

Sustainable biofuels from forests, grasslands and rangelands

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The promise of switchgrass, the challenges for forests and the costs of corn-based ethanol production: Ecological scientists review the many factors surrounding biofuel crop production and its implications on ecosystem health in three new Biofuels and Sustainability Reports. Produced by the Ecological Society of America (ESA), the nation's largest organization of ecological scientists, and sponsored by the Energy Foundation, these reports explore the production and use of biofuels from an ecological perspective.

Biofuels are liquid fuels derived from biological materials, such as plant stems and stalks, vegetable oils, forest products or waste materials. The raw materials, called feedstock, can be grown specifically for fuel purposes or can be derived from existing sources such as agricultural residue or municipal garbage. Sustainable biofuels are based on production that does not negatively affect energy flow, nutrient cycles and ecosystem services.

There are many options currently being explored for biofuel production and the reports address the implications of producing biofuels from forests, grasslands, rangelands and agricultural systems and the likely effects on water, soil and the atmosphere.

Sustainable Biofuels from Forests

Marilyn Buford and Daniel Neary from the U.S. Forest Service outline

the challenges surrounding the production of sustainable biofuels from woody biomass, including balancing energy demands with water production, wildlife habitats and [carbon sequestration](#) in "Sustainable Biofuels from Forests: Meeting the Challenge."

Woody biomass from forests can be converted to biofuels, biobased products and biopower through thermochemical (heat and pressure converts woody biomass into alcohols and other chemicals), biochemical (woody biomass is broken down into sugars) and direct combustion methods. The researchers suggest that 334 million dry metric tons of forest wastes and residues could be produced each year on a sustainable basis in the U.S. These residues and wastes would come from logging activities, processing mills and pulp and paper production among other sources.

Grasslands, Rangelands and Agricultural Systems

In "Grasslands, Rangelands and Agricultural Systems," scientists Rob Mitchell, Linda Wallace, Wallace Wilhelm, Gary Varvel and Brian Wienhold discuss sustainable biofuel options in grasslands and rangelands that dominate the mid-region of the U.S. They specifically address recent interest from policymakers and energy producers in switchgrass for bioenergy, and the effects this perennial crop has on soil and water.

"Switchgrass has garnered a lot of attention as a potentially efficient, profitable and environmentally-friendly biofuel crop," says Rob Mitchell from the U.S. Department of Agriculture, Agricultural Research Service. "It is known for its environmental advantages on marginal cropland like reducing inputs, controlling erosion, sequestering carbon and enhancing wildlife habitat. But there is an array of factors to consider. For example, switchgrass roots run deeper than other crops, so deep soil samples are required to determine the exact amount of fertilizer to be applied to

prevent nutrient run-off. Therefore, switchgrass, as with all biofuel crops, will require innovative and site-specific management practices in order to be economically and environmentally sustainable."

Growing Plants for Fuel

"Growing Plants for Fuel: Predicting Effects on Water, Soil and the Atmosphere," authored by Philip Robertson, Stephen Hamilton, Stephen Del Grosso and William Parton, reviews the trade-offs associated with gasoline blended with corn-based ethanol. They describe the consequences of this particular biofuel on the atmosphere, marine and freshwater ecosystems, wildlife habitats and on the area of land available for food production.

The researchers also discuss the potential benefits of cellulosic feedstocks, such as the woody biomass and switchgrass methods listed above, as alternative biofuel feedstocks that could avoid many of the downsides of grain-based biofuel crops, such as corn.

These three reports join an additional report published in January called "Biofuels: Implications for Land Use and Biodiversity." In that ESA report, scientists Virginia Dale, Keith Kline, John Wiens and Joseph Fargione review current research on biofuel production and its potential effects on ecosystems. They also analyze the social, economic and ecological challenges of [biofuel](#) production and the most effective routes to developing sustainable, renewable fuel alternatives.

More information: All four reports are available online at esa.org/biofuelsreports/

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