Cellulosic biofuels can benefit the environment if managed correctly

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'The climate benefit of cellulosic biofuels is actually much greater than was originally thought,' said Phil Robertson, University Distinguished Professor of Ecosystem Science at Michigan State University. Credit: MSU

Could cellulosic biofuels - or liquid energy derived from grasses and

wood - become a green fuel of the future, providing an environmentally sustainable way of meeting energy needs? In *Science*, researchers at the U.S. Department of Energy-funded Great Lakes Bioenergy Research Center say yes, but with a few important caveats.

"The climate benefit of cellulosic biofuels is actually much greater than was originally thought," said Phil Robertson, University Distinguished Professor of Ecosystem Science at Michigan State University and lead author on the study. "But that benefit depends crucially on several different factors, all of which we need to understand to get right."

Although not yet a market force, cellulosic biofuels are routinely factored into future climate mitigation scenarios because of their potential to both displace petroleum use and mitigate greenhouse gas emissions. Those benefits, however, are complicated by the need for vast amounts of land to produce cellulosic biofuels on a large scale.

"The sustainability question is largely about the impact of using millions of acres of U.S. land to grow biofuel crops," Robertson said. "Can we do that without threatening global food security, diminishing biodiversity, or reducing groundwater supplies? How much more fertilizer would we use? What are the tradeoffs for real climate benefit, and are there synergies we can promote?"

Drawing from ten years of empirical research, Robertson and GLBRC colleagues from MSU, the University of Wisconsin and the University of Maryland identify several emerging principles for managing the complex environmental tradeoffs of cellulosic biofuel.

First, the researchers show how growing native perennial species on marginal lands -land not used for food production because of low fertility or other reasons - avoids competition with food security, and provides the greatest potential for climate mitigation and biodiversity

benefits.

Second, crop choice is key. Native perennial species offer superior environmental outcomes to annual crops, but no single crop appears to be ideal for all locations. In fact, in some cases mixed species crops provide superior benefits. Third, nitrogen fertilizer use should be avoided or minimized because of its global warming and other environmental impacts.

According to the researchers, these principles (as well as four more outlined in the paper) are enough to begin guiding sound policy decisions for producing sustainable biofuels. Looking forward, however, the team calls for more research on designing landscapes to provide the optimal suite of energy, climate and environmental benefits. They say that understanding how best to integrate benefits and tradeoffs will be key to the future success of cellulosic biofuels.

"With biofuels, the stakes are high," Robertson said. "But the returns are also high, and if we take key principles into account we can begin shaping the policies and practices that could help make cellulosic biofuels a triple win for the economy, the climate and for environmental sustainability in general."

More information: "Cellulosic biofuel contributions to a sustainable energy future: Choices and outcomes" *Science*, science.sciencemag.org/cgi/doi … 1126/science.aal2324

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