Biofuels Research in the Consultative Group for Int'l Agricultural Research (CGIAR): A Perspective from the Science Council

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Presentation Overview

- CGIAR and the Science Council
- Recent Developments in Biofuels
- Challenge for the CGIAR
- Opportunities and Risks of Biofuels
- Research role of the CGIAR
- SC policy statement

CGIAR & the Science Council

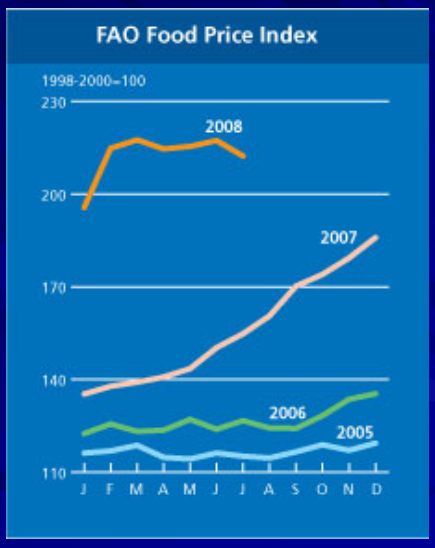
- Consultative Group for Int'l Agricultural Research
  - established 1970; 65 donors;
  - support 15 Research Centres;
  - ~ 1,000 scientists

  - **poverty alleviation, food security, environmental sustainability**
- Science Council
  - 7 scientists supported by a Secretariat (6 professionals)
    - Priority setting and strategy planning for the CGIAR system;
    - Review quality and relevance of science in each Center;
    - Advice on science policy and broad strategic questions

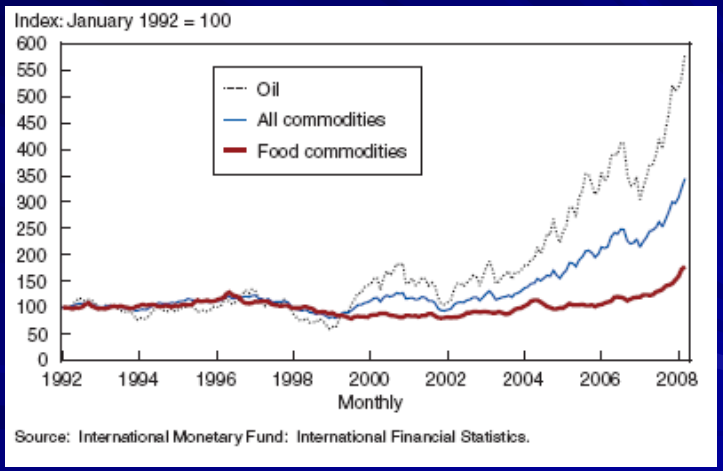
Recent Developments

- Rising prices of oil and other forms of energy + generous gov't subsidies → food crop conversion to biofuels profitable
- Brazil, USA leading producers of bioethanol (90%)
  - one-quarter of USA maize now used for ethanol ... and rising
- EU leading producer of biodiesel
  - heavily subsidized in the form of high import tariffs, production subsidies and fuel tax preferences → 10% transport by 2020.
- Developing countries have national biofuel policies with mandates for ethanol and biodiesel use
- Rapid global expansion in the demand and supply of biofuels shaping agricultural markets in new and fundamental ways,
  → linking food prices to energy prices

Trends in monthly world food price indices since 2005 (FAO 2008)



Price indices for food commodities, all commodities and oil, 1992-2008 (May)



Future Developments

- Oil prices likely to remain high
- Global public & private investments in biofuels expected to reach $100 bn by 2010 ($38 bn in 2005, $5 bn in 1995)
- Continued strong public support / tax incentives for biofuels developed and developing countries

→ **Increasing trend in use of biofuels**

The CGIAR Challenge

- Developing countries eager to develop domestic biofuel industries
  - the right path ? and what steps should the CGIAR take ?
  - some CG biofuels related research underway (sorghum, cassava, *jatropha*)
  - but, priority of this work ?? what are the implicit trade-offs ??
  - ? Who is likely to benefit most, and least?
    - between urban and rural households
    - between producers (large vs. small) and consumers
- Defining a "people-centred" response to the global biofuels boom, which
  - offers opportunities for commodity producers, but
  - does not compromise the food security of poor producers and consumers
  - pays adequate attention to the full set of environmental risks

