

Climate Change and Health

Food Security and Malnutrition

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Overview

- **Define terms**
- **Discuss food insecurity and its causes**
- **Discuss how climate change is likely to affect crop production and food security**
- **Explore how climate change is already affecting food security**
- **Evaluate burden of disease from undernutrition**
- **Explore causes of food insecurity**

Malnutrition: Definitions

- **Undernutrition:** deficiencies of essential vitamins and minerals (collectively referred to as micronutrients)
- **Obesity:** over-consumption of specific nutrients - another form of malnutrition
- **Hunger:** discomfort from not eating
- **Undernutrition:** an important determinant of maternal and child health

Characteristics and Impacts of Undernutrition

- **Undernourished often have co-existent disease, including parasites**
 - Increased demand for calories
 - Can limit nutrient absorption
- **Both forms of undernourishment**
 - Often co-exist
 - Reduce cognitive potential, height, strength, stamina, and learning capacity, causing a multiple burden; also increase stigma

Food Security and Right to Food

- **Food security defined as follows:**
 - “When people, at all times, have physical, social and economic access to sufficient, safe and nutritious food preferences for an active and healthy life” (FAO, 2002)
- **The right to food is universal**
 - International Covenant on Economic, Social, and Cultural Rights (UN-OHCHR, 2008)
 - The related concept of food entitlement was identified by 1998 Nobel Laureate Amartya Sen

Causes of Food Insecurity

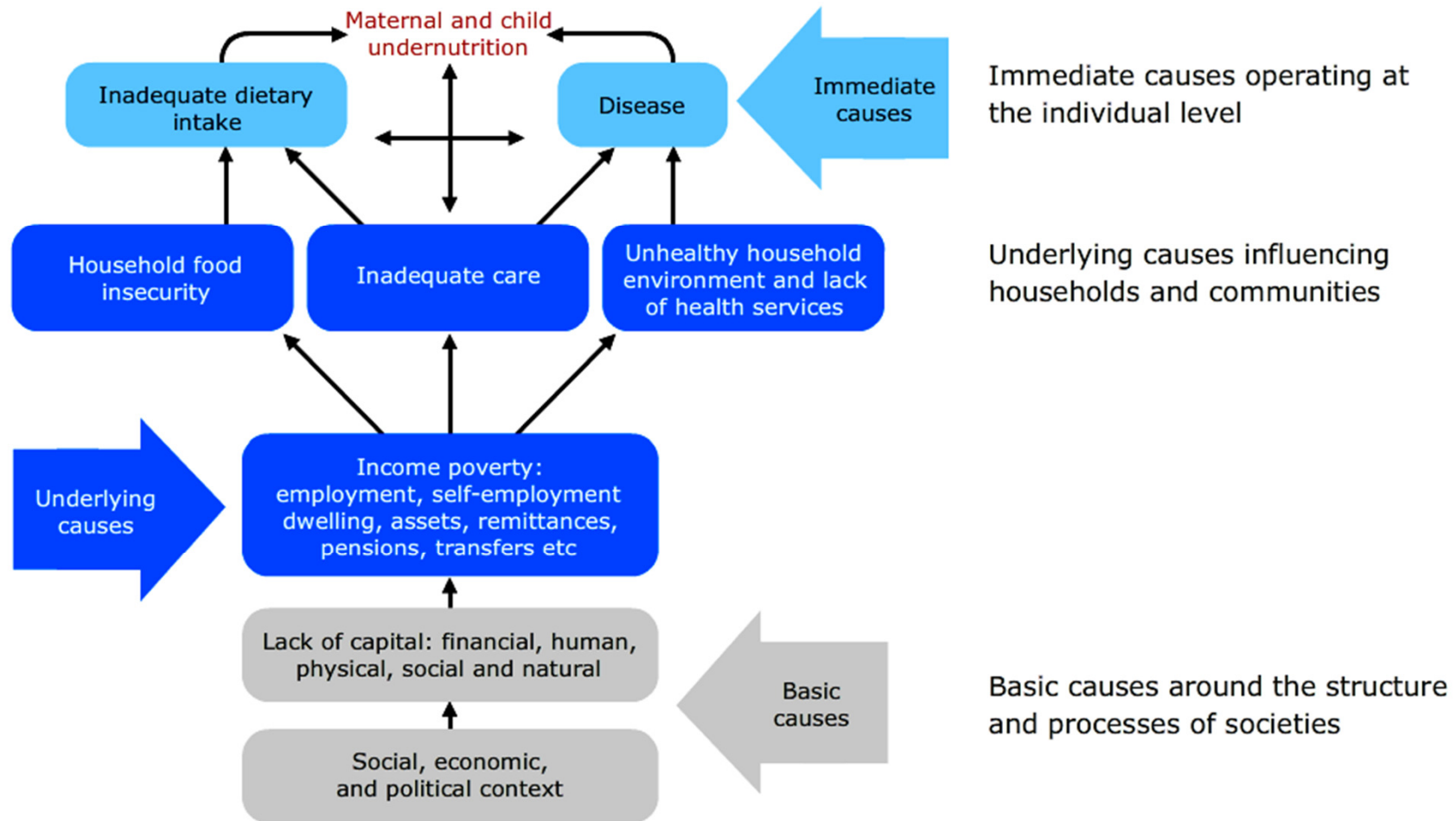
- **Best understood with a systems view**
- **Result from a combination of factors:**
 - Lack of “food entitlement” – inequality, appropriation, poor governance, subsidies
 - The “stork and plow” – struggle between increases in population and food
 - Total (growing) consumer demand combined with proximity to further yield growth of key crops

Causes of Food Insecurity (cont.)

- Under-investment in agricultural research**
- Excessive reliance on “Gene Revolution”**
- Conflict and poverty**
- Diversion of food crops for feed and fuel**
- Global environmental change: climate change, plus atmospheric, water, and soil factors**
- Global economic failure**
- Rising cost oil, fertiliser, transport, other inputs**

Causes of Food Insecurity (cont.)

The UNICEF conceptual framework, which the nutrition community has been using for programming for the past 25 years, identifies three levels of causes of undernutrition.



