Global Food Security and Climate Change

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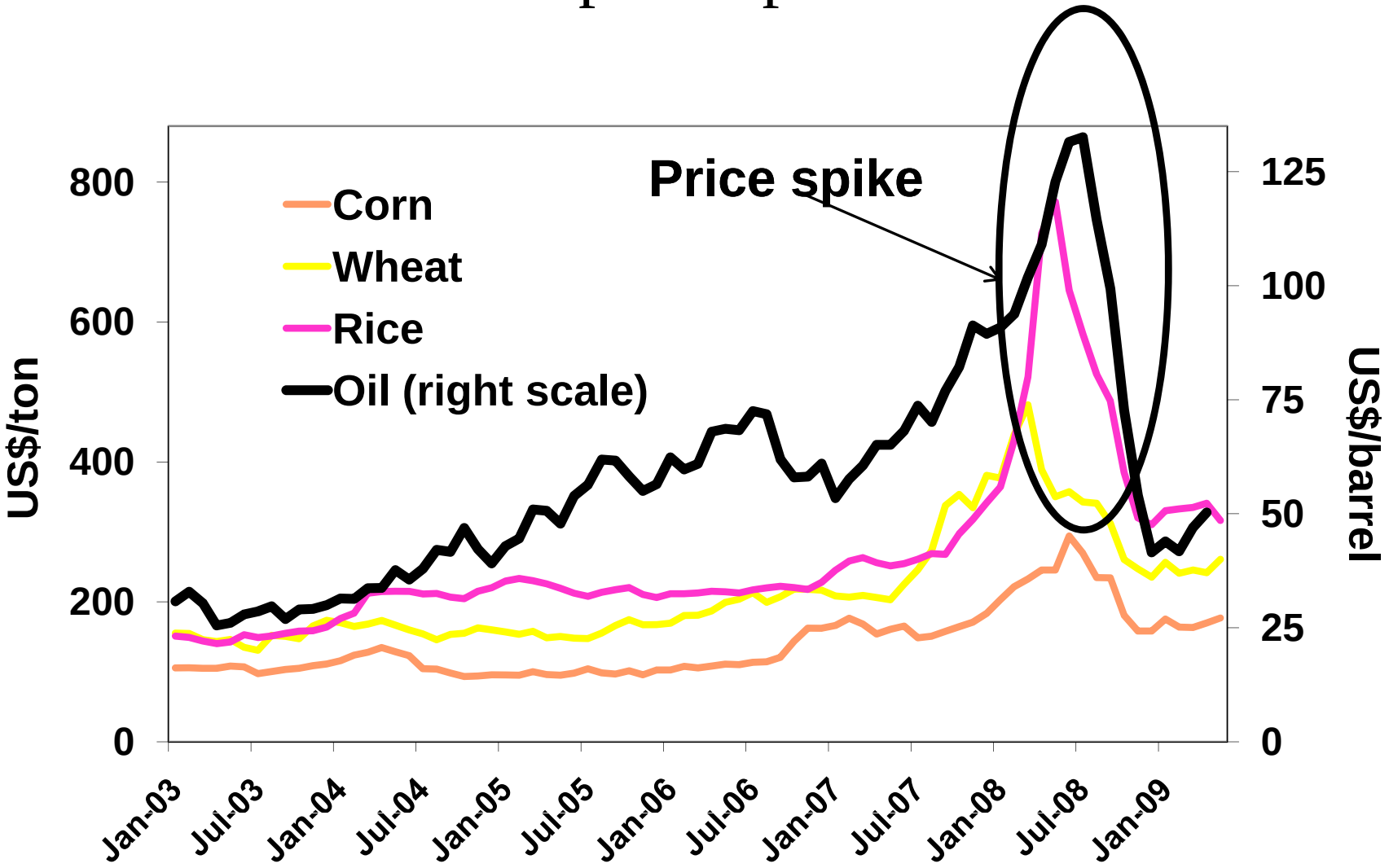
Contents

1. Recent Food Crisis

- It was directly caused by increased oil prices, use of maize for ethanol, commodity speculation, export bans of rice by India and Vietnam,……
- There is a strong linkage between oil price and food price.
- Increased biofuel demand increased grain price by 30% (IFPRI) and 75% (Chief Economist of the World Bank).

Food crisis - price spike 2007-08



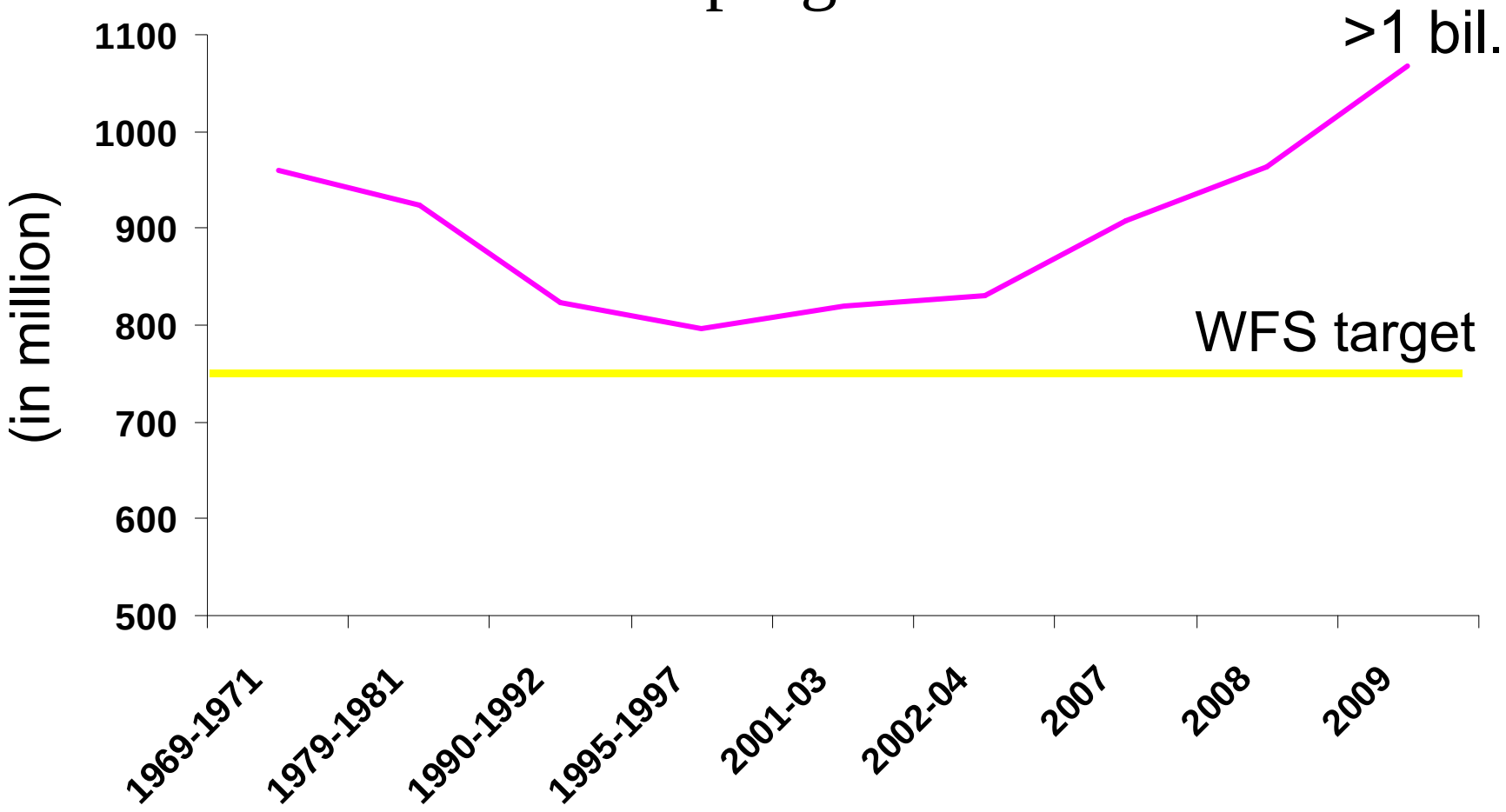
Source: Data from FAO 2009 and IMF 2009.

