What Will It Take To Feed the World Sustainably?

Roz Naylor, Stanford University, October 2008
Number of undernourished in the developing world: observed and projected ranges compared with the World Food Summit target

- Range around the point estimates reported at the WFS
- Range for the year of the WFS (1996)
- WFS target
- Point estimates prepared in 2004

Source: FAO
Figure 27
Agricultural trade balance of least-developed countries

Source: FAO.
Challenges for 21st Century

• Reduce global hunger (food security)

• Meet world food demand with sustainable agricultural practices

• Food safety
## Population Growth

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Source: UN Population Division Population Database (2006 Revision)
http://esa.un.org/unpp/index.asp
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### Income Growth
Green Revolution

- New plant architecture & shorter maturity length
- Fertilizer and water inputs
- Disease/pest resistance
- Improved animal breeds
- Information technology
Plants

Soil

Gas Emissions

Microbes

N Fertilizer

NH₃, NO, N₂O, N₂

Leaching

NO₃⁻
“Poets -- and city folks -- love to romanticize agriculture, portraying it as some sort of idyllic state of harmony between humankind and nature. How far this is from the truth! Since Neolithic man domesticated the major crop and animal species some 10-12 millennia ago, agriculture has been a struggle between the forces of natural biodiversity and the need to produce food under increasingly intensive production systems.”

-- Norman Borlaug (2002)
Biofuels Production, 1980-2007

Energy and Commodity Prices
1960-Present

Deflated Prices, 1960-2007 (deflated using IMF US GDP Deflator)

- Wheat
- Maize
- Rice
- Soybeans
- Petroleum (Right-Hand Axis)
Question: Are biofuels the culprit?

- Tight markets: shock the system
- Policy mandates
- Substitution (crops, end uses)
- Speculation
Soybean Growth in Brazil

photo by Leomar José Mess
Novo Tempo Press

Source: Luiz Martinelli
The nature of the current price rise appears to be different

Look at production trends and cereal stocks….

real global cereal price index
(All prices = 100 in 1960)

Look at futures in 2010
Wheat Rust in East Africa and Asia

- 1999: First appeared in Uganda
- Spread to Ethiopia, Kenya, Sudan
- 2007-2008: more virulent strain discovered in Yemen and Iran
- Based on wind patterns, expected to move east into India, Pakistan, neighboring countries - this region produces 25% of global wheat crop
- Yield losses as high as 71% observed in experiments
- 80% of wheat varieties grown in Asia and E Africa are susceptible, including rust-resistant varieties developed by CIMMYT
- India’s response: ban rice exports
Going Hungry
Consequences of the food crisis

- Unrest/protests
- Export ban/restrictions

[Map showing countries affected by grain prices and unrest]

Grain prices in dollars
Wheat per 100 bushels
Rice per ton

Source: Thomson Financial Datastream, FAO


*one bushel of wheat weighs around 27 kg
Turmoil in global food markets

- Biofuels
- Population
- Income
- Animal protein

- Climate
- Policy

- Drought
- Crop substitution
- Disease
- Soy
- Ug99

- Exchange rate
- Oil prices
“What we are witnessing is not a natural disaster, a silent tsunami or a perfect storm. The food crisis is a man-made catastrophe. And as such, must be fixed by people.”

--Robert Zoellick, The World Bank
What Will It Take?

- Management
- Technology
- Agricultural Investments
- Policy
- Consumer behavior
Resilience

Figure 9.3 The dynamics of agricultural sustainability
Cargill: Soy Trade in Brazil
Technology: Gene Stacking
U.S. Farm Bill (May 2008)

$288 Billion over 5 years

- Liquidity (loan rate)
- Stability (target, direct pay)
- Income enhancement
- Food security, safety net
- Conservation

- Protecting special interests
- Getting elected
- Complying with WTO and other agreements
U.S. Ag Investments and Food Aid

Fig. 2: US Food Aid Shipments and Grain Prices, 1980-2007

SOURCES:
Grains Prices: average annual wheat-maize price, International Monetary Fund
Biofuels Policies

• 2008 Farm Bill, CRP:
  – Priority given to enrollment of while fields that qualify to produce perennial biomass crops for cellulosic energy production

• Appropriation for Conservation

• EU Biofuels Sustainability Criteria
Consumer Choices

- Meat consumption (not if, but how much?)
- Sustainable products
- Organic products
- Origin of product