Production ecological perspectives on biofuels

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Content

- Introduction – why biofuels
- Global demand for food
- Production ecological principles
- Resource availability/quality
  - Africa case
- Concluding
Introduction
Why agro-energy?
Why agro–energy?

- Compulsory blending ➔ artificial market
  - CO2 neutral energy (Climate change)
  - Comply with Kyoto agreement
- Alternative renewable energy sources
  - Geopolitics ➔ dispersed production of energy
  - Storage of energy
- Support dwindling agricultural sector
  - Reuse set-aside land OECD
Sustainability criteria biofuels
Sustainability criteria biofuels

- Minimum prevention of GHG emissions
- No competition with food
- No loss of biodiversity

- Socio–economic
  - Labour and land rights, fair income, ...

- Resource use efficiency
  - Water, nutrient use efficiencies, ...
Agricultural production can keep no pace with demand
Speed for demand of agro–energy too fast
Poor will pay the price
Agricultural production can keep no pace with demand
Speed for demand of agro–energy too fast
Poor will pay the price

Agro–energy will increases world food problem

Do not impose blending targets, but allow agricultural systems to provide biomass for biofuels taking ecological principles as a basis

Prem Bindraban – 10 Jan 2007
Reality … 2008
50–100 million food insecure people more (>>845)
- Price hikes
  - Not caused by biofuels (political)
  - 30% (IFPRI)
  - 80% (World Bank)
- Food riots
- Conflicts on land rights
- Increasing prices of raw materials
- Flemish bus project on biofuels stopped
- …
World Food
Agriculture and Food Security

All people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

World Food Summit
Rome, FAO, 1996
Concern for food

- Malthus (Principles of population)
- Paul Ehrlich (Population bomb)
Concern for food

- Malthus (Principles of population)
- Paul Ehrlich (Population bomb)
- Lester Brown (Who will feed China?)
- World Food Summits
Realised food production increase

Index value vs. Year

- Production
- Population
- Per capita production

Year:
- 1960
- 1965
- 1970
- 1975
- 1980
- 1985
- 1990
- 1995
- 2000

Index value:
- 90
- 110
- 130
- 150
- 170
- 190
- 210
- 230
- 250
Technology and Institutions

“Techniques”: Tool / method that enhances productivity, communication, comfort...
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“Techniques”: Tool / method that enhances productivity, communication, comfort

“Institutions”: written and unwritten rules of behavior organized systems with specific tasks
Discontinuities in productivity
Discontinuities in productivity

![Graph showing yield of paddy (Indonesia)](image)

**Yield of Paddy (Indonesia)**

- **UK**: 78 kg ha\(^{-1}\) yr\(^{-1}\)
- **USA**: 4 kg ha\(^{-1}\) yr\(^{-1}\)
- **3 kg ha\(^{-1}\) yr\(^{-1}\)

- **130 kg/ha per year**

**1950 1960 1970 1980**

**1950 1960 1970 1980**

**Time**

**Yield** (kg/ha)
Discontinuities in productivity

Technological innovation

+ 

yield (kg ha\(^{-1}\))

78 kg ha\(^{-1}\) yr\(^{-1}\) UK
4 kg ha\(^{-1}\) yr\(^{-1}\) USA
3 kg ha\(^{-1}\) yr\(^{-1}\)

yield of paddy (Indonesia)

(kg/ha) 

130 kg/ha per year
2.5 per year


1900 1950 1980 time
Discontinuities in productivity

Technological innovation + Institutional change =

yield of paddy (Indonesia)

year

(kg/ha)

1000

2000

3000

4000

5000

0

1900

1950

1980

time

yield (kg ha\(^{-1}\))

78 kg ha\(^{-1}\) yr\(^{-1}\)

4 kg ha\(^{-1}\) yr\(^{-1}\)

50 kg ha\(^{-1}\) yr\(^{-1}\)

3 kg ha\(^{-1}\) yr\(^{-1}\)

UK

USA

1950

1960

1970

1980

130 kg/ha per year
Discontinuities in productivity

Technological innovation + Institutional change = Transition

yield of paddy (Indonesia)

yield (kg ha⁻¹)

1900 1950 1980

1000 2000 3000 4000

UK

78 kg ha⁻¹ yr⁻¹

USA

4 kg ha⁻¹ yr⁻¹

50 kg ha⁻¹ yr⁻¹

3 kg ha⁻¹ yr⁻¹


year

130 kg/ha per year

2.5 kg/ha per year

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Technology package

- Fertilisers
- Irrigation
- Biocides
- Mechanisation
- Improved crops
Agricultural productivity

- Africa South of Sahara
- European Union 15
Deteriorating resource base

Nutrient depletion
- No data
- Low
- Moderate
- High
- Very high

Decrease of the crop yield potentials increase
We can potentially feed the world – BUT

Based on WRR, 1995
FAO database
Oil world database
We can potentially feed the world – BUT

...
We can potentially feed the world – BUT

Based on WRR, 1995
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We can potentially feed the world – BUT

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FOOD SECURITY
food supply/demand
ratio < 2
ratio 2 - 5
ratio > 5

INTENSIVE FARMING and MEDIUM FOOD DEMAND scenario

13
34
5
Soybean 30
We can potentially feed the world – BUT

Based on WRR, 1995
FAO database
Oil world database
Global demand for food

World population increase
2000: 6 000 000 000
2040: 11 000 000 000
Global demand for food

World population increase
2000: 6 000 000 000
2040: 11 000 000 000

Increasing wealth → meat consumption increases
Production ecological principles
Basic production ecological principles

Model-plants

- water
- nutrients

Based on own experiments
Basic production ecological principles

Model-plants

- water  + water
- nutrients  - nutrients

Based on own experiments
Basic production ecological principles

Model-plants

- water
- nutrients

+ water
- nutrients

Based on own experiments
Basic production ecological principles

Model-plants

- water  + water  - water
- nutrients  - nutrients + nutrients

Based on own experiments
Basic production ecological principles

Model-plants

- water  + water  - water
- nutrients  - nutrients + nutrients

Based on own experiments
Basic production ecological principles

Model-plants

- water + water - water + water
- nutrients - nutrients + nutrients + nutrients

Based on own experiments
Based on own experiments
Production Ecological Approach

Growth & yield defining factors

Growth & yield limiting factors

Growth & yield reducing factors
Production Ecological Approach

Growth & yield defining factors

• Weather
• Crop genetic potential

Growth & yield limiting factors

Growth & yield reducing factors
Production Ecological Approach

Growth & yield defining factors
- Weather
- Crop genetic potential

Growth & yield limiting factors
- Water
- Nutrients

Growth & yield reducing factors
Production Ecological Approach

Growth & yield defining factors
- Weather
- Crop genetic potential

Growth & yield limiting factors
- Water
- Nutrients

Growth & yield reducing factors
- Weeds
- Pests
- Diseases
Input and output

Rainfed – fertilizers

Marcel Galiba
Input and output

Rainfed + fertilizers

Rainfed - fertilizers

Marcel Galiba
Input and output

Rainfed + fertilizers

Rainfed - fertilizers

Marcel Galiba

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Substantial potential

Ton (grain equivalent) per hectare