

CGIAR 40  
YEARS

HAPPY BIRTHDAY CGIAR!

**Kenneth Cassman**  
Chairman, ISPC

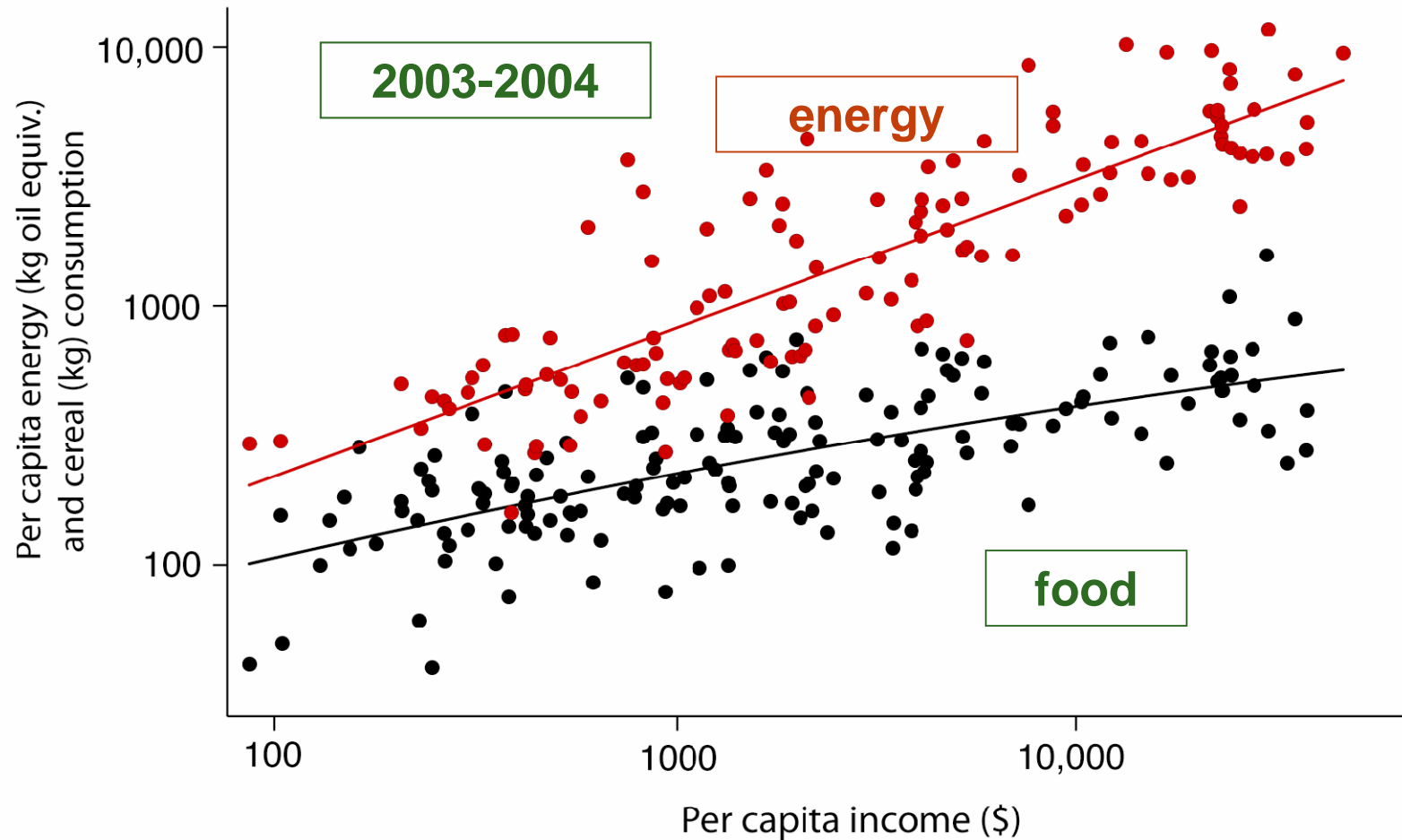


# What outcomes and impacts should the CGIAR be held accountable for in the next 40 years?

**The CGIAR must serve as the global catalyst and contributor to:**

- A stable climax human population of 9.2 billion in 2050, in a food secure world with decreasing atmospheric greenhouse gas concentrations**
- What does that vision require?**
  - Average annual income of ~US\$5000**
  - Universal education**
  - Adequate, affordable, accessible, nutritious food supply**

