OPINION: HOW BIOFUELS COULD CUT CARBON EMISSIONS, PRODUCE ENERGY AND RESTORE DEAD LAND

A new way of producing biofuels could not only curb carbon emissions and produce renewable energy, but also restore unusable agricultural land and improve biodiversity. But only if this winning breakthrough find its way onto the political agenda.

The twenty-first century is having a troubled infancy. Six years in and it is facing the twin perils of climate change and a looming energy crisis. Solutions to both are in high demand and many research dollars and pounds are being channelled into developing environmentally-friendly, renewable resources.

Biofuels – the product of living things – certainly fit the bill, being both renewable and biodegradable.

But there is always a catch. Currently, biofuels are a matter of harvesting single crops grown on fertile soils such as corn or sugarcane or waste products such as straw.

In George Bush's State of the Union address of January 2007, corn-based biofuels played a major role in reducing the USA's dependence on oil. But it is highly unlikely that these fuels will make a large dent in America's energy demands.

The fuel-bearing plants need land to grow on, and the choice becomes either using up current agricultural land that provides much-needed food for growing populations, or to clear natural land and damage the ecosystems they nourish.

Any new crops must also be irrigated and treated with potentially polluting fertilisers and pesticides. And the water, chemicals and eventual crops must be transported with fossil-fuel-burning vehicles.

At first glance, biofuels seem to create more problems than they solve. In an ideal world, we would source biofuels from crops grown on used land with no other agricultural value, with a minimum of chemical help.

But such a world may be just round the corner, thanks to scientists from the Universityof Minnesota. David Tilman, Jason Hill and Clarence Lehman have discovered that the key to low maintenance biofuels is diversity.

The trio cultivated plants in 152 plots on agriculturally degraded soil (see left; photo taken by David Tilman), with low levels of the nitrogen that crop plants need to thrive on. They were irrigated once when the crops were planted, and left untouched by fertilisers.

They found that plots which cultivated a variety of plants produced far more energy than those with a single species, with the most productive ones containing 16 different species.

These so-called ‘low-input, high-diversity’ or LIHD plots contained a mix of humble woody plants, legumes and grasses, such as wild lupine, goldenrod, and switchgrass.. They produced over three times as much energy as monocultures of single species.

Tilman found that every hectare of the LIHD plots yielded 68 gigajoules of energy a year but because they were so low maintenance, they only needed 4 gigajoules to pay off the energy debt of production, harvesting and transport. At processing plants, the fuels can be converted into gasoline, diesel and electricity.

In this way, each hectare of LIHD plots produce over 50% more usable energy on abandoned soil than other crops do with fertile soils.

Part of the LIHD crops' success lay in the fact that legumes can seed impoverished soils with valuable nitrogen. Over the decade the experiment ran for, nitrogen levels in the LIHD plots increased by a quarter.

The biological diversity in each plot also warded against diseases and marauding species, never allowing a single invader to gain a proper foothold. This greatly reduced the need for pesticides and chemical protections.

Providing an alternative to fossil fuels is just one way in which LIHD biofuels could help to curb carbon emissions – they also act as carbon sinks. Monocultured crops such as corn and soybean produce less greenhouse gases than petroleum-based petrol and diesel, but they are still carbon-positive – their production leads to a net increase in carbon dioxide.

In contast, LIHD biofuels are carbon-negative, removing carbon dioxide from the atmosphere and storing it in both the soil and the growing roots of the plants themselves.

This stored CO_2 outweighs the total amount emitted during production and transportation by more than ten times and every hectare of crop captures about 4 tonnes of carbon dioxide every year. Compared to corn-based biofuels, the greenhouse gas reductions achieved by LIHD fuels were 6-16 times greater.

The world currently has at least 500 million hectares of agriculturally abandoned land that serves no fruitful purpose, and could be used to sow LIHD crops.

The resulting biofuel harvest could replace 13% of the world's petroleum consumption and 19% of its electricity needs.

LIHD biofuels are an environmentalist's dream, and could provide a very rare win-win situation for the world's energy providers. They represent a way of providing renewable energy while reducing carbon emissions, conserving biodiversity and both using and renewing otherwise degraded land.

It is an opportunity that scientists need to explore further and the world's policy-makers need to start taking seriously.

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