

# The Global Food Challenge

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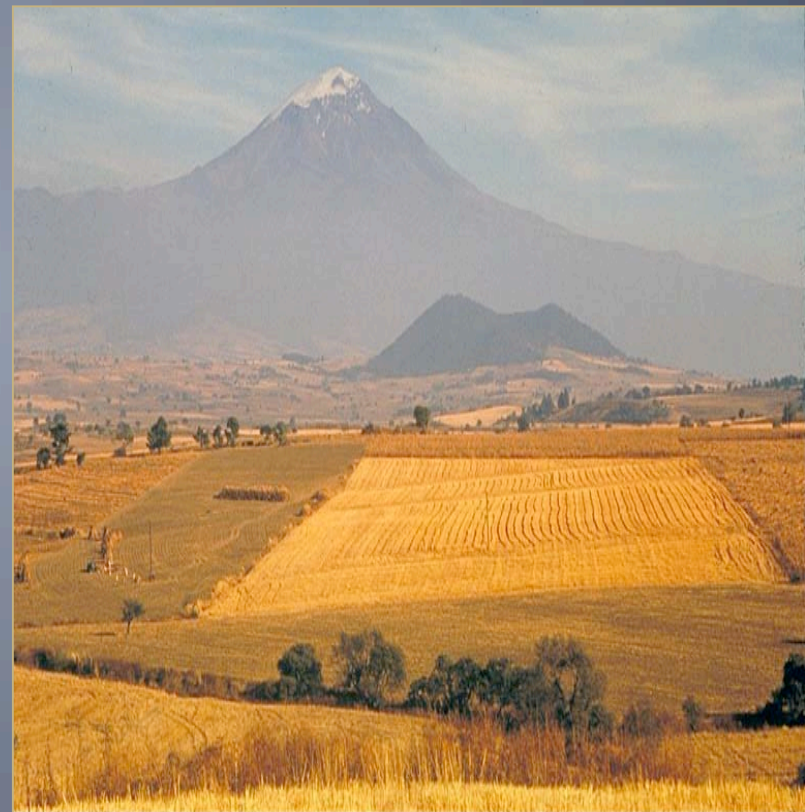
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# Challenges for the 21st Century

- How to feed a more populous and richer world in the decades to come?
  - With global climate change?
  - Without destroying the environment in the process?
- How to provide food access to the ~1 billion people who remain chronically hungry?
- How to address food insecurity within traditional national security circles?



# Food Security



When all people at all times have physical and economic access to the food necessary to lead a healthy and productive life.

- FAO

World Bank estimates:

Pop <\$1/day: 15%

Pop <\$2/day: 50%

## Undernourishment in 2004-6 and 2009, by region

Millions of people

	<u>2004-6</u>	<u>2009*</u>
Asia and the Pacific	566	642
Sub-Saharan Africa	212	265
Latin America and the Caribbean	45	53
Near East and North Africa	34	42
Developed countries	15	15
<b>World Total</b>	<b>872</b>	<b>1,017</b>


\* Estimated by FAO.

SOURCE: FAO State of Food Insecurity in the World (2009)



WAL-MART





# The 9 billion-people question

A special report on feeding the world | February 26th 2011

### Core crop price spikes stoke food inflation

Corn price (cents per bushel)



Wheat price (cents per bushel)



Soyabean price (cents per bushel)