## Energy or Cereal Consumption versus Income by Country

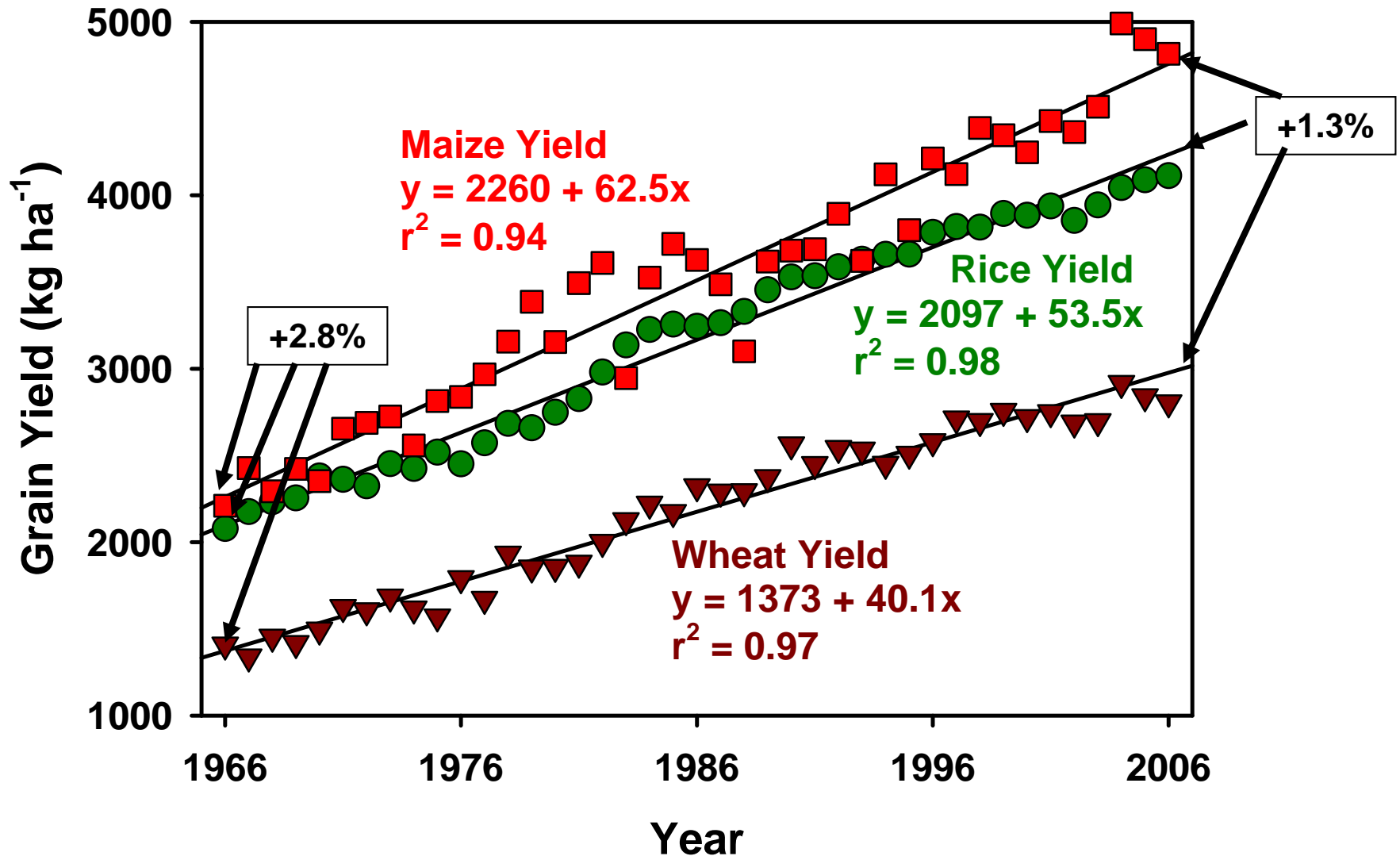


Naylor et al., 2007. *Environment* 40: 30-43. Energy and income data from World Bank development indicators; cereal consumption data from FAOSTAT.

