



Energy
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Biofuel and the new economics of agriculture

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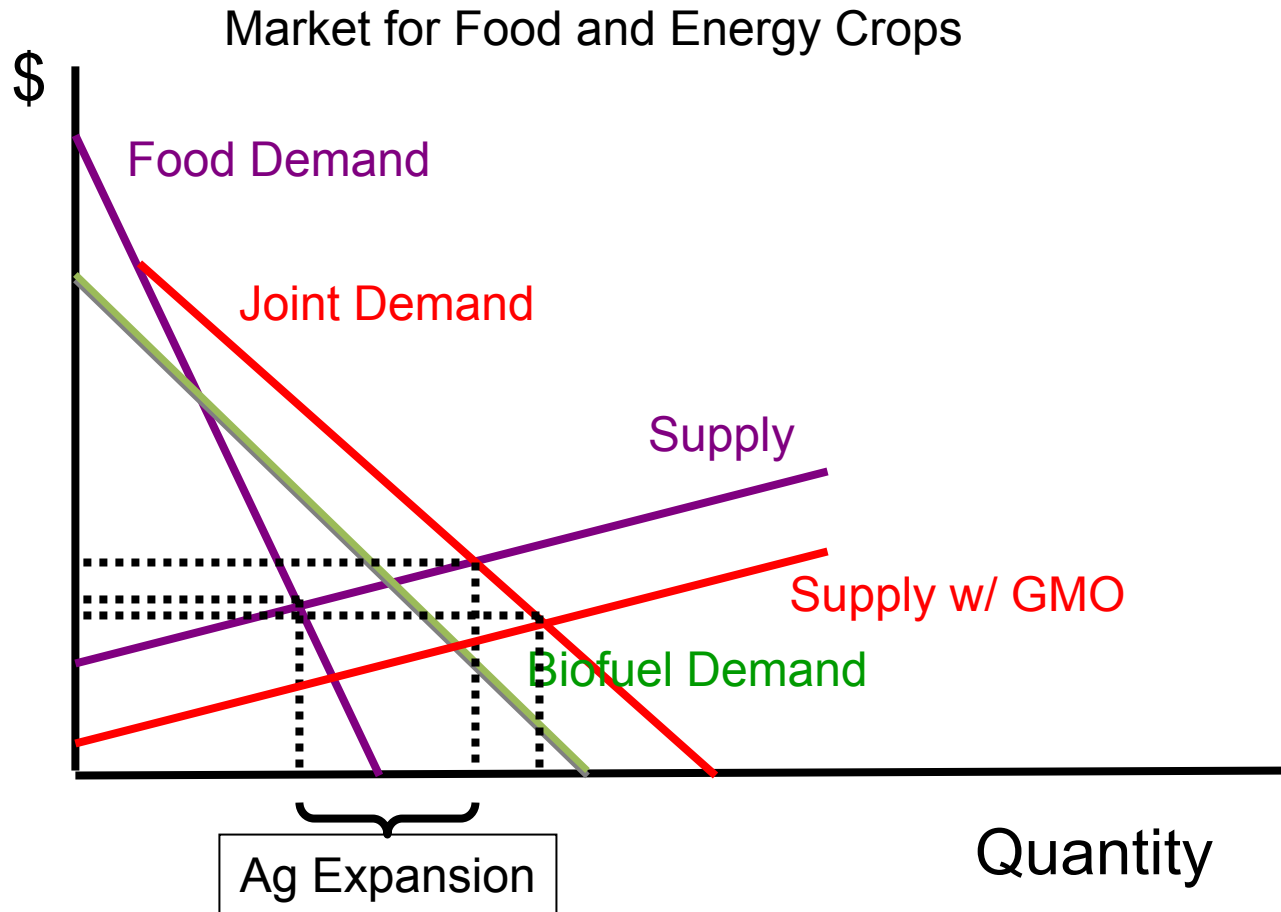
Presented at Farm foundation Workshop Berkeley July 28 2008

Agricultural and Resource Economics | UC Berkeley

Why Biofuel ?