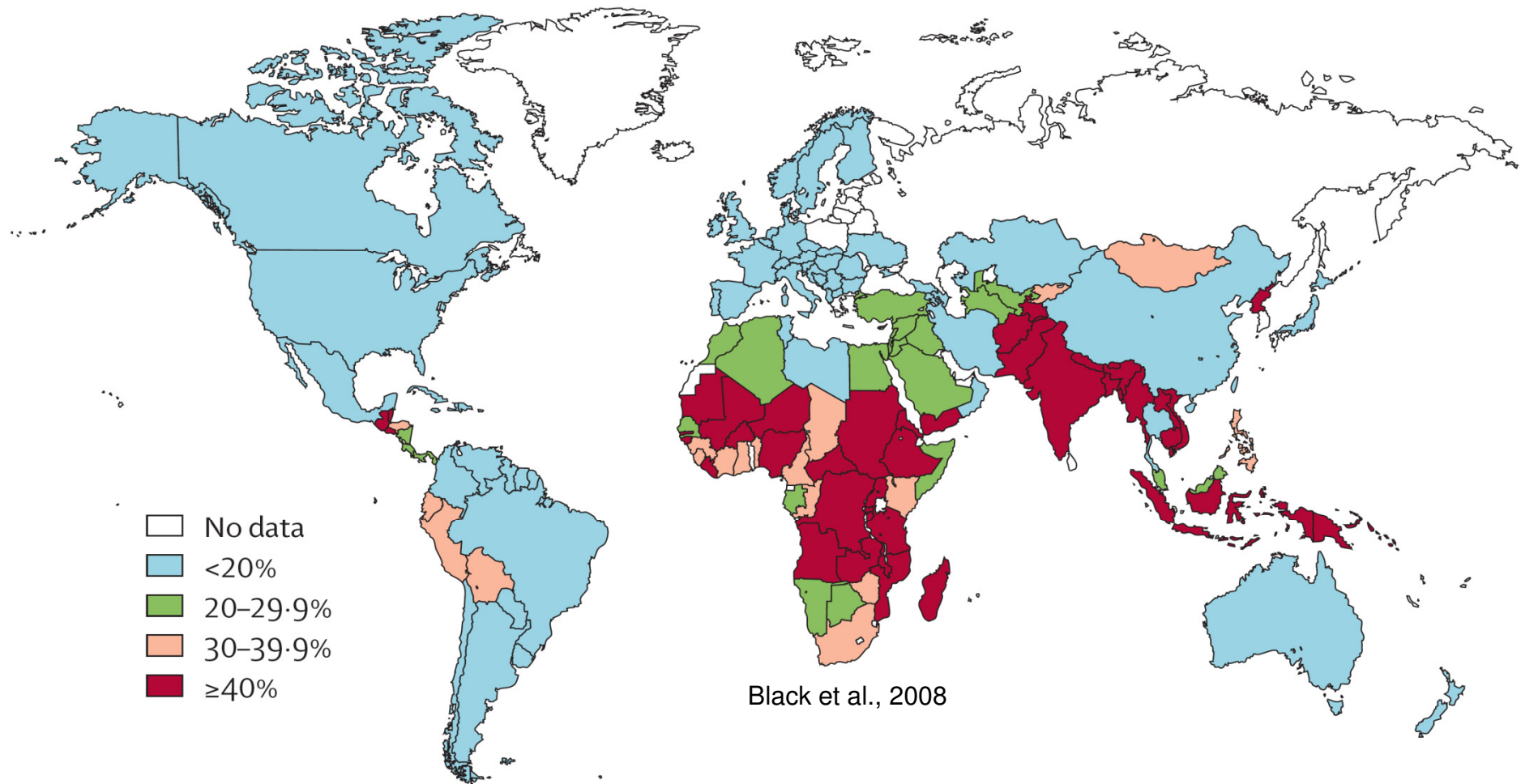
modified by Black et al, Lancet 2008

Global Burden of Disease - Undernutrition

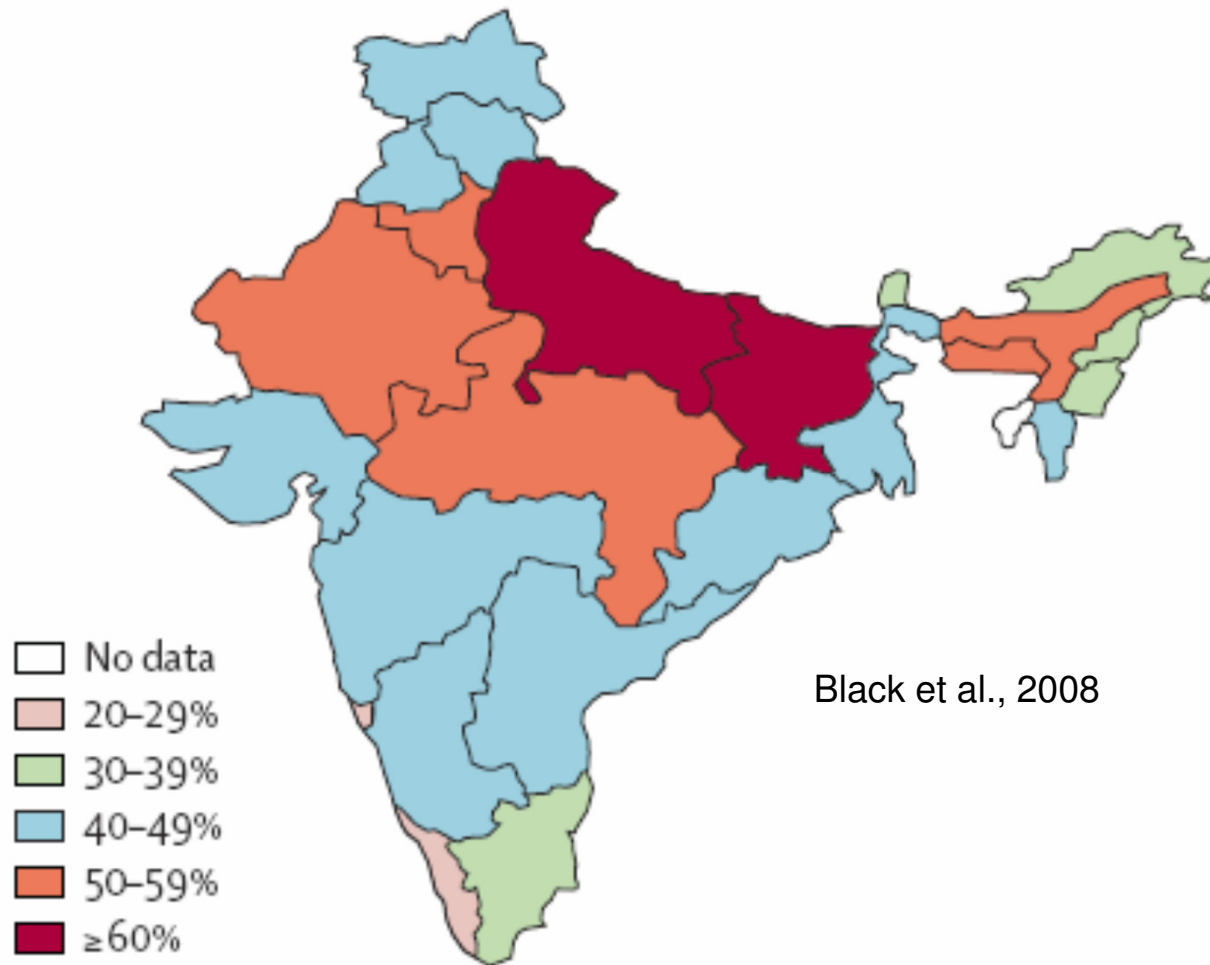
- **21% disability-adjusted life-years (DALYs) for children younger than 5 years**
- **35% child deaths – 11% of total global Burden of Disease (BoD)**

Black et al., 2008

Prevalence of Stunting in Children Under 5 years (2005)



Prevalence of Stunting in Children Under 5 years in India (2005)