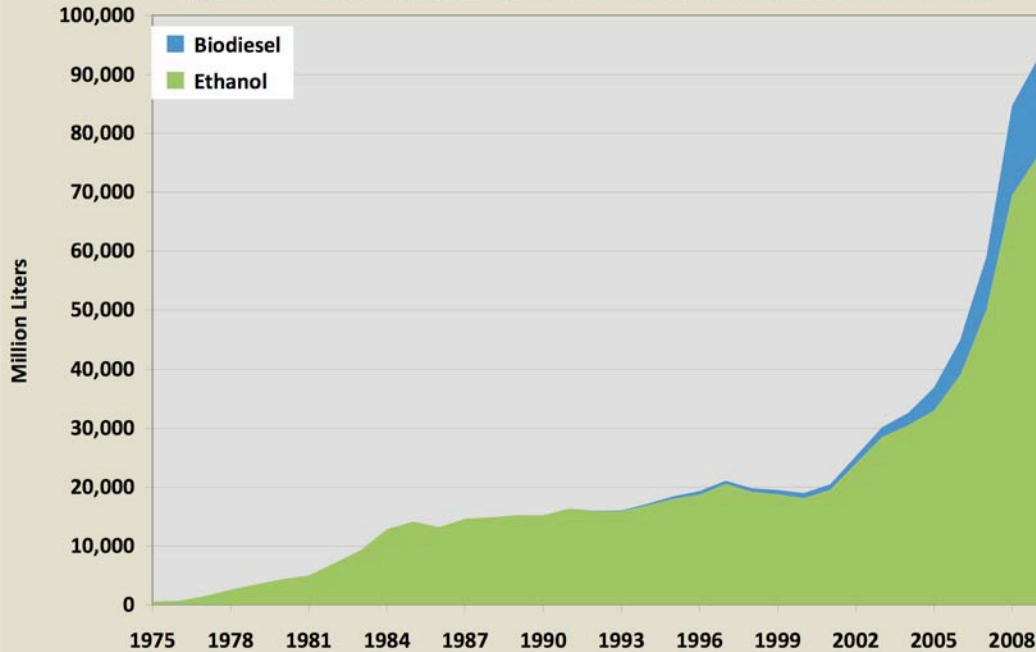


Source: Thomson Reuters Datastream

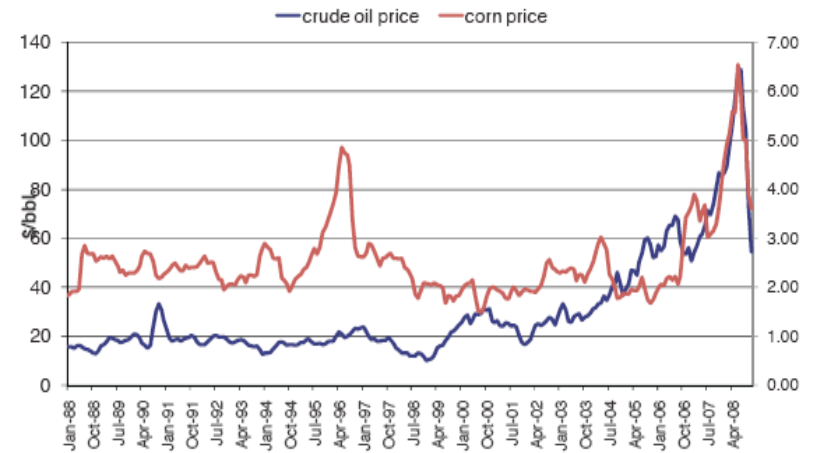


# Crop-Based Biofuels Boom

Figure 1. World Ethanol and Biodiesel Production, 1975–2009



Source: F.O. Licht, REN21



s: Corn price, USDA; oil price, DOE/EIA, refiner composite crude oil acquisition price.

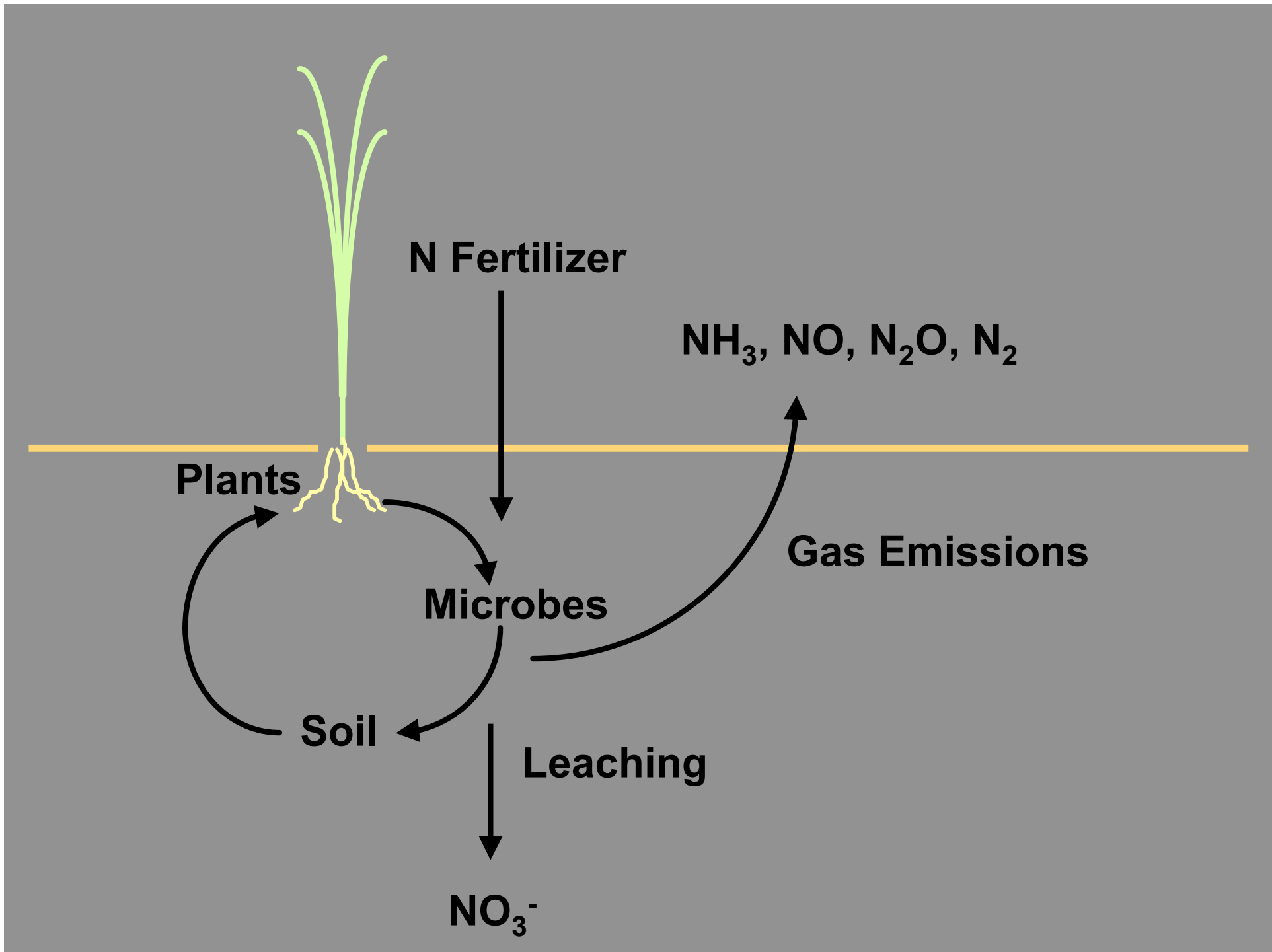
40% of US corn crop now used for ethanol