Who suffered?

- Assume a person spends 50% of her/his income on food.
- Assume now that the price of food doubles.
- For this person price level increases by 50% (100% x 0.5).
- Thus, this person's **real** income becomes 2/3, other things being the same.

The poor suffer most as they spend a large share of their income on food.

Rising number of hungry people in the developing world



Data source: FAO 2006, 2008, 2009.

More Fundamental Cause

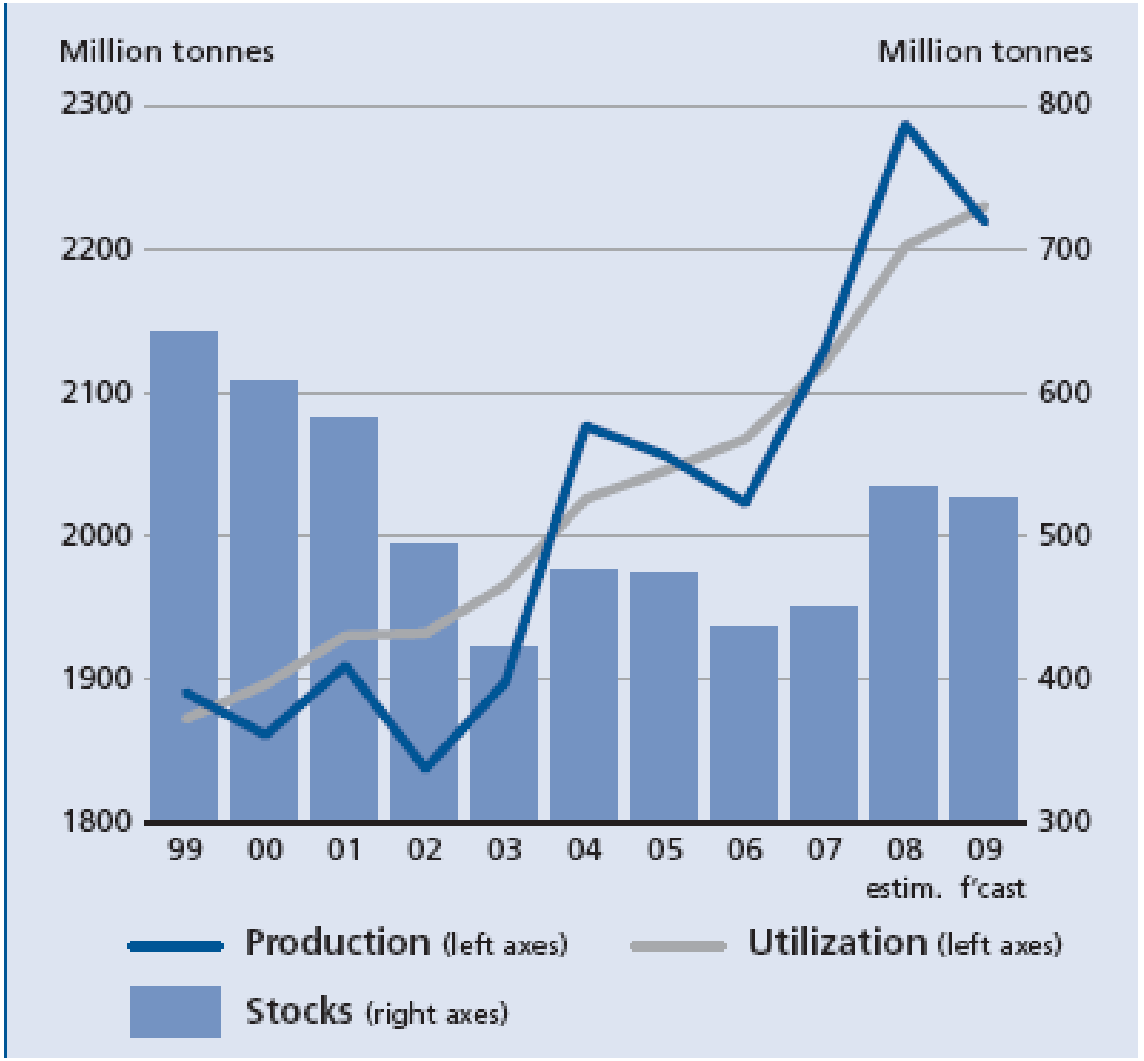
- Complacency or over-confidence on global food supply-demand

  → Underinvestment in irrigation, research and development, and other measures to increase food production

  → Even without climate change, food prices are bound to increase

  -- Decreasing food stocks, reflecting the excess of consumption over production

Cereal Supply, Demand, and Stocks



Source: FAO 2009.

What can we learn from food crisis?

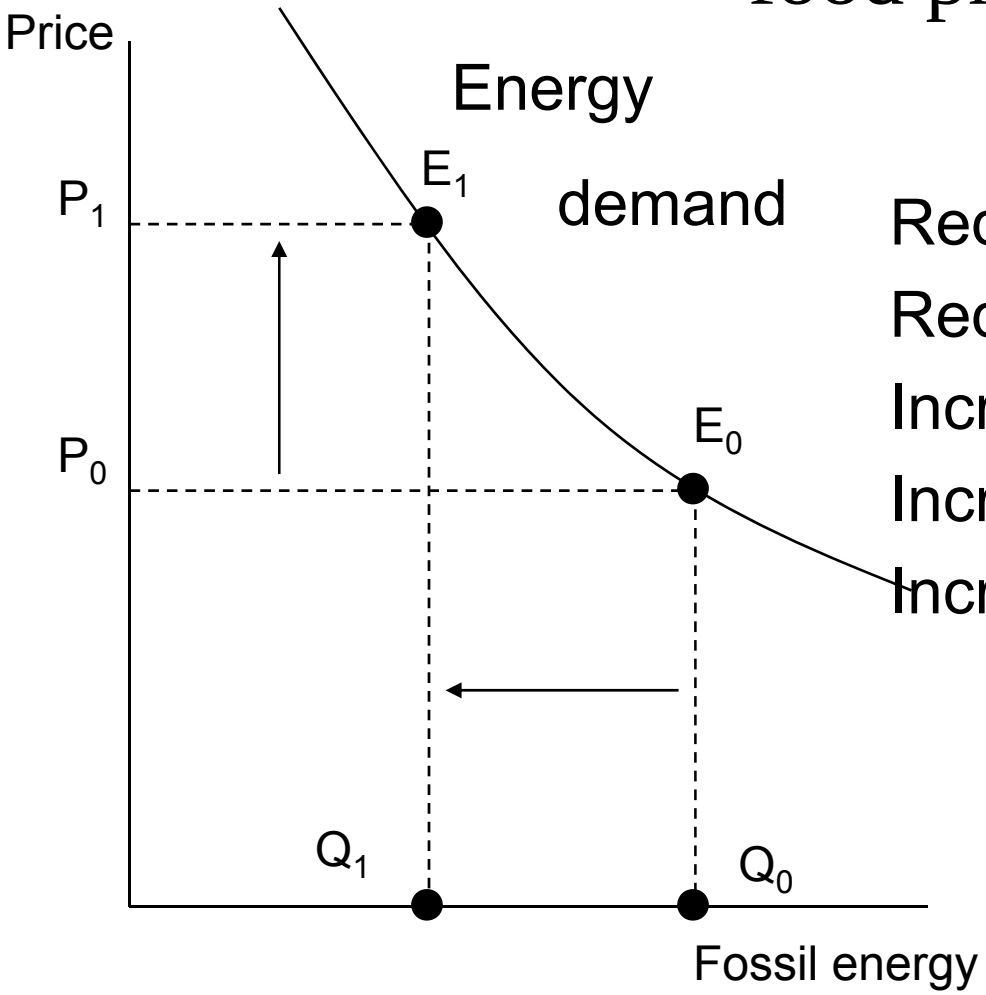
1. Strong energy-food nexus:

   Food price increases when energy price increases.

