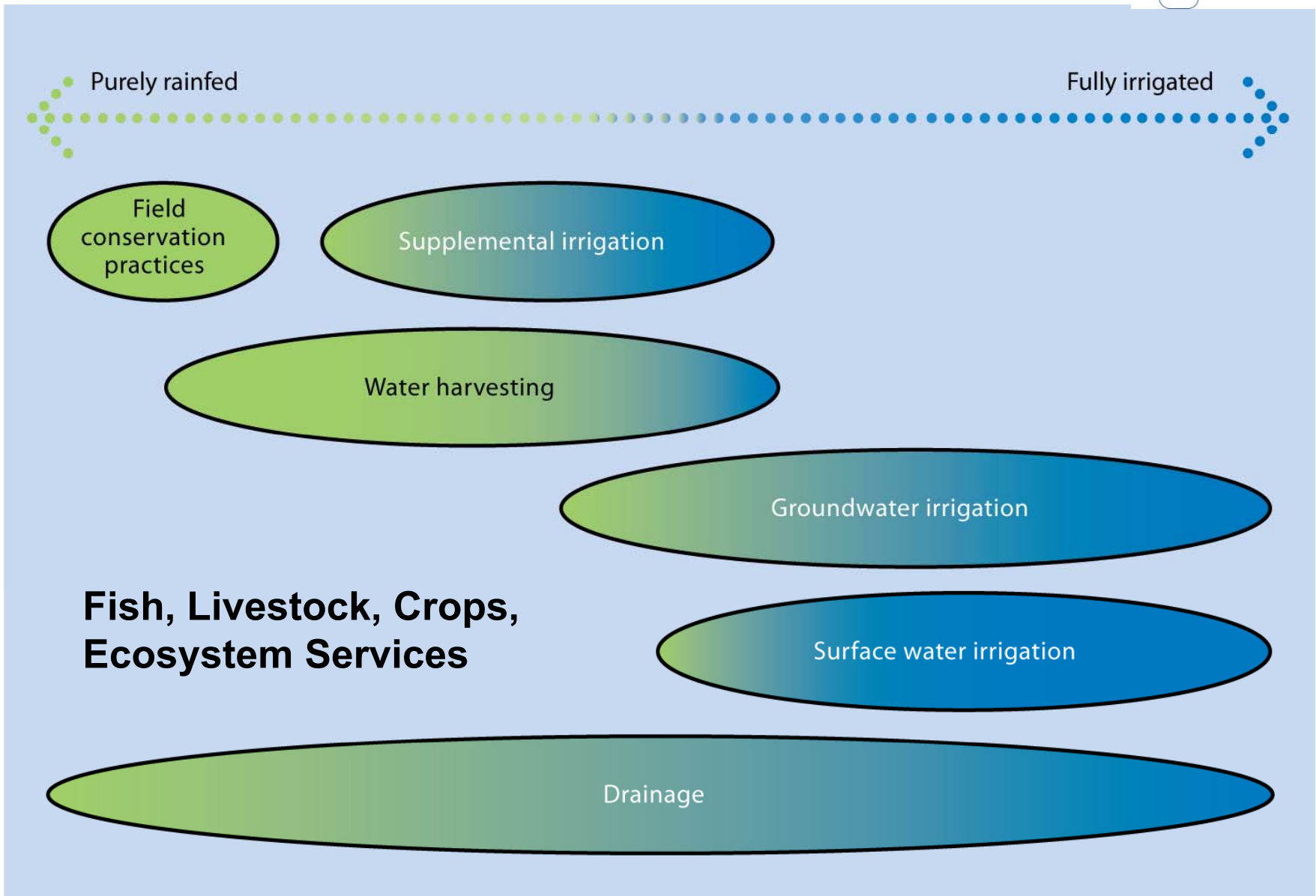
Around 70% of the world's under-nourished live in rural areas where non-agricultural livelihood options are limited.