# Agricultural Intensification







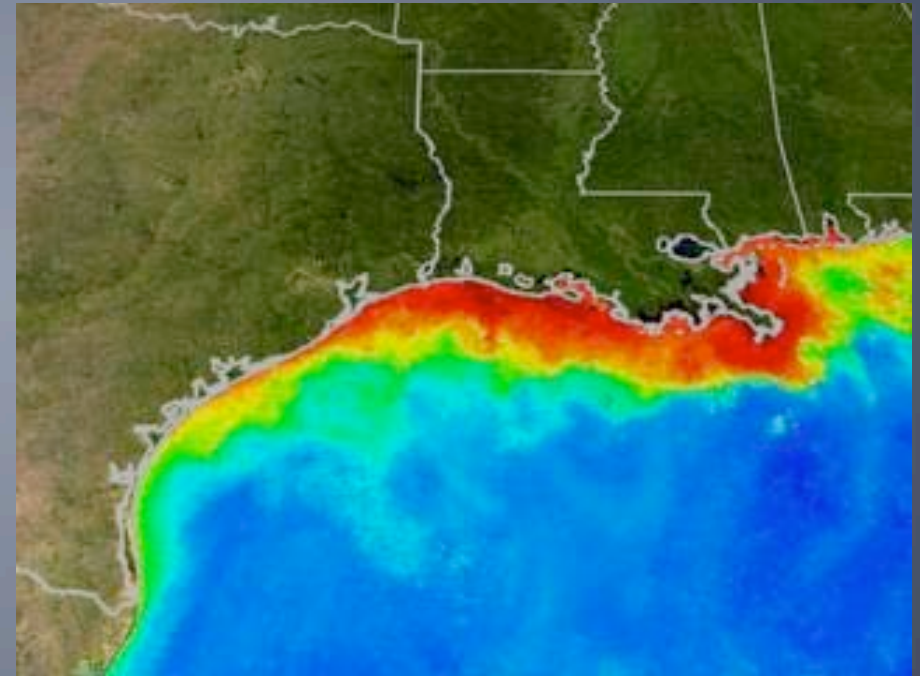
West Kenya: -52 kg/N/ha/year



North China Plains: +227 kg/N/ha/year

(Src: Vitousek et al, *Science*, 2009)

# Social Costs of Excess Nutrients



# Joey's Corn and Cattle Operation

- Corn yields: 240 bu/acre
  - 4x a generation ago
- Cattle weight gain 4 lb/day w/ hormone implants
  - ~2x a generation ago
- 175 day grow out
  - vs. 280 a generation ago



# Intensification of Animal Production



Links to:

- Income growth
- Technology
- Global trade
- Fisheries decline



# An Inconvenient Trough\*



- Global livestock production accounts for ~18% of total greenhouse gas emissions ( $\text{CO}_2$ ,  $\text{N}_2\text{O}$ ,  $\text{CH}_4$ )
  - Land use change, fertilizer for feeds, waste/gas
- Stress on land and water resources; nutrient effluents

\*(Source: Steinfeld et al (2007) for research; Atlantic for phrase)

# Grass-fed Beef: The Land Tradeoff



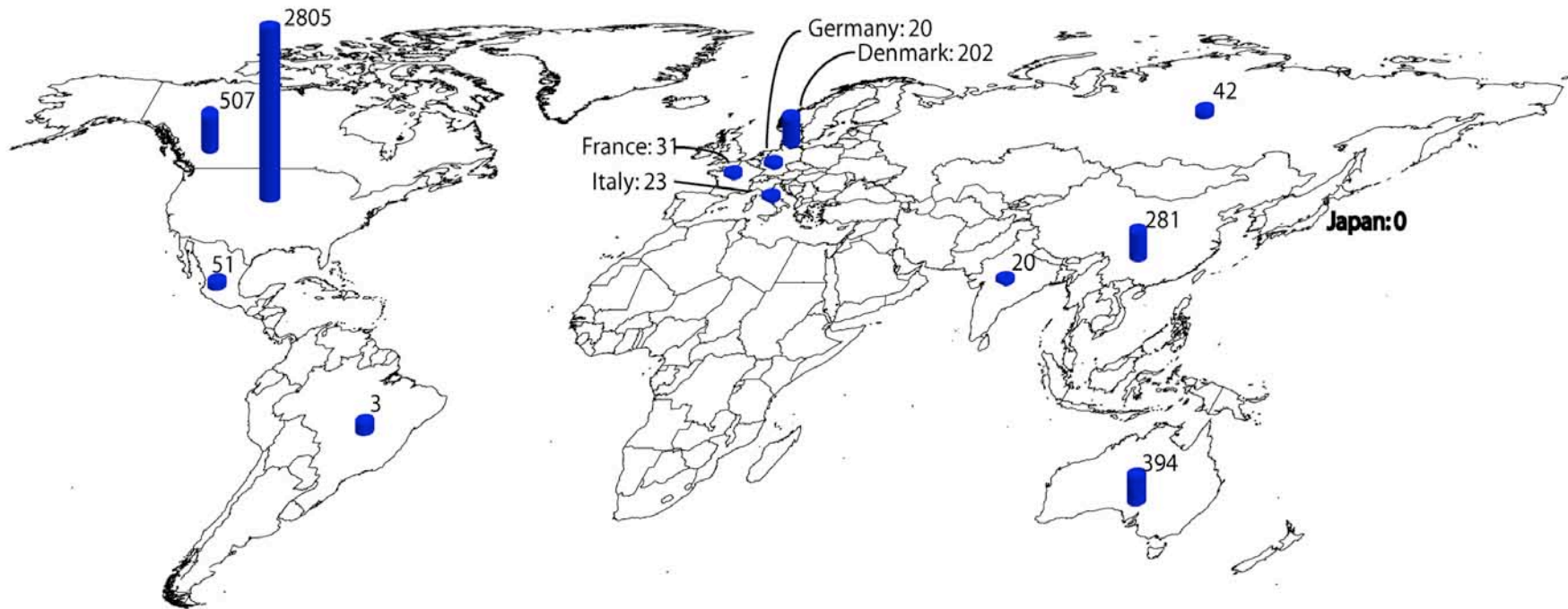
- How much land would it take to transition from grain- to grass-fed beef in the US?
  - Assuming current consumption of beef and current productivity of pasture (no dairy)
- **61% more land required** for cattle under grass-fed regime
  - (~100 million more acres)
- Or to maintain same rangeland: **38%-66% drop in beef consumption**



# Feed Crops: The Water Tradeoff

Virtual water associated with feed production for pigs and chickens consumed in Japan