# Biofuels compared to what?

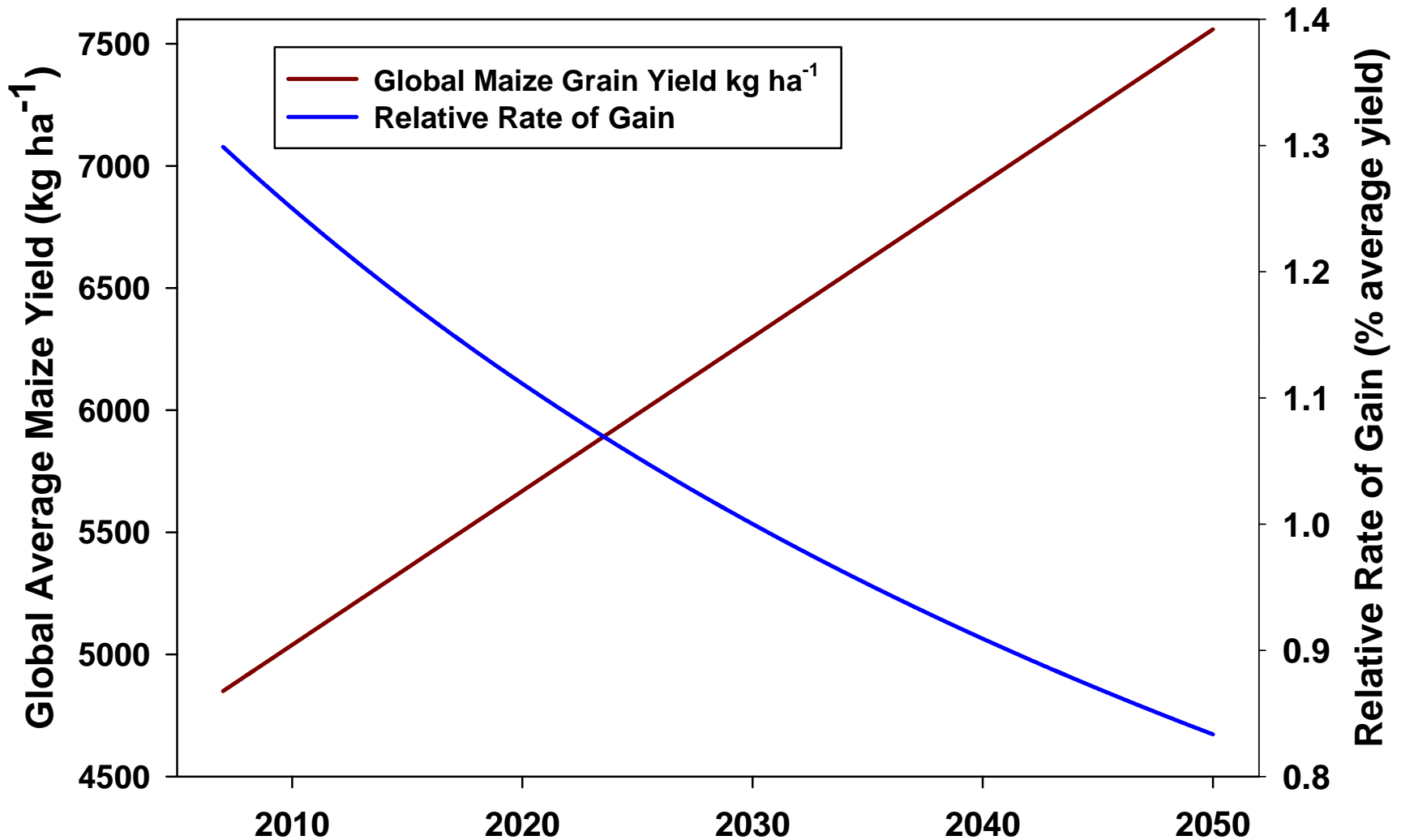


# Global Cereal Yield Trends, 1966-2006



THESE RATES OF INCREASE ARE NOT FAST ENOUGH TO MEET EXPECTED DEMAND ON EXISTING FARM LAND! source: FAOSTAT

# Tyranny of constant rate of yield gain: Decreasing relative rate of gain





**Urban-industrial expansion onto prime farmland at the periphery of Kunming (+6 million), the capital of Yunnan Province, China,**

