Land is a limited resource. The development of sustainability criteria will help avert unsustainable use of plant material for biofuel production. The use of biomass for fuel and energy purposes must not jeopardize European and third countries’ ability to secure its people’s food supply, nor should it prevent achieving environmental priorities such as protecting forests, preventing soil degradation and keeping a good ecological status of waters.

1. Can Europe increase its biofuels production with current biomass resources?

The European Environment Agency study on the availability of sustainable biomass for bioenergy and biofuels in Europe shows that significant amounts of biomass are available to support ambitious renewable energy targets, even when strict environmental constraints are applied.

The potential is not only sufficient to reach the European renewable energy target in 2010, which requires an estimated 150 MtOE of biomass, but it even leaves room for ambitious future renewable energy targets beyond 2010. Strict assumptions were made in this study on maintaining food crops for domestic supply, preserving natural habitat, protected forest, and also land with extensive or ‘environmental-oriented’ farming.

Source: EEA report No 7/2006

Environmentally-compatible primary bioenergy potential in the EU.

- Additional agricultural potential (DE, FR)
- Additional forest potential
- Agriculture
- Forestry
- Waste

Effect of increasing energy and CO2 prices towards 2030

Source: EEA report No 7/2006
2. How can second generation biofuels production help meet the EU targets of 10% biofuels in 2020?

An important step in increasing biofuels production and sustainability is the competitive production of biofuels from (hemi)cellulose and organic agricultural waste instead of from starch, sugar and oils - which are used today. These are the second generation biofuels. It has been estimated that to reach the EU target of 10% biofuels substitution in the transport sector, second generation biofuels need to represent about 30% of biofuels produced. Second generation biofuels have a better GHG emission balance; their use has the potential to reduce the pressure on food crops and decrease land use. This can happen either by exploiting agricultural wastes such as wheat straw, household and other organic wastes or energy crops and short rotation wood. However, such second generation technology is still only at the development stage and requires concerted investment and political support.

<table>
<thead>
<tr>
<th>Land use for biofuels</th>
<th>Area (Mio ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil seeds for biodiesel</td>
<td>2,9</td>
</tr>
<tr>
<td>Cereals for bioethanol</td>
<td>12,3</td>
</tr>
<tr>
<td>Sugarbeet for bioethanol</td>
<td>0,6</td>
</tr>
<tr>
<td>Short rotation coppice &amp; straw (BTL)</td>
<td>1,7</td>
</tr>
<tr>
<td><strong>Total area for biofuel production</strong></td>
<td><strong>17,5</strong></td>
</tr>
<tr>
<td>Non-biofuel arable production</td>
<td>91,6</td>
</tr>
<tr>
<td>Idle arable land</td>
<td>4,7</td>
</tr>
<tr>
<td><strong>Total arable land</strong></td>
<td><strong>113,8</strong></td>
</tr>
<tr>
<td>Share of imports</td>
<td>20%</td>
</tr>
<tr>
<td>Share 2nd generation</td>
<td>30%</td>
</tr>
</tbody>
</table>

Land use for biofuels. Source: DG AGRI Impact Study²

Corn Field (Crops are Accelerating). Source: USDA statistics

Land use for biofuels. Source: USDA

Source: USDA
3. Can we increase biofuels production without using more land?

It is important to protect natural habitats and ecosystems. It is thus necessary to use our land more efficiently. Land productivity (producing more biomass per hectare), as well as crop quality (producing crops that have more fermentable carbohydrates or higher oil content) can be increased via plant improvement through modern breeding techniques and biotechnology.

Due to improved agricultural practices including integrated crop management and better varieties, the corn yield in the US has increased from about 72 bushels per acre (4.5 t/ha) in 1970 to 149 bushels per acre (9.4 t/ha) in 2006. The trend is accelerating with advances in modern biotechnology.

4. Do biofuels cause deforestation in tropical areas?

Deforestation on a large scale has been occurring for at least a century and has its own dynamic linked with the trade of tropical wood and the wide use of these woods in construction and furniture. Deforestation is often the result of poorly regulated trade of tropical wood and a lack of political will to enforce forest policy. Biofuel, by introducing a new demand, can indeed put pressure on forest resources. Establishing and enforcing sustainability criteria for biofuels are crucial to ensure that biofuels use does not lead to further deforestation.