Bars refer to water left behind in producing country during feed production  
Data are in millions of cubic meters



Feed water totals for Japan

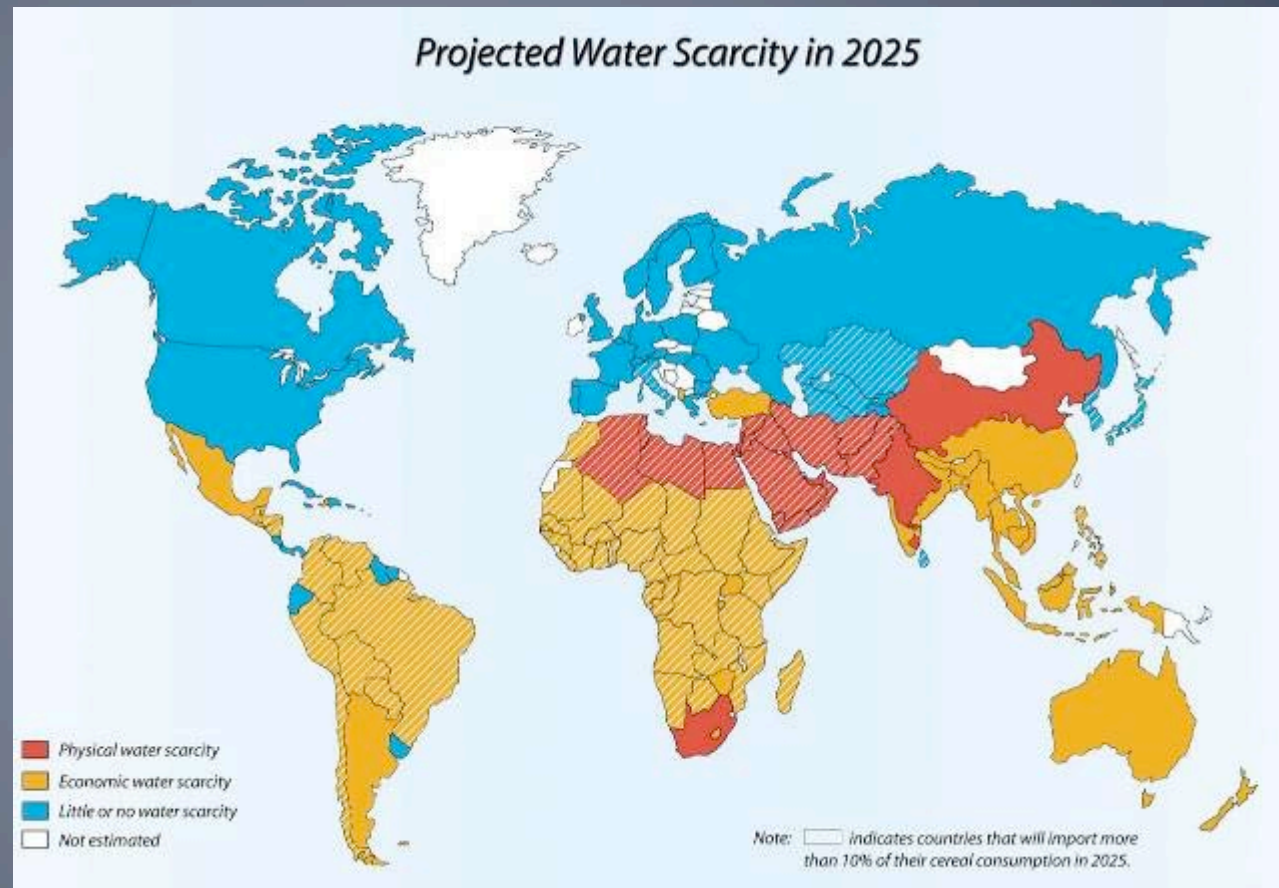
Import + production = 4.4 billion cubic meters

Import only = 4.4 billion cubic meters

# Water scarcity for food production?

**Physical scarcity:** Not enough water.

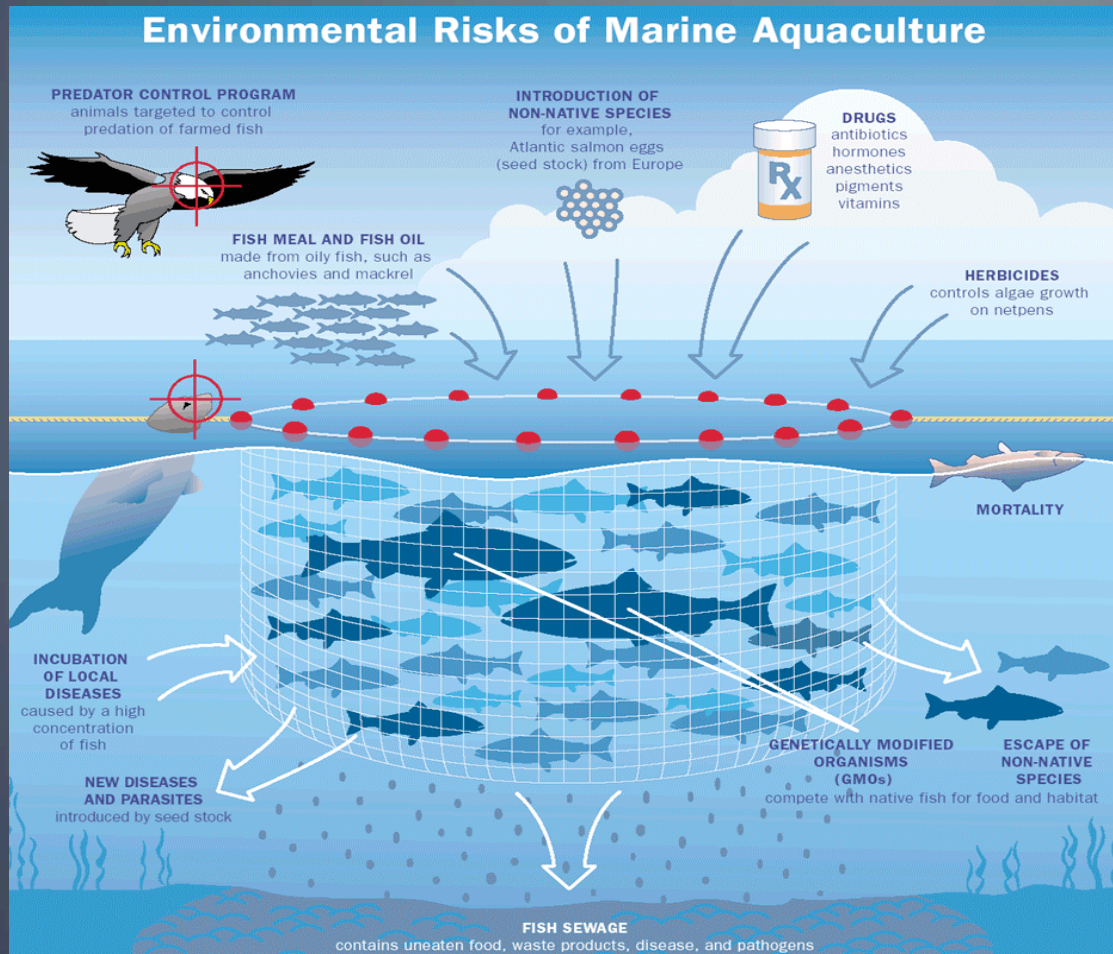
**Economic Scarcity:** No infrastructure to make water available to farmers.