Biofuels: Opportunities and Risks

- Potential Benefits:
  1. Increasing energy availability and security
  2. Reduced greenhouse gas emissions / mitigate climate change
  3. Increasing biofuel and food crop producers' incomes
  4. Increasing employment & economic development in rural areas
- At the same time, serious doubts about the energy, GHG emissions, and nutrient balances and water use of bioenergy feedstocks currently in use, and the potential adverse impacts on food security and the environment.

1. Energy Availability/Security ?

- Some, but only very marginal effects on supply/prices/energy security
- Land requirement alone is excessive
  - if entire USA maize crop were diverted to biofuel production (no maize for the food and feed market), it would displace only around 10% of the nation's gasoline consumption
- Using starch to produce biofuels is inefficient (from energy balance)
- More significant for '2nd generation' biofuels, i.e., producing ethanol from ligno-cellulose in major crop & other plants (native grasses, algae)
  - much higher energy balance: 2 - 36 vs. 1.3 from maize grain based ethanol
  - major research underway, cost efficient technologies
  - potential for using marginal, degraded land – not validated
  - competition with livestock feed, sustainability issues

2. Reducing GHG emissions ?

- Renewable source of energy → potential for carbon savings, but depends on:
  - type of feedstock (raw material)
  - production process
  - conversion into a usable fuel
  - changes in land use (direct and indirect)
- Biofuels can create a huge 'carbon debt' when forests, peatlands & savannahs converted to cropland (biofuels)
  - Searchinger et al (2008); Fargione et al (2008); Gibbs et al (2008)
- Obligatory blending and govt subsidies of biofuels production creates a strong incentive to produce biofuels in any possible way ... yet,
  - techniques to achieve this large-scale production in a sustainable way are not yet available.

Potential adverse environmental effects (for first generation)

- Increased demand for water to agriculture to sustain bioenergy production & processing;
- Reduction in water quality from increased fertilizer rates and pesticide use with currently available technologies
- Expansion of cropping to marginal lands, forests, wetlands, grassland savannahs resulting in a significant increase in erosion, ecosystem degradation and loss of biodiversity;
- Increased levels of nitrous oxides released from fertilizer use—the single most important GHG output in the biofuels process.
- **Needed**: Appropriate technologies, regulations, standards, certification schemes to mitigate, but, difficult to enforce (policy environments weak)

3. Increasing incomes via higher food commodity prices ?

- Positive impacts for producers/processors
- Trade-offs between food (calories) and fuel (energy) as global biofuels economy expands
- Adverse impacts for millions of small scale net purchasers of food and urban poor
  - increasing poverty & food insecurity
  - undermining progress towards Millenium Development Goals

Impact of biofuels on commodity prices

- Biofuels market: major new and growing source of demand for maize, sugar, oilseeds, cassava and palm oil
  - 11% of global maize and 7% of global vegetable oils → ethanol and biodiesel production
- Account for a significant share of the increase in food grain prices
  - 3 % of the total increase (USA gov't report, June 2008)
  - 75% of the total increase (World Bank, April 2008)
  - 25% of the total increase (IFPRI, May 2008)
- High oil price effect vs. biofuel subsidy/mandate effect
  - latter ~ one-quarter of the price increase (Purdue U, July 2008)
- Empirical estimates: caloric consumption of the poor falls by .05% for every 1% rise in price of major staples

4. Increasing rural employment & economic development ?

- Increasing crop prices revitalizes the rural economy...