- Increase in demand for fuel
 - 18 cars/1000 people in China vs. 800 in US
 - Tata's Nano car
- Constrained supply of oil
 - Tar sands, CTLs have their own problem
- Concern about climate change
- Limited capacity to induce conservation (minimal support for carbon tax, CAFÉ and LCFS have limited capacity for change)
- Biofuel are not new- take advantage of human skill -farming

Biofuel And the Food Market-short term analysis



The Basic Economics of Biofuel

- **Introduction of Biofuels:**
 - **Increased food prices; and**
 - **Reduces food availability**
- **The effects can be countered by:**
 - **Increased agricultural and conversion productivity**
 - **Second generation biofuels**
 - **Ag Biotech**

Boom/bust and subsidies

- Food Crop biofuels are viable economically when food prices are **low** and fuel prices are **high**
- Subsidies always help...
- Higher energy prices in the 2000s combined with subsidies and low food prices made biofuel profitable
- Recent increases in corn price – led to big losses to corn biofuel processors

Impact of biofuel based on 2007-back of envelope calculations

- Biofuels replaced 1- 2% of liquid fuels
- Reduce prices by 2-4%
- Saved consumers globally up to \$60 billion
- About 12% of the corn output was in biofuel
- Direct Price effects between 16-40% of increased price of corn
- Then there are indirect effect through reduced inventories
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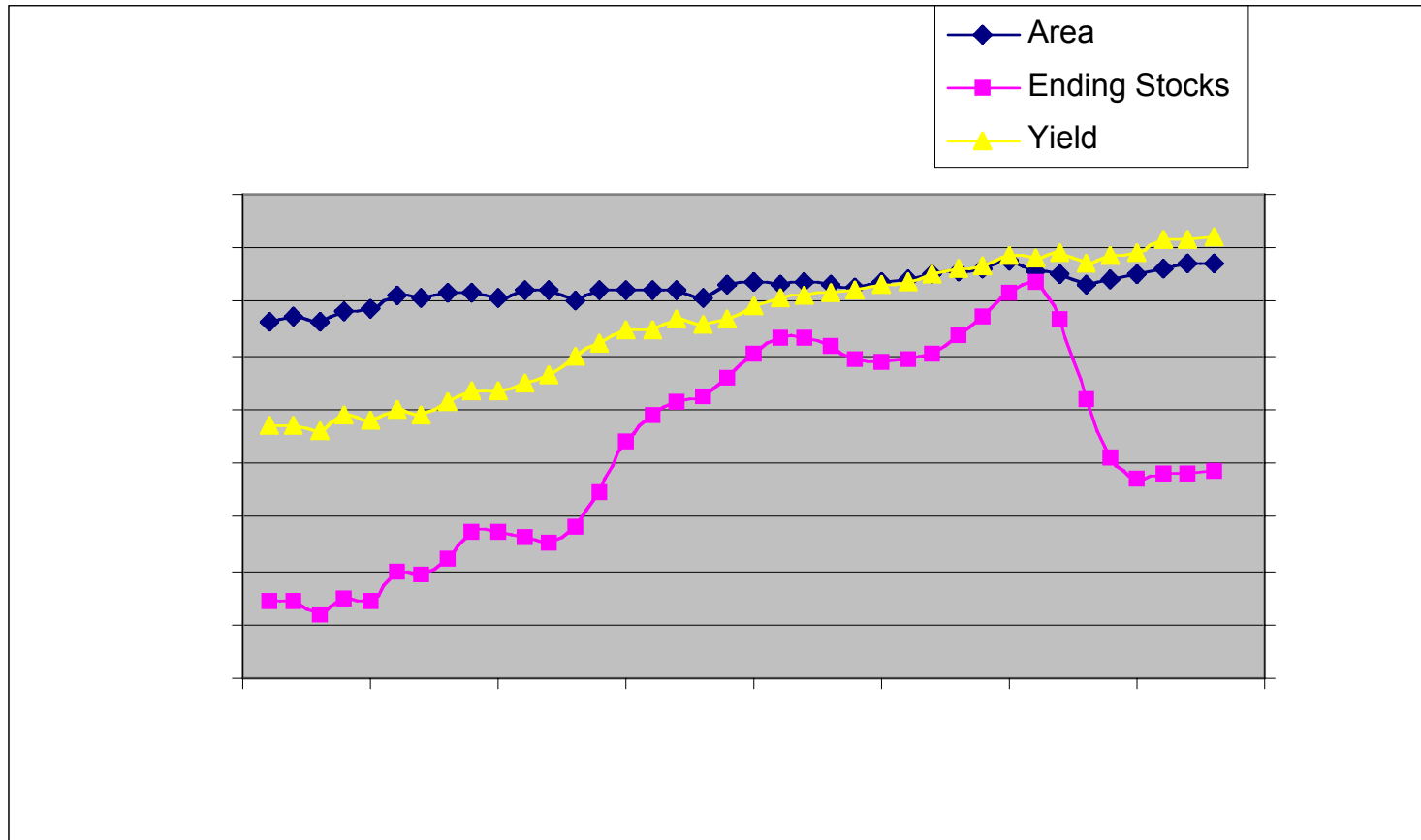
Productivity, inventories technologies, and prices

