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Title of Paper: Developing a Land Use/Biodiversity Indicator for Agricultural Product LCA's

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Oral Presentation

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Abstract:

Land use is clearly the single greatest source of environmental impacts of human activities, and nowhere is this more obvious than in the agricultural use of land. Despite this fact, the effects of land use on the biodiversity of plants and animals is rarely evaluated in Life Cycle Studies.

To address this lack, IERE has begun a project to develop and evaluate potential indicators of land use/biodiversity. The project was begun with a workshop held in conjunction with Defenders of Wildlife July in Washington DC, and attended by a diverse group of interests, representing government, environmental NGO's, and industry. The outcome of that workshop was a list of potential indicators for land use. These are shown below:

- Protection of priority habitats/species
- Soil characteristics, soil health
- Proximity to & protection of high priority vegetative communities
- Interface between water and terrestrial habitats/buffer zones
- Assimilative capacity of water and land; hydrological function
- Percent coverage of invasive species (within protected areas)
- Road density
- Percent native-dominated vegetation
- Restoration of native vegetation
- Adoption of Best Management Practices linked to biodiversity objectives
- Distribution (patchiness, evenness, etc.)
- Connectivity of native habitat

IERE is currently testing measures of these indicators, and will present results at this conference.

Introduction

One aspect of the environmental impact of agriculture that is very often overlooked is the direct effects of land use on native ecosystems. The essential aspect of agriculture is that one replaces the native organisms with others that are beneficial to humans. By definition, this reduces the biodiversity of the area under cultivation. Studies by the World Resources Institute[i] show that the greatest biodiversity losses are derived from changes in land use, rather than to any chemical impacts. Efforts by SETAC-Europe[ii] to deal with land use issues have produced an approach that focuses on the depletion of biotic and abiotic resources. They note that there is no best available practice in this developing field of assessment.

The Institute for Environmental Research and Education, in conjunction with the Defenders of Wildlife have approached this issue by asking experts in ecology what indicators they thought were most likely to capture the issues relevant to retaining biodiversity in agricultural settings. A workshop held in 2000 was asked to suggest indicators that would be easy to measure, good indicators of environmental impacts, and easily aggregated from the individual farm through local, regional, national and global levels. Despite the disparate backgrounds of the workshop participants, there was good agreement about the potential indicators that should be evaluated.[iii] They included:

	Biodiversity Indicators	**Proposed Measures**
1	Protection of priority habitats/species	Area of habitat that is physically protected (i.e.; through fencing or other methods); habitat to be identified as including • 100 feet each side of rivers; • maps with location of Threatened & Endangered species
2	Soil characteristics: soil health	Concentration of organic carbon in the soil
3	Proximity to & protection of high priority vegetative communities	Area of habitat set aside (not farmed) that is identified as "high priority" in The Nature Conservancy vegetative maps
4	Interface between water and terrestrial habitats/buffer zones	Total linear space of aquatic habitat (i.e. river, lakeshore, etc) protected via physical means vs. total area managed
5	Assimilative capacity of water and land (TMDL process); hydrological function;	Depletion of water resources (annual use versus recharge rate)
6	Percent coverage of invasive species (within protected areas)	For physically protected areas, density of non-native vegetation (area percent)
7	Road density	Miles of road per square mile
8	Percent native-dominated vegetation	Area in native species dominated areas/total area managed
9	Restoration of native vegetation	Area newly returned (in last 12 months) to native habitat
10	Adoption of Best management Practices (BMP's) linked to biodiversity objectives	Number of BMP's adopted
11	Distribution (patchiness; evenness, etc.)	Size of native-managed acres vs. total acres managed Size of native-managed acres vs. average field size
12	Connectivity of native habitat	On managed acres, percent of native-managed land units that has at least one adjacency to other native-managed land

Methods and Results

To evaluate these indicators, we surveyed a group of producers in the United States. Producer e-mails were obtained through a website advertising grassfed products. The survey was performed by e-mail, and producers were asked to return their results rapidly leaving blanks where information was not readily available. The objective of the survey was to evaluate the difficulty of obtaining information about farm practices and to begin the evaluation of the usefulness of the indicators as a result. The study was viewed as a first step towards selecting indicators that are easy to use and meet the requirements noted above.

Of 116 questionnaires, 49 were returned within 10 days, or 42 percent. The questionnaire is shown as an appendix below.

Some questions were asked about what farmers were producing, in order to evaluate the results in light of that information. The majority of the respondents were producing a diversity of crops, including beef, veal, bison, goats, sheep, horses, rabbits, fish, poultry, eggs, dairy products, grain, vegetables, flowers, perennials, fruits, nuts, honey, forage, hay, and alfalfa. Twenty percent of the respondents reported only one crop, and of these, 40% were raising beef.

The size of the managed lands ranged from 3.6 hectares to 300,000 hectares. The median size was 83 hectares. Only 43 percent of respondents could estimate their water consumption, although 31 percent reported no irrigation at all. Only 37 percent knew the amount of organic matter in their soils. Of those who had measured their soil organic matter, the concentration range from 1.5 to 8.5 percent, with a mean of 3.6% and a median of 3.15%. With the exception of the producers with the highest levels of organic matter, all were managing their land to increase organic matter. Many cited evidence that it was increasing, for example reduced water runoff, without actual soil measurements.

There was a great diversity of practices related to preserving wildlife and ecosystem function. Some producers had done nothing, while others managed their grazing, fencing, planting and harvesting completely with an eye to preserving wildlife and biodiversity. On average, respondents noted three management practices related to maintaining ecosystem function or protecting wildlife.

