EU-Biomass potential and environmental constraints

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1. Introduction of EEA studies:
   Study 1: How much biomass can Europe produce without harming the environment?
   Study 2: Estimating the environmentally compatible bioenergy potential from agriculture.

2. EU-farming context

3. Environmental constraints for biomass cropping

4. Overall environmentally-compatible bioenergy potential from agriculture

5. Conclusions and recommendations
Objective: determine the bioenergy potential from agriculture, forest, waste in 2010, 2020, 2030, which

- **causes no additional pressure** on farmland and forest biodiversity and soil and water resources

- **Respects other environmental objectives**
Key environmental issues of EU-agriculture

- Agriculture is a key land use (50-70%)
- Soil erosion is a significant concern especially in Mediterranean countries
- Although GHG and ammonia emissions have declined with 9% (1990-2000) the absolute emission remains very high
- Irrigation and water abstraction is a large and growing problem both in the Mediterranean and parts of new MS and places significant pressure on aquatic systems and water tables
- Diffuse pollution is major concern for quality of ground and surface water
- Farming is key factor in decline of biodiversity but also maintains habitats and biodiversity values
Large differences between farming in EU
The intimate relationship between farming and biodiversity

- In 20th century semi-natural habitats declined by over 90% in most parts of Europe as a consequence of polarisation (intensification and abandonment (EEA, 1998)
- 1980-2000 very strong decline in most farmland birds
- 92% of the target butterfly species depend on agricultural habitats (extensive grasslands)
- Of the Prime Butterfly Areas:
  - 43% suffer from intensification
  - 47% suffer from abandonment
  - 10% suffer from both
% Natura 2000 sites covered by targeted agricultural habitats that depend on a continuation of extensive farming practices
Estimating the environmentally compatible bioenergy potential from agriculture.
Environmental constraints as basis for agricultural potential study (I)

Extensively cultivated farmland usually has higher biodiversity value

→ 30% of Utilized Agricultural Area ‘environmentally oriented’ farming in 2030 (20% Be, Lux, Malta, NL)

Some farmland species require “ecological stepping stones”

→ set-aside 3% of intensively used farmland for nature conservation

High loss of biodiversity & release of soil carbon if grassland/Olive groves/Agro-forestry systems (dehesas) are transformed into arable land

→ Only extensive bioenergy use from grassland
Environmental constraints as basis for agricultural potential study (II)

Mixed land use, introduction of perennials, Low-input-high output farming systems and strong adaptation to ecological constraints will put lower pressure on environmental resources and provides more ecological niches

→ diverse set of energy crops and conversion pathways needed

→ critical selection of energy crops per environmental zone/region and their management
Determining the agricultural bioenergy potential

- Environmental impact of energy crops
- Characteristics of Env. zone
- Allocation of MS to Env. zones
- Statistical yield/zone
- Projection of yields
- Heating value biomass

Yield (MTOE/ha) by zone & crop

Available land area (ha) by Member State

Released agricultural land due to yield increase & market liberalisation

Additional land due to increasing fossil energy/carbon prices

Primary bioenergy potential by Member State (in MtOE; lower heating value of biomass)
Sustainable crop mix: minimise environmental pressure by growing the right crops

1. Selection of initial crop mixes per environmental zone (13 zones in EU)
2. Every bioenergy crop has a specific environmental performance
3. Grow bioenergy crops with low environmental pressure
4. Set the crop-specific pressure into context of specific environmental characteristics of the region
5. Prioritisation of crops per environmental zone

- erosion
- soil compaction
- nutrient inputs
- ground & surface water
- pesticide pollution of soils and water
- water abstraction
- fire risk
- biodiversity
- diversity of crop type
## Environmental pressure: maize used for bioethanol

