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Ensuring sustainability of biochar: Learning from the experience of bioenergy

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Introduction

Biochar has the potential to make a major contribution to climate change mitigation and enhancement of land productivity, but to achieve this potential, biochar must avoid criticisms such as have been levelled at the bioenergy industry. The bioenergy industry is expanding rapidly around the globe, largely in response to climate change and energy security policies that promote its adoption. Bioenergy has potential to contribute significantly to mitigation of GHG emissions, and deliver positive environmental, social and economic outcomes. However, bioenergy, especially biofuels, have been criticised for delivering questionable greenhouse benefits, reducing soil fertility, causing deforestation, threatening biodiversity and increasing poverty through inflating food prices and displacing vulnerable communities. Recently, some have challenged the sustainability of biochar on similar grounds, raising concerns about production methods and potential negative environmental and social consequences.

In order for biochar to fulfil its considerable promise the industry should learn from the experiences of bioenergy. The biochar industry should take pre-emptive action to encourage and demonstrate sustainability as the adoption of biochar becomes more widespread.

Discussion

In recent years the bioenergy industry has undertaken major efforts to address sustainability challenges, through collaborative processes to define sustainability, identify measures for its assessment, and develop institutional mechanisms to promote adoption of sustainable systems. Many of these measures are applicable to biochar.

The development of a scientifically robust and socially accepted sustainability framework for biochar requires:

- engagement of a broad range of stakeholders, working to achieve consensus;
- a scientifically-based conceptual framework for sustainability assessment; and
- institutional mechanisms involving regulation and incentives, at domestic and international level, to ensure the widespread adoption of agreed sustainability assessment and assurance measures.

A framework for sustainability assessment should comprise:

- agreed principles of sustainable biochar systems, encompassing environmental, social and economic goals;
- articulated criteria that describe the elements of sustainability; and
- identified indicators for monitoring and assessment of trends in sustainability.

A system of criteria and indicators could form the basis of sustainability guidelines or standards for biochar, which could be applied within a domestic or international certification scheme.

The challenges in devising such a scheme include

- identifying indicators that are practical, cost-effective, outcome-based, and sensitive to change in significant processes of the coupled human-environment system;
- identifying indicators that are relevant across a range of environments and production systems;
- minimising transaction costs, to encourage participation, while maintaining sufficient rigour to ensure credibility;
- ensuring that small-scale producers are covered but not disadvantaged; and

- maintaining compliance with World Trade Organisation requirements on technical barriers to trade.

Sustainability should be clearly defined then assessed and assured at each stage of the value chain, and for the system as a whole. The following elements should be considered in assessing biochar systems:

- Impacts of biomass supply: e.g.
  - soil health, including nutrient levels, organic matter, structural stability, erosion;
  - depletion of plant and soil carbon stocks (rate of harvest compared with rate of growth, and off-site impacts due to indirect land use change);
  - impact on water resources;
  - on-farm and off-site biodiversity impacts;
  - local and regional social impacts.
- Impacts of biochar production: e.g.
  - emissions of pollutants and nutrients to air and water;
  - efficiency of utilisation of syngas and process heat to displace fossil energy sources.
- Impacts of biochar application: e.g.
  - nutrient value of biochar;
  - contaminant content of biochar;
  - impacts on soil health, leaching of nutrients, breakdown of pesticides.
- Whole system assessment: e.g.
  - life cycle climate change impact;
  - ecosystem function and resilience;
  - community impacts including incomes and health.

The issue of indirect land use change has been a particular challenge to the bioenergy industry, because of difficulties in attribution and quantification. Some have proposed adjusting the calculated mitigation value of bioenergy products based on estimated emissions due to land use change, but there is much debate over appropriate methodology and data. Additionally, many believe that the biomass producer, who often has limited choice of crop and control over the ultimate fate of his product, should not be penalised for deforestation outside his control; rather, indirect land use change should be managed and assessed at a regional scale.

Actions can be taken at a project scale to reduce the risk of indirect land use change, for example: utilization of waste biomass sources, intensification of production on existing agricultural land through, for example, agroforestry and intercropping; rehabilitation and utilisation of degraded land; and increased efficiency of energy utilisation.

Ideally, what is required is policy that promotes sustainable land use, whether the product is used for food, feed, fuel or biochar. Sustainable land use policies could also address the potential contaminant risk (such as where biochar is produced from contaminated feedstocks), ensuring that the product is fit for land application. Sustainable land use policies combined with effective regulation of biochar production facilities, and incentives for efficient utilisation of energy, could provide a strong framework for development of a sustainable biochar industry.

However, until such policies are implemented universally, the biochar industry needs to focus on development and promotion of guidelines that address the various elements of sustainability of biochar, as well as the whole system impact. Compliance with such guidelines could be verified by third parties, as a basis for certification of “sustainable biochar” products. Governments can play a role through policies that favour or discourage particular biomass sources, or support certified products. Ensuring sustainability will become a greater challenge as the biochar industry expands: the industry needs to be prepared to deal with issues and perceptions as they arise.

Conclusions

Ideally, sustainable biochar systems should be ensured through a policy framework that integrates sustainable land use, renewable energy and climate change goals, with effective industry regulation. Until such integrated policy is implemented universally, the biochar industry needs to manage sustainability from within, developing and promoting sustainability guidelines. Guidelines need to consider biomass sourcing, biochar production, and biochar utilisation, as well as management of whole system impacts.

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