Black et al., 2008

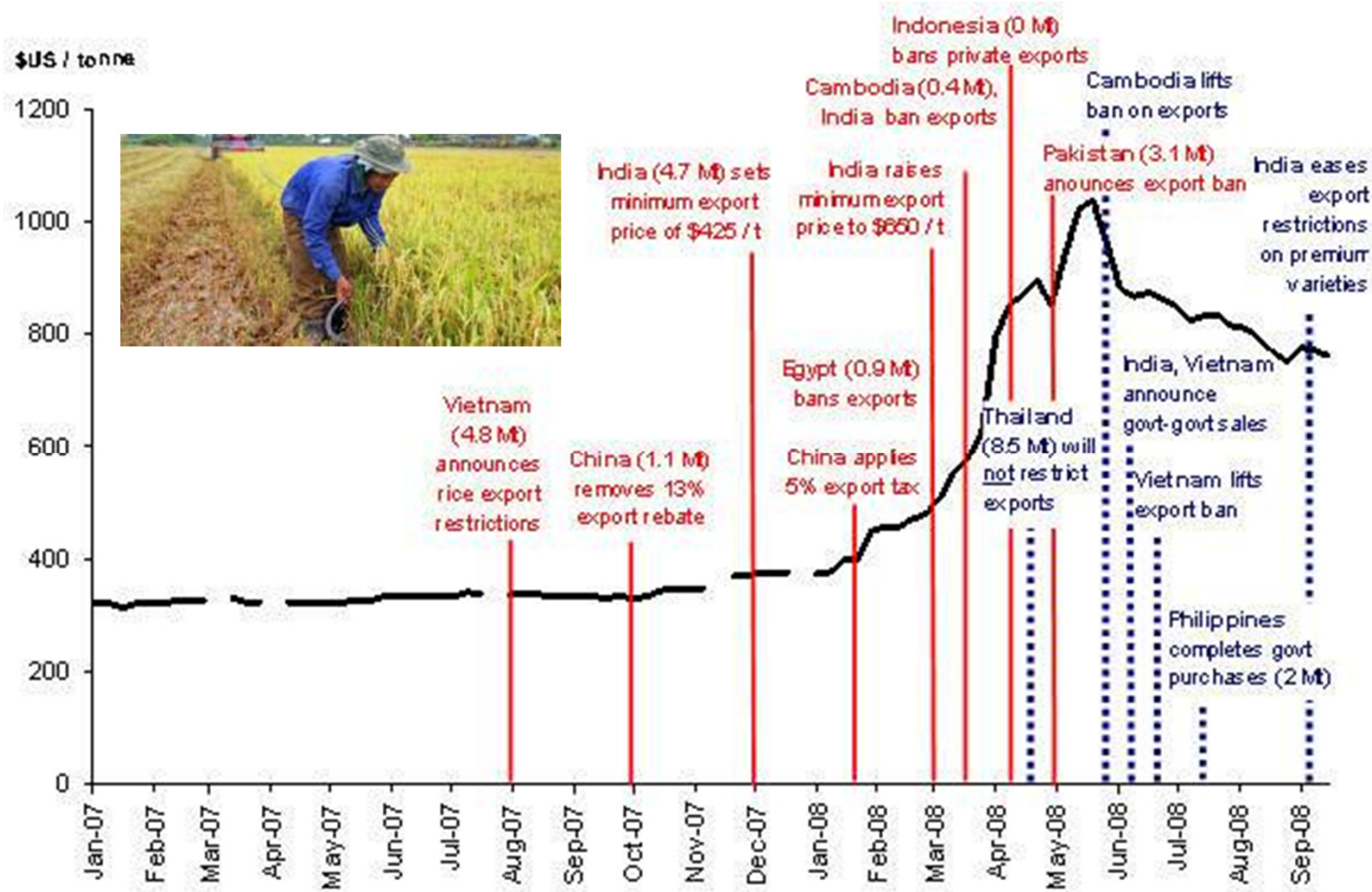
India has more than 61 million stunted children, 51% of the national population and 34% of the global total. However, stunting prevalence varies substantially by state.

March 2008: UN World Food Program Anticipates “Global Hunger Crisis”

- **Rapid worldwide food price rises 2007-2008**
 - **Urban food riots Caribbean to Middle East (especially Egypt) and Far East**
 - **Food export restrictions**
- **WFP describes “perfect storm”:**
 - **Demand for feed (e.g., China, India)**
 - **Biofuels production (diversion of arable land)**
 - **Rising costs of fertilizer and oil**
 - **Climate change**
 - **Commodity speculation**

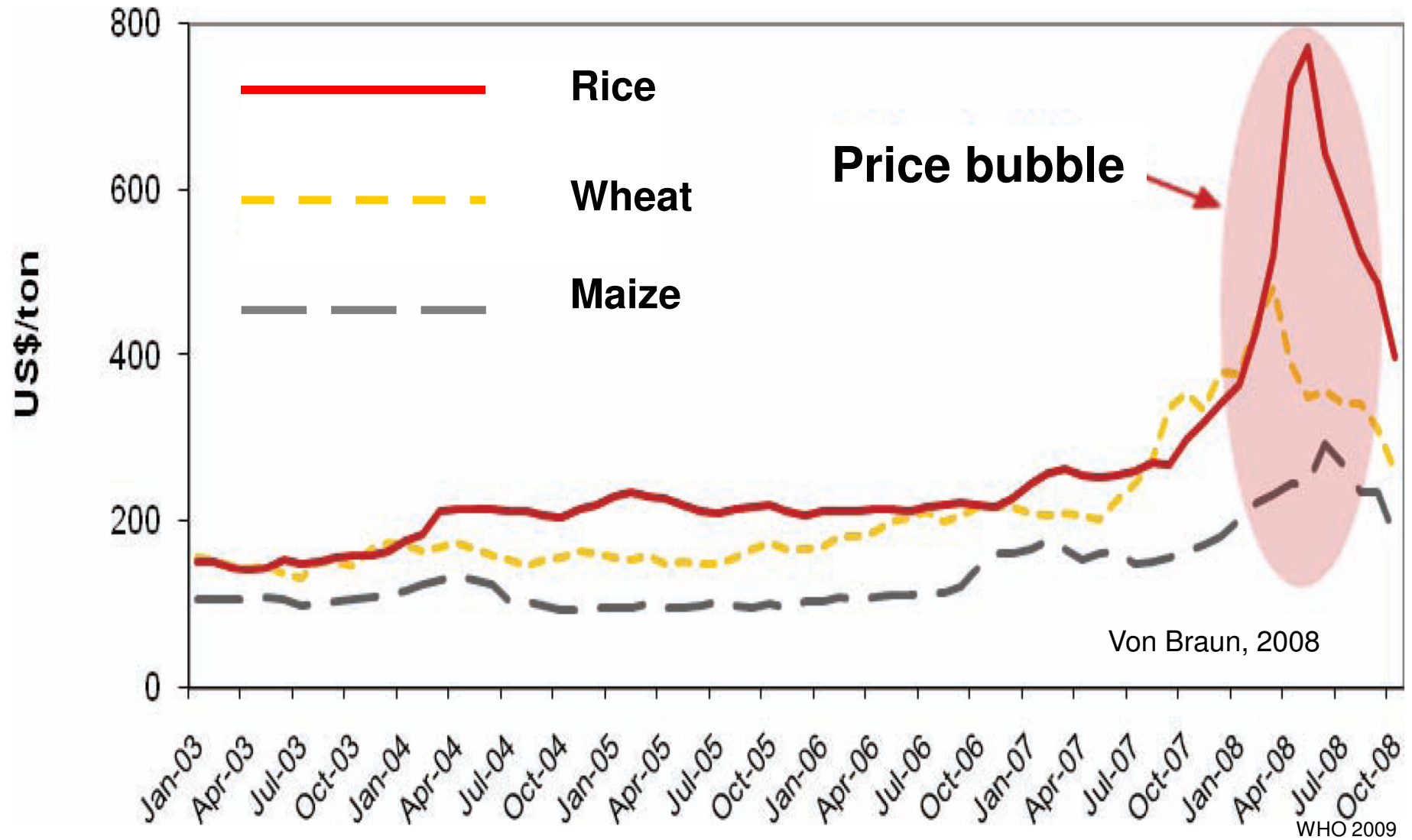


2008: “Rice Turns into Gold”