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Score</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion</td>
<td>C</td>
<td>Long period of uncovered soil, row crop</td>
</tr>
<tr>
<td>Soil compaction</td>
<td>C</td>
<td>Poorly developed root system; late harvesting (often on wet soils) and usually followed by sowing of winter crop</td>
</tr>
<tr>
<td>Nutrient inputs into surface and groundwater</td>
<td>B/C</td>
<td>N-application rates are generally high but also good N-utilisation by crop. Especially in Central and southern Europe N-surpluses in maize are reported to be high. Leaching risk is high because of low soil coverage (row crop)</td>
</tr>
<tr>
<td>Pesticide pollution of soils and water</td>
<td>B</td>
<td>Poor competitive ability until the crop canopy has closed; subject to many diseases and pests, hence crop protection is quite intensive.</td>
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<tr>
<td>Water abstraction</td>
<td>B</td>
<td>Medium water requirement and high water efficiency. In Mediterranean will require irrigation because typical summer crop.</td>
</tr>
<tr>
<td>Increased fire risk</td>
<td>A</td>
<td>Harvested before dried up.</td>
</tr>
<tr>
<td>Link to farmland biodiversity</td>
<td>B/C</td>
<td>Generally negative impacts on quality of habitats. Most severe impact in southern regions because of irrigation requirement leading to disturbance of hydrological regimes. Provides some shelter opportunities for fauna in autumn.</td>
</tr>
<tr>
<td>Diversity of crop types</td>
<td>C</td>
<td>Very common crop in most parts of EU (except Northern Europe)</td>
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**A: low risk  C: high risk**
## Environmental pressure: Switchgrass

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</tr>
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<tbody>
<tr>
<td>Erosion</td>
<td>A</td>
<td>permanent crop</td>
</tr>
<tr>
<td>Soil compaction</td>
<td>A</td>
<td>Deep rooting; perennial. Limited mechanisation</td>
</tr>
<tr>
<td>Nutrient inputs into surface and groundwater</td>
<td>A</td>
<td>Low nutrient requirement, no or limited yield response to fertilisation</td>
</tr>
<tr>
<td>Pesticide pollution of soils and water</td>
<td>A</td>
<td>Practically no pesticide need, only at establishment</td>
</tr>
<tr>
<td>Water abstraction</td>
<td>A/B</td>
<td>Drought resistant and very efficient water use (C4), but because of deep roots ground water abstraction possible</td>
</tr>
<tr>
<td>Increased fire risk</td>
<td>B</td>
<td>Burns easily when dry, but dry in winter and not in summer when highest risk for fires</td>
</tr>
<tr>
<td>Link to farmland biodiversity</td>
<td>A</td>
<td>No or low pesticide and nitrogen applications so no direct negative impacts on habitat quality; can provide winter shelter; birds nesting inside plants, although very dense (no space for weeds)</td>
</tr>
<tr>
<td>Diversity of crop types</td>
<td>A</td>
<td>Currently not common.</td>
</tr>
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</table>

**A: low risk   C: high risk**
Estimating the final crop mix and total energy potential per Member State

- Present 2000 crop mix
- Sustainable biomass crop mix
- Technological development
- Economic efficiency (energy yield/ha)
Environmentally-compatible bioenergy potential from agriculture by crop group
Conclusions (I)

- 15% of EU energy consumption 2030 (293 MTOE) could be covered by the environmentally compatible biomass potential (agriculture (49%), forestry (19%) and waste(32%))

However it is a theoretical study:
- very optimistic technological assumptions (2\(^{nd}\) generation economical from 2015/2020 onwards)
- this does not mean that the exploitation will really be carried out in a sustainable way:
  - Maintain and reach 30% share of environmentally oriented farming
  - 3% set-aside in intensive farmlands
  - Maintain extensive land use in their present land cover and do not remove landscape structural elements
  - Environmentally optimal crop mixes and practices
Conclusions (II)

- The issue of competition of bioenergy and food and feed production was avoided.
  - Large part of potential could come from released land because of assumed liberalisation and yield increases (75% of potential)
  - 5 million hectares of arable land were predicted to be released (only in France and Germany) because of competition between energy and food and feed production (25% of potential)
- No consideration was given to replacement of reduced exports by production elsewhere to satisfy growing world food demand
- GHG emissions per crop and conversion pathway were not directly taken into account
Research needs

- More guidance needed to identify most suitable (sustainable) biomass crops mix per location?
- How to estimate practical yields (experimental <> practical by farmers)
- A lot of RTD needed on plant breeding, selection of crops, varieties and crop genetics to improve biomass crops under different climatic circumstances (certainly arid conditions).
- More RTD needed on exploring potential ‘win-win’ solutions from energy cropping and other feedstock uses.
Research needs

• More RTD on measures to improve the efficiency in relation to the input-output ratio in the cropping phase and the energy efficiency in the full chain

• At this moment biomass subsidies are not linked to a “sustainability” standard” (climate effect, biodiversity, security of supply, rural economy, etc): More research should therefore be done on answering the questions:
  • What is sustainable?
  • How do you measure it?
  • How do you certify that?
Thank you very much for your attention

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