Renewable Energy Topics Handout

What is Life Cycle Assessment and How Does It Impact Farmers?

by Joel Tallaksen, Research Scientist, Univ. of Minn. West Central Research and Outreach Center
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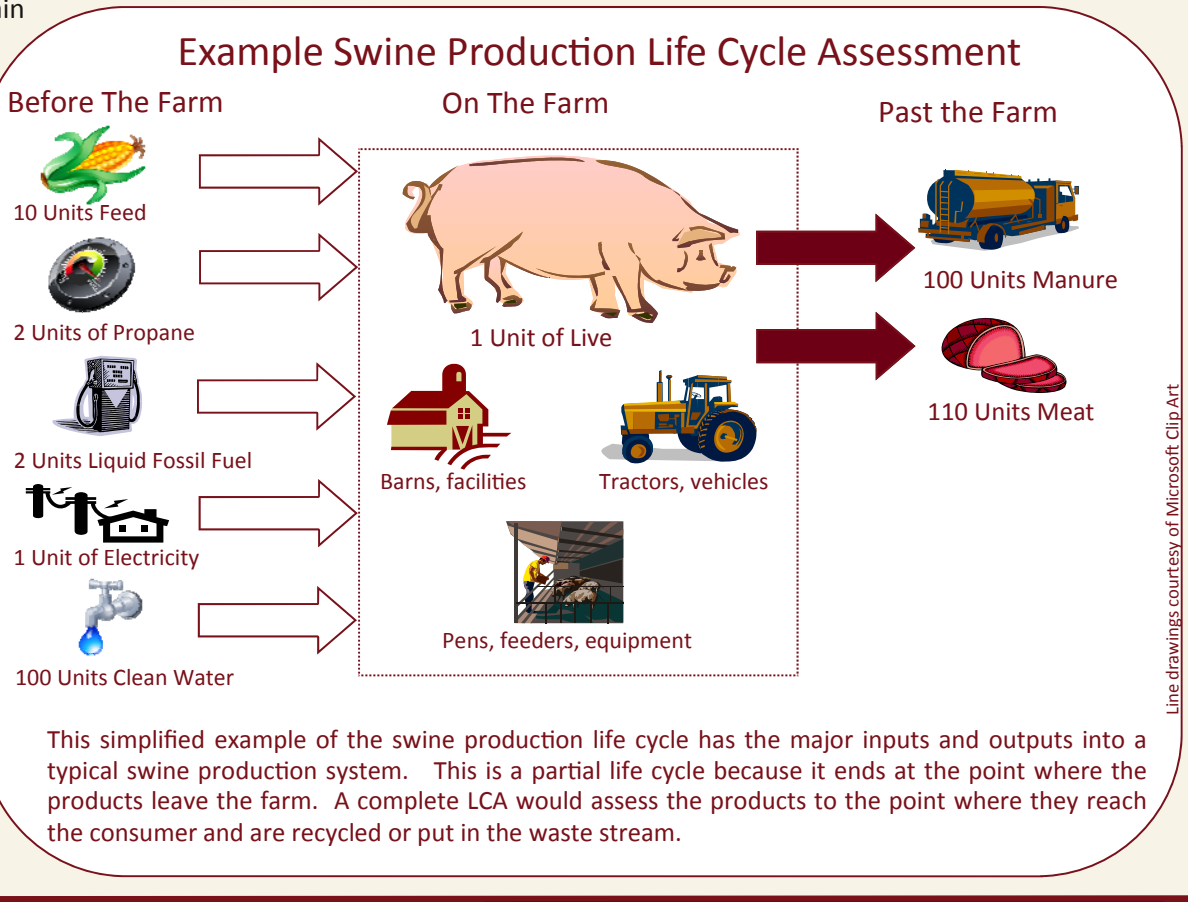
Over the last 30 years, manufacturers have been using Life Cycle Assessment (LCA) to identify the inputs and outputs from their operations and the impacts of those inputs and outputs on the environment. This was mainly limited to large corporations in industrial manufacturing, power production industries, and raw materials suppliers. However, in the last several years, LCA methods have begun to be used in many more industries, including agriculture. Tools such as LCA are being used by agricultural product manufacturers to address consumer demands and market requirements for agricultural products that have lower impacts on the environment.

Agriculture, just like manufacturing operations, uses raw materials, labor, and energy in the production of grain and other products. LCA is an accounting system that analyzes the amount of these inputs needed for each unit of output. The LCA process also estimates the impacts of using the resources to make a product. A very common focus for LCAs is the amount of energy being used to make a product, the amount of carbon dioxide being released to the atmosphere in the manufacturing process, and the impacts that these have on global climate change.