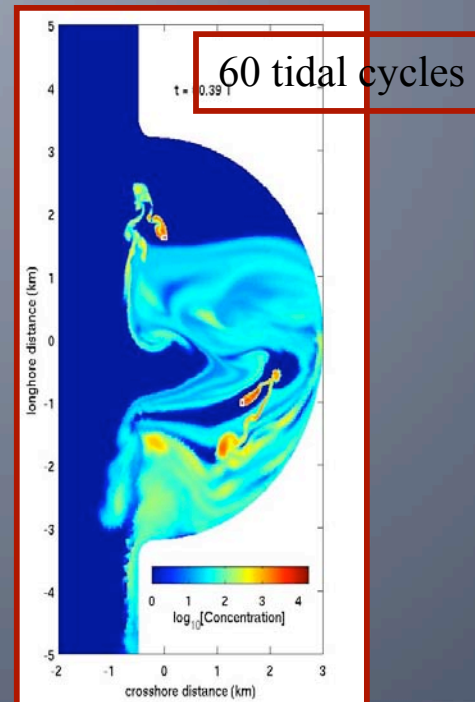
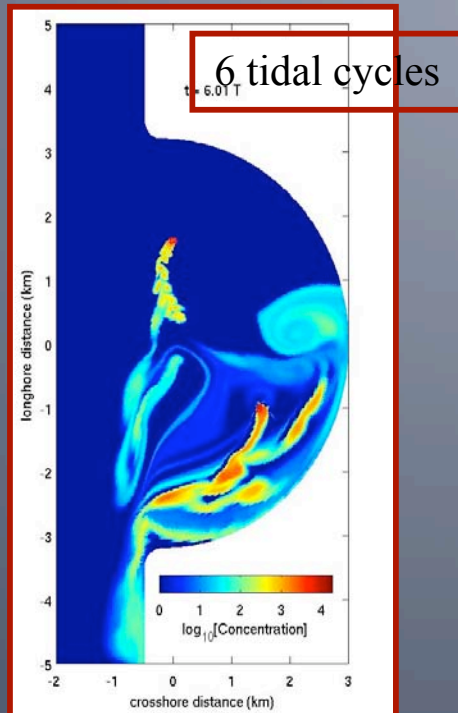
Source: IWMI

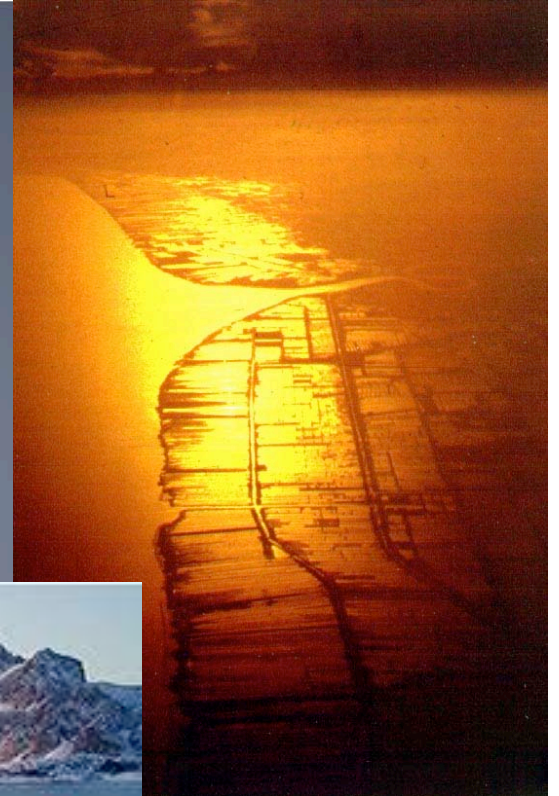
A third of the world's population will suffer from water scarcity in 2025

# Aquaculture: Intensive Fish Production



# Feedlots of the Sea?





# Which Fish is Best to Buy?



# Land Expansion for Agriculture



% achieved through area expansion  
(1995-2009)

- Brazil soy: 81%
- Asia oil palm Asia: 92%





- 42 million ha in 2008-09
- Land speculation when financial markets have low yields
- 75% land sales in Sub Saharan Africa
- Countries with weak land institutions, “under-utilized”  
e.g., Sudan, Zambia, Mozambique, Madagascar



