Keeping carbon down

Carbon Management (2012) 3(1), 21–22

> “We need a discussion about what to use this scarce resource ‘biomass’ for, as political decisions have been and are being made that affect biomass use across all sectors of society.”

Johannes Lehmann*

Keywords: biochar ■ bioenergy ■ bioproducts ■ carbon sequestration ■ climate change ■ soil health

Biomass carbon is becoming an increasingly scarce commodity. Societal needs for more food, fodder, fiber and fuel increase costs of biomass products. Sawdust, which 10 years ago was a waste stream in need of disposal, has, in many regions, become a sought-after resource. Modern bioenergy is positioned to utilize an increasing share of global net primary productivity and, if we are not careful, may in the future impinge on food supply. And the need to withdraw biomass puts more and more constraints on availability of biomass for other ecosystem services, as well. The emissions of carbon dioxide have well-known ramifications for the climate, but the multiple uses of biomass may also affect water quality, soil health and, in a feedback net, primary productivity. We need a discussion about what to use this scarce resource ‘biomass’ for, as political decisions have been and are being made that affect biomass use across all sectors of society.

Consider the case of bioenergy: there is undoubtedly a need to develop clever renewable energy technologies, even after we have exhausted all opportunities to reduce energy use and improve energy efficiency. Biomass is one of the few avenues presently conceivable to meet some demand for renewable liquid transportation fuels for the next decades. However, it is unlikely to do so in the long term in light of increasing demands, unless there is a profound shift in transportation energy strategies. In addition, bioenergy will never be able to satisfy all our energy needs, simply because net primary productivity is not sufficient and multiple uses compete on a global scale [1]. There are, however, regions and local opportunities where biomass is the energy source of choice, and should be developed into a clean and efficient technology. This may include low-cost approaches to the local production and consumption of liquid biofuels in rural communities of the developing world who could in the future be priced out of the gasoline market.

But as a global strategy, we should think more critically about whether it is a priority to return biomass carbon to the atmosphere as bioenergy, or whether there are more valuable products to be made from biomass. Energy can also be generated from solar, water or wind sources in increasingly efficient ways. Hydroelectricity and wind are the two largest contributors to the increase in global renewable energy providing 82% [2]. Wind has an estimated 12% potential to add to total global energy capacity by 2035. But there are many carbon-based products in industry that can be made only from

*Department of Crop & Soil Sciences, Atkinson Center for a Sustainable Future, Cornell University, Ithaca, NY 14853, USA
E-mail: CL273@cornell.edu

10.4155/CMT.11.72 © 2012 Future Science Ltd

ISSN 1758-3004

biomass to replace fossil sources, as well as many uses of biomass in the environment that we cannot substitute.

Throughout human history, biomass has been used to generate a variety of products that are now in many cases produced using fossils. Early examples are the use of pyrolysis liquids as pesticides, adhesives or medicinal tars during the Paleolithic to the Neolithic periods [3]. The Egyptians, Greeks and Romans all used pyrolysis to generate a diversity of products. By the turn of the 19th century, pyrolysis was the only technology to produce methanol, acetone or acetic acid, including some liquid fuels [4]. Equally, fermentation has been used to produce many different industrial alcohols and acids.

In addition to industrial products that can be produced from biomass, biomass also fulfills a multitude of ecosystem services. Soil organic carbon is the key ingredient of healthy soils to grow plants, filter water and sequester carbon. Historic losses of soil organic carbon by agriculture have been estimated at 42–78 Gt on a global scale [5]. A significant portion of that loss may and should be replenished to mitigate climate change and would make a relevant contribution of approximately 10% of fossil fuel emissions. More importantly, recapitalizing world soils with organic carbon would improve food security, as organic matter is the single most important ingredient of productive and healthy soils. Similar arguments can be made for the management of vegetation to secure biodiversity, ecosystem health, water resources and livelihoods of those populations relying on forest resources.

These are all needs that organic carbon services. We should more rigorously investigate ways to maximize retaining biomass carbon in ecosystems and manufacturing streams through a combination of conservation practices, pyrolysis, biochar return to soil, fermentation and digestion.

Organic carbon is valuable but not always valued. Mechanisms to value carbon through trading, auctions and taxes in the framework of mitigating climate change have not pulled their weight. A monetary value of carbon in soil for crop production has not been seriously considered, even though the value of improving soil carbon was found to lie between £31 and £66 per ha in a study on UK farms [6]. An aggressive global strategy to harness opportunities for retaining and sequestering biomass carbon for climate change mitigation is hotly debated, often under the umbrella of so-called geoengineering or climate engineering. It may be a mistake to see biomass use solely through a lens of climate change mitigation, given the multiple environmental needs it fulfills. But it is equally questionable to disregard the need to adapt to and mitigate climate change. It is sensible to prioritize carbon sequestration technologies that create value locally by retaining carbon, such as those that utilize biomass and intend to replenish organic carbon using agroforestry, crop rotations, no-tillage or biochar. Central is not to loose sight of these values to local populations and biodiversity that must be sustained over time.

We do not know what our overall portfolio of biomass use, energy generation and climate change mitigation strategies will look like in 100 years. But if we embark on a path that includes strategies to maximize carbon products from biomass in combination with maintaining and replenishing global soils with organic matter, we at least know that we will have healthy soils and healthy ecosystems, no matter whether this form of carbon dioxide removal scales to a major or a minor fraction of mitigating the climate challenge. I believe there are no strong arguments against that. Governments, and especially transnational governance bodies such as the UN, should provide a platform for a coordinated and informed discussion beyond political and commercial interest groups. The formation of a Global Soil Partnership launched at FAO in 2011, for example, is encouraging [101]. Clearly, there is a need for a discourse on the wider biomass utilization that allows informed decision making with global goods in mind.

Financial & competing interests disclosure

The author has no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties. No writing assistance was utilized in the production of this manuscript.

References

1 Dornburg V, van Vuuren D, van de Ven G *et al.* Bioenergy revisited: key factors in global potentials of bioenergy. *Energy Environ. Sci.* 3, 258–267 (2010).

2 US EIA. *International Energy Outlook 2011.* US EIA, Washington, DC, USA (2011).

3 Tiilikkala K, Fagernäs L, Tiilikkala J. History and use of wood pyrolysis liquids as biocide and plant protection product. *Open Agr. J.* 4, 111–118 (2010).

4 Goldstein IS. *Organic Chemicals from Biomass.* CRC Press, Boca Raton, FL, USA (1981).

5 Lal R. Soil carbon sequestration impacts on global climate change and food security. *Science* 304, 1623–1627 (2004).

6 Gaunt JL, Verheijen FGA, Sohi S, Kibblewhite MG. *To Develop a Robust Indicator of Soil Organic Matter Status.* Department for Environment, Food and Rural Affairs, London, UK (2005).

Website

101 Global Soil Partnership for Food Security launched at FAO. New effort to assure soils future generations. www.fao.org/news/story/en/item/89277/icode