2. Increasing “food shortage” or food price hike even without climate change due to complacency and population growth (6.8 billion in 2009, but will reach 9.1 billion by 2050)

3. Strong food-poverty linkages

Implication of strong energy-food nexus: Abatement of GHG emission will result in higher food prices



Reduction in GHG emission →
Reduction in fossil energy use →
Increase in energy price →
Increase in fertilizer price →
Increase in food price

2. Impacts of Climate Change

- Expected changes

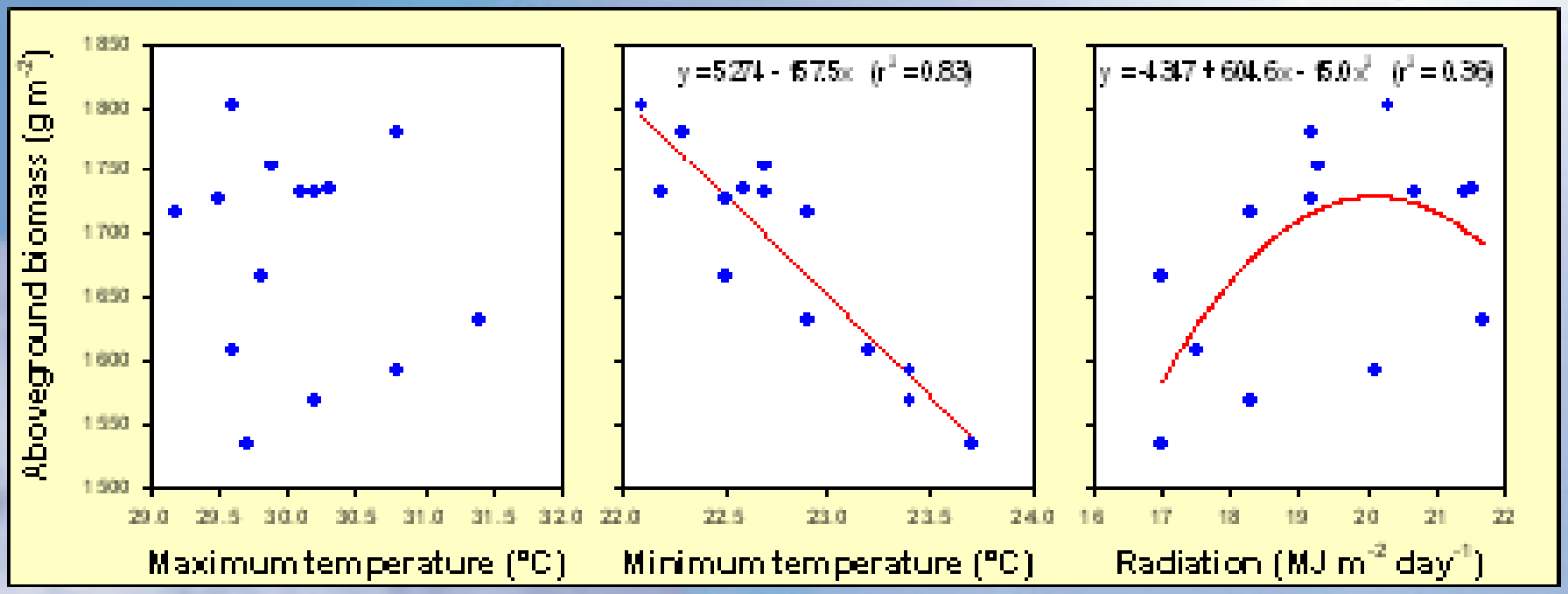
  -- Higher temperature, sea level rises, frequent flood, drought, and outbreak of pests and diseases, use of farmland for bio-energy production, ……

- Climate change and agriculture

  -- Agriculture is the sector most vulnerable to climate change because of its high climate dependence. Indeed all “the expected changes” enumerated above will lead to reduction in food production.

From the beginning…

1961: first experiment on the effect of high temperature on grain filling in rice (IRRI)

