The Economics of Biochar Production

Biochar…Black is the New Green Workshop
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Leadership and You

- Potential Uses and Potential Benefits
- Economics considering Carbon Sequestration
- Production and Transportation
- Regulation

Potential Uses and Benefits of Biochar

- Properties of Biochar:
  - High stability of biochar against decay.
  - Strong ability to retain nutrients compared to other types of organic matter.
  - Allows for a reduction in fertilizer use and other soil inputs resulting in decreased nitrous oxide emissions in fertilized fields.
- Ideal for potential use in:
  - Improvement in soils (rehabilitation and agricultural production).
  - Use in climate mitigation strategies.

Potential Uses of and Benefits of Biochar

Soil Reclamation of Sterile or Impaired Soils; Fellet, Marchoil, Vedove, and Peressotti (2011):

- Use of biochar (orchard biomass) to treat mine tailing piles in Italy.
- Found that the treated soil's pH nutrient retention, and water holding capacity increased.
- Bioavailability of Cadmium, Lead, Thallium, and Zinc all decreased as biochar content increased.
- Concluded "…changes promoted by the biochar seem to be in favor of its use on mine wastes to help the establishment of a green cover in a phytostabilization process."

Potential Uses of and Benefits of Biochar

Water Benefits and Crop Productivity:

- Asai, et. al (2009); Clark (2014); Laird, et al (2010): each found that biochar application improves soil's water permeability levels and provides better water capacity.

- Blackwell, et al (2010): found improved crop nutrition through biochar applications in a drought period attributed to increased water uptake potential during drought stress periods.

- Baum and Weitner (2006), Chan, et al (2008), Steiner, et al (2007): found increased crop productivity when biochar is added with both fertilizer(s) and without fertilizer(s).

Carbon Sequestration

- Two Scenarios to Consider:
  - When there is a carbon market that recognizes the avoided emissions and carbon sequestration due to the application of biochar in agricultural soils.
  - When the market price of biochar itself is low enough to allow farmers to earn a profit after applying the amendment to their soil.
- Field, Keske, Birch, Defoort, and Cotrufo (2012):
  - Breakeven point for biochar production and use when a carbon market ***exists*** is approximately $50.00 per metric ton of CO_2.
  - Biochar production and application ***can be profitable*** when it is possible to capitalize on the impacts of carbon sequestration.

Production and Pricing

When it Makes Economic Sense – Existence of a Carbon Market ***and*** the Market Price of Biochar:

- Galinato, Yoder, and Granatstein (2011): **NO** Carbon Market
  - Price of Biochar: $9.19 per metric ton in order for a farmer to break even.
  - Price of Biochar: $4.82 per metric ton in order for a farmer to earn a profit (excluding the costs of transportation and application.
- Galinato, Yoder, and Granatstein (2011): **Carbon Market**
  - Market is at $31.00 per metric ton of CO_2 or higher, the cost of biochar can be as a high as $100.73 per metric ton and a farmer will still break even.
  - If the market is as low as $1.00 per metric ton of CO_2, there is ***no*** price scenario in which a farmer does ***not*** lose revenue.

Production and Transportation

- Profitability of other byproducts…Bio-Oil and Biogas
- Take into consideration the feedstock...chemical composition, availability, access.
- Transportation:
  - A major factor that significantly influences the economics of biochar production.
  - In mobile pyrolysis: (1) movement of the pyrolysis reactor to the biomass or (2) movement of the biomass to the pyrolysis reactor; Palma, et al (2011): found that the net present value of production improves as the number of times the mobile pyrolysis devise is moved ***decreases***.

Regulation and the Regulatory Environment

- United States:
  - No national regulatory protocols in place specific to the production, storage, transportation, application, and use of biochar.
  - State regulation(s) are fragmented and mostly not biochar-specific.
  - No consideration of regulating the additional byproducts…namely bio-oil and biogas.
- Europe and The European Union:
  - Switzerland has been the first country in Europe to explicitly ***approve*** the use of biochar in agricultural processes.
  - REACH: Registration, Evaluation, and Authorization of Chemicals.
- Japan:
  - Approved the use of biochar for soil conditioning in 1984.

In Conclusion…

Economic Feasibility of Biochar Production is dependent on:

- The end use of biochar once it is produced.
- The existence of a carbon market and prevailing market prices for CO_2 and biochar.
- The use of the other pyrolysis byproducts including bio-oil and biogas.
- Costs associated with production, storage, application and even transportation of biochar.
- Impact of biochar on crop productivity which is impacted by the type of feedstock used in biochar production.

Thank you.

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