



2013 State of the Biochar Industry

A Survey of Commercial Activity in the Biochar Field: Report Overview

A report from the International Biochar Initiative (IBI); by Stefan Jirka and Thayer Tomlinson

Executive Summary

In a world increasingly defined by resource limitations and climatic uncertainty, there is a search for strategies to mitigate these risks. In recent years, biochar has been identified as a potential tool to increase agricultural productivity, enhance agriculture's resilience to the impacts of climate change, reduce greenhouse gas (GHG) emissions, and produce sustainable energy. In response, a biochar industry has emerged. Biochar, when added to soils, may enhance the resilience of soil ecosystems in the face of intensifying weather events and pressures to improve soil productivity. But not all biochars are created equal. Diversity of feedstocks, production technologies, and biochar end uses reflect a complexity of variables that define biochar, not all of which are yet completely understood. Even so, early successes in biochar commercialization are evident in some areas and a biochar supply chain has emerged—from equipment manufacturers to biochar purveyors to production and use consultants. The biochar industry, at present, is in a fledgling state but there is upward trending growth for companies working in specific markets. The future success of the industry will depend on a convergence of factors relating to research, investment, policy, innovation, and public education.

Purpose of this Report

The State of the Industry Report provides a broad overview of the current state of the biochar sector as identified by surveys and other data throughout 2013. It gives the expert as well as the layperson a snapshot of commercial and non-commercial biochar operations and activities, and puts this information into the context of larger forces that influence the biochar space including agriculture, GHG or carbon markets, and public policies. The report is based primarily on information gathered through public surveys and internet-based research but also on accumulated knowledge of the present biochar landscape offered by the authors of and contributors to this report. It is the intent of IBI to produce this report on an annual basis to track trends and growth in the biochar industry—both on the commercial as well as the project side.

IBI paying members have advance access to the 62-page report which they can read by logging into the member-section of the website at <https://ibi.memberclicks.net/login>.

For more information on joining IBI as a member, please see: <http://www.biochar-international.org/join>. For more information overall, please see the report webpage at http://www.biochar-international.org/State_of_industry_2013.

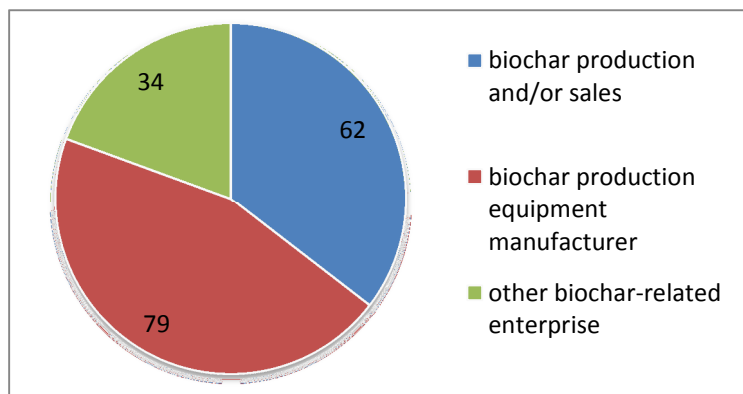
The full report will be made available to the general public on April 15, 2014.

Key Findings

- In 2013, **the biochar industry is in a fledgling state**, comprised largely of enterprises selling relatively small volumes of biochar products locally for end uses such as gardening and tree care. **Biochar has yet to make a substantial entry into large-scale agricultural operations.**
- Unblended biochar and biochar products blended with other materials are being sold in many countries at a wide range of retail prices ranging from **\$0.08 to \$13.48 per kg**. The average price reported was \$2.48 per kg.
- Companies reported **volumes of biochar sales totaling 827 metric tons**. 90% of those transactions were made by businesses in North America and Europe with the remainder made in Asia and Africa.
- **Woody biomass is by far the largest source of feedstock** for the biochar industry. Globally, the forestry and wood products sector offers a widely accessible source of woody residues that are often centrally located for ease of collection and transportation.
- The **scales and types of biochar production technologies being developed and marketed range widely**—from micro-scale cookstoves to large-scale industrial facilities. This diversity in technologies, and other characteristics like feedstocks and end uses, may be characteristic of an industry at an early stage of development and experimentation.
- The main **barriers to industry expansion are a lack of consumer awareness, technological constraints, and access to financing**. It is not yet possible to predict the yield gains from biochar in a way that would allow proposed applications to be valued. Education of stakeholders—from farmers to regulators to lenders—is key to expanding the industry.
- Scientific research into the various facets of biochar continues to expand rapidly. The number of **peer-reviewed biochar-related publications increased nearly five-fold over the last five years** with over 380 papers published in 2013.

Information in the Report

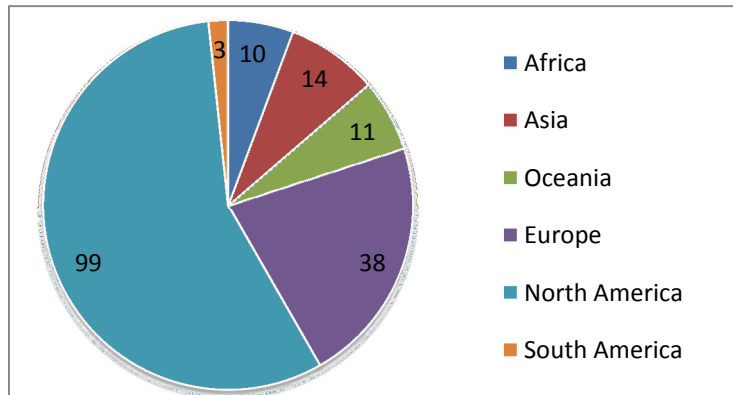
Information in this report is derived primarily from three sources: 1) two public surveys conducted by IBI during the summer of 2013; 2) data aggregated from the IBI member database; and 3) internet-based research of biochar-related company websites. Further information was gleaned, when possible, from consultations with stakeholders ranging from biochar entrepreneurs to scientists, and review of existing publications and analyses of biochar and related industries.