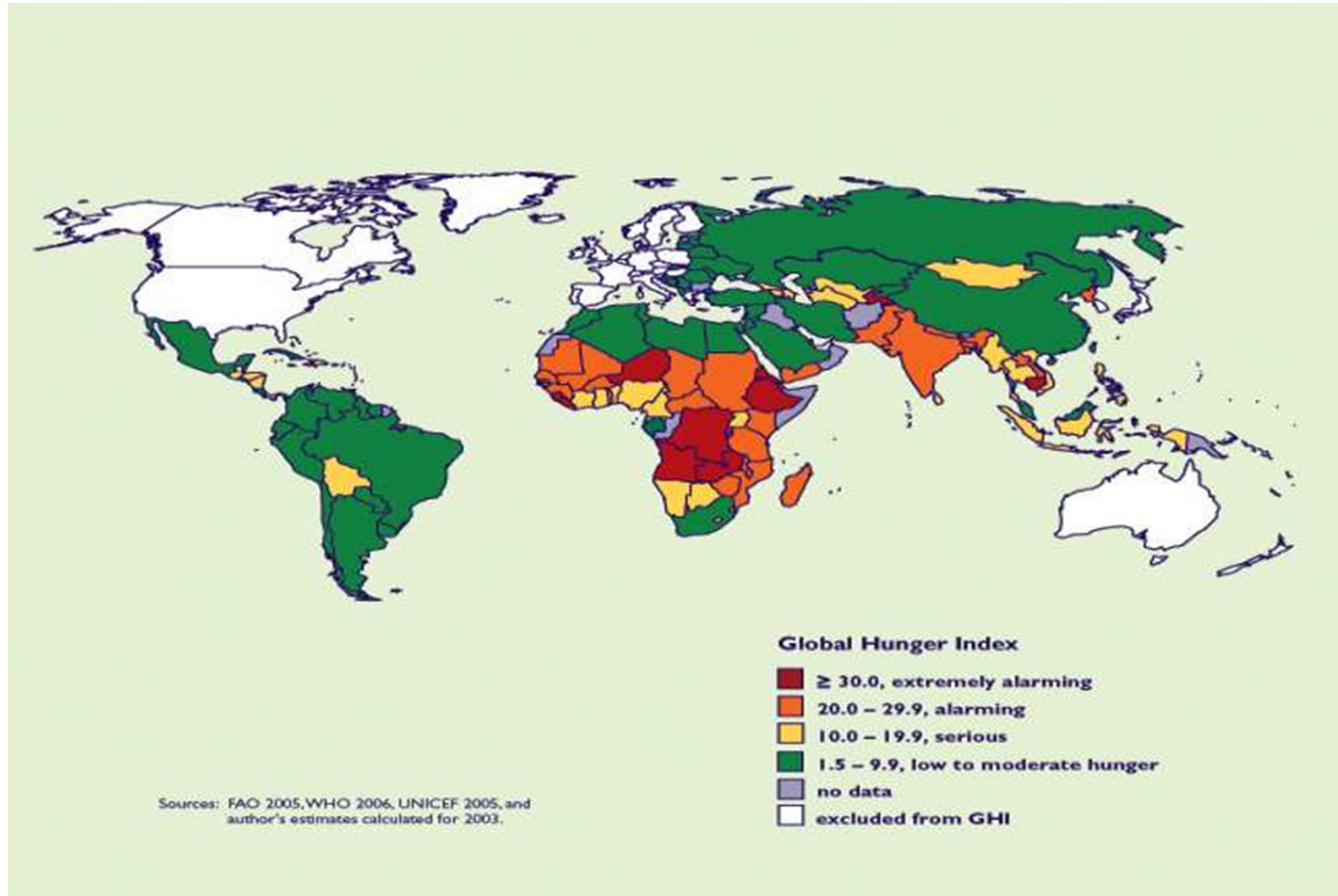


In three years to mid-2008, international prices of wheat and maize tripled, while rice grew fivefold

Grains: Global Price Trends 2003-2008



Global Hunger Map: 2006

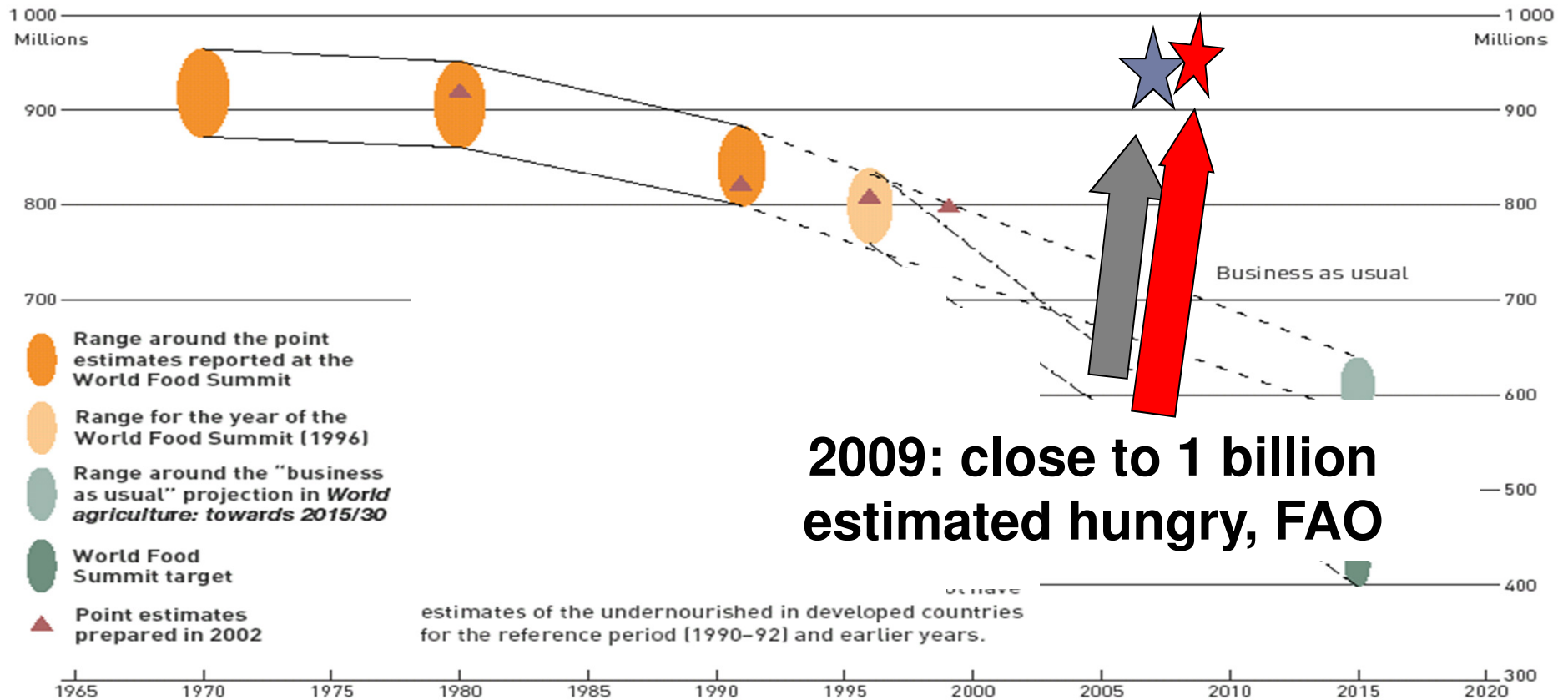


Reducing Hunger: The First Millennium Development Goal

- **Between 1990 and 2015 reduce the proportion of people whose income is less than one dollar a day and who suffer from hunger by 50%**
 - **A much more modest goal than from the 1996 World Food Summit (Pogge, 2004)**
 - **Progress indicator: Monitor proportion of children who are underweight**