Use it Better

Improve and Safeguard Water Access

Access to Technologies

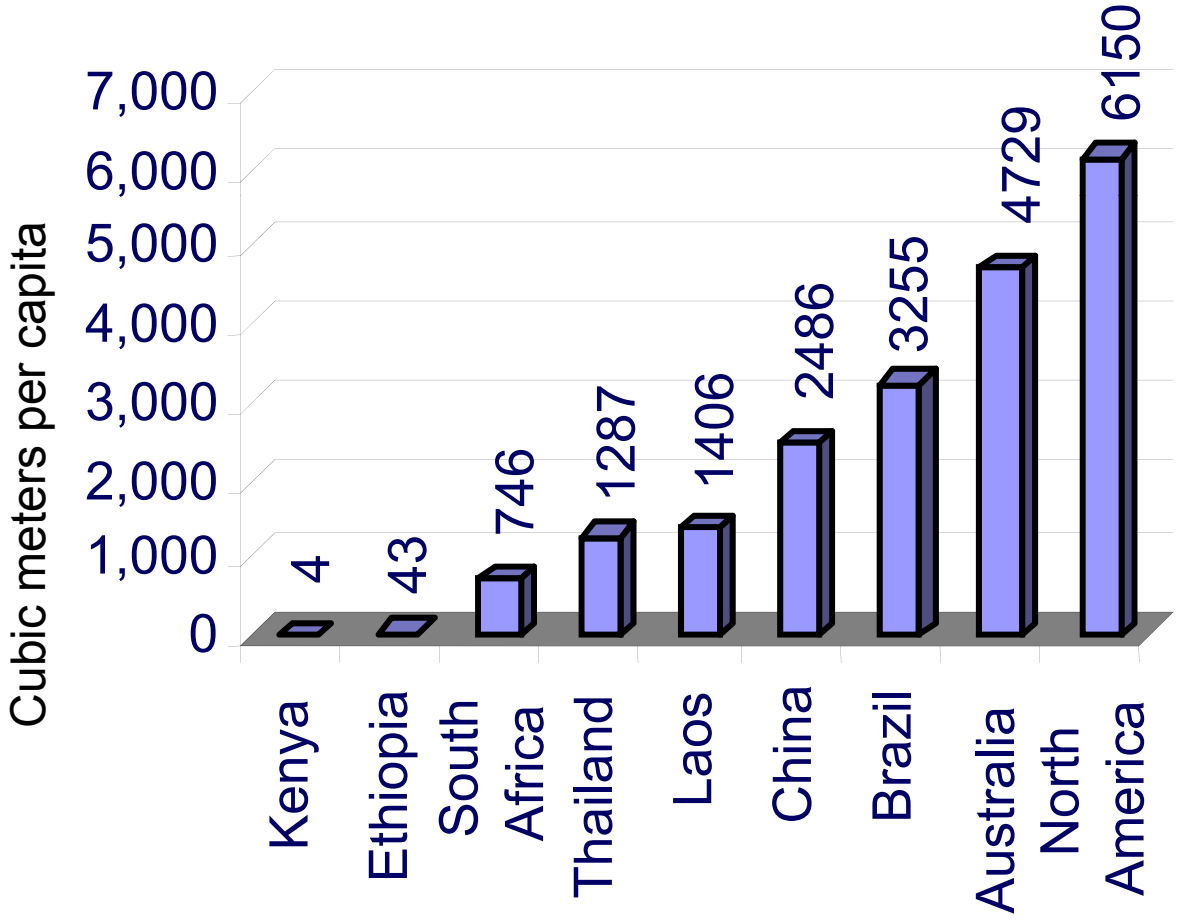
Consider A Range of Agricultural Water Management Options



Water Storage Mitigates Climate Variability

But need to re-think water storage: role of groundwater and soil moisture.

