Ecological and Social Implications of Biofuels

A Natural Resource Perspective

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Each biofuels project will have site-specific requirements and consequences. Both the angel and the devil will be in the details…

Non Sequitur - by Wiley

The point is not about biofuels technology per se, but rather, the way in which biofuels technology (or any development project, for that matter) is implemented can matter a great deal.

Any development project involving crop production should analyze:

Ecological issues such as…

- Biodiversity impacts, direct & indirect, including invasive species
- Clean production
- Ecosystem impacts via harvesting forest waste
- Energy intensity
- GHG and other emissions
- Impacts from production & processing
- Impacts of genetically-engineered species & organisms
- Land use changes
- Pesticides and fertilizers
- Pressures on quality and quantity of fresh water supplies

Social issues such as…

- Changes to social compacts
- Competition with traditional practices
- Employment
- Energy security
- Human rights
- Land tenure and property rights
- Poverty reduction

First Generation Biofuels – Key Sustainability Issues to Consider

- Climate change benefits depend on previous land use and land use displacement
- Competition with land used for food security
- Competition with land providing environmental benefits such as clean water production and biodiversity habitat
- Impacts from production & processing: air pollution from burning, pressures on fresh water supplies, pollution from fertilizers
- Land tenure/indigenous rights concerns

Second Generation Biofuels – Key Sustainability Issues to Consider:

- Competition for land for food security
- Competition for land for environmental benefits (biodiversity, clean water production, etc.
- Impacts of genetically-engineered species & invasive species
- Impacts from diverting cellulosic material (harvesting dead and unwanted timber, removing crop residue from soils, etc.)
- Pesticides and fertilizers for monocultures
- Competition with traditional cultural and community practices

Third Generation Biofuels – Key Sustainability Issues to Consider:

- Can be energy intensive
- Can have significant chemical inputs, requiring clean production methods
- Effects of releasing biotech varieties into the environment, particularly oceans, need to be analyzed
- Fresh water requirements for some processing approaches may need to be analyzed

Case Study: Environmental and Social Consequences of Poplar on Marginal Agricultural Land in Minnesota

The Positives *(compared to previous land use)*:

- Less chemical use and soil disturbance
- More wildlife habitat
- Crop/income diversification
- Net decrease in Carbon emissions (GCC benefits)
- Support for old and new industries (jobs)

The Challenges *(compared to previous land use)*:

- New crop without subsidies
- Public concern that poplar does not have environmental benefits of natural forest or prairie
- Requires farmer education and outreach
- Less secure market for product

Case Study: Environmental and Social Consequences of Palm on Forest Land in Asia

The Positives *(compared to previous land use)*:

- Crop/income diversification
- Support for new industries (jobs)

The Challenges *(compared to previous land use)*:

- Scientific evidence that forest conversion to palm increases soil erosion, decreases biodiversity, decreases water quality, etc.
- Requires farmer education and outreach
- Land tenure/indigenous rights concerns (e.g., forced displacement)
- Net increase in carbon emissions, contributing to GCC
- Unfair labor practices
- Loss of traditional ways of life for local communities

Recommendations to promote sustainably grown, biodiversity-friendly biofuels*

1. Evaluate the entire life cycle of biofuel production, use, and waste disposal to calculate the ecological footprint of any biofuel.
2. Require that the sustainability of biofuel feedstock production be assessed, and promote only biofuels that can be produced sustainably.
3. Select species with high conversion efficiencies to minimize land area needed to produce biofuels. This will generally include lignocellulosic feedstocks for next-generation biofuel production and, most promisingly, microalgae.
4. Encourage restoration or reclamation of degraded areas for biofuel cultivation, wherever appropriate.
5. Prohibit clearing of natural areas to increase area under cultivation.
6. Ensure that feedstock production does not adversely affect ecosystem processes and sensitive habitats and investigate production methods that may enhance ecosystem processes over time.

**Each is also an area needing additional research to help identify best practices, and each area can be expanded to detail distinct tiers for certification standards.*

*From: Martha J. Groom, Elizabeth M. Gray, and Patricia A. Townsend, **Biofuels and Biodiversity: Principles for Creating Better Policies for Biofuel Production**, Conservation Biology, Volume 22, No. 3, 602–609, © 2008 Society for Conservation Biology.*

Recommendations to promote sustainably grown, biodiversity-friendly biofuels *(Continued)**

7. Promote use of energy crops that can be grown with low fertilizer, pesticide, and energy inputs in most settings.
8. Promote use of native and perennial species.
9. Prohibit use of species that can become invasive.
10. Promote polyculture to reduce soil depletion and create biofuel cropping systems that can be used by a greater diversity of wild species.
11. Employ conservation tillage or other appropriate techniques to conserve soils.
12. Measure the greenhouse gas emissions over the biofuel production and use life cycle, and promote only those biofuels that are based on feedstocks and refining methods that are net carbon neutral or that sequester carbon.

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