Millennium Development Goal on Hunger: Falling Even Further Behind

Number of undernourished in the developing world: observed and projected ranges compared with the World Food Summit target



Climate Change: Likely to Harm Many Vulnerable Populations

- **Four of five major global climate models project consistent expansion of arid areas in developing countries**
 - Home to almost 1 billion people
 - More than 180 million people in Africa alone

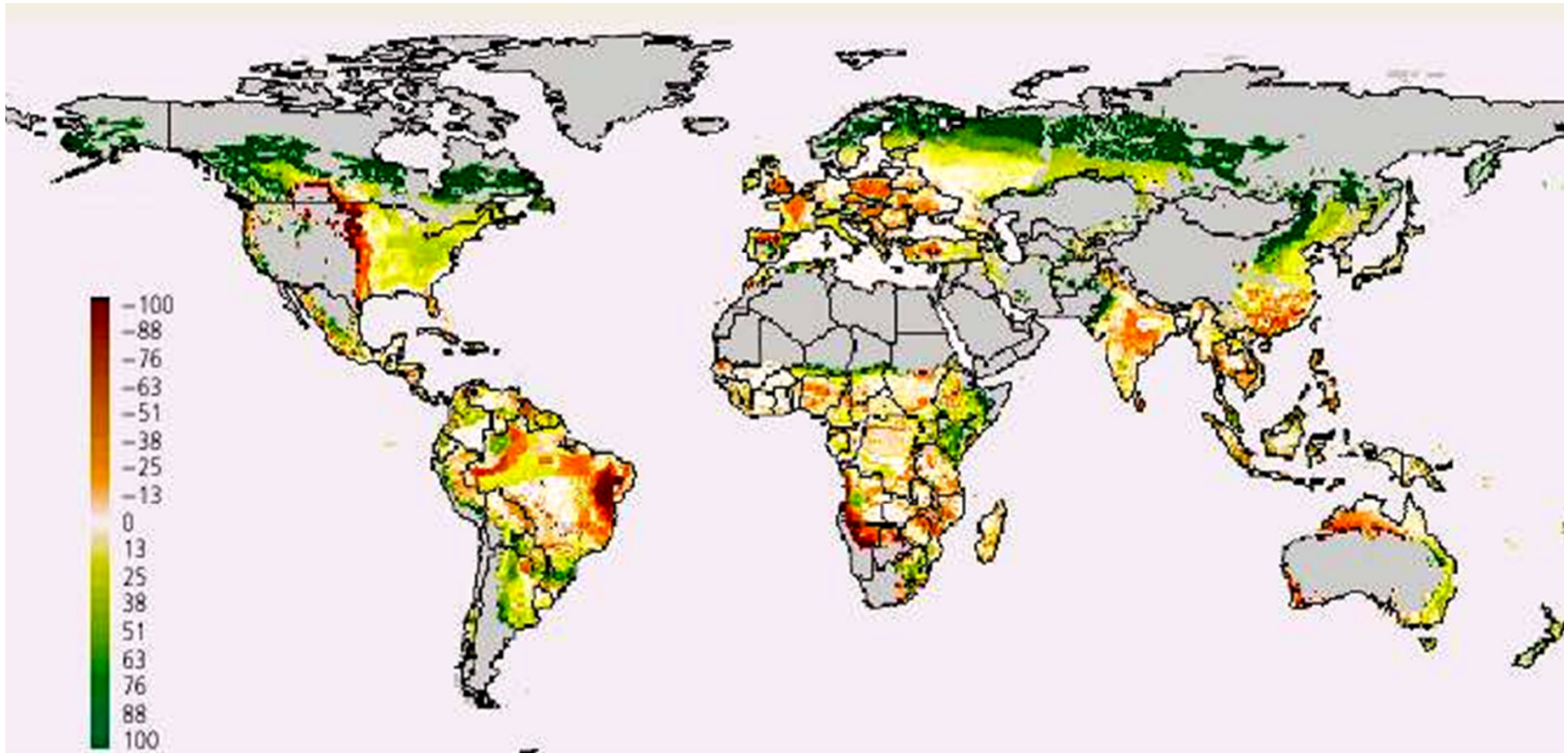
Fischer et al., 2005

Climate Change and Global Cereal Production: Change 1990 to 2080

	Range (% change)	
World	-0.6	to -0.9
Developed countries	+2.7	to +9.0
Developing countries	-3.3	to -7.2
Southeast Asia	-2.5	to -7.8
South Asia	-18.2	to -22.1
Sub-Saharan Africa	-3.9	to -7.5
Latin America	+5.2	to +12.5