And beyond: insurance, local trade



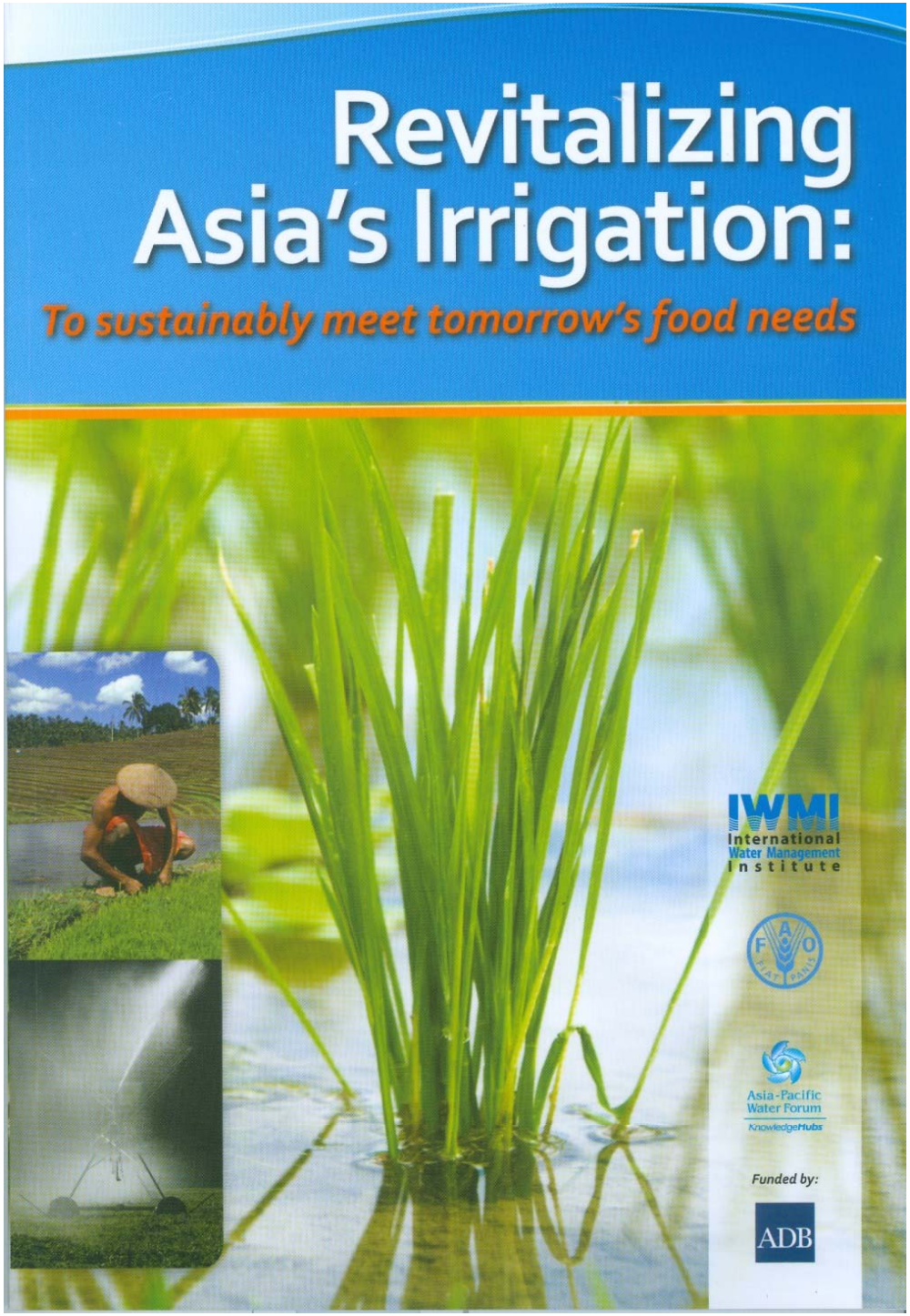
Source: World Bank data from ICOLD

Increase Water Productivity

- Physical Water Productivity – more crop per drop
  - To reduce future water needs
  - For food production increases
- Economic Water Productivity – more value per drop
  - For more income, growth
  - Integrated, multiple use systems

Opportunities in Rainfed Landscapes

- *Largest opportunities to improve WP are in rainfed landscapes – low WP, high poverty*
- *Technology*
  - water harvesting, supplemental irrigation
  - Field water conservation to reduce evaporation (convert E to T)
  - Improved nutrients
  - Varieties – drought resistance
- *Expand Policies to include upgrading rainfed systems*



