

A better way to predict the environmental impacts of agricultural production

April 21 2017



Credit: SC Department of Agriculture

Consumer goods companies often rely on life-cycle assessments (LCA) to figure out the potential consequences of how they design products and source ingredients. This kind of assessment, while sophisticated, often lacks detail about how the products affect natural resources such as land, water and biodiversity.

A team of researchers from Stanford University and the University of Minnesota, in a partnership called the Natural Capital Project, along with researchers from Unilever's Safety and Environmental Assurance Centre, developed a new kind of assessment to integrate these impacts in a more detailed way. They call it Land Use Change Improved Life Cycle Assessment, or LUCI-LCA. It's designed to help researchers or companies more accurately predict impacts of new designs and sourcing.

The researchers tested this new LCA by evaluating the potential environmental impacts of two bio-plastic products that could be produced from sugarcane grown in Mato Grosso, Brazil, or from corn grown in Iowa. Their approach—which includes more accurate data about the regional land composition than the traditional LCA—came to different conclusions about which option would be more environmentally responsible. The group published the results in the April 21 issue of *Nature Communications*.

"The size and reach of multinational companies is stunning, on par with that of many nations," said Gretchen Daily, professor of biology at Stanford and senior author of the paper. "When we think about how to bring human activities into balance with what Earth can sustain, corporations have a major role to play in decoupling economic growth from environmental impact."

Improving impact assessment

Life-cycle assessment offers a systematic way of determining potential environmental impacts of a product from source materials to disposal. Results from these assessments often inform decisions companies make about product design, material and technology choices and sourcing strategies. An incomplete or inaccurate assessment could lead to well intentioned but environmentally damaging decisions.

One problem with a standard [life cycle assessment](#) is that it represents the average land composition of the country from which materials will be sourced. So, in this case, it assumes that Mato Grosso contains the same proportion of rainforest as all of Brazil, and that sourcing sugarcane from that state would lead to deforestation of the Amazon. Daily and her colleagues made improvements that allow for more refined assessment using data relevant to the exact regions from which materials would likely be sourced, taking into account predictions about future impacts to the environment.

"In reality, from the modeling that we did, it looked like most of the expansion of agriculture in Mato Grosso would happen in the savannah," said Rebecca Chaplin-Kramer, research associate at the Stanford Woods Institute for the Environment and lead author of the study. "Whereas in Iowa, if any expansion happens, it will likely mean expanding into forest."

While the standard LCA showed that the Mato Grosso sugarcane would lead to more CO₂ in the atmosphere, this more spatially sensitive LCA found that the carbon footprint of the Iowan corn was larger. In addition, while the traditional LCA found that the corn would result in more water use than the sugarcane, the new LCA found that the sugarcane would use more—900 percent more.

"This work has major implications for anybody involved in product innovation, commodity sourcing or policy setting for new land development," said Ryan Noe, a researcher with the National Capital Project at University of Minnesota and co-author of the paper. "Where that sourcing comes from matters and it's not really being captured with the approaches being used."

Careful consumption

The researchers hope that the stark and significant differences between the results of the two LCAs will encourage companies and policymakers to adopt the new approach for decision-making.

"Our ultimate mission is to get this kind of information - this spatially explicit value of nature - to people and to have the [impact](#) on natural capital included in as many different kinds of decisions as possible," Chaplin-Kramer said.

It took the team substantial time and effort to pull together the data necessary for this case study. But with increased interest, they believe they could develop a more streamlined tool that would require little manual work.

"There's more work at some levels - but this is exactly the kind of 21st-century work that responsible corporations are pursuing to promote green growth and a sustainable human enterprise," Daily said. "In the short run, this approach will reduce costs and risks. In the long run, it is utterly key to survival."

Provided by Stanford University

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