Tubiello and Fischer, 2007

Rain-fed Cereal Production and Climate Change Model: 2080



Fischer et al., 2001

WHO 2009

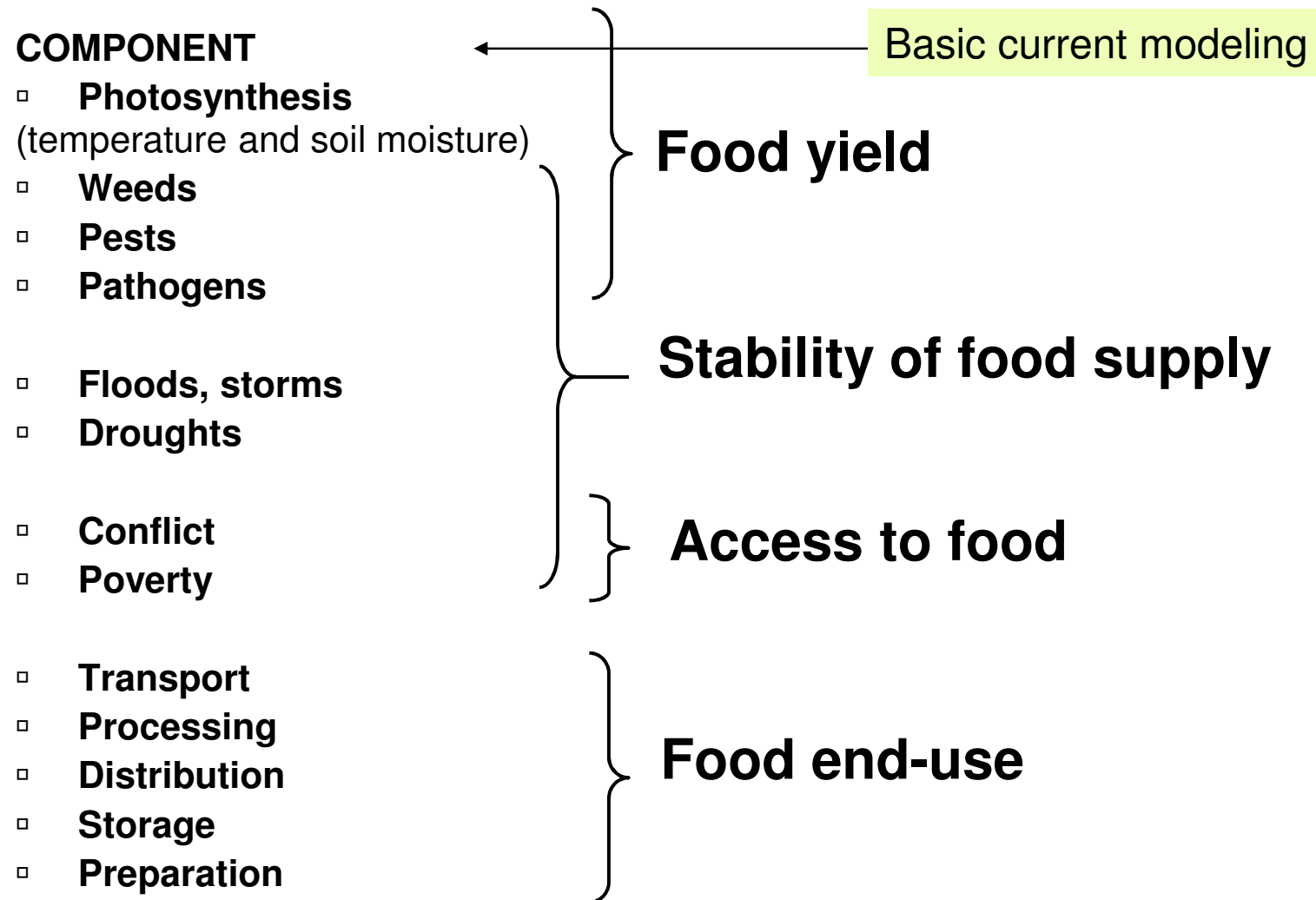
Modelling Climate Change and Future Food Security

- **Current models vary by:**
 - **Pathways of greenhouse gas emissions**
 - **Climate “sensitivity” to CO₂ equivalent levels**
 - **Strength of carbon fertilisation effect**
 - **Incorporation of food trade**

Modelling Climate Change and Future Food Security (cont.)

- **No models for future global fish production**
 - **Per capita global wild fish catch falling**
 - **Aquaculture cannot fully compensate**
 - **Global fish production at risk from climate change, ocean acidification, overfishing, and other ecosystem damage**

Climate-sensitive Elements of the Food System



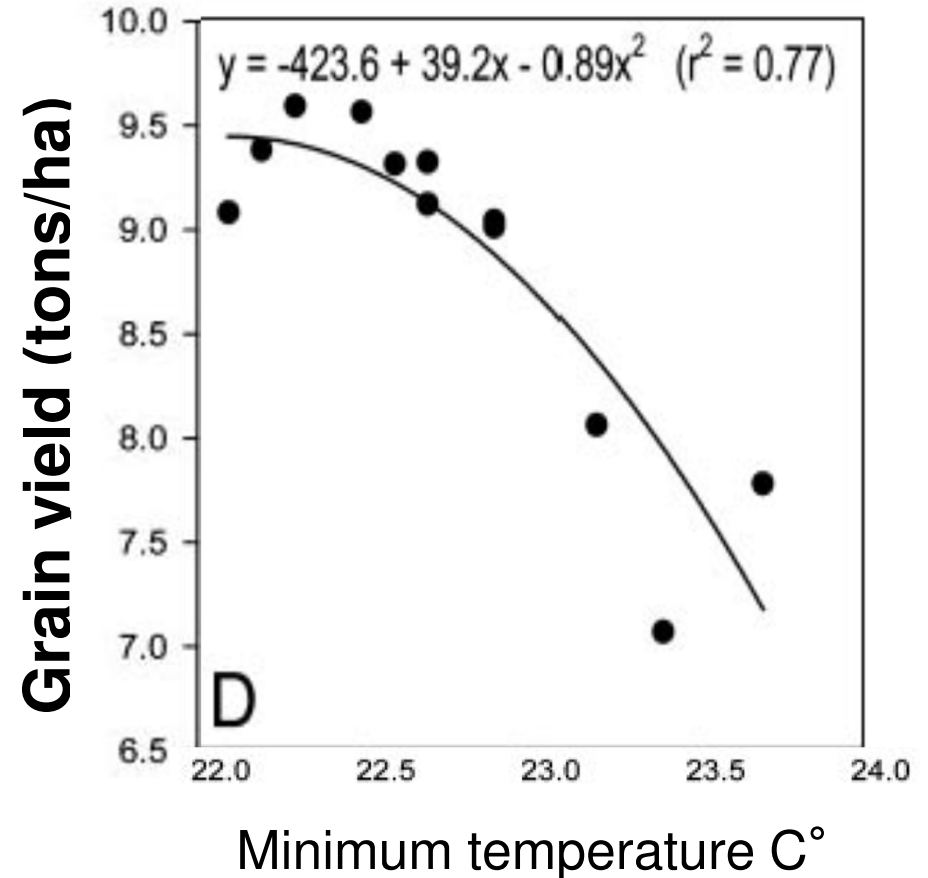
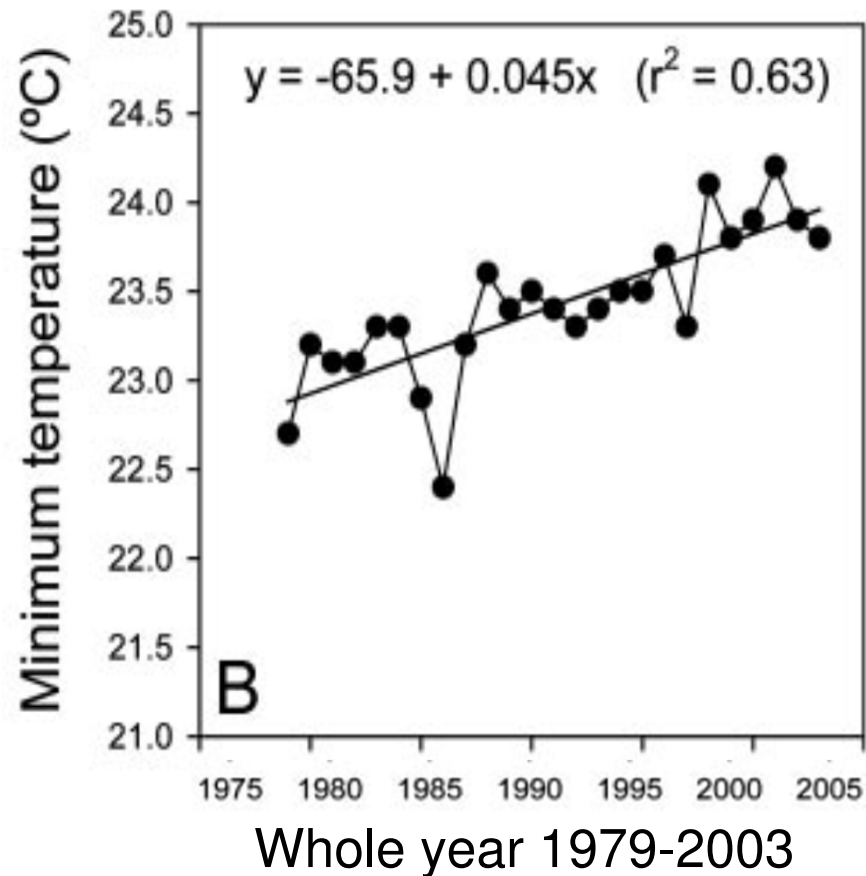
Current Crop Models Limits with Respect to Climate Change

- **Current models do not account for likely impacts from climate change including:**
 - **Heat stress – to rice yield, flowering, and pollinators**
 - **Extreme weather events (e.g., winds, waterlogging)**
 - **Sea level rise, salt water intrusion**
 - **Aquifer depletion and water contamination**

Current Crop Models Limits with Respect to Climate Change (cont.)

