



The Economics of Biochar Production

**Biochar...Black is the New Green Workshop
Minden, NV**

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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 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 device 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.

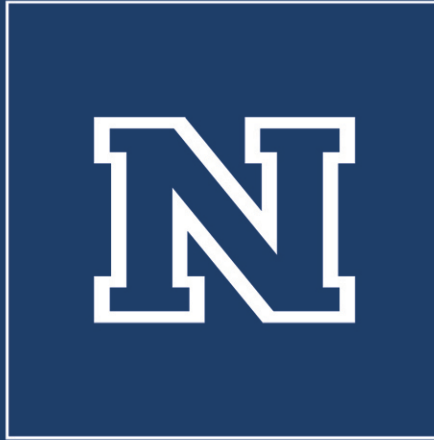
■ Japan:

- 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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