  → raises producers' incomes

  → higher land values

  → attracts capital into rural areas

  → creates jobs and new income opportunities in the rural economy

- Positive experience in Brazil (labour intensification)
- Reproducible ?? Limited to rural areas that have reasonably good road and market infrastructure
  - excludes much of Africa

What the CGIAR should do

- Bring new knowledge/insights, practices and policies to bear on issues that directly or indirectly affect food security and ag sustainability, e.g., biofuels related issues
- Two research themes most relevant:
  - Policy research, including outlook and trend/scenario analyses → Theme 1
  - Sustainable natural resource management, including ecological intensification → Theme 2

Theme 1: Policy Research and Advice

- Understanding the implications of global, national and local biofuel industry developments
  - on poor producers and consumers (food security imperative)
  - on the agro-ecologies (environmental sustainability)
- Designing institutional arrangements, policies and investment strategies that help mitigate adverse food security and environmental outcomes and promote positive ones
- Activities:
  - Outlook and trend/scenario analyses
  - Tools, methods, frameworks and model development

Theme 2. Sustainable NRM Research

- Research on high yielding, sustainable agricultural practices in major traditional and new cropping systems
  - 'ecological intensification' to address new challenges in sustainably managing landscapes, watersheds and farming systems arising from biofuels
  - raising crop yields, protecting environmental quality and conserving natural resources
- Development and use of frameworks, methodologies (life cycle analyses) and key indicators of efficient and sustainable food/biofuel production systems
  - use to evaluate specific food-energy systems over time and develop policies based on internationally agreed methods of assessing sustainability
- Assess effects of a major policy shift toward first generation biofuel production, with respect to:
  - reduction in water quality from increased fertilizer rates with current technologies;
  - expansion of cropping to marginal land → erosion and ecosystem degradation;
  - expansion of cropping into rain forests, wetlands, grassland savannahs

What CGIAR should not do ?

- Basic research on biofuels
  - improving fermentation efficiency
  - experimentation with cellulosic enzymatic processes
  - role for upstream academic org. and private sector
- Genetic improvement / characterization of crops for biofuel use
  - trade-offs, other research opportunities
  - impact on poor (vs. non-poor)
  - alternative suppliers
  - long term value of research investment

The policy message is...

- If government policies continue to promote biofuels as currently used, i.e., targeting large-scale first generation technologies, then **major food security and environmental challenges** loom ahead
- Drawing on the limited land, water and nutrient resources to produce a significant portion of a country's energy demands (in addition to the food, feed and fiber demands of a growing and wealthier population) will exert **enormous pressures on a resource base** that is already struggling to cope
- To achieve sustainable biofuel production, governments should scale back their support for and promotion of large-scale first generation biofuels and seek to **develop/invest in second and third generation conversion techniques** from agricultural residues and wastes

Thank you !

A CGIAR Science Council Policy Statement on Biofuels Production

There are serious concerns about the GHG emissions, energy and nutrient & water use efficiency of large-scale, first generation bio-energy feedstocks currently in use. A major question is whether biofuels obtained from these feedstocks are effective in combating climate change and what impact they will have on soil and water resources. Another fundamental issue relates to the magnitude and nature of their impact on food prices and ultimately on the livelihoods of the poor.

A possible solution to overcome the current potentially large negative effects of large-scale biofuel production is developing second and third generation conversion techniques from agricultural residues and wastes and step up the scientific research efforts to achieve sustainable biofuel production practices. Until such sustainable techniques are available governments should scale back their support for and promotion of biofuels. Multipurpose feedstocks should be investigated making use of the bio-refinery concept.

At the same time, the further development of non-commercial, small scale production of first-generation biofuels in rural settings, e.g., biodiesel for rural household electricity supply in developing countries, should be explored in terms of promoting rural development to reduce dependence on imports of fossil fuels.

Role for Science and Technology

- Food production per person increased by 30% over past 5 decades
- Major role for technology
  - fertilizers
  - variety improvement (rice, wheat, etc.)
  - mechanization
  - irrigation
  - pesticides, herbicides
- Proper institutions and policies in place

Agricultural growth and the poor

- 1% increase in per capital agric output

  → 1.6% increase in the incomes of poorest 20% of a population (Gallup et al. 2007)

- On average, every 1% increase in agricultural yields reduces the # of people living on less than $1/day by 0.83% (Thirtle et al. 2001)