- The same forces lead to increased demands for fuel and food
- When productivity does not grow as fast as demand prices rise and inventories decline
- Low inventories and expectations of high biofuel mandates contributed to the high prices
- Expectation for innovation and technological change tends to reduce price pressure
- We are in a race between demand for food and fuel and technology

Short term vs long term price effects of biofuels

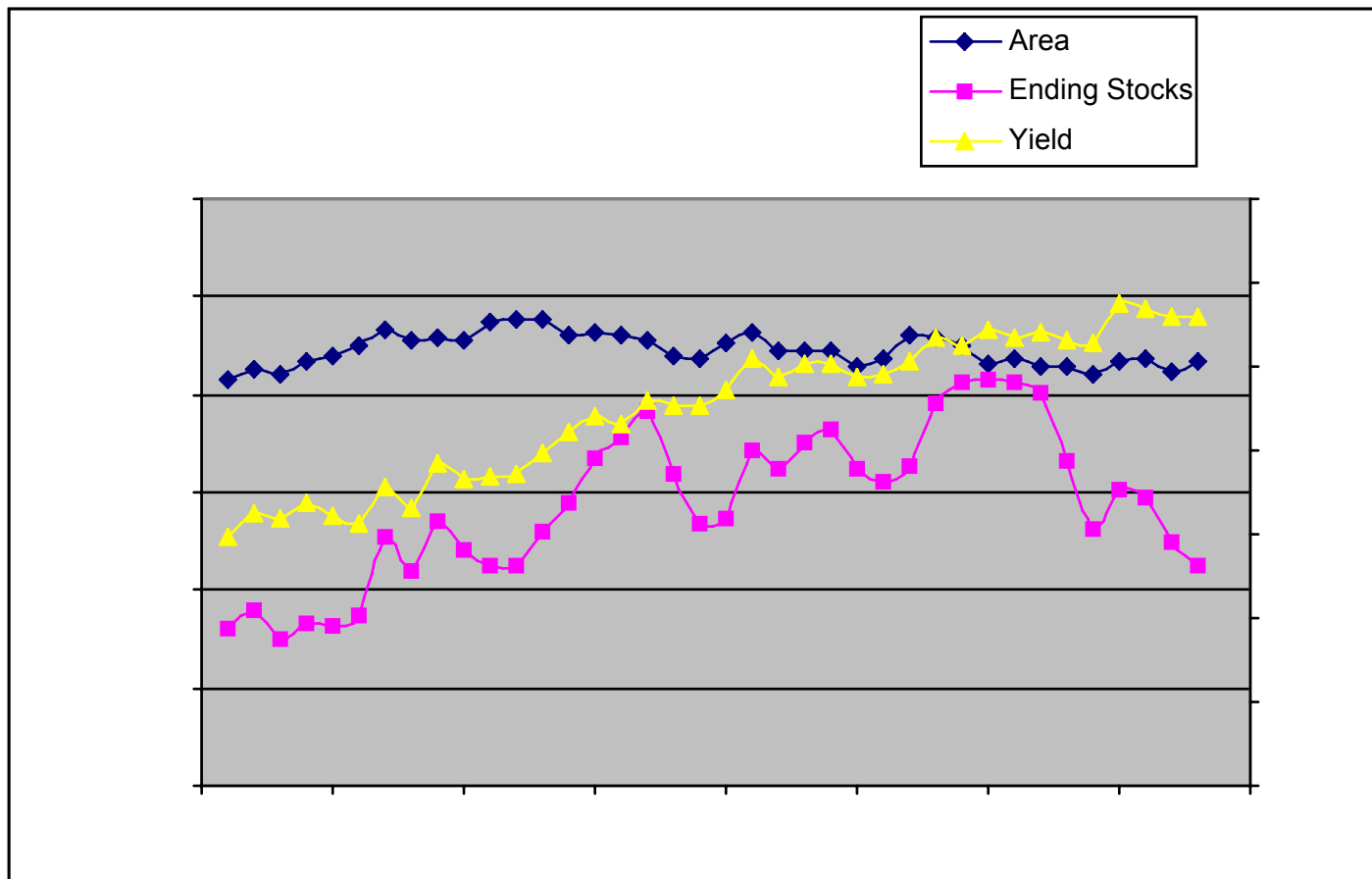
- The impacts of biofuel on food prices has been accumulating
- The 16-40 % increases we attribute to biofuel based on short term elasticities are lower bounds
- Continuing shortages, negative supply shocks (Australia) and expectation for higher price may push for much higher price effects as suggested by the world bank
- But small changes in supply relieving the pressure could have done wonders