As a simple example, consider the inputs and outputs of a swine operation (see the accompanying picture). Feedstuffs (primarily grain and soybean meal), energy, and water are put into the swine production operation, whose main products are meat and manure. Therefore, we can calculate how much grain is needed to make one pound of pork. Similarly, we can look at water and energy use in swine systems. This provides us with information about how efficient the production operation is at using resources. The next step is to figure out what the impact of



This simplified example of the swine production life cycle has the major inputs and outputs into a typical swine production system. This is a partial life cycle because it ends at the point where the products leave the farm. A complete LCA would assess the products to the point where they reach the consumer and are recycled or put in the waste stream.

University of Minnesota
Driven to Discover℠

West Central Research & Outreach Center
46352 State Hwy 329 Morris, MN 56267
Phone: (320) 589-1711
Web: renewables.morris.umn.edu

this system is on the environment. We are taking fresh water from a lake, stream, or aquifer. Energy is likely being produced with fossil resources that emit carbon dioxide when used. In addition, the manure produced in the operation will release ammonia gas and nitrous oxide to the atmosphere; both are linked to global climate change.

As this example shows, the concept of LCA is fairly straight forward. However, a full LCA study is much more complex than the example. Rather than simply calculating the energy directly used in the pork production operation, the study would have to include all the diesel fuel, petroleum-based chemicals/fertilizers, and energy used to produce the feed grain. In addition, the energy used in construction of equipment, buildings, and tractors/vehicles would be part of the LCA. Another factor that is important when discussing agricultural LCA work is land use. Using land in different ways has impacts on the environment. Bringing all these factors together in a LCA requires making some very tough choices in which data to include and what can be left out. Additionally, the volume of data that is needed for a complete LCA is difficult to collect and manage. Therefore, specialized computer software and training is needed to assess, manage, and interpret the data needed in a large LCA project.

So, why would we want to go to the effort of conducting an LCA? LCAs are designed to answer questions about resource use. In heavy industry, it may be valuable to focus on questions like 'how much steel is being used to produce a truck?'. The same sorts of questions can be asked in agriculture. For example, how many acres of corn are needed to produce one ton of market ready hogs? A big advantage of LCA methods is that we can compare different production systems. Again using the swine example, we could compare the acres of corn needed if we fed the animals with a conventional corn diet compared to one with distiller's grains from ethanol production. One of the largest areas where LCA is being used is energy. In a cropping example, the question may be- 'How much more or less energy (diesel fuel) would I use if I switched from conventional tillage to no till?'. Though farmers often look at their data to get a rough answer to these questions, they typically will not go as deeply into the data as LCA methods require. An LCA is designed to look at an entire system in detail, which is needed to assess environmental impacts.

In agriculture, there are two main areas where LCA is being used to examine these impacts; biofuels and food products. In the case of food products, the companies that manufacture or sell the products are under pressure from consumer groups to sell foods that have lower environmental impacts. This includes large multinational food manufacturers, who buy grain, meat, and milk from Midwest farms. The environmental impacts of ethanol and biodiesel production are also being heavily scrutinized. Ethanol opponents have used early ethanol LCAs to suggest that ethanol is not a viable source of renewable energy. This has led some state governments, notably California, to examine how ethanol fits into their environmental goals and what policies are needed to meet those goals.

Though the impacts on farmers are indirect, LCA data has already began to change the farm economy. Companies who want to meet consumer preferences for foods that have less environmental impacts are likely to buy their commodities from producers who meet specific energy, organic, or production goals in their farming operations. Similarly, ethanol produced with methods that require more energy is of less value under the California clean air regulations. This includes the energy used on the farm for growing corn. The data being used to make these decisions is coming from LCA work being done on agricultural production systems.

It is important for farmers to understand that the methods that they use to produce their crops, meat, and milk are being evaluated by techniques such as life cycle assessment and that the data is being used to influence the values of some of their products. Because of the difficulty in conducting LCAs, most farmers wouldn't consider doing one on their own. However, most major commodity organizations are having LCAs conducted as part of their check-off programs. In addition, most land-grant universities are researching LCAs of different agricultural systems. A benefit to all of the LCA work is that farmers are getting new tools to help reduce energy use in their operations, which translates to lower production costs.

Life cycle assessment studies will likely be more important as consumers groups and government agencies continue to push for improved environmental performance from agriculture. While most farmers don't have the time to invest in understanding all the details of LCA, understanding LCA Findings will help them reduce inputs and provide them insight into future trends in consumer demands and government regulations. For more information on specific cropping or animal specific life cycle work, a set of web links has been set up at http://renewables.morris.umn.edu/sustainable_ag/LCA_links.php