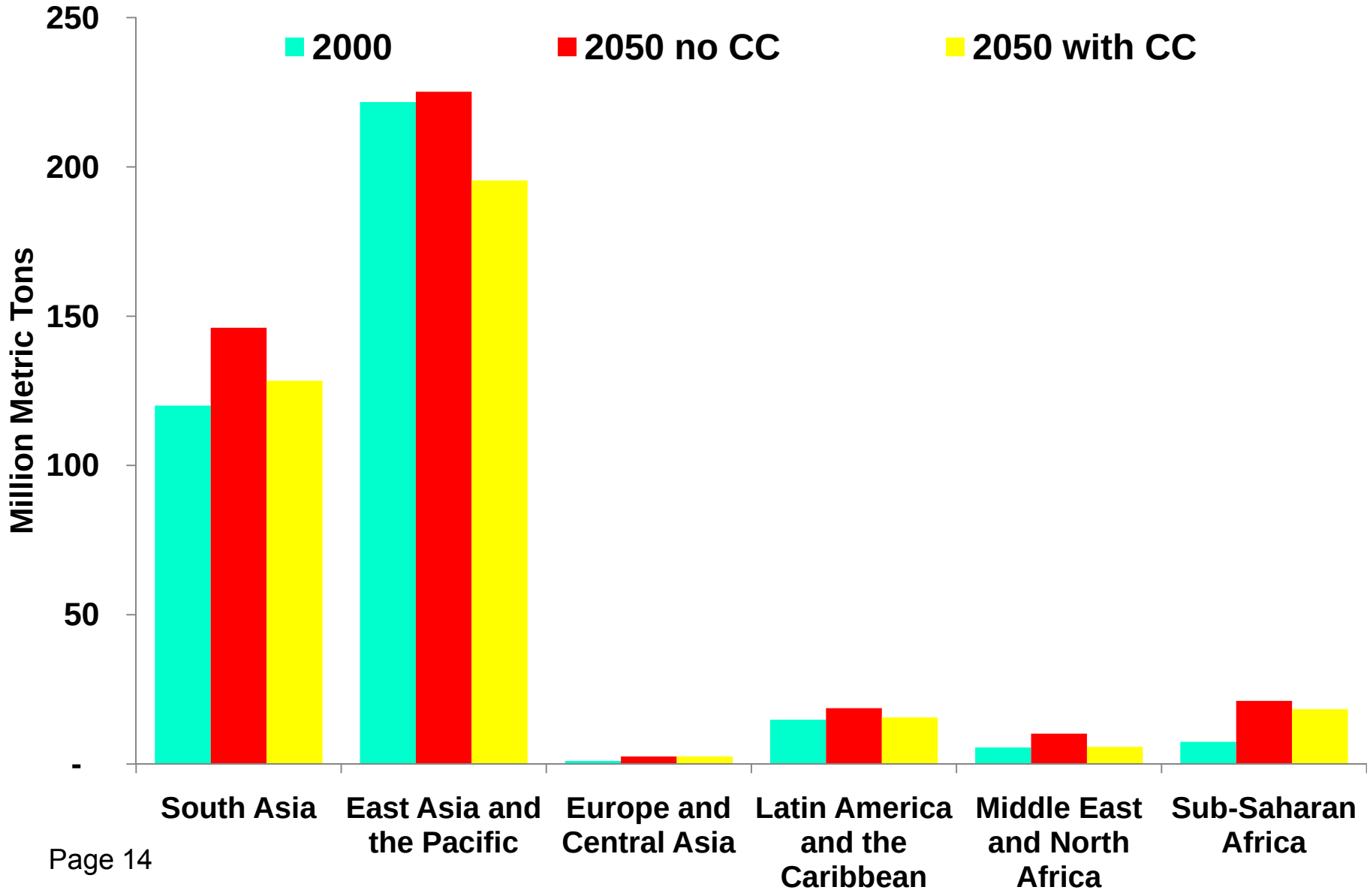


1992 – 2005 decrease in rice yields associated with increasing night temperatures

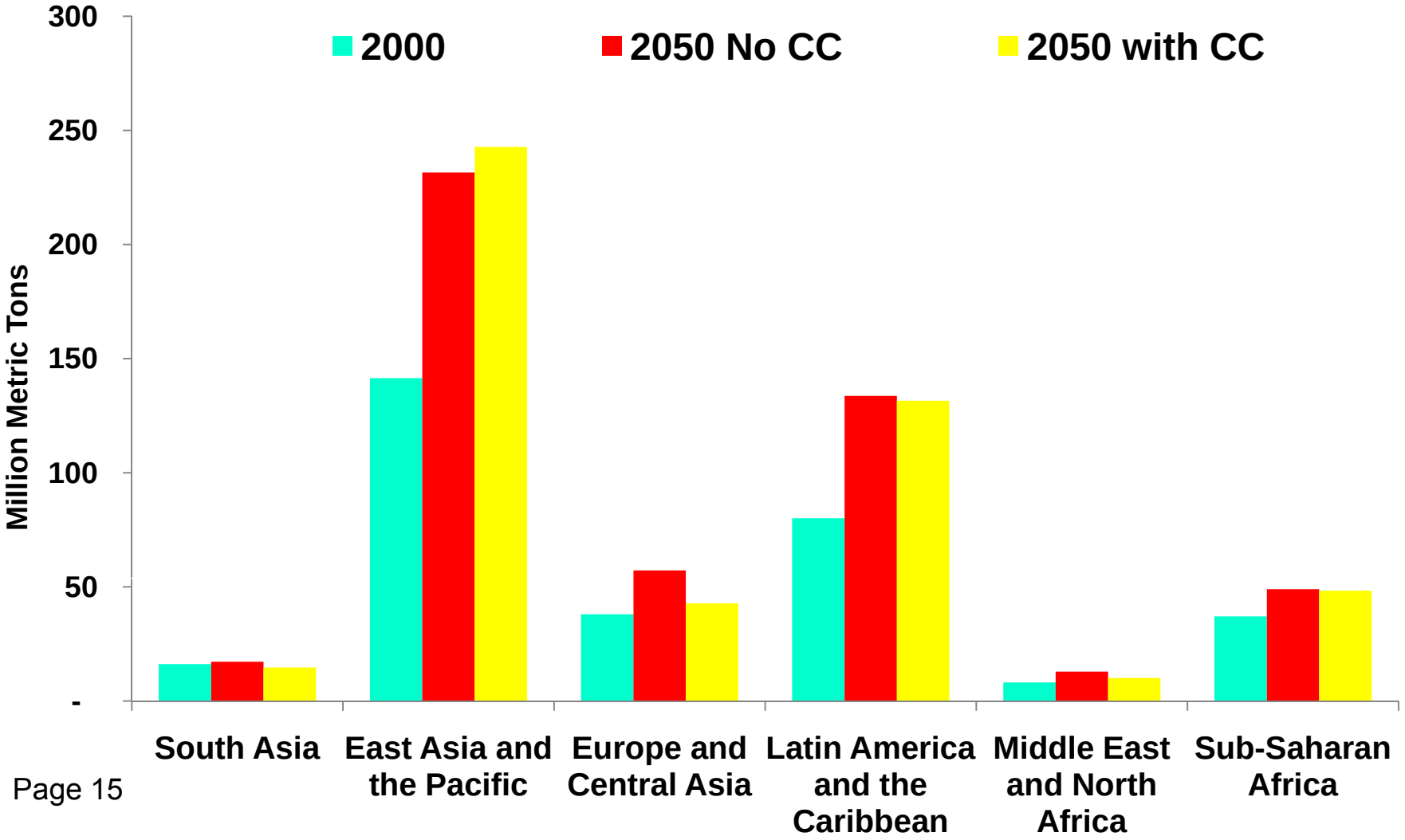
Food Supply and Demand Projections by IFPRI

- Future climate scenarios in 2050 from IPCC
- Crop model to assess the impacts of increased temperature and changes in rainfall pattern
- IFPRI IMPACT Model (global food supply-demand model) to assess the impacts on prices, production, and consumption