Rice yields increase in 70s because of Green Revolution; they have stagnated in recent years

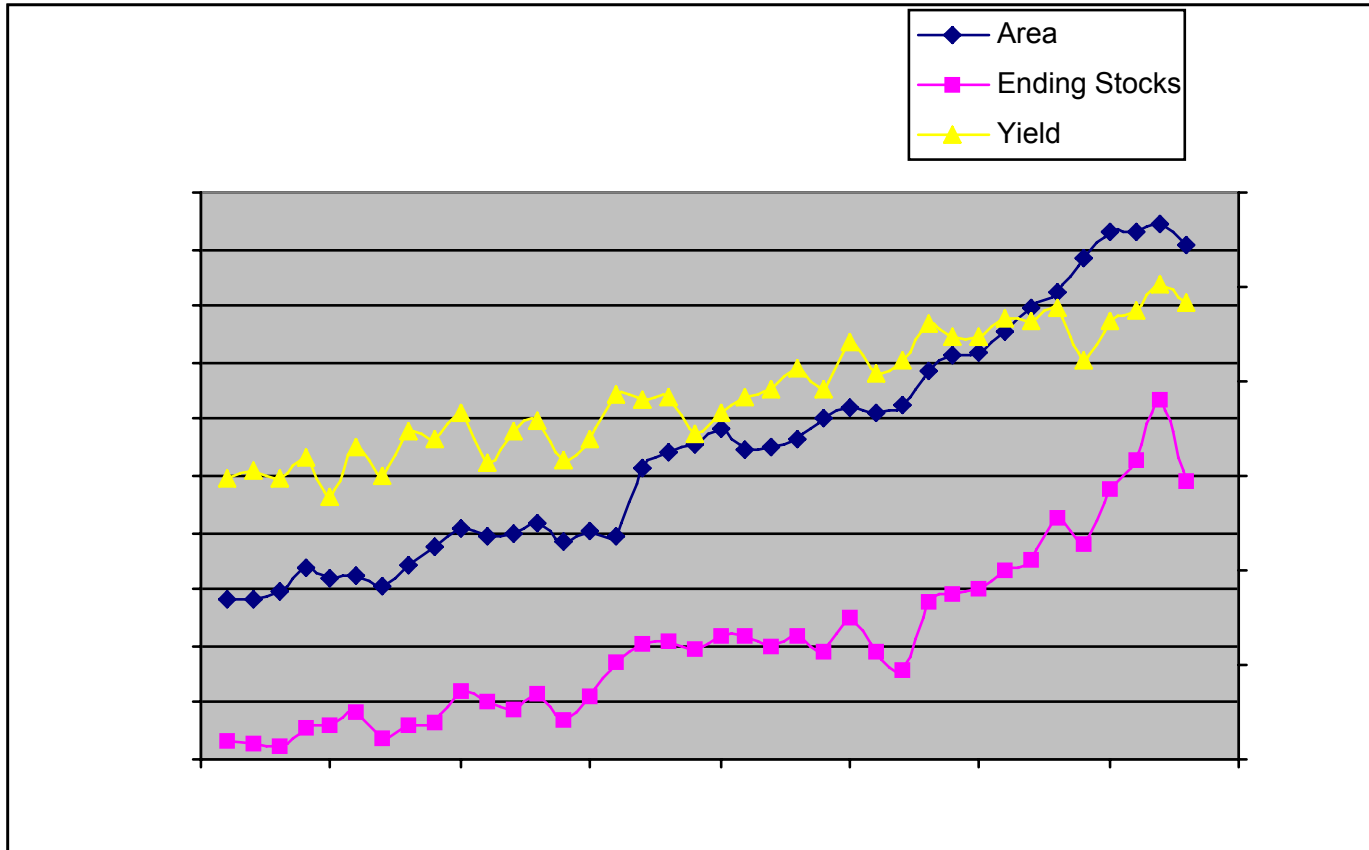


Look at inventories-they declined