# West Papua, Indonesia “Feed the World Project”

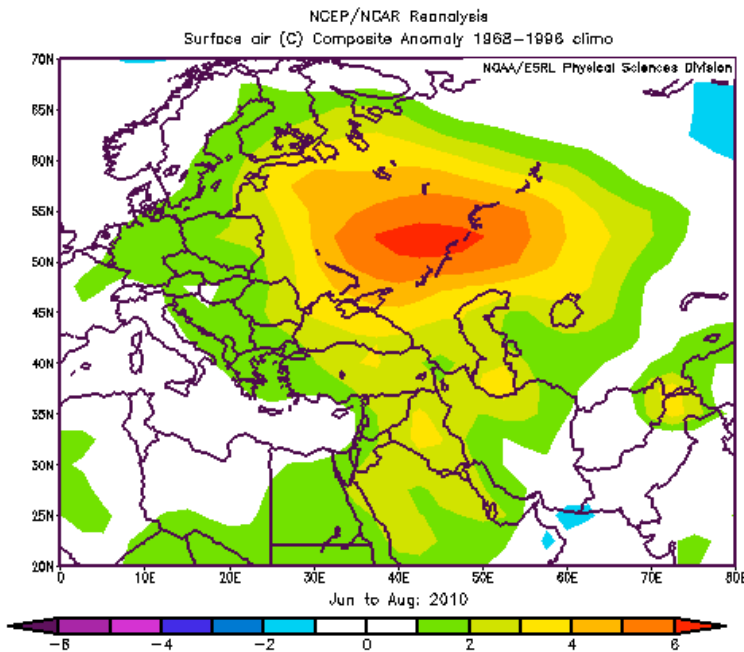
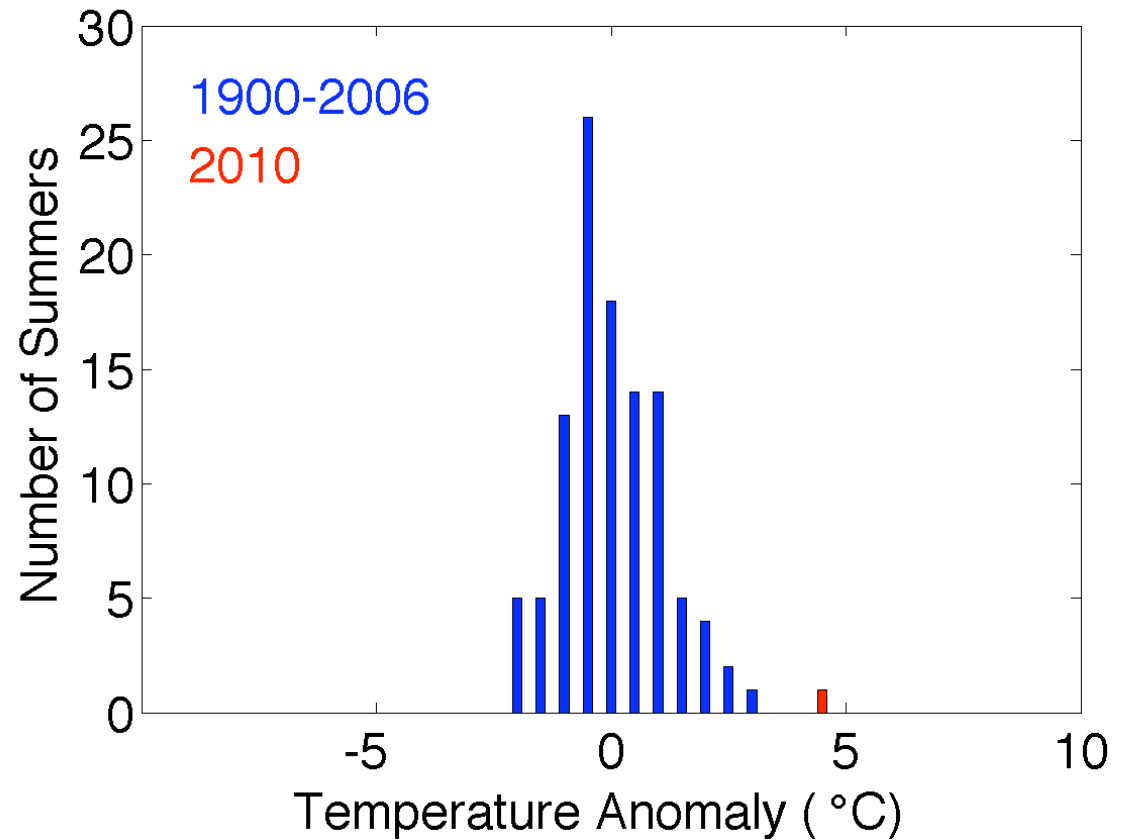


