# Abandoned farmlands are key to sustainable bioenergy

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Biofuels can be a sustainable part of the world's energy future, especially if bioenergy agriculture is developed on currently abandoned or degraded agricultural lands, report scientists from the Carnegie Institution and Stanford University. Using these lands for energy crops, instead of converting existing croplands or clearing new land, avoids competition with food production and preserves carbon-storing forests needed to mitigate climate change. Sustainable bioenergy is likely to satisfy no more than 10% of the demand in the energy-intensive economies of North America, Europe, and Asia. But for some developing countries, notably in Sub-Saharan Africa, the potential exists to supply many times their current energy needs without compromising food supply or destroying forests.

Elliot Campbell, Robert Genova, and Christopher Field of the Carnegie Institution's Department of Global Ecology, with David Lobell of Stanford University, estimated the global extent of abandoned crop and pastureland and calculated their potential for sustainable bioenergy production from historical land-use data, satellite imaging, and ecosystem models. Agricultural areas that have been converted to urban areas or have reverted to forests were not included in the assessment. The results of the study are published in the June 25 online edition of *Environmental Science and Technology*.

The researchers estimate that globally up to 4.7 million square kilometers (approximately 1.8 million square miles) of abandoned lands could be available for growing energy crops. The potential yield of this

land area, equivalent to nearly half the land area of the United States (including Alaska), depends on local soils and climate, as well as on the specific energy crops and cultivation methods in each region. But the researchers estimate that the worldwide harvestable dry biomass could amount to as much as 2.1 billion tons, with a total energy content of about 41 exajoules. While this is a significant amount of energy (one exajoule is a billion billion joules, equivalent to about 170 million barrels of oil), at best it would satisfy only about 8% of worldwide energy demand.

"At the national scale, the bioenergy potential is largest in the United States, Brazil, and Australia," says lead author Campbell. "These countries have the most extensive areas of abandoned crop and pasture lands. Eastern North America has the largest area of abandoned croplands, and the Midwest has the biggest expanse of abandoned pastureland. Even so, if 100% of these lands were used for bioenergy, they would still only yield enough for about 6% of our national energy needs."

The study revealed larger opportunities in other parts of the world. In some African countries, where grassland ecosystems are very productive and current fossil fuel demand is low, biomass could provide up to 37 times the energy currently used.

"Our study shows that there is clearly a potential for developing sustainable bioenergy, and we've been able to identify areas where biomass can be grown for energy, without endangering food security or making climate change worse," says Field, director of the Department of Global Ecology. "But we can't count on bioenergy to be a dominant contributor to the global energy system over the next few decades. Expanding beyond its sustainable limits would threaten food security and have serious environmental impacts."

Source: Carnegie Institution