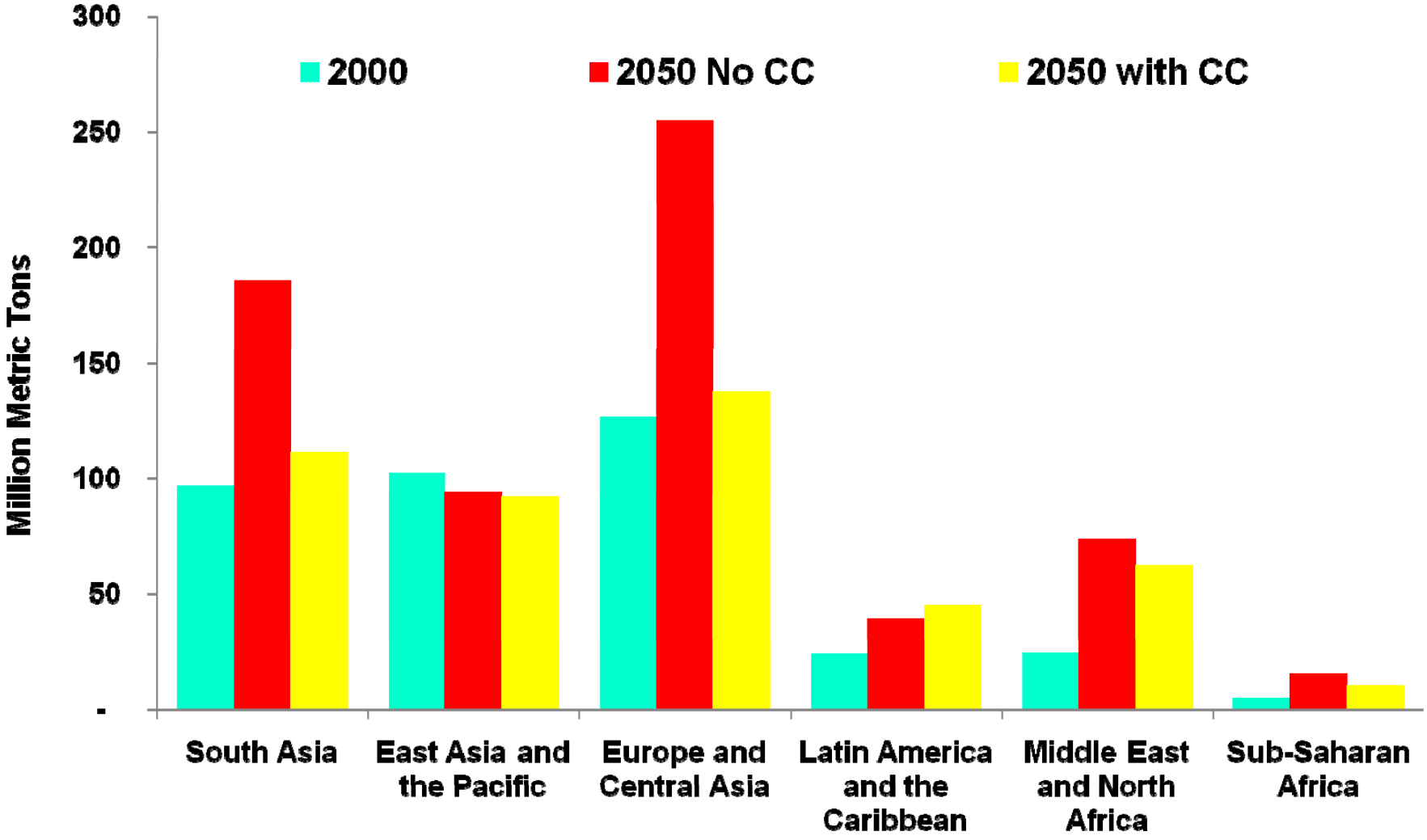
Impact on Rice Production



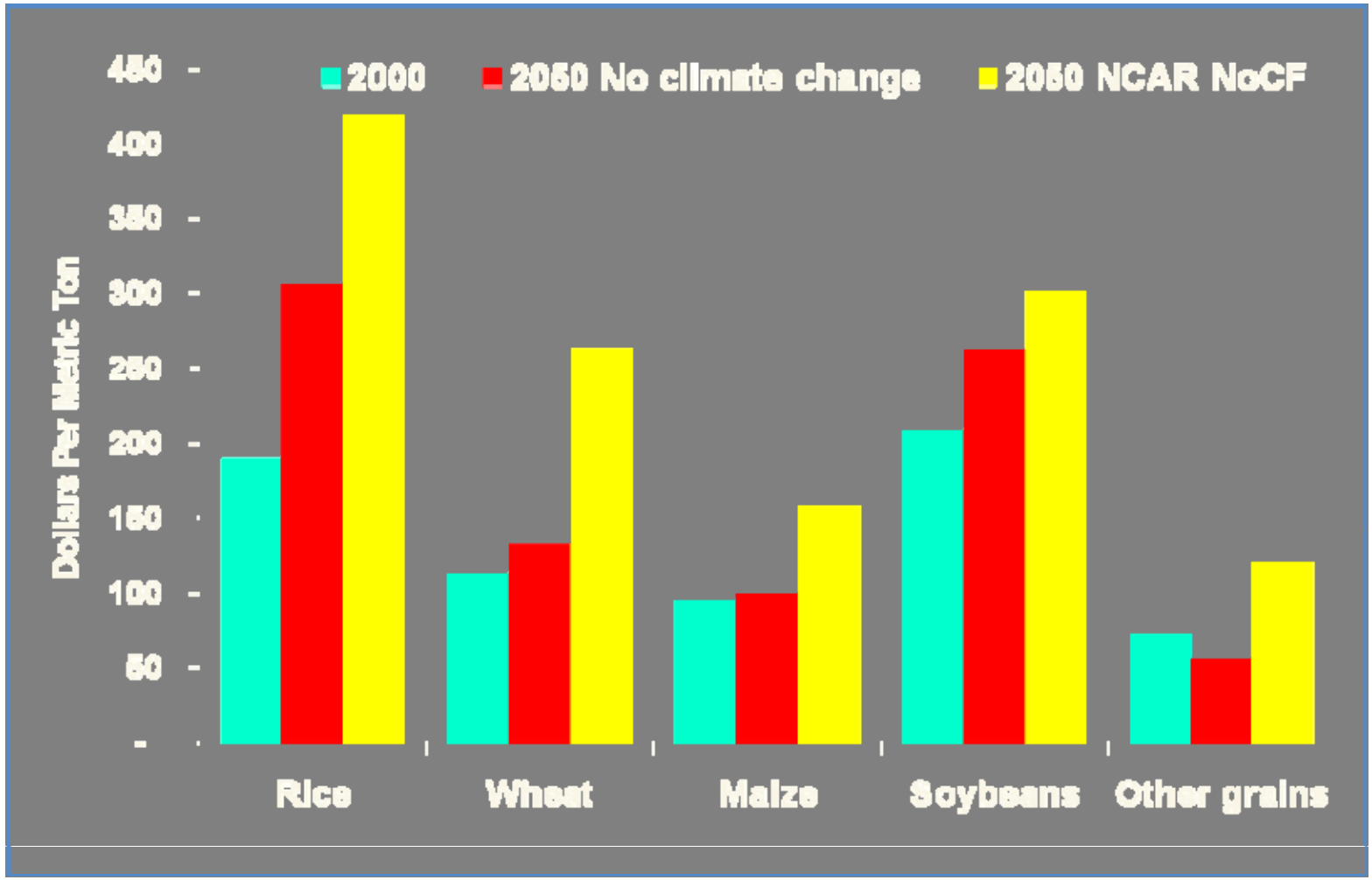
Impact on Maize Production



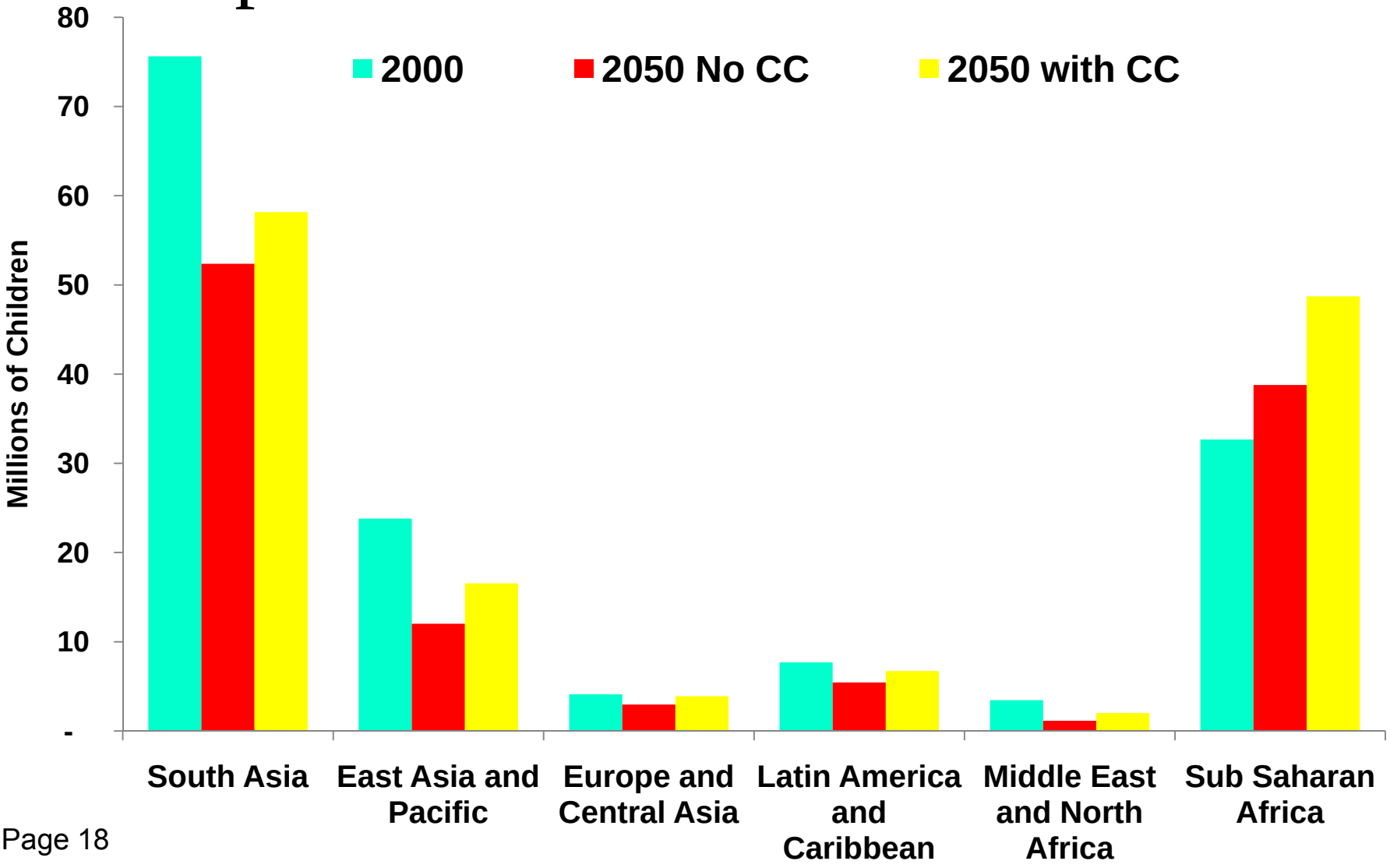
Impact on Wheat Production



Impact on International Food Prices



