UNEP

International Panel for Sustainable Resource Management

Towards sustainable production and use of resources:

ASSESSING BIOFUELS

Biofuels have received much attention from decision-makers in government and industry, and of the wider public world-wide. As the number of publications devoted to this renewable source of energy is expanding rapidly, it has become increasingly difficult for decision-makers to identify the key messages on which to build their decisions. The International Panel for Sustainable Resource Management (IPSRM) is responding to this challenge with its first assessment report *Towards sustainable production and use of resources: Assessing Biofuels.* This report is the result of extensive literature examination and a thorough review process, involving a number of experts, to provide a robust assessment of key problems of production and use of biomass for energy purposes and options for more efficient and sustainable production and use of biomass. The focus is on so-called first generation biofuels, due to availability of state-of–the art reviews, but also considers further lines of development. It takes a global perspective, recognizing regional and local differences.

Putting biofuels development into a broader perspective of resource efficiency, the report examines the interaction of biofuel production with a number of global trends, including population growth, changing nutrition patterns, yield improvements and climate change.

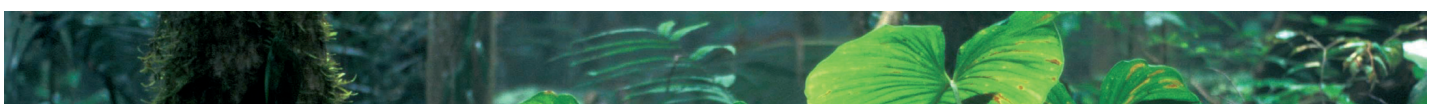
- The global population is expected to grow by 36% between 2000 and 2030
- For the world average, cereal yields are predicted to grow about as fast as the overall population. A higher potential for yield improvements is commonly seen for developing countries, especially for Africa.
- Global trends might become less favourable, as average crop yields may compensate for population growth but not for an increasing demand of animal based food which requires more cropland for feed.
- Climate change has already reduced average crop yields. Future development may widen the gap between developed and developing countries, by decreasing production capacity in particular in semi-arid regions. A higher frequency of extreme weather events will further increase uncertainty.
- These facts suggest an expansion of cropland only to feed the world population; further land requirement for fuel crops would come on top.
- An estimated 8% to 34% of total cropland would be required to provide 10% of transport fuel demand with current 1st generation biofuel technologies.

Biofuels differ in terms of impacts on climate, energy security and ecosystems. Environmental and social impacts need to be assessed throughout the entire life-cycle.

- An analysis of a number of existing Life-cycle-assessments (LCA) of biofuels showed a wide range of net greenhouse gas balances compared to fossil fuels. Differences depend on the feedstock, production methods, conversion technology and location. Compared to fossil fuels, the highest Greenhouse Gas (GHG) savings are recorded for sugar cane and forestry residues. However, negative GHG savings (i.e. increased emissions) may occur when production takes place on converted natural land and the associated mobilization of carbon stocks is accounted for. In these scenarios, negative GHG balances are the worst for biofuels produced from palm oil, soya beans and corn.
- LCAs provide useful guidance to help compare options. However, a number of sensitivities and methodological limitations need to be recognised when interpreting results.
- A number of important impact categories are usually not looked at in existing LCAs, including water, biodiversity, eutrophicaton and acidification, and N_2O emissions.

Impacts need to be assessed on the project level and in a broader regional and global perspective.

- A single project may be acceptable in terms of impacts, but cumulated impacts of several projects may lead to significant impacts, on both a regional and global scale. In this context,



the report raises the question whether significant biofuel expansion could be ***"too much of a good thing"***.

- The report calls for additional measures to complement LCAs to capture the overall impacts of biofuels in the spatial and socio-economic context, like sustainable land use management.

Land is a limiting factor.

- If land is converted from natural habitat to agricultural uses, there is significant risk for biodiversity loss.
- If carbon sinks, such as forests, grass- and peatlands, are destroyed to make room for cultivation, negative consequences on green-house gas balances can occur.
- As long as the overall demand for cropland grows (for food), additional land use for crop production for biofuels will lead to direct and indirect land use change, most probably in tropical countries, where conditions for feedstock production are most favourable.