The use of vegetable oils for biodiesel is currently estimated at about 5 Mt. At the same time, from 2003-2006, the production of vegetable oils has increased by 18.3 Mt, with increases of 4.9 Mt for rapeseed, 4.7 Mt for soybean and 8.7 Mt for palm. Hence, the use of vegetable oils for biodiesel production cannot be the only cause for the recent increase in vegetable oil production. In Malaysia, palm oil plantations have been cited as a major cause of deforestation and biofuels have been blamed. However, only 5% of palm oil produced today goes to biofuels. Increase in palm oil use is partly due to recent US and EU health regulations aiming at reducing content of trans-fatty acid and hydrogenated fats in food, which has driven a replacement of soy oil by palm oil.

5. Can yields be increased to address the need for more biofuels without using more water and land?

It is likely that with temperature rises and desertification, land area available for farming will be reduced. Faced with a rapidly increasing world population, the United Nations estimates that farmers will need to at least double their production over the next 25 years. Combining food production and environmental protection is therefore a key challenge.

In increasing agriculture production, the availability and use of water is a primary restriction to productivity. The International Water Management Institute estimates that “It takes on average roughly 2500 litres of crop transpiration and 820 liters of irrigation water withdrawn to produce one litre of biofuel. But regional variation is large.”

In Brazil conventional sugar cane produces up to 110 tonnes per hectare which is transformed into approximately 7.500 litres of ethanol (per hectare) plus sugar. A new GM variety of sugarcane is able to produce up to 200 tonnes per hectare. Coupling the conventional biofuel production with a second generation (cellulosic) processing technique this can be transformed into approximately 22.000 litres of ethanol. In this case, plant science could triple biofuels production from a hectare of land.3

In Brazil for example the production of sugar cane for ethanol only uses 1% of the available land and sugar cane is not suitable for growth in the Amazon area. The recent increase in sugar cane production for biofuels is not large enough to explain the displacement of small farmers or soy production into deforested zones.

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Biotech crops have already been developed to be better adapted to warmer conditions. Selective herbicides and herbicide-tolerant soya, maize, cotton and oilseed rape have allowed farmers to reduce the amount of ploughing required before planting their crop, thereby reducing water dissipation. They also help to reduce fossil fuel use, carbon emissions and soil erosion. New varieties of drought-resistant crops, or crops such as Jatropha or salinity resistant tomatoes, which can easily be grown on marginal lands, also offer new opportunities to some of the world’s poorest regions.
6. How can we meet today’s demands of fuel and food?

In regions such as China or India, where maize or sugar cane is irrigated, the water withdrawal per litre of biofuels can be up to 3500 litres. The water withdrawal has a direct impact on immediate water availability for human consumption and agriculture but it should not be forgotten that crops release water to the atmosphere which contributes to the water cycle.

In Europe where rainfed rapeseed or cereal is used, the amount of irrigation for biofuel crops is negligible. In the US, where mainly rainfed maize is used, only 3% of all irrigation withdrawals are devoted to biofuel crop production, corresponding to 400 litres of irrigation water withdrawals per litre of ethanol.

Genetic modification is already being used to develop crops tolerant to drought conditions. Indeed, a number of crop varieties have been developed which are stress tolerant. This will enable areas of semi and land, both now and in the future, to be used to cultivate food crops, with huge potential benefits. Tolerance to abiotic stress like water shortage and salinity is complex but promising results have been obtained in model plants and are being transferred to important food species in field conditions. Maize, rapeseed, and rice could be the first important crops benefiting from these emerging technologies.

7. How does feedstock use and agricultural practices influence the GHG balance of biofuels?

The vast majority of studies have found that, even when all fossil inputs are accounted for, producing and using biofuels from current feedstock result in reductions in GHG emissions compared to petroleum fuels. A better understanding is needed to fill gaps in knowledge regarding life-cycle GHG emissions [...] other heat-trapping emissions associated with biomass production and use.

Results vary with the feedstock used and assumptions about land use changes, fertilizers application and by-products use. More data and a common methodology is needed to measure land use change input and agricultural practice impact on GHG balance. EuropaBio is currently developing a Biofuels and Climate Change Factsheet which will address this question. For more information, visit: http://www.europabio.org/Biofuels/index.htm

References and Further Reading

3. Fernando Reinach, Votorantim Ventures, Brazil – presentation at IB World Congress, Toronto 2006

Other factsheets in the series available on: http://www.europabio.org/Biofuels/Biofuels_about.htm

EuropaBio's (the European Association for Bioindustries) mission is to promote an innovative and dynamic biotechnology-based industry in Europe. EuropaBio’s corporate and associate members operate worldwide.