Impact on Childhood Malnutrition



Is IFPRI Projection Under- or Over-Estimated?

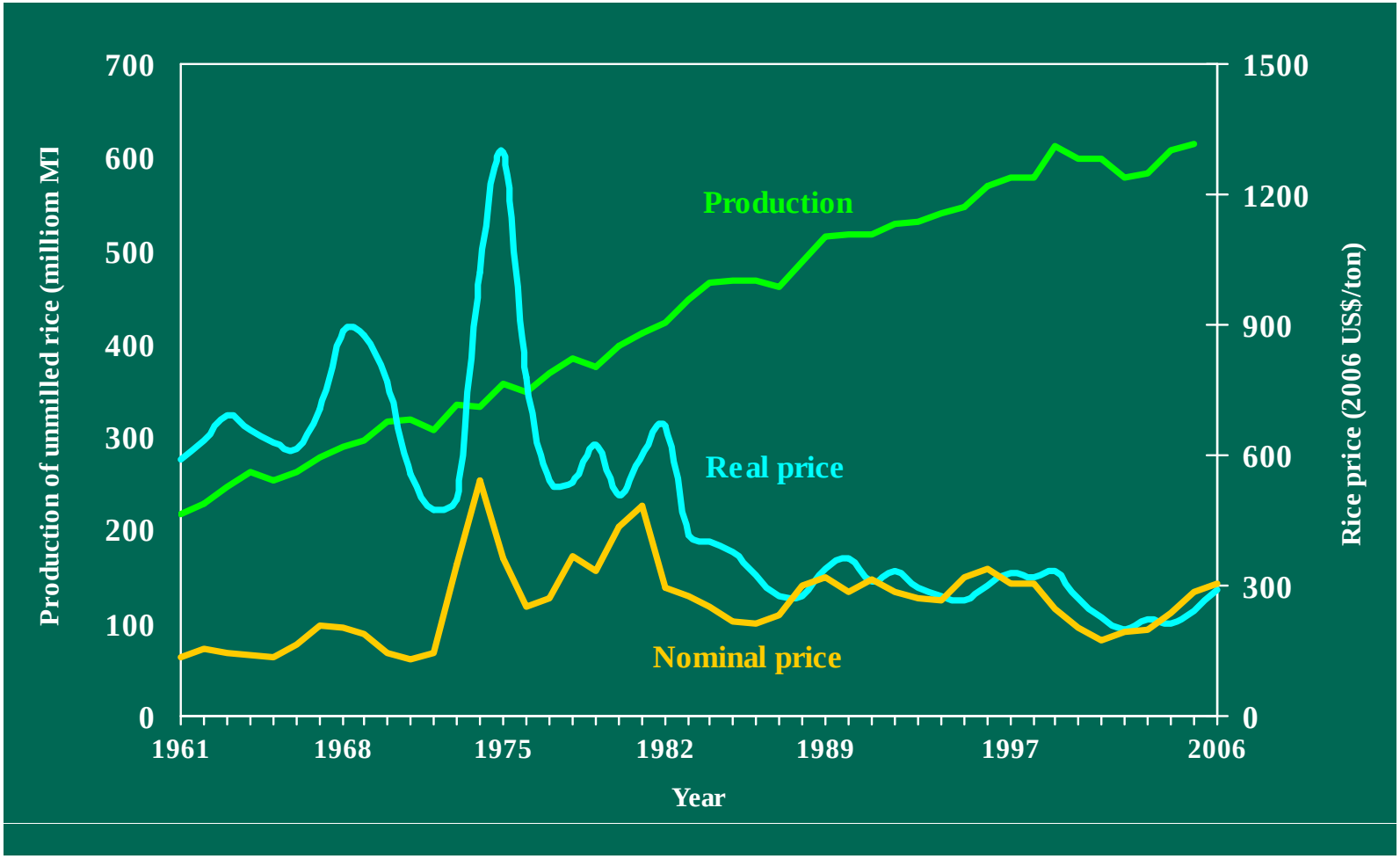
- It is likely to underestimate the impacts of climate change because of the omission of some impacts:

  -- outbreak of pests and diseases

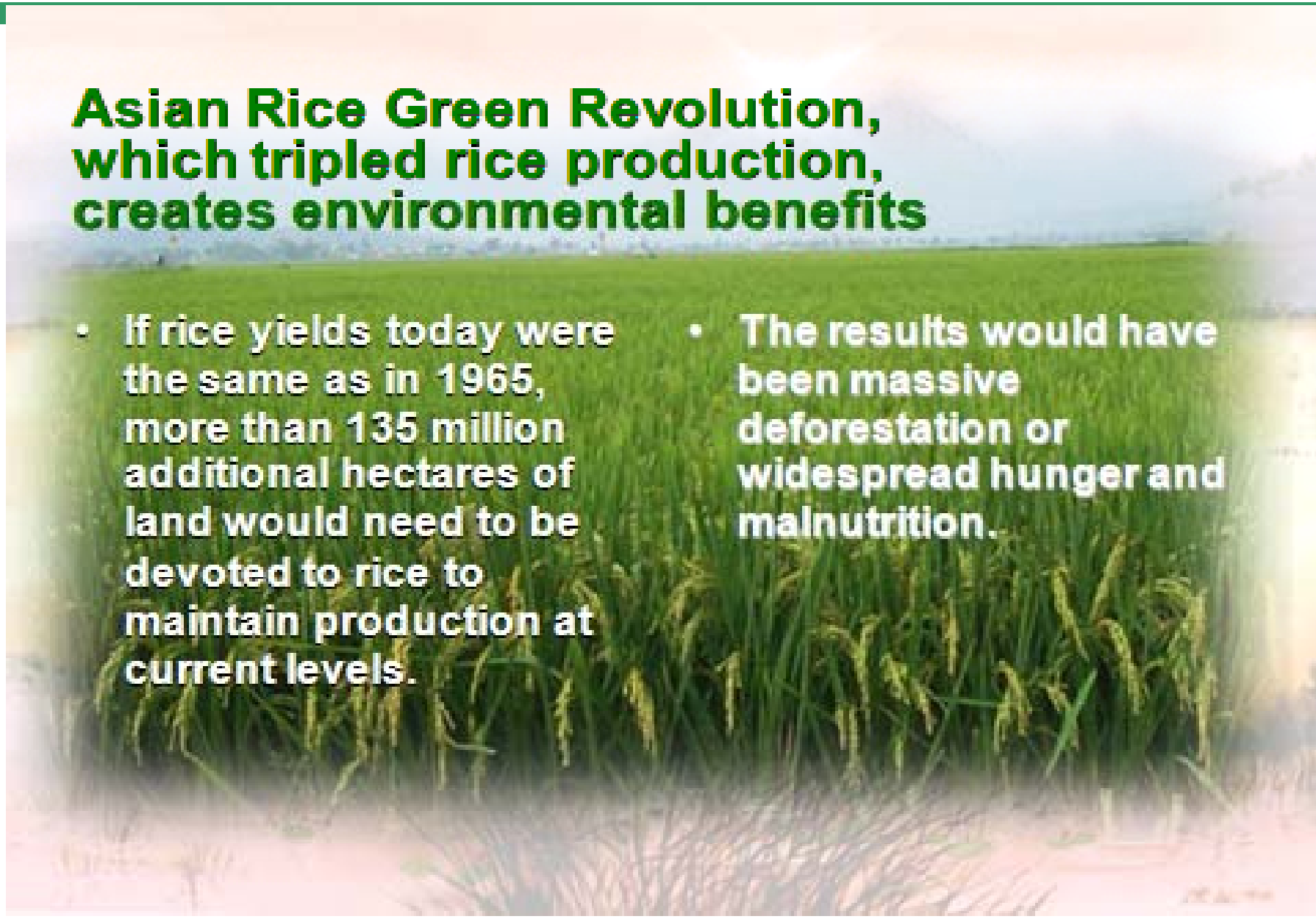
  -- sea level rises

  -- deforestation, which occurs to expand cultivation areas for food security

Trends in world rice production and real rice price,1961-2006



Source: Production: FAOSTAT Electronic Database, FAO.20Apr2006 udpate.
Rice Price: Relate to Thai rice 5%-broken deflated by G-5 MUV Index deflator (adjusted based on 1 March 2007 data update)
Source: www.,WorldBank.org


Asian Rice Green Revolution, which tripled rice production, creates environmental benefits
• If rice yields today were the same as in 1965, more than 135 million additional hectares of land would need to be devoted to rice to maintain production at current levels.
• The results would have been massive deforestation or widespread hunger and malnutrition.

3. Other Factors Leading to Food Insecurity

- Growing water scarcity, particularly in Asia

  Growing demand for water in urban and industrialized areas, resulting in reduced supply of water for agriculture

- "Japanization" of Chinese agriculture

  Small farm size (0.6 ha) + increasing wages ➔ increasing labor cost ➔ Increased need for but infeasibility of large mechanization that can save labor costs ➔ Massive imports of foods ➔ Higher food prices

4. Possible Scenario: Vicious Circle

Climate change and other changes leading to reduction in food production

➔ higher food prices

➔ (1) food insecurity with deepened poverty, (2) unsustainable land use including deforestation, and (3) adaptation efforts, which mitigate the impacts of climate change

➔ further effort to reduce GHG emission by curtailing the use of fossil energy ➔ higher energy price ➔ higher food price

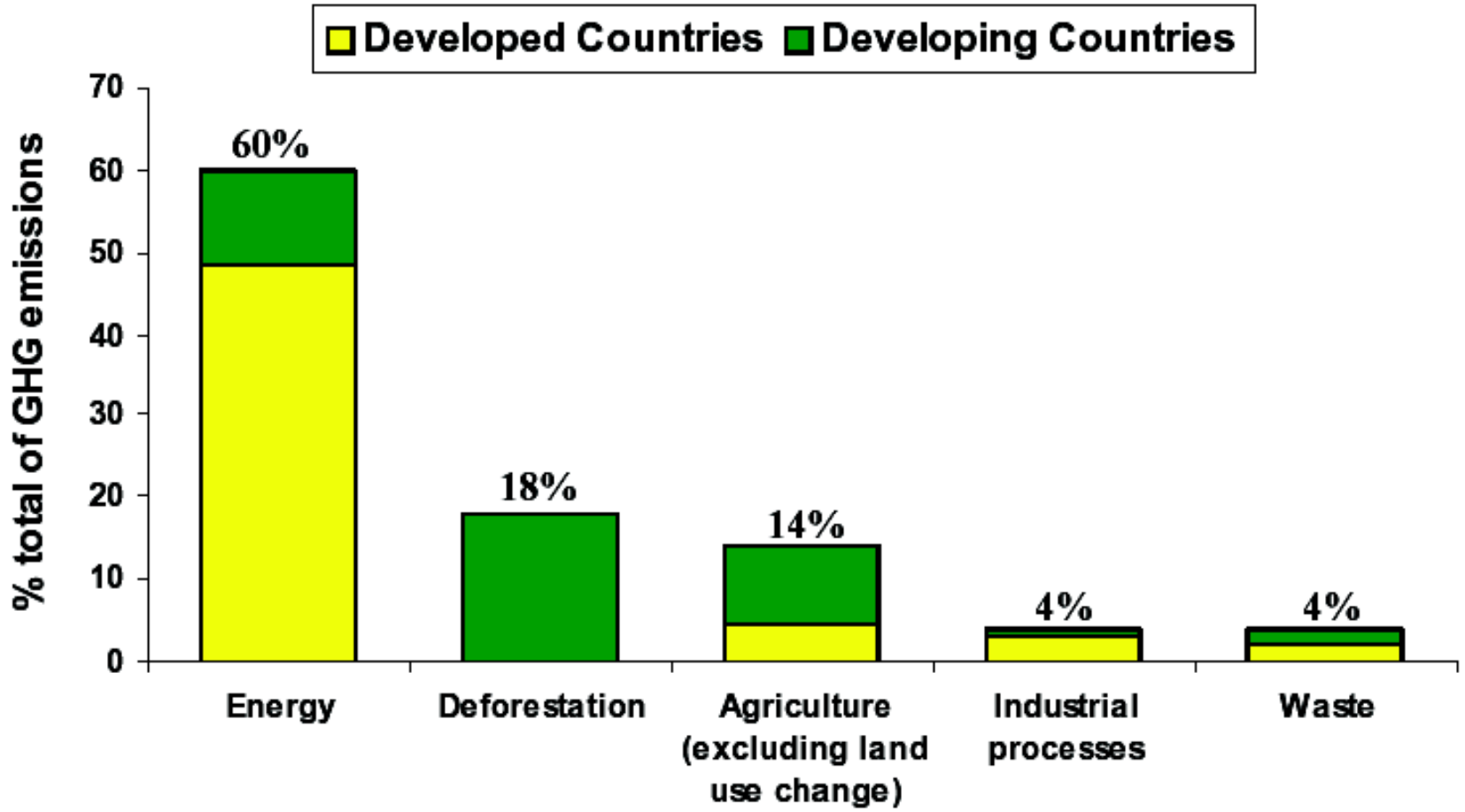
Agriculture in developing countries is responsible for GHG emission

- Deforestation to expand cultivation areas, which leads to flooding and unstable water supply
- Emission of methane and nitrous oxide

  -- Emission of these GHGs is more pronounced in developing countries

* Increasing emission from increased use of fossil energy in developing countries

Sources of GHG Emission



Sources: World Resources Institute 2007; World Development Report 2008

Importance of Agriculture in the Context of Climate Change

1. Agriculture will be a major target of adaptation

   -- Adaptation reduces vulnerability by reducing the impacts of climate change

   -- Specifically we need to reduce downward risk of production by developing heat-, drought-, pest- and disease-resistant, and submergence- and salinity-tolerant technologies, particularly in developing countries, which are more vulnerable to climate change.