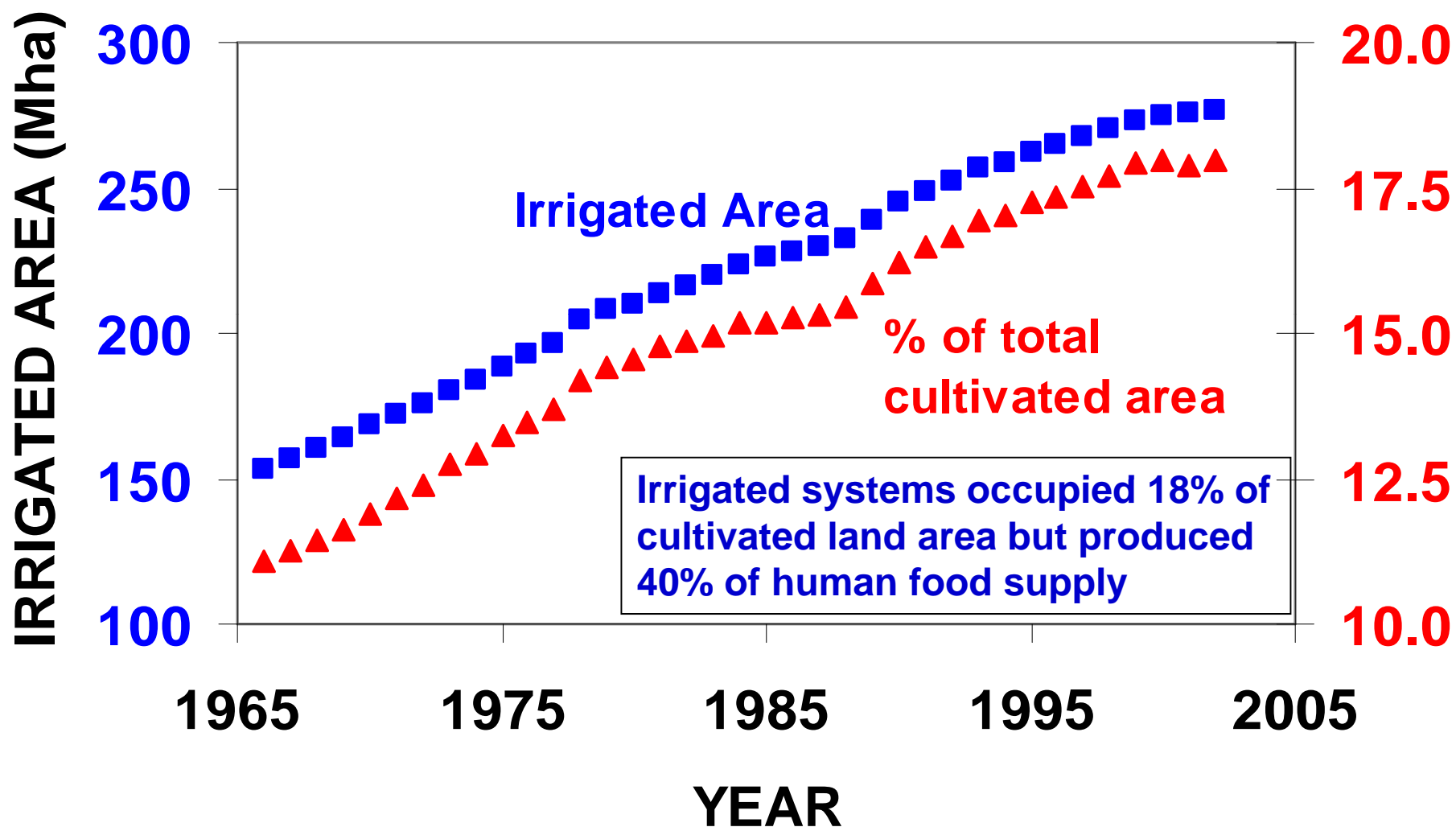
**Photo: K.G. Cassman**

**Food insecurity: unsustainable agriculture on marginal land  
by poor farm families without other options**



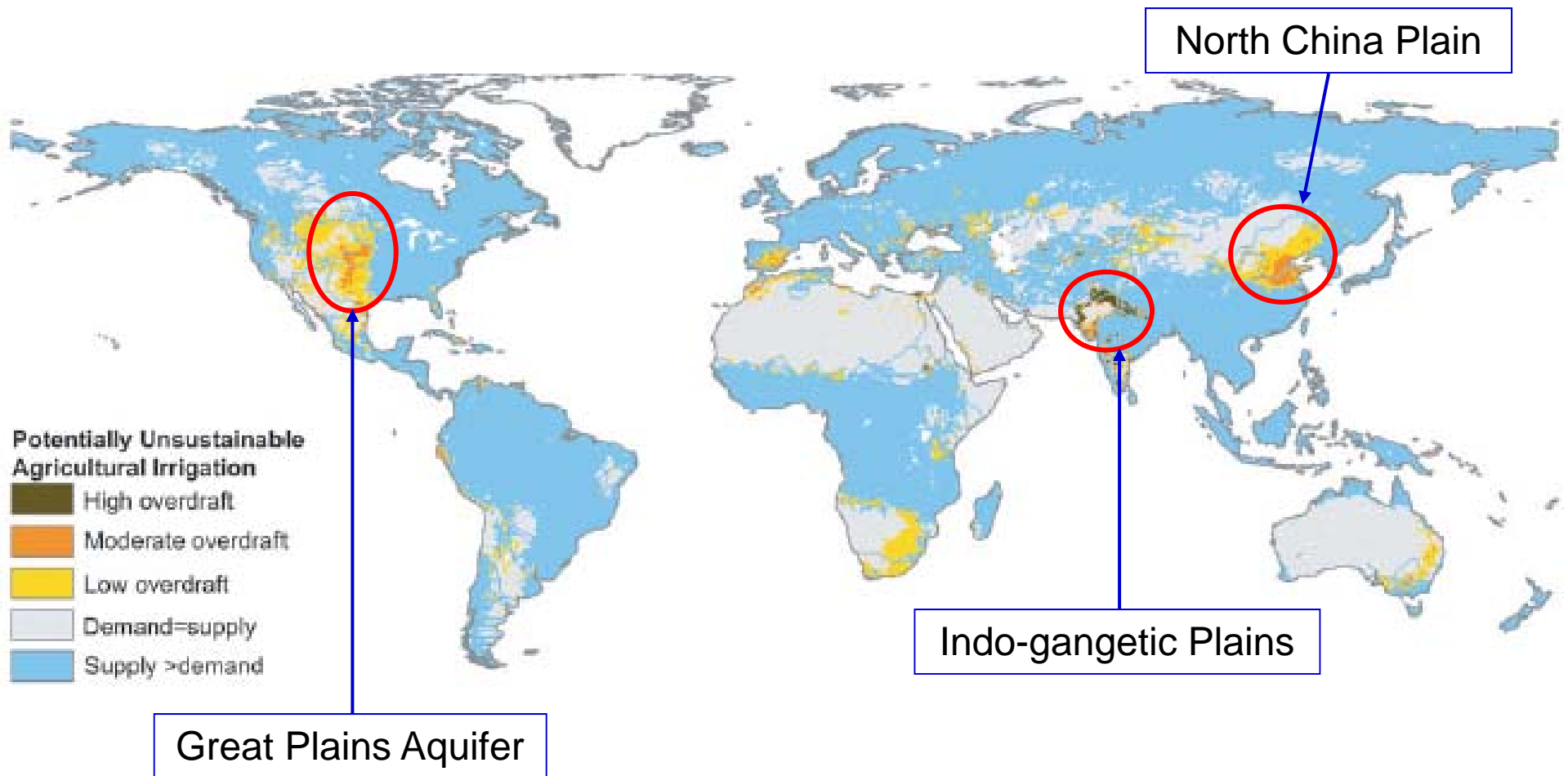
Photo: K.G. Cassman