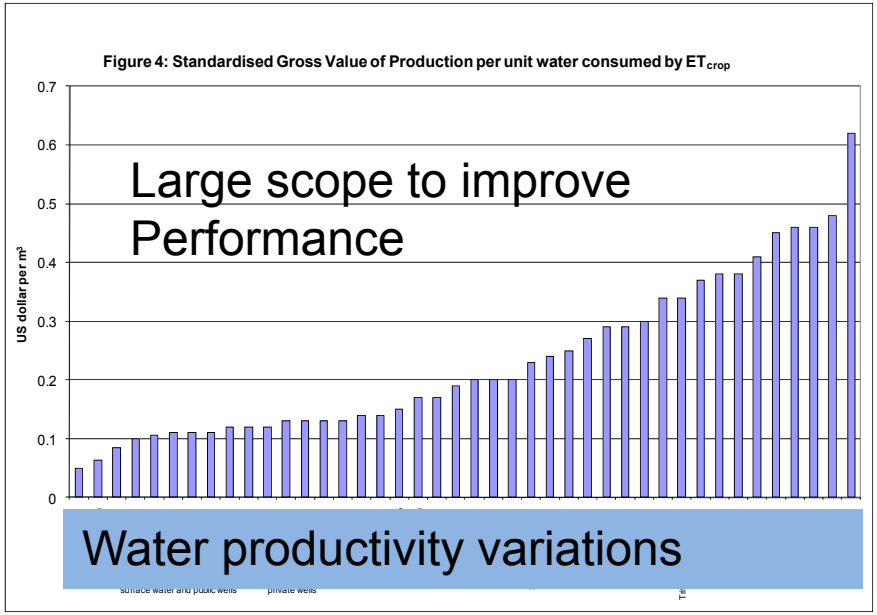
Asia needs to feed an extra 1.5 billion people by 2050, with food needs projected to double.

Cannot rely on rainfed alone

Asia contains 70% of the world's irrigated area

Important to do it right for:

- Climate change
- Food security
- Environment



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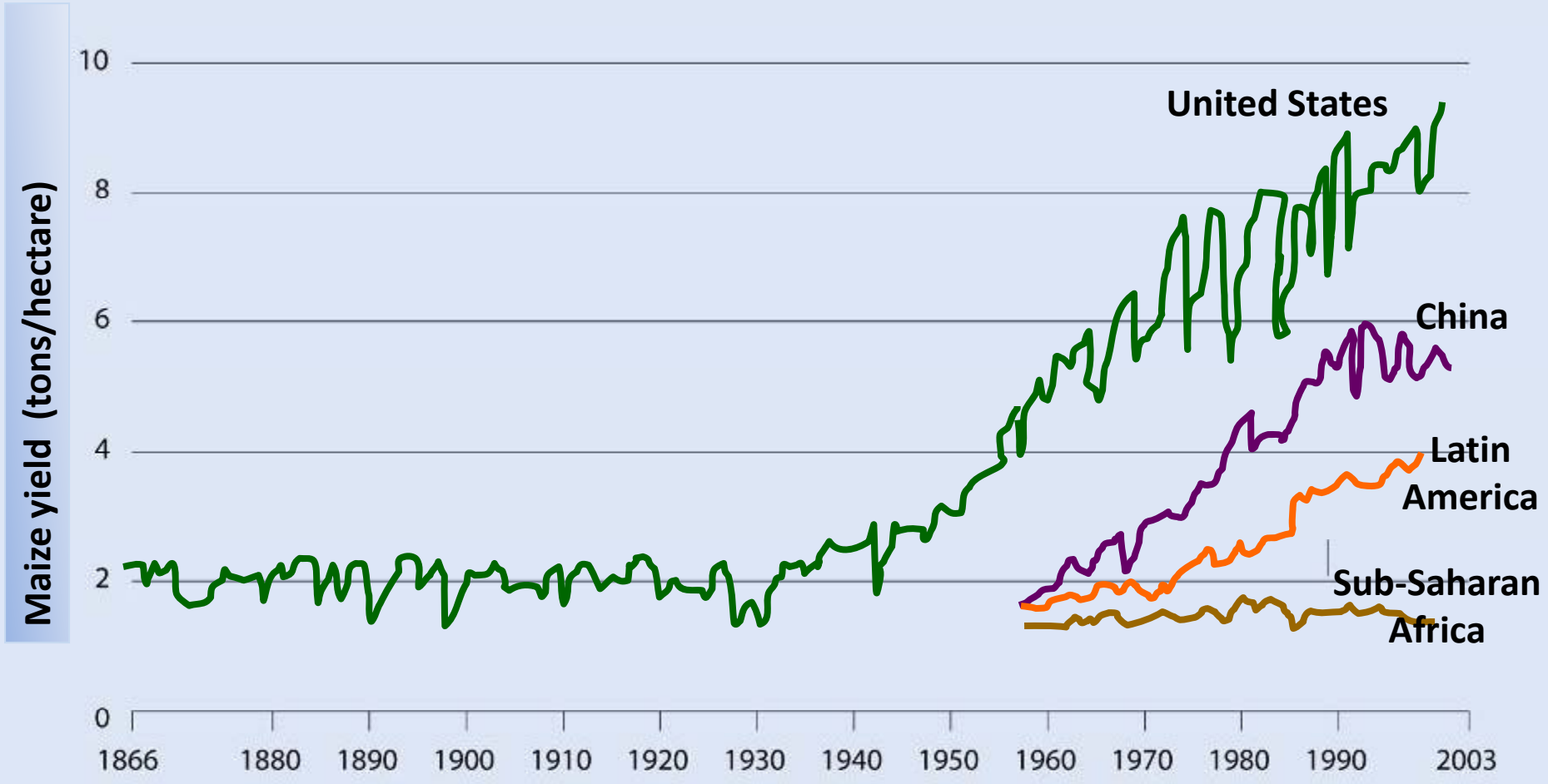
Productivity