- Loss of land due to urbanization and to biofuels production**
- Rising cost of oil and fertiliser**
- Future shortage of potassium — an essential element**
- Atmospheric brown cloud (“solar dimming”)**
- Political economy and conflict — “entitlement” factors**

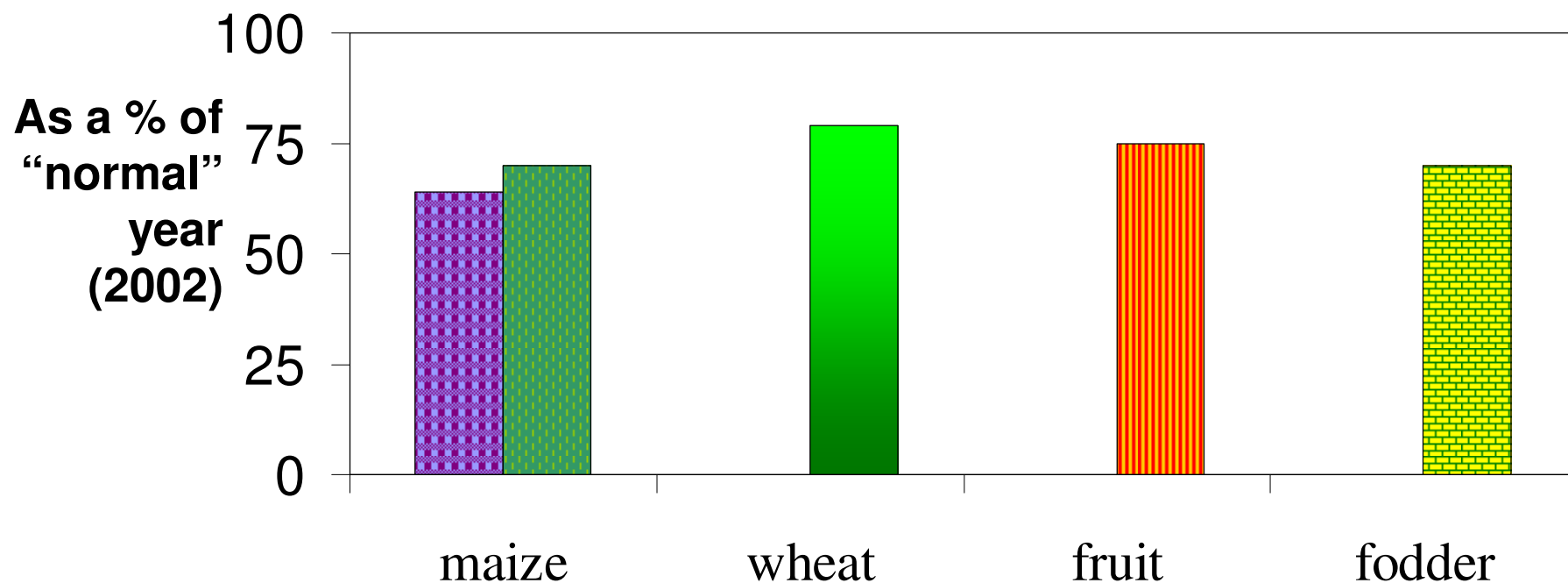
Global Warming's Higher Night Temperatures Decrease Rice Yields



Biofuels and Food Security

- **Amount of humanitarian food aid available for impoverished countries will be affected in the short-term ... food aid shipments from USA inversely correlated to commodity prices (Naylor et al., 2007)**
- **For every 1% increase in the real prices of staple foods, 16 million more people could become food-insecure (Runge and Senauer, 2007)**

Reduction in Harvest During 2003 European Heatwave



Data: Battisti and Naylor, 2009

Climate Change and Current Crop Models: Summary

- **Most predict a small benefit, little change, or slight harm to the North**
- **Most predict varying degrees of harm in the South**
- **Most thus predict increased global inequality**
- **Most assume strong carbon fertilisation**

A Global Food Crisis is Brewing

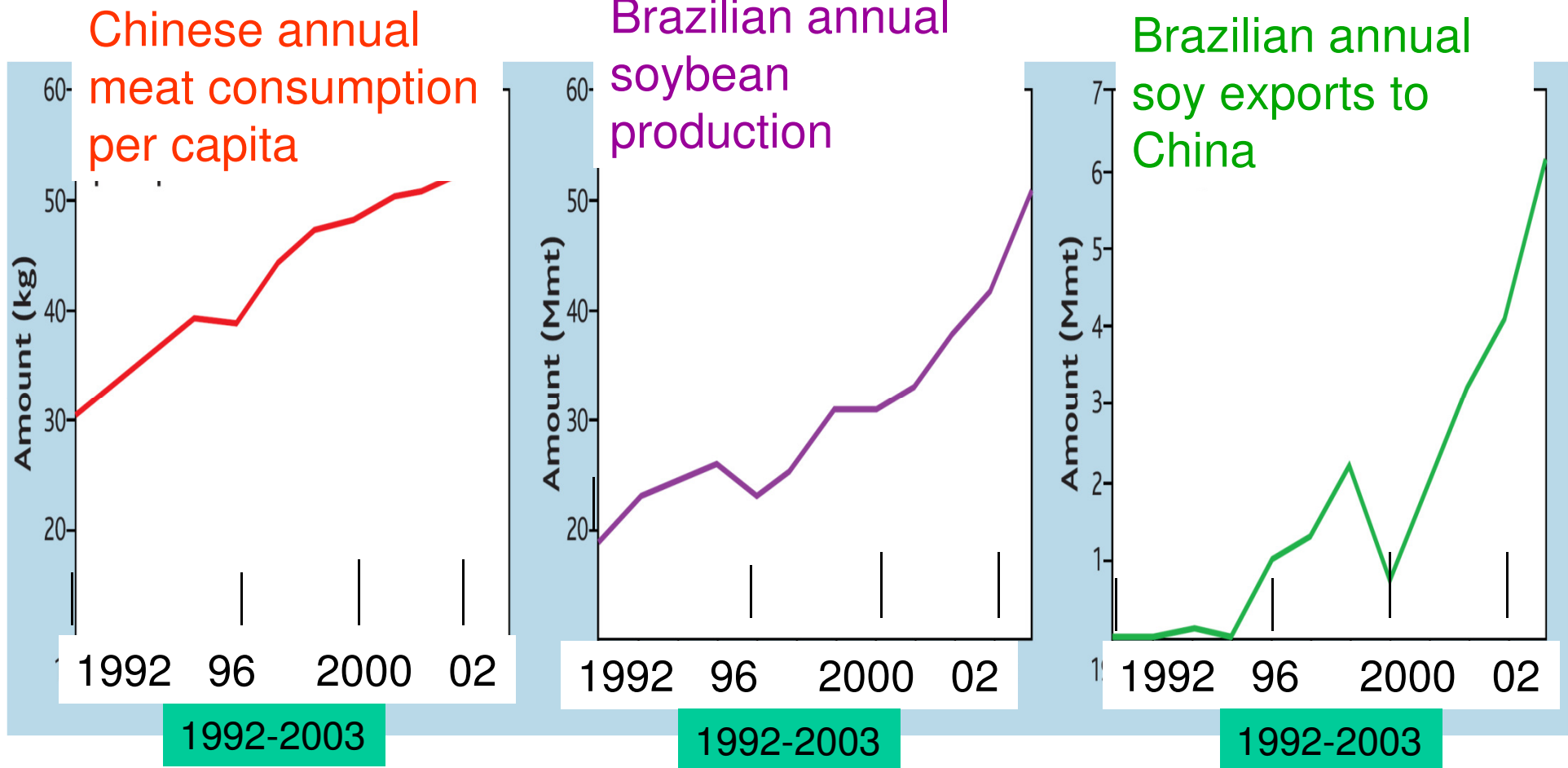
- **“The stress on crops and livestock will become global in character. It will be extremely difficult to balance food deficits in one part of the world with food surpluses in another, unless major adaptation investments are made soon to develop crop varieties that are tolerant to heat ..”**