Water is another limiting factor, both in terms of quality and quantity.

- Agriculture already uses some 70% of fresh water globally. Expansion of crop production for biofuels would be adding to this. In particular in water scarce regions, this may lead to another form of competition with food.
- Extreme weather events due to climate change might increase uncertainty in terms of available water resources. Water quality has deteriorated in river basins like the Mississippi, as a consequence of large scale fuel cropping.

There are avenues for more sustainable production and use of biomass for energy purposes that can help reduce potential pressures on the environment.

The report highlights and critically assesses a number of options that may help achieve higher efficiency of use of resources. Options range from measures to:

- ***improve the efficiency of production of biomass***

Increasing agricultural yields has some potential to reduce pressure on land use; particularly in developing countries crop and land productivity can be improved to increase production on existing cropland. Restoring formerly degraded land is a mixed bag: While production may be less profitable, small-scale biofuel projects, with jatropha for instance, have demonstrated the potential for local energy provision. Lands available for biofuel production need to be assessed carefully, as for example, so-called marginal lands may harbour high levels of biodiversity, or natural regeneration would be more beneficial from an environmental perspective than establishment of biofuel crops.

- ***use biomass more efficiently***

Energy recovery from waste and residues can save significant GHG emissions without requiring additional land. Specifically, municipal organic waste and residues from agriculture (both crop production and animal husbandry) and forestry provide significant energy potential which is still largely untapped. In the same vein, using biomass to produce material first, then recovering the energy content of the resulting waste (cascading use), can maximize the CO_2 mitigation potential of biomass.

This report also emphasizes the importance of utilizing the most efficient use of biofuels. Stationary use of biomass – to generate heat and/or electricity – is typically more energy efficient than converting biomass to a liquid fuel. It may also provide much higher CO_2 savings at lower costs. Stationary use technologies provide promising options for energy provision in developing countries for the community and households. The substitution of traditional biomass use for heating and cooking, for instance, may help overcome energy poverty and improve health conditions. In developed countries, state-of-the-art technology provides multifunctional services, for example by combining waste treatment with energy provision. Biogas is an example of a stationary use application thought to have particularly good potential as a renewable energy source with good GHG savings, especially when waste is used.

- ***consider different technologies***

Like biomass, solar energy systems also transform solar radiation into useable energy much more efficiently. In particular, they have a significantly lower land requirement and may also be associated with less environmental impacts. Cost, however, is still relatively high.

Policy makers can implement various strategies to increase resource productivity.

The IPSRM report emphasises the importance of policies which aim at a system-wide increase of resource productivity.

- An increasing number of countries are adopting sustainability standards for biofuel production. While such product standards that focus on the project level, are useful, they need to be complemented by policy instruments that account for direct and indirect land use change.
- In particular, policies for biofuel consumption will have to be revisited and targets adjusted to levels which can sustainably be supplied. For that purpose, domestic and foreign land use for national consumption of biomass will have to be accounted for.
- Programmes for sustainable land use management will have to consider all types of land use as well as conservation areas.
- Feed-in tariffs or market-oriented measures, such as green pricing, are other measures that could be used to help foster the market entry of power generated by waste and residues.
- The report also underlines that setting the policy framework to foster a more productive use of resources might be more effective than supporting specific technologies.
- Reducing the overall energy demand, particularly increasing fuel efficiency of vehicles and fostering modal shift, may prove to be a much more efficient way to reduce GHG emissions than expanding biofuel production.
- Considering different energy supply systems – bioenergy as part of a mix – is also needed to optimize resources.

Last but not least, this report calls for further exploration and documentation of some critical areas in biofuel development in order to obtain a full understanding of impacts and benefits. As market demand increases, further research is needed on the sustainable production and use of 2nd generation biofuels, which appear to be promising but not without risk either.

A summary and the full report as well as a ppt presentation with the main findings can be downloaded at: www.unep.fr

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