Companies in the biochar sector

The report begins with a brief history of biochar use worldwide and then delves into the current state of biochar commercial activity which highlights feedstocks, use of biochar, costs, production, purveyors of biochar goods and services, policies to facilitate growth, barriers to moving forward,

and market trends and outlook. The second section of the report covers biochar projects globally including the state of projects overall, project locations, goals, production and use results and overall development. The report concludes with recommendations for future industry growth. Also included as an appendix to this report is a list of 175 global biochar companies including their geographic location, primary services, and website URL. Data from the two surveys as well as the IBI member database and research is represented throughout utilizing charts and graphics.



Geographic distribution of businesses

Recommendations for Future Industry Growth

The information provided in the report provides a snapshot of current trends in the biochar industry. Significant advancements have clearly been made in an industry that barely existed five years ago. Biochar is being produced for sale across the globe, consumers are utilizing biochar products for a wide range of purposes, and income is being generated for businesses involved in the biochar space.

Yet, it is also true that there is ample room for growth. To meet this goal, certain gaps need to be filled. While there are many needs, the following is a list of high-priority recommendations for biochar scientists, producers, technology developers, project developers, and stakeholders to accelerate the pace of growth and lower barriers-to-entry.

- 1) **Create biochar decision support systems.** As outlined in this report, biochar is a spectrum of materials that contain unique properties. The specific combination of physicochemical characteristics of any one biochar material is dependent on feedstock type and process parameters. Because of these differing properties, biochar impacts on soils and crops will vary with specific biochars. To facilitate decision-making, there is a need to characterize biochars before use, and for decision-making tools or systems—designed with the biochar end user in mind—to determine the suitability of using a specific biochar in the context of defined soils and cropping scenarios. This system should consider such variables as feedstocks, characterization of the biochar, soil types, climatic patterns, crop needs, and others. Furthermore, such a system should be integrated with existing efforts to develop comprehensive soil fertility management and ecosystem service support systems.
- 2) **Conduct long-term field trials.** Biochar differs from other soil amendments that are more familiar to the farming community, chiefly chemical fertilizers and compost. The value proposition of biochar includes longer term effects on soil functions—factors such as increased water retention, drought tolerance, nutrient bioavailability, aeration, microbial activity, and others—as opposed to only immediate gains in crop productivity. Because these benefits accrue and change over multiple growing seasons, there continues to be a need for long-term field trials, covering a range of feedstocks, biochars, crops, soil types, and geographies, to get a better grasp of the cumulative effects biochar has when used as a soil amendment. Included in this is a need for a full characterization of the biochar material combined with the *in situ* monitoring of biochar to better understand its effects and fate in soils.
- 3) **Invest in technology R&D and alternative financing mechanisms to bring down the upfront cost of production equipment.** At present, the economics of biochar as a

commercial enterprise are not usually favorable in most situations. One of the main factors holding back the industry is the cost of biochar production equipment. While activities investigating technologies to create biochar are ongoing, the amount of money being funneled into biochar production R&D is small relative to related industries developing new technologies for similar markets such as biofuels. The upfront capital cost of biochar production machinery is an important contributor to the manufacturing cost per tonne of biochar. Investment in the form of grants and subsidies to support financing of biochar production equipment, particularly on the part of governmental entities, could instigate public-private partnerships and drive innovation in biochar production equipment. As technology development matures, costs will likely go down, as well.

- 4) **Enhance international collaboration.** Relevant to all of the above recommendations, the biochar field is, at present, comprised of a somewhat disparate set of actors often operating in distinct geographic and focal areas. For example, the biochar-producing cookstove sector may share only some common goals with the large-scale biochar production sector but, additional dialogue between these groups could benefit the field overall. Sharing lessons learned across geographies—from both the research and commercialization perspectives—could help significantly speed up the implementation of successful biochar businesses. Protection of intellectual property is, of course, important. But at this early stage in industry development, collaboration among existing businesses through information sharing, and reporting in the aggregate can help to raise the profile of biochar, creating consumer awareness—one of the key obstacles to wide-scale dissemination—and growing global markets for biochar. One potential activity is the sharing of business case studies to get a nuanced understanding of how biochar entities are shaping their activities in their local context, how they are communicating about the costs and benefits of biochar to their customers, and the methods they are using to expand into new markets.
- 5) **Increase education and outreach.** While education and outreach activities are ongoing within the biochar community, the conversation needs to spread beyond the community to include stakeholders critical to the success of the biochar industry. An articulated campaign to educate farmers and ranchers, horticulturalists, agricultural researchers, regulators, and others could greatly increase awareness around the need to characterize biochar as well as the material benefits of biochar. Outreach with a wide range of stakeholder communities including agribusiness, farmers, ranchers, foresters, compost producers, regulators, and proponents of bioenergy, climate change mitigation and sustainable agriculture, could potentially be followed by a more well-defined campaign to target key decision makers, project developers, and market players.



Biochar is a spectrum of materials made up of differing physicochemical properties. Note the well-defined pore structure in the scanning electron micrograph image on the right. Images courtesy of the UC Davis Biochar Database and biocharproject.org