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The environment

Biofools

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Farming biofuels produces nitrous oxide. This is bad for climate change

MANY people consider the wider use of biofuels a promising way of reducing the amount of surplus carbon dioxide (CO_2) being pumped into the air by the world's mechanised transport. The theory is that plants such as sugar cane, maize (corn, to Americans), oilseed rape and wheat take up CO_2 during their growth, so burning fuels made from them should have no net effect on the amount of that gas in the atmosphere. Biofuels, therefore, should not contribute to global warming.

Theory, though, does not always translate into practice, and just as governments have committed themselves to the greater use of biofuels (see table), questions are being raised about how green this form of energy really is. The latest come from a report produced by a team of scientists working on behalf of the International Council for Science (ICSU), a Paris-based federation of scientific associations from around the world.

The ICSU report concludes that, so far, the production of biofuels has aggravated rather than ameliorated global warming. In particular, it supports some controversial findings published in 2007 by Paul Crutzen of the Max Planck Institute for Chemistry in Mainz, Germany. Dr Crutzen concluded that most analyses had underestimated the importance to global warming of a gas called nitrous oxide (N_2O) by a factor of between three and five. The amount of this gas released by farming biofuel crops such as maize and rape probably negates by itself any advantage offered by reduced emissions of CO_2.

Although N_2O is not common in the Earth's atmosphere, it is a more potent greenhouse gas than CO_2 and it hangs around longer. The upshot is that, over the course of a century, its ability to warm the planet is almost 300 times that of an equivalent mass of CO_2. Robert Howarth, a professor of ecology at Cornell University who was involved in writing the ICSU report, said that although the methods used by Dr Crutzen could be criticised, his fundamental conclusions were correct.

Energy rush

Biofuel substitution targets (percentages refer to share of total primary energy* and transport fuel)

Country	Total primary energy	Transport fuel
Australia	-	350m litres
Britain	-	5%† (2010)
Canada	-	5% renewable content in petrol by 2010; 2% in diesel by 2012
France	10% (2010)	7% (2010), 10% (2015)
Germany	4%	5.75%†
Italy	-	2.5%
Japan	-	50m litres from domestic biofuel production (2011)
Netherlands	10% (2010)	5.75%†
New Zealand	90% total electricity	3.4% total transport fuel sales† (2012)
Poland	7.5% (2010) 14% (2020)	5.75%
Spain	12.1%	5.83%† (2010)
United States	-	136 billion litres† (2022)

Source: ICSU/SCOPE International Biofuels Project Rapid Assessment *Includes biomass †Mandatory

N_2O is made by bacteria that live in soil and water and, these days, their raw material is often the nitrogen-rich fertiliser that modern farming requires. Since the 1960s the amount of fertiliser used by farmers has increased sixfold, and not all of that extra nitrogen ends up in their crops. Maize, in particular, is described by experts in the field as a "nitrogen-leaky" plant because it has shallow roots and takes up nitrogen for only a few months of the year. This would make maize (which is one of the main sources of biofuel) a particularly bad contributor to global N_2O emissions.

But it is not just biofuels that are to blame. The ICSU report suggests N_2O emissions in general are probably more important than had been realised. Previous studies, including those by the International Panel on Climate Change (IPCC), a United Nations-appointed body of experts, may have miscalculated their significance—and according to Adrian Williams of Cranfield University, in Britain, even the IPCC's approach suggests that the global-warming potential of most of Britain's annual crops is dominated by N_2O emissions.

The broader issue, therefore, is the extent to which humanity has hijacked the "nitrogen cycle", as the passage of that gas into and out of the atmosphere is known, for its own use. Alan Townsend, of the University of Colorado, Boulder, is one of those trying to calculate the extent of this change. What seems certain is that the nitrogen cycle is changing faster and more profoundly than the carbon cycle, which has attracted much more attention.

This week Dr Townsend, and others involved in something called the International Nitrogen Initiative, are meeting in Paris to try to organise an international assessment of what is going on. This would do for nitrogen what the IPCC has done for carbon. To some, worries about nitrogen will doubtless seem to be no more than the latest environmental bandwagon. But the case of biofuels shows that without proper consideration of all greenhouse gases, not just CO2, it is too easy to rush headlong into expensive methods of mitigation that actually make things worse.