Threat to ecosystem services

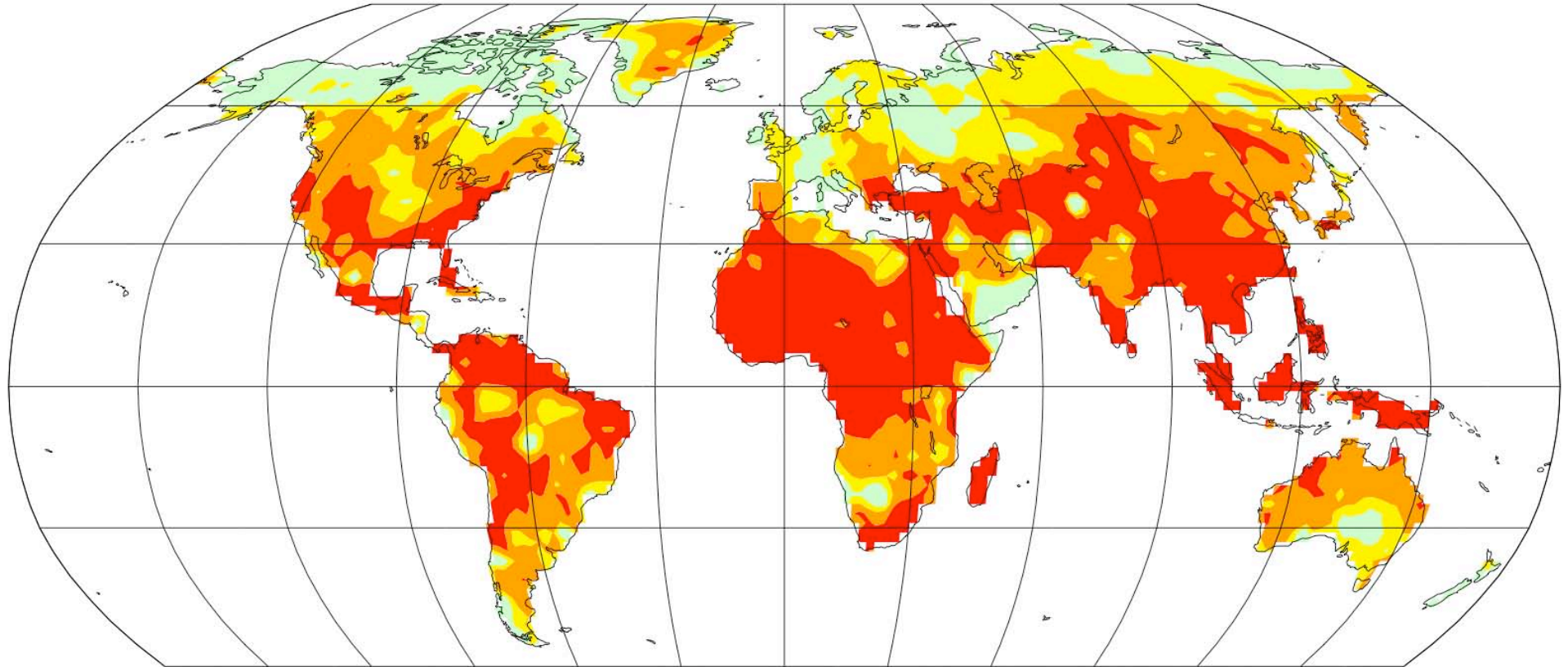
# Global Climate Change



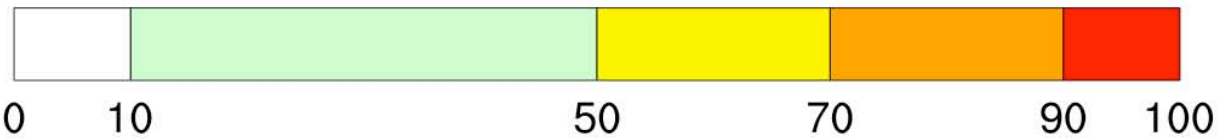
# Heat Wave in Russia's Prime Wheat Region, 2010



## Summers in 2080-2100 Warmer than Warmest on Record



percent (%)



(IPCC Predictions, 4th assessment, 23 models, A1B scenario)

# Agriculture-Energy-Climate Links



Energy and climate implications of high-yielding, intensive agriculture?



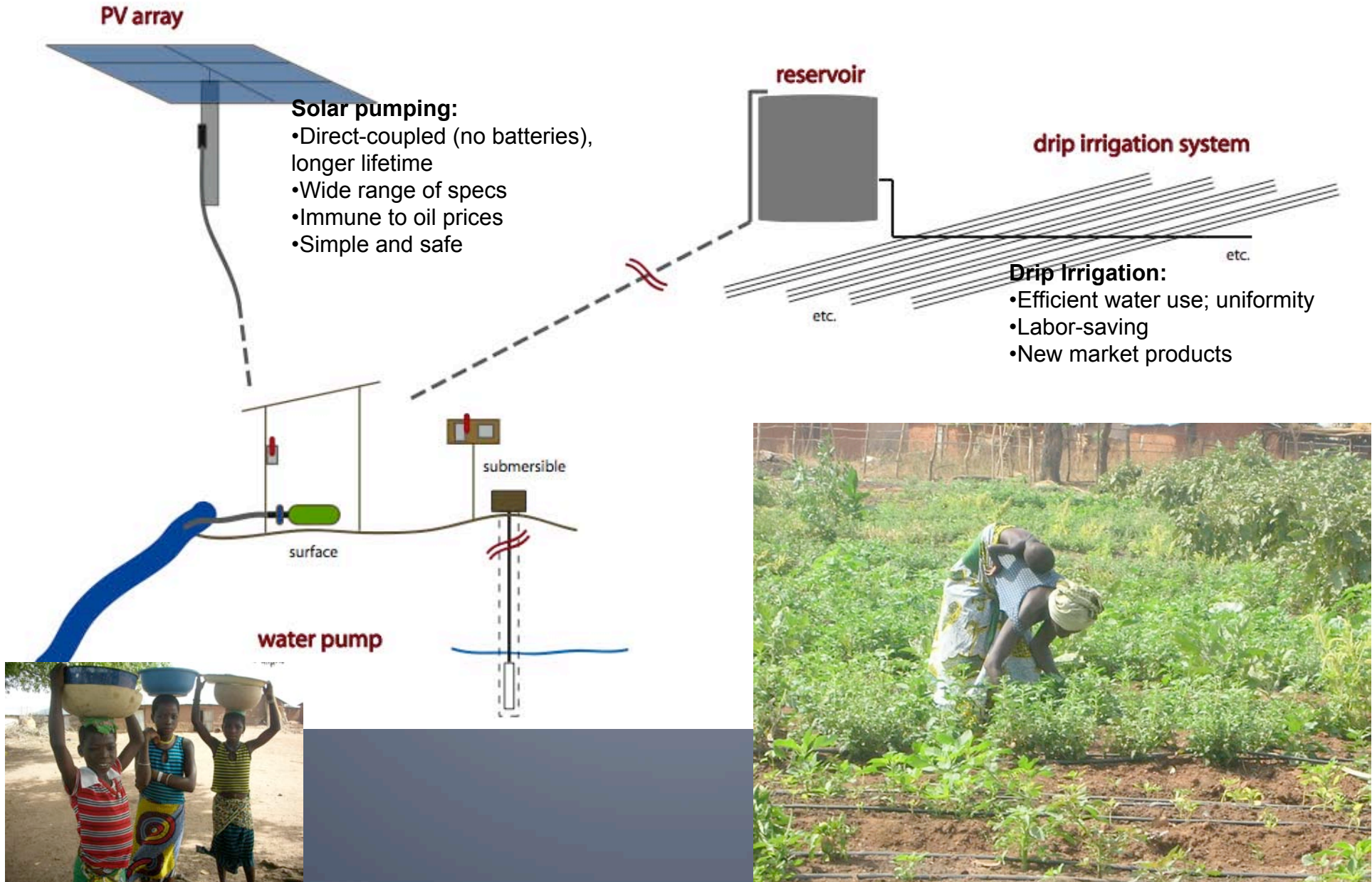
Hypoxia from fertilized corn (ethanol) or from oil spill?