Battisti and Naylor, 2009

Climate Impact of Global Livestock

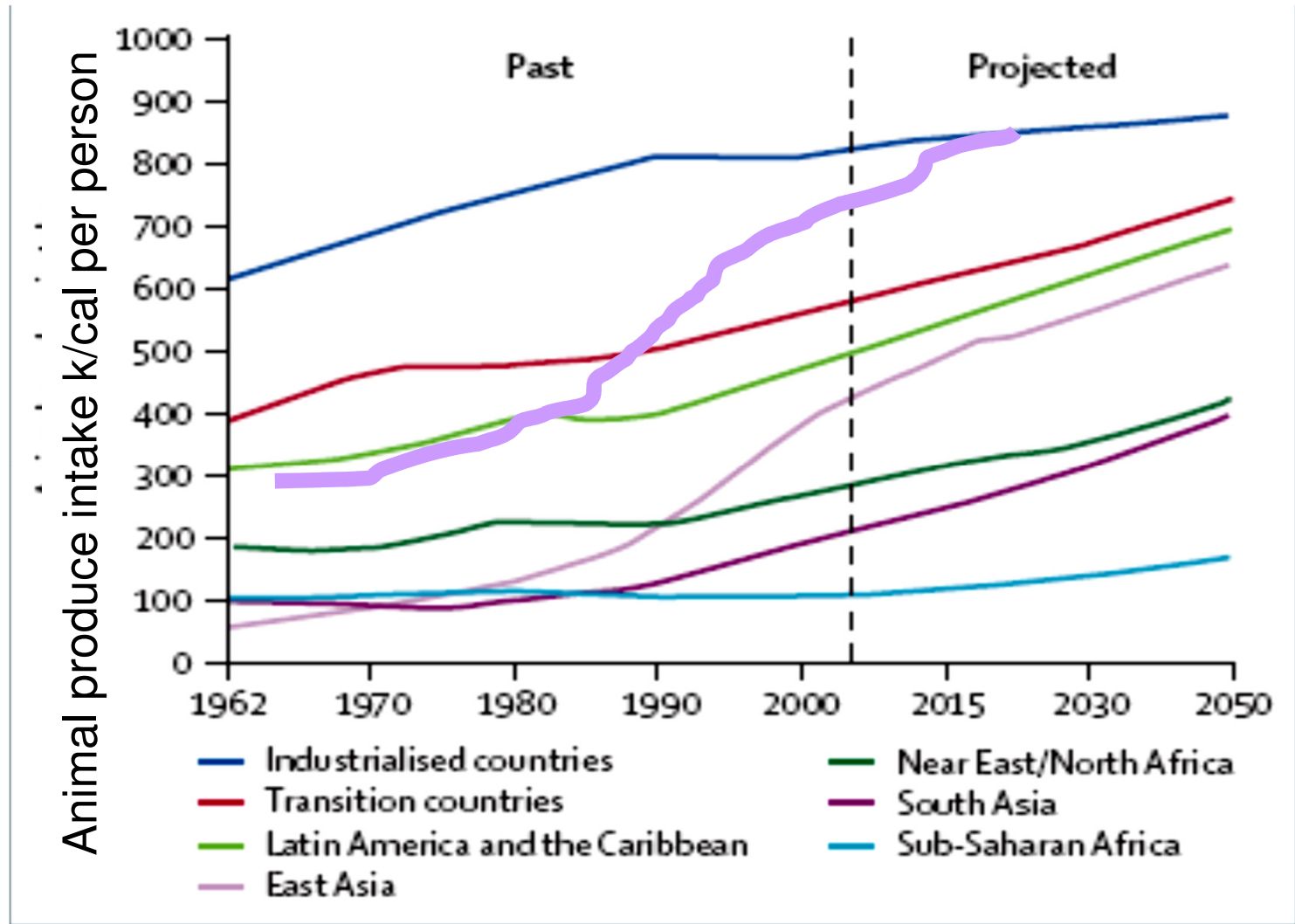
- **Livestock are responsible for 20% of GHG emissions:**
 - CO₂ land clearance, fertiliser, harvest, shipping
 - CH₄ digastrics (sheep, cattle, goats)
 - CH₄ manure
 - NO₂ fertiliser
- **Creates incentives for forest clearance**
 - Loss of biodiversity, carbon sinks, other ecosystem services
- **Livestock production requires the most water resources in the food chain**

Landless Livestock?



Naylor, 2005; Steinfeld et al., 2006

Future Food Security



Projected global increase in average animal produce consumption

Contract and Convergence of Meat Consumption

- **Reduce average daily meat consumption to 90 grams/day by those consuming more**
- **Increase meat consumption for those below 90 grams/day threshold (“under-consumers”)**
- **Limit global livestock “climate footprint” to current level, accounting for population growth**
- **Benefits**
 - **Improved human health**
 - **Climate change mitigation**

Steps to Improve Future Food Security

- **Improve governance and leadership**
- **Secure food entitlement**
- **Pursue and encourage technological breakthroughs**
 - **Water quantity and water quality**
 - **More investment in research for sustainable agriculture**

Steps to Improve Future Food Security (cont.)

- **Address food demand and supply**
 - **Population growth not “fixed”**: can change by reducing global inequality
 - **Limit meat consumption to 90 grams/day**
- **Improve food production models**
 - **Account for likely climate change impacts**
- **Pursue climate change mitigation**

Conclusion

- **Food security is already a significant challenge**
- **All else equal, climate change is likely to worsen global food security**
- **There are clear steps that can be taken to help mitigate the anticipated challenges to food security attributable to climate change**

Discussion

Questions?

Thoughts?

Concerns?

Suggestions?



Acknowledgements

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