Source: U.S. data, U.S. Department of Agriculture's National Agricultural Statistics Service; all other countries and regions, FAOStat.

WP for Livestock and Fish

- Beef 0.03 to 0.1 kg/m^3 (ET)
- Fish 0.05 to 1.0 kg/m^3 (ET)

Rapid increase in consumption of fish, meat, milk, with income

Huge scope for improvement – feed source, and animal husbandry important

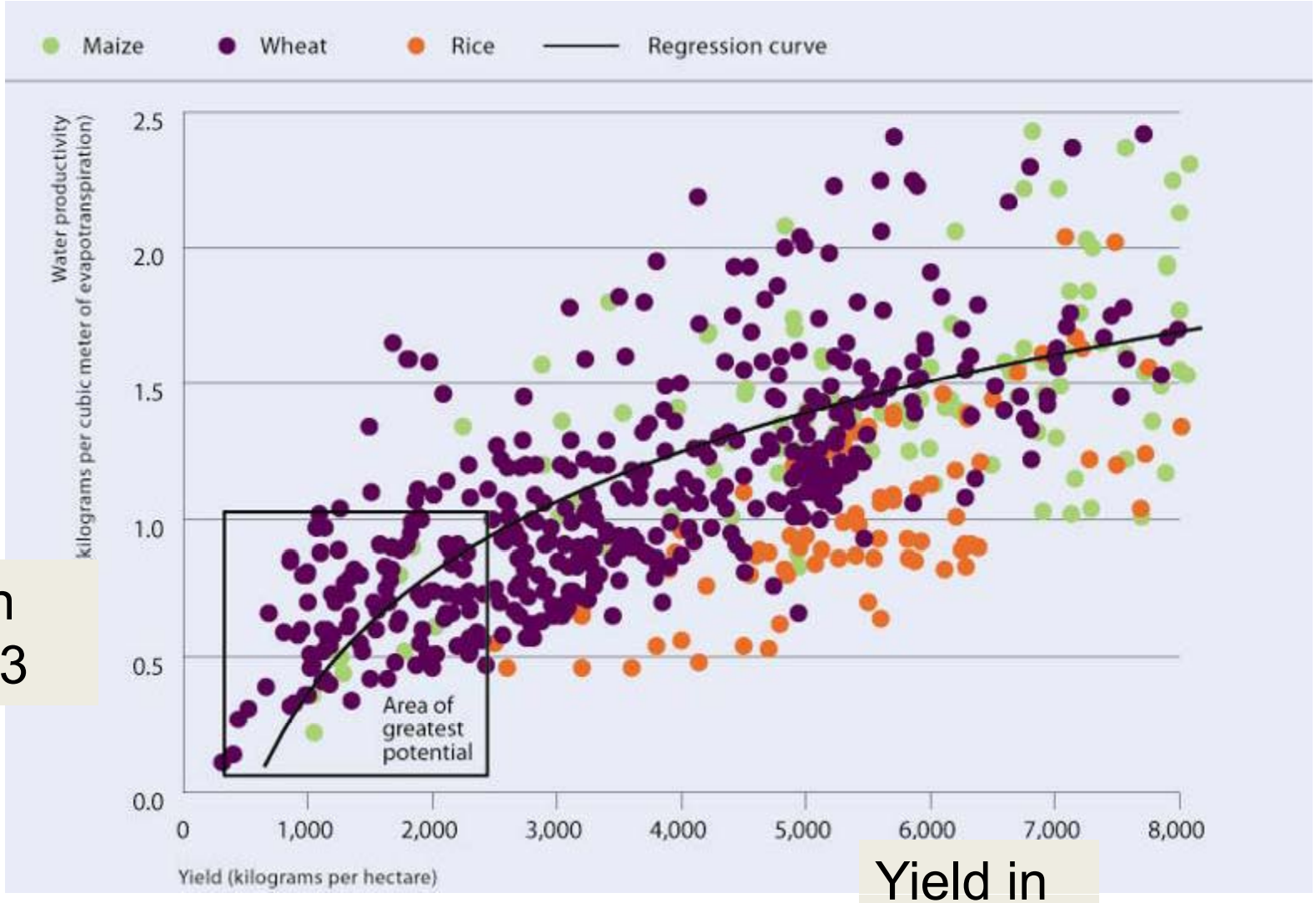
Range of water productivities in biological, economical and nutritional terms for selected commodities