# Let's put our innovative minds to work

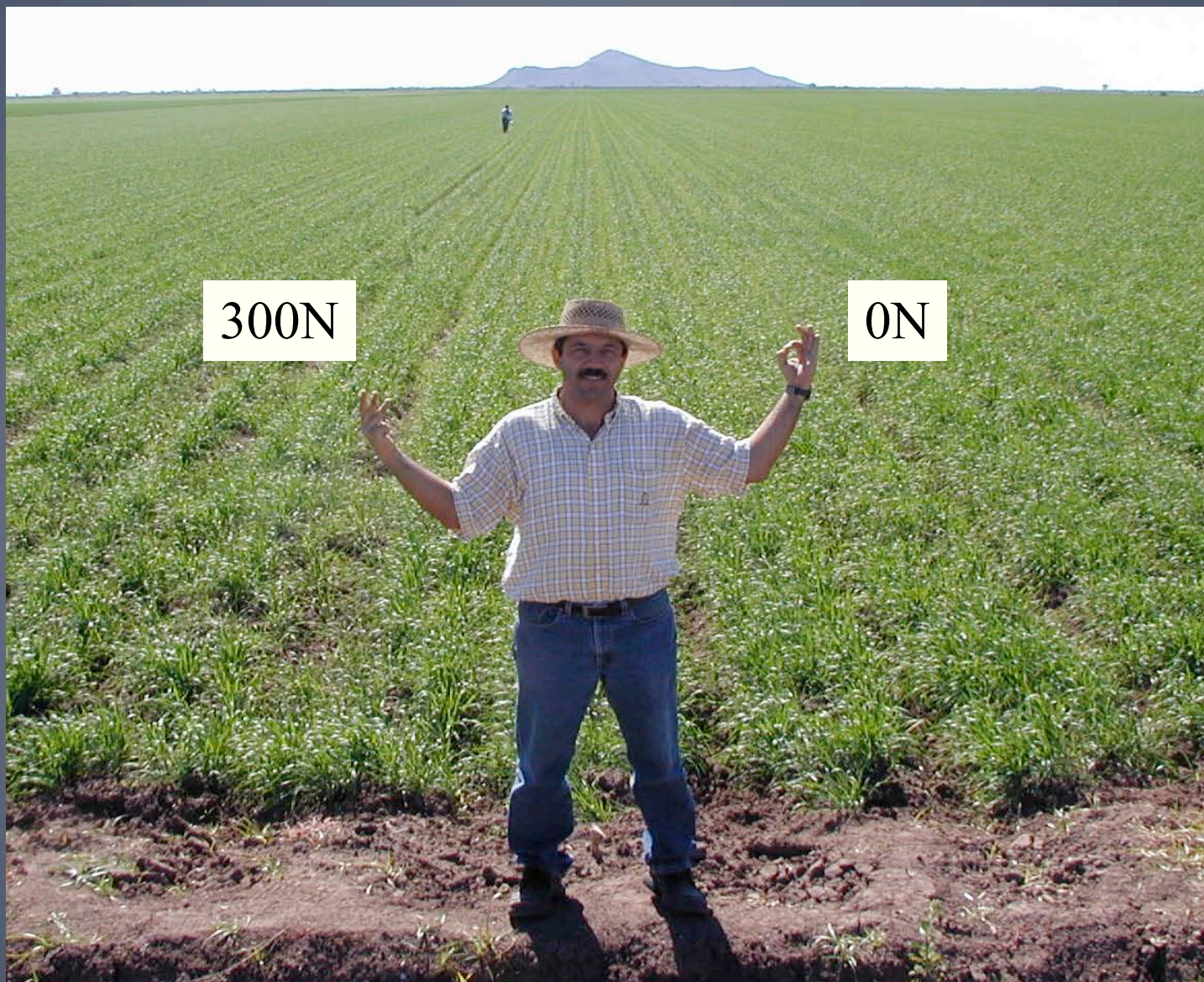


- Technology
- Management
- Policy
- Consumption

# Solar-Powered Drip Irrigation



# N Overshoot in Yaqui Valley



Manuel Lopez de Lara- Villa Juarez, Yaqui Valley, Mexico  
(photo: Ivan Ortiz-Monasterio, CIMMYT)



# Examples of Policy Involvement



- U.S. Farm Bill (production vs. conservation incentives)
- U.S. biofuels policy
- U.S. aquaculture policy (CA, Federal)
- Indonesia's food and agricultural policies
- China's rural development policies







The good news is that we're driving a Mercedes.....