## Global Irrigated Area and as a % of Total Cultivated Land Area, 1966-2004



# Overdrafted aquifers supporting irrigated agriculture

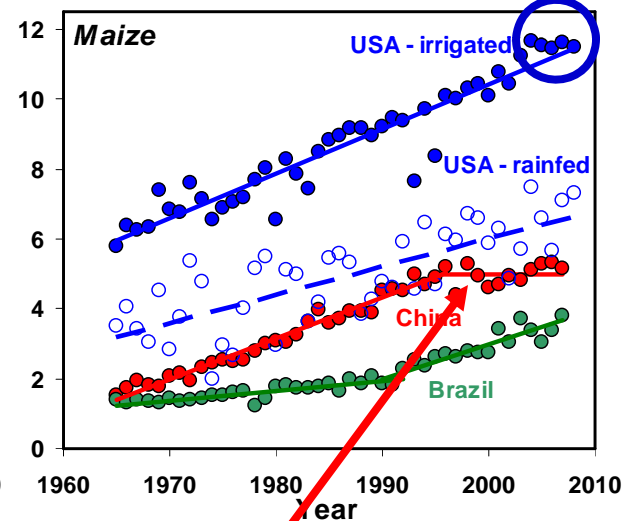
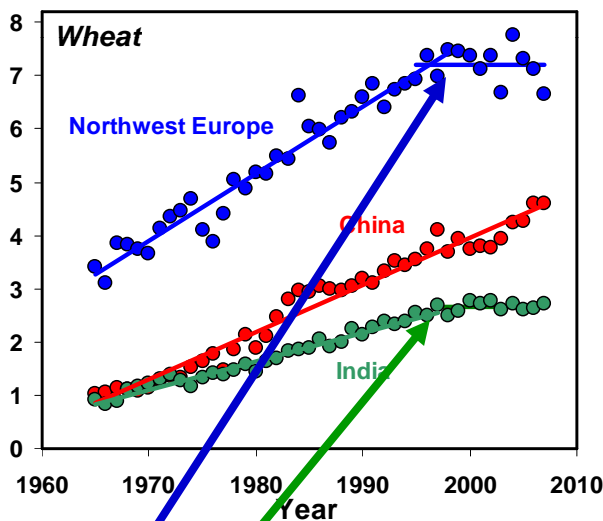
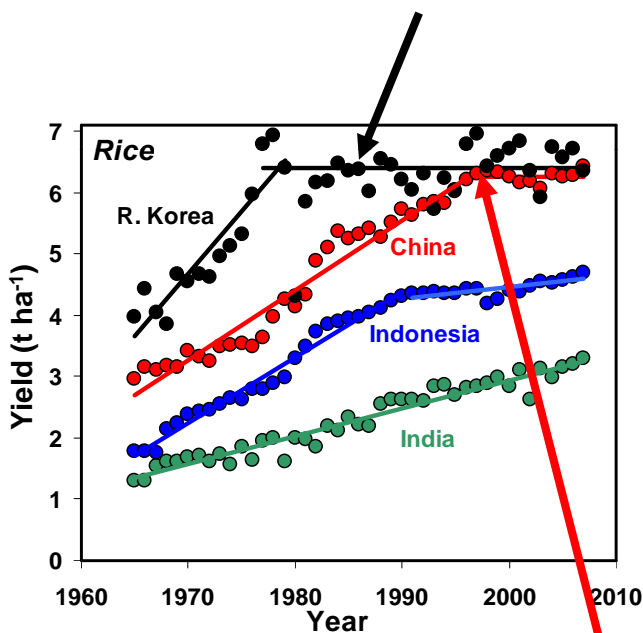
Source: Millennium Ecosystem Assessment



**Yield plateaus are evident for several cereal crops for several major crops and countries: Korea, Japan, China for rice, wheat in northwest Europe and India, maize in China and.....also for irrigated maize in the USA.**

