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Searching for sustainability:
Sending the right signals in the BioPreferred program

Searching for Sustainability:
Sending the Right Signals in the USDA Biopreferred Program

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Questions to be Addressed:

- How should the “sustainability” of biobased products be assessed?
- Should LCA be used?
- How should LCA be used?
- Should a more simplified assessment approach be used?

Sustainability is an essentially contested concept

- There is widespread agreement on the abstract core *notion* itself, whilst there is endless argument about what might be the best *realization* of that notion.
- ***'Sustainability'*** assessments must be conducted with a clear purpose and clearly stated objectives.

BioPreferred Program Goals

- The BioPreferred^{SM} program aims to increase the purchase and use of *renewable*, *environmentally friendly* biobased products while providing "green" jobs and new markets for farmers, manufacturers, and vendors.

- By extension: increase the production of biobased products, create incentives for development of new biobased products, and improvement of existing biobased products.

Source: http://www.biopreferred.gov/

Life Cycle Assessment (LCA)

- Life cycle inventory analysis (LCI) aims at describing environmentally relevant physical flows to and from the full life cycle and its subsystems.
- Ideally, it should include **average data** on each unit process within the life cycle.
  - grid electricity is a average mix of coal, natural gas, hydro produced power ….
- Assumes that neither supply nor demand affect prices -prices are set by long-term marginal production costs. (i.e., all demand for good under analysis is met by production of that good.)
- The LCI model does not include unit processes other than those of the life cycle investigated.
- Most LCAs are of this sort and are termed ***attributional***.

Consequential LCA

- Recognizing that life cycles are industrial systems that are part of larger economic systems, has led to the use of LCA to search for the ***consequences*** of technology dissemination.
- Modeling how increased demand is met in an LCA is crucial for the outcome.
  - e.g., if soybeans are used to make polymer, the price of soybeans goes up and as a result soybean production increases via several means.
- Searchinger et al. (2008) was a widely publicized, if incomplete, example of indirect consequences.

Responses to Increases in Agricultural Commodity Prices

- Intensification (increasing inputs)
- Substitution (changing crops; e.g., C-S to C-C)
- Extensification (bringing new land into production)

- Ag impacts are particularly sensitive to differences in average versus marginal production. This drives the profile of most biobased products.
- Key modeling assumptions:
  - Production (i.e., demand) levels
  - Crop yield elasticity
  - Elasticity of land transformation
  - Elasticity of crop yields with respect to area expansion
  - Trade elasticity

Consequential LCA

- Consequential LCI methodology aims at describing how the environmentally relevant physical flows to and from the technosphere will **change in response to possible changes made within the life cycle.** A consequential LCI model includes unit processes that are significantly affected irrespective of whether they are within or outside the life cycle.
- Ideally, it should include **marginal data** on bulk production processes in the background system.
- In a consequential LCI, **allocation is usually avoided by means of system expansion**.
- A consequential LCI model will often use economic models and other tools designed to quantify specific causal relationships between demand, supply and production practices. (**Economic models were not designed for this purpose.**)

LCA Recap

- Attributional LCA neglects many important impacts of technological change and increases in demand. It is "incomplete but accurate".
- Consequential LCA includes the impacts of technological change, dissemination, and changes in demand – but is data-intensive and still immature. It is "complete but inaccurate".

Ref.: Sandén B.A., Karlström, M. (2007).

How should we use the results of the assessments to guide decision-making?

A Rationalist Approach to Environmental Sustainability Policy

- Aggregated economic and environmental performance indicators are calculated by mathematical models to inform policy makers and all stakeholders of all feasible alternatives.
- The non-dominated set of alternatives is generated.
- All trade-offs among the indicators are displayed.

Many Indicators - Many Problems

more relevant for individual choices than policy choices

Impact	*Normalization Value*
Global Warming	25 582 640.09 g CO_2 equivalents/year/capita
Acidification	7 800 200 000.00 millimoles H+ equivalents/year/capita
Eutrophication	19 214.20 g N equivalents/year/capita
Fossil Fuel Depletion	35 309.00 MJ surplus energy/year/capita
Indoor Air Quality	35 108.09 g TVOCs/year/capita
Habitat Alteration	0.00335 T&E count/acre/capita[a]
Water Intake	529 957.75 liters of water/year/capita
Criteria Air Pollutants	19 200.00 microDALYs/year/capita
Smog	151 500.03 g NO_X equivalents/year/capita
Ecological Toxicity	81 646.72 g 2,4-D equivalents/year/capita
Ozone Depletion	340.19 g CFC-11 equivalents/year/capita
Human Health	274 557 555.37 g C_7H_8 equivalents/year/capita

[a] One acre is equivalent to 0.40 hectares.

Source: BESS 4.0

Harsh Reality

- Cognitive and analytical resources are limited.
- Public decision making is characterized by conflicting objectives representing the values of different participants with no 'optimal' solution.
- At best it will achieve a *satisficing solution*, which is a solution path acceptable (not optimal) for the majority of parties concerned.
- Comprehensive planning is impossible.
- We MUST "muddle through" with successive limited comparisons based on a few important evaluation criteria.

*Lindblom, C. E. 1959. The science of muddling through.

Looking for the “more preferred” rather than the best

- Purpose and objectives must be clear and sufficiently narrow.
- A degree of comprehensiveness is possible and necessary.
- Tinbergen Rule* states that for each and every policy target there needs to be at least one policy tool.

*Tinbergen, J. (1952). *On the theory of economic policy*.

BioPreferred Program Benefits

- The BioPreferred program offers three major benefits: Climate Change Impact Reduction, Energy/Environmental Security, and Economic Development.

Source: http://www.biopreferred.gov/

Summary

- Consequential LCA is appropriate if goals include increasing biobased product demand, technological improvement and new technology dissemination.
- Consequential LCA requires further development. It is rapidly maturing for impacts like climate change forcing.
- "Carbon Footprint" is a useful simplified form of LCA (e.g., see PAS 2050 guidelines)

Summary (cont.)

- Biobased product policy should be pursued to achieve limited, clearly defined objectives (e.g., measures of BioPreferred benefits).
- Signals to producers should be clear: what constitutes improvement and what it is worth.
- Performance thresholds have limited impact – incentives for continuous improvement are needed.

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