leading to price pressure

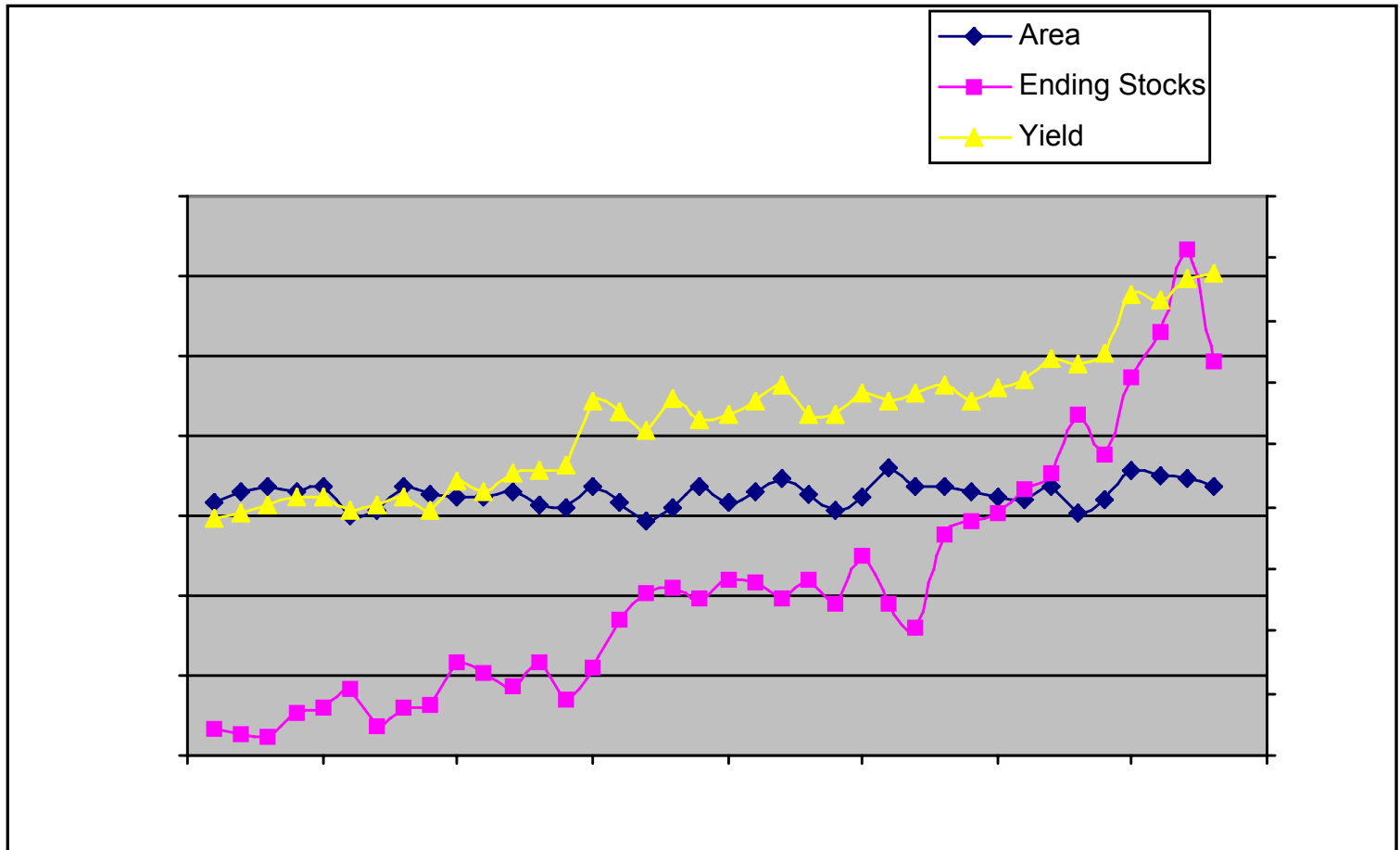
Wheat also benefited from Green Revolution and has seen little productivity growth of late.