Cassman, 1999. PNAS, 96: 5952-5959

Grassini et al., 2011. FCR 120:142-152



Cassman et al., 2003, ARER 28: 315-358

Cassman et al., 2010, Handbook of Climate Change

# The problem with high grain prices...

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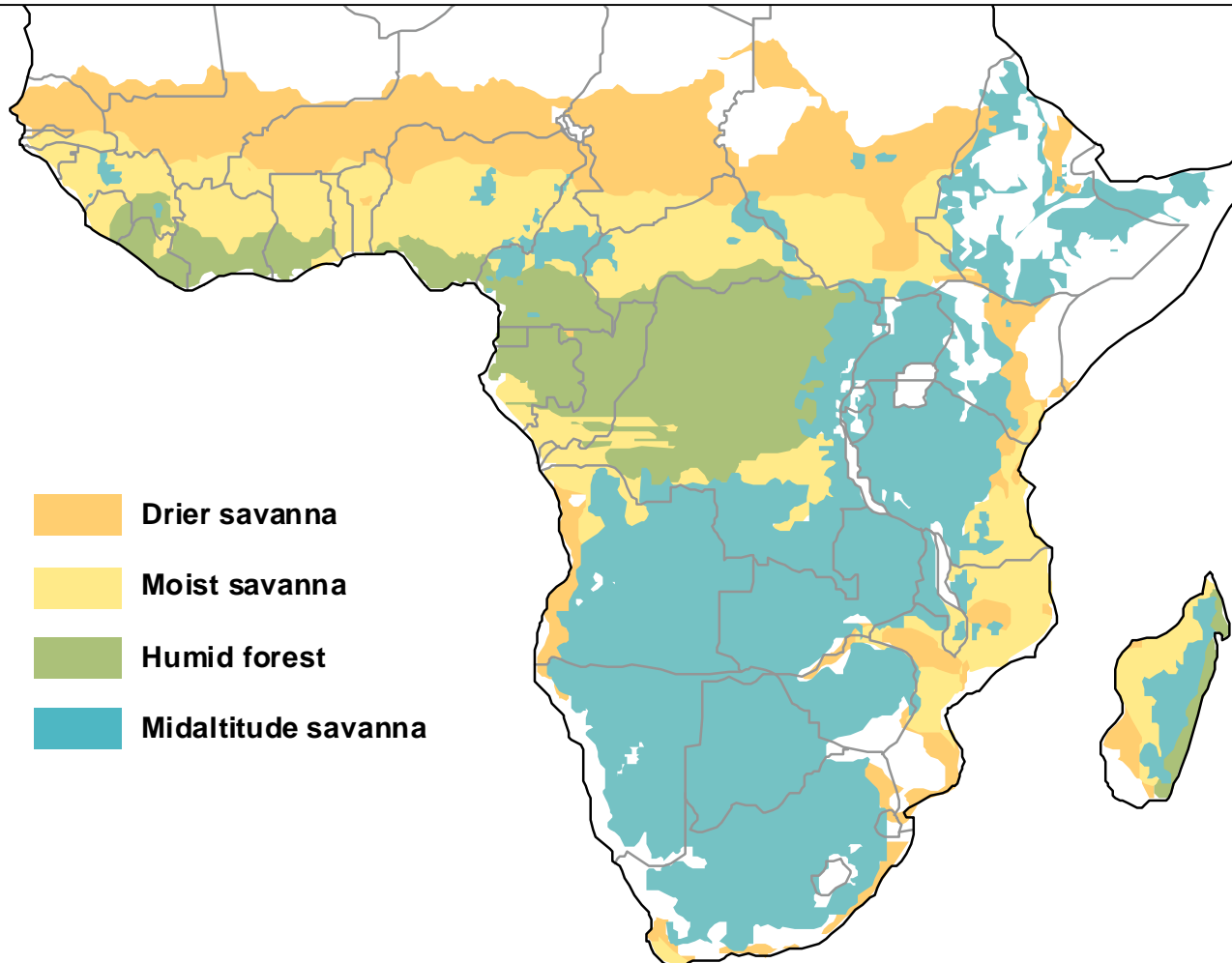
- **Contributes to political instability, especially in developing countries**
- **Reduces disposable income in low-income countries where food costs are often >50% of disposable income**
  - **Lowers rate of economic development**
  - **Lower incomes slows progress towards achieving zero population growth**
- **Increases poverty and hunger**
  - **Constrains progress towards Millennium Development Goals**
- **Favors conversion of natural ecosystems to crop land, which accelerates GHG emissions**

# **Sustainable Intensification**

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**How high can average farm yields go using crop and soil management practices that conserve natural resources, protect environmental services, and give an acceptable rate of economic return?**

**Greatest opportunities for sustainable intensification exist in regions with largest gap between potential production and current average yields**



# Summary

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- **Business as usual will not meet 2050 food demand without a large expansion of agriculture at expense of natural ecosystems and associated greenhouse gas emissions**
- **Avoiding this scenario requires acceleration in yield gains on existing farm land while protecting the environment**
- **Sustainable intensification of this magnitude represents the single greatest scientific challenge facing humanity; requires the best and brightest**
  - **Also requires use of all available tools: agroecology, conventional & molecular breeding and transgenic cultivars, information technology, simulation models, commercial and organic fertilizers, integrated pest management**
- **The CGIAR must play a critical catalytic role in producing science and scientists to produce the knowledge and technologies required to achieve sustainable intensification of agriculture, and to inform policy makers**