Product	Water Productivity			
	Kilograms per cubic meter ET	Dollars per cubic meter ET	Protein grams per m^3 ET	Calories per m^3 ET
Wheat ($0.2 per kilogram)	0.2-1.2	0.04-0.30	50-150	660-4,000
Rice ($0.31 per kilogram)	0.15-1.6	0.05-0.18	12-50	500-2,000
Maize (0.11 per kilogram)	0.30-2.00	0.03-0.22	30-200	1,000-7,000
Beef ($3.0 per kilogram)	0.03-0.1	0.09-0.3	10-30	60-210
Fish (aquaculture)[a]	0.05-1.0	0.07-1.35	17-340	85-1,750

[a]Includes extensive systems without additional nutritional inputs to superintensive systems

Source: Muir, 1993; Verdegem, Bosma, and Vereth 2006; Renault and Wallender 2000; Oweis and Hachum 2003; Zwart and Bastiannsen 2004

Water productivity rises faster at lower yields and levels off at higher yields



WP in Kg/m3

Yield in Kg/ha

Source: Adapted from Zwart and Bastiaanssen 2004
In Water for Food, Water for Life, Earthscan Publishing

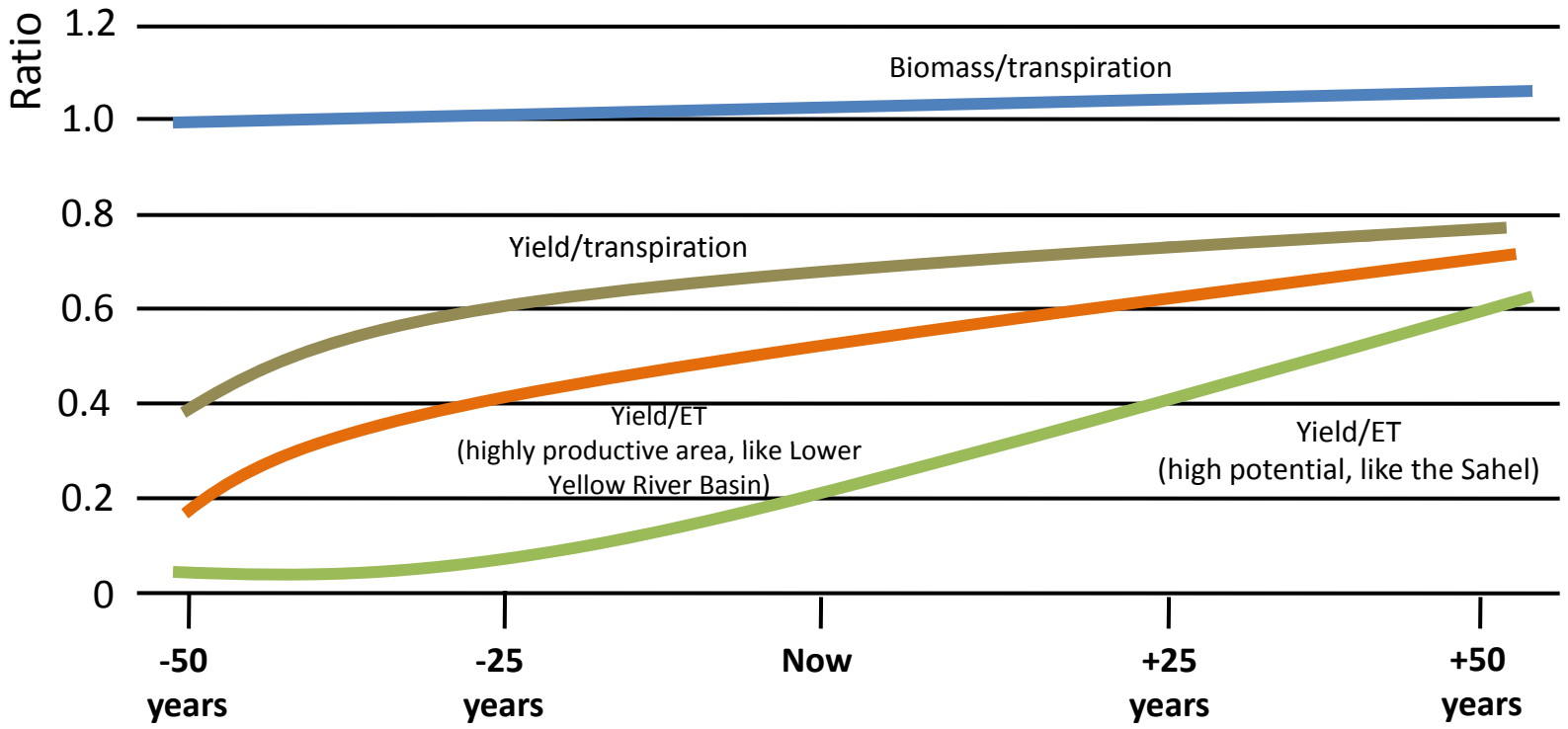
Comprehensive assessment of water management in agriculture

Water productivity is subject to diminishing returns

Source: Based on the yield-water productivity relationship for rainfed cereals in Rockström (2003)

In Water for Food, Water for Life, Earthscan Publishing

The highest gains in water productivity for common crops such as rice, wheat and maize are likely in areas where yields are still low



Source: *Schematic developed for the Comprehensive Assessment of Water Management in Agriculture*

Caution – It is not easy