Soybean has benefited from GMO



Cotton sees sharp increase in productivity growth around 2000 due to GMO



Cheap and clean oil and food Require more R&D Ag investment

- Ag research has been deemphasized in recent year
- Biotech **-over-regulated and underdeveloped**
- Cotton and corn yields have yield much more relative to rice and
- Food productivity- except of some biofuel crop stagnating
- Much More food and fuel from the land will not be feasible without massive land expansion and increased productivity
- We face a food and fuel productivity challenge

Biofuel and Climate Change

- Biofuel is not fully renewable because energy is needed to produce inputs and refine fuels
- Some biofuel emits more GHG than they save
- Corn save 18% gGHG under reasonable conditions but that may change if more coal is used in processing
- .. Sugarcane ethanol emits 60% less than oil much less than corn .
- But impact of Biofuels on climate change is difficult to figure out
- There are direct and indirect effect through land expansion

The current high food prices will lead to supply expansion

- Increased productivity and expanded production especially in
 - Eastern Europe
 - Africa
 - Caribians
- Expansion of biotechnology- introduction of second generation-draught tolerant
- Development of second generation biofuel

First and Second Generation biofuels

- Except of sugar cane, sweet sorghum, and some oil crops, the first generation of biofuels have limited capacity to address climate change concerns.
- Second generation emphasizes conversion of celluloid to fuels – by bio-engineering and chemical means
- Second generation may result in new fuel
 - **Butanol may replace ethanol**
- A key points is productivity- new high yield crops

Productivity Matters

CROP	Harvest-able Biomass (tons/acre)	Ethanol (gal/acre)	Million acres needed for 35 billion gallons of ethanol	% 2006 harvested US cropland ⁵
Corn grain ¹	4	500	70	25.3
Corn stover ²	3	300	105	38.5
Corn Total	7	800	40	15.3
Prairie	2	200	210	75.1
Switch-grass	6	600	60	20.7
Miscanthus	17	1700	18	5.8
Source: Steve Long				

properties of non food crops

- Miscanthus switch grass jantropha are perennials- more sustainable than annual
- Processor are less exposed to supply instability
- Less demanding environmentally
- Require significant initial investment- till maturity
- Can grow on marginal land- but performs better on top lands

Second generation biofuels may not be only on farms

- Fuels from celluloid can be a by product of forest management and output of agro-forestry
- Other methods – use of algae and bacteria may utilize bodies of water
- Challenge to do it sustainably
- Provide rural growth opportunities

Cheap and clean fuel and food Require more R&D investment and sound regulations

- Ag research has been deemphasized and over regulated in recent year
- Food productivity- except of some crop stagnating
- Expansion of food and fuel with small or no expansion of land base land will be feasible with
 - Increased productivity of underperforming regions
 - Introduction and Adoption of new technologies

The Future of Biofuel is Dependent Upon Innovation

- Need better feedstock
 - Cleaner processing
 - Higher productivity agriculture
 - Dissemination and access to technology
- Lessons of electronics and biotech: Emergence of educational industrial complex
 - Public/private partnership in R&D and infrastructure
 - Technology transfer, start-ups
- Evolution of industry affected by IPR and regulation
 - IPR: access, sharing arrangement and enforcement
 - Regulations: land use, carbon content

Biofuels- present coordination challenges

- Adoption is a four step dance involving
 - farmers
 - Processors
 - Distributors
 - Consumers
- Needs creative contracting and supply chain
- Integration of agricultural environmental and energy polices

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Dealing with side effect of biofuel

- **Green house gas issues can be addressed**
 - **Carbon tax (if feasible)& carbon trading**
 - **Certification of biofuel providers**
 - **Signing agreement in major countries to limit or control deforestation**
- **Food shortage problems may require**
 - **Food fund to address food shortages**
 - **Adapting mandates to adjust to food availability conditions**
 - **Increased productivity of food and biofuel**
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Biofuel and rural development

- Biofuel can be source of rural development- new renewable industry spread over space
- Farming harvesting and initial processing will be done in rural region – but may require
 - Investment in infrastructure, transport, human capital
 - Design of institutions to capture benefits locally and protect against financial and environmental

The challenges of biofuels

Biofuel-vs. other fuels and –alternative energy solution (batteries)

Full gas tanks vs empty stomachs.

Local farmers vs. agribusiness and big oil.

Oil vs water

Conservation vs evolution

New Policy perspective

- Taking small risks to avoid big ones

- Integrating ag environmental and energy policies

- Rethink political and institutional constraints

Research
leading to this
presentation was
supported by

THE EBI
ERS -USDA
The World Bank
We thank them
all