   -- More challenging is the development of chemical fertilizer-saving technology.

Importance of Agriculture in the Context of Climate Change (continued)

2. We need to enhance water control by irrigation investment etc.
3. We should reduce GHG emission from agriculture (e.g., methane and nitrous oxide) by developing monitoring system to reward the effort to reduce GHG emission in agriculture – participation of agriculture in CDM and carbon trade.
4. We need to develop agriculture in general so as to maintain or improve the food security.

Successful adaptation: sub1 gene

- Understanding of crop biology and genetics
- Ability to integrate that understanding into a breeding program
- Capacity and penetration to enable the adoption of the crops

Key Challenges in Agriculture

1. Develop water-saving technology to release water from agriculture to urban and industrial uses.
2. Develop drought-tolerant technologies to increase food production in dry and drought-prone areas in Asia and almost the whole region of sub-Saharan Africa, where people are particularly poor.
3. Develop chemical fertilizer-saving technology
4. Invest in irrigation, roads, and other infrastructure.

* Since basic scientific knowledge is global and regional public goods, international efforts to support agricultural research (e.g., CGIAR) is needed. Also needed is adaptive research to develop and disseminate location-specific technologies and investment in infrastructure, which are local public goods.

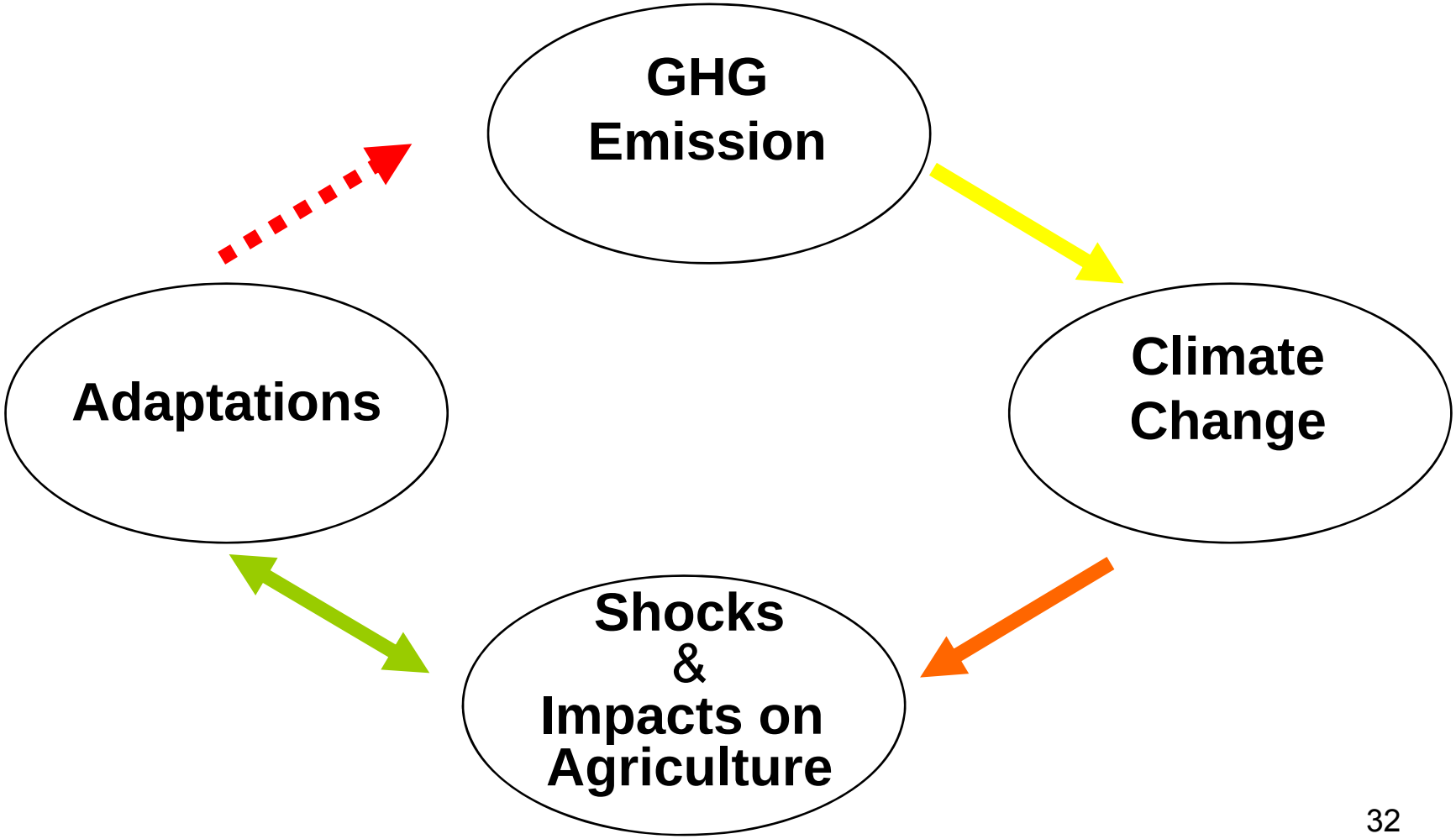
5. Towards Virtuous Circle

- Successful adaptation will mitigate the adverse impacts of climate change but not affect climate change itself.
- Sustainability of agriculture and sustained food security, particularly in poor countries, will never be achieved without significantly reducing GHG emission.
- We need to cut “energy-food” nexus.

What Do We Have to Do?

- We need major and *committed* reduction in GHG emission in both developed and *developing* countries, in order to achieve 50% reduction in GHG emission by 2050.
- We need adequate adaptation, particularly in agriculture in developing countries, which is *most vulnerable* to climate change.
- How can we achieve mitigation and adaptation simultaneously?

Structure of the Problem



Free Riding, Mitigation, and Adaptation

- I definitely propose to use "support for adaptation in agriculture in developing countries" as a strategic tool to reduce free riding:

  -- Adaptation is often related to local public goods

  -- Targeting is possible

  -- Assist adaptation for a particular country if this country reduces the emission of GHGs.

- Target the poor countries ***and countries which commit to the reduction in the emission of GHGs***.

* Support China, India, and other growing LDCs to reduce emission of GHGs is another important strategy.

Supportive Agricultural Policies for Food Security

- Keep trade open, particularly in food exporting countries
- Establish grain reserves to reduce price fluctuations
- Strengthen food monitoring system and information network to avoid “wrong” speculations

6. Conclusions: Roles of Natural and Social Sciences to Combat Climate Change

- Need for Science-Based Technology Solutions
  - -- Development of fossil energy-saving technologies
  - -- Efficient use of renewable energy
  - -- Efficient production of biofuel
  - -- Development of “adaptive” agricultural technology
  - -- Development of chemical fertilizer-saving technology
- Need for Strategies to Realize Technology Solutions
  - -- Carbon trading
  - -- Use of “adaptation for mitigation” to facilitate the post-Kyoto international agreements

Thank you very much for your attention