Most, though not all producers set aside habitat for native species and wildlife. As a median, 11 percent of their land was physically protected for wildlife values. As a median, each producer protected 213 meters of shoreline, and 1.2 hectare of wetlands. Only a very few producers knew whether their property contained endangered species habitat, and it was unlikely that the preserved areas were adjacent to other preserved areas. It is clear that habitat fragmentation is a major biodiversity problem in agricultural lands in the US.

Producers reported a range of zero to 100% coverage by invasive species in their protected areas, with an average of 17% and a median of zero. 73% reported that no new

areas were returned to native vegetation in the last year, with an additional 4 percent not responding to the question. Of those returning native habitat, a range of 1.6 to 800 hectares were returned. A summary of these results is in the table below.

Proposed Measures	**Results**
Area of habitat that is physically protected (i.e.; through fencing or other methods); habitat to be identified as including • 100 feet each side of rivers; • maps with location of T&E species	Median: 6 hectares protected Median: 1.2 Hectares by water T&E species unknown
Concentration of organic matter in the soil	Average: 3.6; median 3.15
Area of habitat set aside (not farmed) that is identified as "high priority" in TNC vegetative maps	Unknown
Total linear space of aquatic habitat (i.e. river, lakeshore, etc) protected via physical means vs. total area managed	Median: 213 meters
Depletion of water resources (annual use versus recharge rate)	Unknown
For physically protected areas, density of non-native vegetation (area percent)	Median 0, Average:17%
Miles of road per square mile	Not asked
Area in native species dominated areas/total area managed	11%
Area newly returned (in last 12 months) to native habitat	Median: 0; Average: 23 hectares
Number of BMP's adopted	Average & median: 3
Size of native-managed acres vs. total area managed Size of native-managed area vs. average field size	Median: 11% of total area protected; Size of manage area = 100% of size of fields
On managed acres, percent of native-managed land units that has at least one adjacency to other native-managed land	Median:0

Discussion

The list of producers used for this survey represents a sub-set of individuals seeking to pursue more “natural” farming and therefore they are not representative of US Farmers as a whole. All discussion of results should be evaluated with this in mind. The high and rapid return rate for the survey showed that it is, indeed possible to obtain useful information about the land use practices of producers in the United States.

It was clear that respondents did not always understand the questions. For example, many of the respondents described their farming practices as management-intensive grazing only, instead of a mix even though they reported growing produce or flowers. Future surveys will have to be designed so that there is a clear description of the meaning of each question.

Despite the nature of the sampled population (many of whom noted that they produced certified organic crops), there is a great variability in the awareness of farmers about their environmental impacts and the ecological condition of their land. Few farmers knew

about endangered species habitat on their land, and less than half knew about their water consumption or the concentration of organic matter in their soils.

It appears that estimates of direct impact on endangered species habitat will have to depend on experts evaluating the locations, using data collected by ecologists. On the other hand, data about land-water interfaces is probably relatively easy to obtain through surveys. Farmers were aware of all water bodies, whether perennial or ephemeral on their land. It seems likely that this information would be readily available to all farmers.

The data collected here do not address some of the issues raised by SETAC Europe about indicators for biodiversity and land use. Specifically, they cannot address issues of a baseline from which to measure performance. The choice of a baseline is a value-weighted exercise, and may best be evaluated through political processes such as local and regional land use planning. Since the data shown here represent a high diversity of management practices and are drawn from all areas of the United States, they can only be illustrative of the kinds of indicators that may be useful in evaluating the life cycle impacts of agricultural products.

In addition, these data do not speak to the efficacy of these indicators for evaluating biodiversity or habitat diversity. Future work should compare performance on such measures as species richness and these indicators.

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[i] World Resources Institute (1999): Guide to the world resources 2000-2001: People and ecosystems: The fraying web of life. Elsevier, New York

[ii] SETAC WIA-2 taskforce on Resources and land (2001)Impact Assessment of resources and land use

[iii] Schenck, R.C. 2000. Land Use and Biodiversity Indicators for Life Cycle Impact Assessment. Int. J. LCA 6(2).

Questionnaire on Agriculture Indicators of Land Use

Management Information

1) What do you produce?
2) How would you describe your farm management approach? (mark with an x)
   __ Management-intensive grazing
   __ Mix of grazing and conventional techniques
   __ Other (Please describe)

3) How many acres do you manage?

4) What is the average size of the parcels of land you manage (the average size of a field)?

Habitat Conservation Information

5) How many acres do you physically protect through fencing or the like, to protect habitat? (protected area could still be grazed, but only native species could be planted; and grazing must be managed to minimize impacts on water bodies)
6) How much protected acreage is within 100 feet of a water body, or is in an area with threatened or endangered species?
7) If you are protecting a water body, what is the linear length you are protecting? (i.e. two times the length of a stream or the length of the shoreline of a lake)
8) Do you set aside any land completely (i.e. not farming or grazing) that is high value wildlife habitat?
9) How much of the protected (non farmed) area is covered with non-native or invasive species (guess to the nearest percent).
10) How much acreage have you returned to native species in the last 12 months? (planting windbreaks with native trees is a way to return to native species).
11) How much of the native species area has at least one adjacency to other native species areas?

Other Issues

12) Do you withdraw water from a well or surface water body?
___well
___river/lake (please name the water body or your town and state)

___no irrigation
13) How much water do you use in a year?

14) What is the average concentration of organic matter in your soils?

15) Is that percentage increasing, decreasing or staying the same?

16) How many best management practices do you employ to preserve wildlife? An example is excluding stock from temporary streams and ponds while water is in them or keeping fields flooded while water birds are migrating, or keeping grain standing for cover for wildlife. Description of your practices would be helpful.