- *Adoption rates are low* – water productivity not necessarily a farmer concern, need to understand political-economy of water use
- *Scale effects*: Farm water productivity gains can increase basin depletion, not save water
- Need to understand *tradeoffs* and align *incentives* of different actors by a variety of means (economic incentives, allocation)

Engage in Policy Reform

- Poverty, hunger, gender inequality, and ecosystem degradation continue
  - not because of technical failings but because of political and institutional failings
- Diversity is a key to resilience
- No blueprints - **need to craft local solutions**

Address Drivers of Change

Our policies and actions outside the water sector;

- Agriculture
- Business
- Trade
- Response to climate change
- Diets
- Energy/biofuels

have a profound impact on water resources.

Photos from Diet for a Small Planet

Make difficult choices now, not later;

Try to increase the pie – share the benefits

But difficult choices remain:

- Water storage for agriculture – water for environment
- Upstream – Downstream
- Productivity - Equity
- This generation – the next one (GW decline)

Make better water choices

- Start with rain when thinking about water, work locally, think ecosystems, engage in policy and politics
- Produce more with less water from a range of agricultural water management options
  - Look for untapped opportunities: rainfed systems across SS Africa
  - Irrigation productivity gains across Asia
  - Solutions require us to think beyond water entry
- Lighten your footprint