Global Perspectives

Agriculture and Bioenergy

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Alexander Müller
Assistant Director-General

Food and Agriculture Organization of the United Nations
World population: 1750 – 2050

Further growth, but at drastically declining rates

Source: UN, 2003
Population growth is concentrated in developing countries

Population growth: absolute increments

Assumptions
Urban and Rural Population – 1950-2030

Urbanization to accelerate

Assumptions

Source: UN, World Population Assessment 2002
Ageing and population dividend of an Asian Tiger

Thailand: Population Structure, Changes from 1950 to 2050

1950

Age cohort:
- 100+ years
- 95-99 years
- 90-94 years
- 85-89 years
- 80-84 years
- 75-79 years
- 70-74 years
- 65-69 years
- 60-64 years
- 55-59 years
- 50-54 years
- 45-49 years
- 40-44 years
- 35-39 years
- 30-34 years
- 25-29 years
- 20-24 years
- 15-19 years
- 10-14 years
- 5-9 years
- 0-4 years

Based on: UN 2004 (http://www.un.org/esa/population/unpop.htm)
José Schmidhuber (2006)
From widespread hunger towards a double burden of malnutrition in developing countries

Dietary Energy Supply (DES)
1961

Source: FAOSTAT and World agriculture: towards 2015/30
Josef Schmidhuber (2008)
Success and failure in fighting hunger

Source: FAO, SOFI, 2002
Main import and export regions in world cereal markets

World markets and export opportunities

The world markets for agricultural produce

- 1979-81
- 1999-01
- 2015
- 2030
World markets and export opportunities

Cereal imports of developing countries
1970-2030

Historical Development

- East Asia
- South Asia
- Near East/North Africa
- Latin America
- s.S.Africa

Projections

The world markets for agricultural produce
World Cereal Production and Utilization
FAO food price indices
Wheat export price
(U.S. No.2 H.W. Gulf)

CBOT wheat futures
(March)
Maize export price
(U.S. No.2 yellow, Gulf)

CBOT maize futures
(March)
# How big is the market for biofuels?

## Energy production and potential, biofuels and land use

<table>
<thead>
<tr>
<th>Energy source</th>
<th>Year</th>
<th>World</th>
<th>OECD</th>
<th>non-OECD</th>
<th>World</th>
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<tbody>
<tr>
<td>All sources (TPES)</td>
<td>2002</td>
<td>428</td>
<td>224</td>
<td>205</td>
<td></td>
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<tr>
<td></td>
<td>2030</td>
<td>670</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>2050</td>
<td>850</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Biomass</td>
<td>Actual use</td>
<td></td>
<td>2002</td>
<td>4711</td>
<td>14</td>
</tr>
<tr>
<td>Theoretical potential</td>
<td></td>
<td>&gt;&gt;2000</td>
<td>Global photosynthesis: ~ 4000 EJ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical potential</td>
<td>1990</td>
<td>225</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2050</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic potential</td>
<td>1990</td>
<td>89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2050</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biofuels</td>
<td>Ethanol</td>
<td>2004</td>
<td>0.84</td>
<td>0.34</td>
<td>0.51</td>
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<tr>
<td></td>
<td>Biodiesel</td>
<td>2003</td>
<td>0.06</td>
<td>0.04</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Potential</td>
<td>2050</td>
<td>53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural land</td>
<td>Used</td>
<td>1997-99</td>
<td>1506</td>
<td>658</td>
<td>848</td>
</tr>
<tr>
<td>Total suitable</td>
<td></td>
<td>4188</td>
<td>1406</td>
<td>2782</td>
<td>(4730)</td>
</tr>
</tbody>
</table>

1.) Potential based on Schrattenholzer and Fischer, IIASA, 2000
2.) Based on IEA: Key energy statistics, 2004
4.) Assuming an average yield per hectare for ethanol of 4200 l (3000 l US maize, 5500 l Brazil cane, 6900 l France sugar beet) and of 3800 l/ha for biodiesel (average). Most recent yields are about 10% higher for cane and 20% higher for maize.
5.) 850 million ha would be required to meet today’s transport fuels needs (77 EJ) at current yields (l biofuel/ha), technology, and crop composition.
6.) Area for developing and developed countries, not OECD and non OECD
7.) Assuming an energy content of 34 MJ/l for biodiesel and 21.1 MJ/l for ethanol
9.) 41.868 Mtoe = 1 EJ
11.) 15-60 EJ: most biomass fuels are not traded on world markets, estimates of consumption are highly uncertain.
The price links

Sweet substitutes:
Oil prices above US$35/bbl "drive" sugar prices

Data: Nymex and EIA, J. Schmidhuber (2007)
Competitiveness by feedstock

Parity prices: Petrol–Crude oil – Ethanol

Various feedstocks and farming/production systems

Petrol, US$/l

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8

Crude, US$/bbl

0 20 40 60 80 100 120

- Blue: Gasoline-Crude US$
- Yellow: Cane Brazil, top producers
- Red: Cassava, Thaioli, 2 mio l/d
- Purple: Maize, US
- Green: Cassava, Thailand, OTC joint venture
- Orange: Mixed feedstock Europe
- Cyan: BTL: Synfuel/Sunfuel
- Light blue: Palmoil, MPOB project

Josef Schmidhuber (2005)
US ethanol-some market impacts

The impacts on prices and markets

![US ethanol production, use of maize and policy programmes](chart)

- Maize used in mmt
- Ethanol produced in million m3

- Clean Air Act
- MTBE
- RFS (8/05)
Cross links: Impacts on international commodity prices

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Sugar</th>
<th>Maize</th>
<th>Sugar and Maize</th>
<th>Soybeans and Maize</th>
<th>Sugar, Maize and Soybeans</th>
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</thead>
<tbody>
<tr>
<td>Sugar</td>
<td>+9.8</td>
<td>+1.1</td>
<td>+11.3</td>
<td>+2.3</td>
<td>+13.8</td>
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<tr>
<td>Maize</td>
<td>+0.4</td>
<td>+2.8</td>
<td>+3.4</td>
<td>+4.0</td>
<td>+4.2</td>
</tr>
<tr>
<td>Vegetable oils</td>
<td>+0.3</td>
<td>+0.2</td>
<td>+0.2</td>
<td>+7.6</td>
<td>+7.8</td>
</tr>
<tr>
<td>Protein</td>
<td>+0.4</td>
<td>-1.2</td>
<td>-1.2</td>
<td>-8.1</td>
<td>-7.6</td>
</tr>
<tr>
<td>Wheat</td>
<td>+0.4</td>
<td>+0.6</td>
<td>+0.9</td>
<td>+1.8</td>
<td>+2.0</td>
</tr>
<tr>
<td>Rice</td>
<td>+0.5</td>
<td>+1.0</td>
<td>+1.2</td>
<td>+1.1</td>
<td>+1.4</td>
</tr>
<tr>
<td>Beef</td>
<td>+0.0</td>
<td>+0.2</td>
<td>+0.2</td>
<td>+0.4</td>
<td>+0.4</td>
</tr>
<tr>
<td>Poultry</td>
<td>+0.0</td>
<td>-0.4</td>
<td>-0.4</td>
<td>-2.1</td>
<td>-2.0</td>
</tr>
</tbody>
</table>

Source: @2030 simulation results