
# SURVEY AND ANALYSIS OF THE US BIOCHAR INDUSTRY

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## Introduction

The US market potential for biochar is estimated at over 3 billion tons.[1] However, there are many factors affecting the development of that market, including: technology, quality standards, education and marketing, and economics. Dovetail Partners, the US Biochar Initiative (USBI), the International Biochar Initiative (IBI) and The Watershed Research and Training Center have collaborated on an assessment of the state of the biochar industry. The objective is to define the scope and scale of the North American biochar market, and quantify its potential for woody biomass utilization. The study results identify constraints of the current production system and identify gaps requiring further attention. The supply potential from National Forests is a specific consideration within the research. National Forests in many regions are located in close proximity to agricultural lands (i.e., potential biochar users) and have the potential to be a major supplier of woody biomass due to management and restoration needs on National Forests.

Forestlands across the US are in need of improvement and restoration. Forest practitioners are in need of additional profitable avenues for low-value woody biomass. Biochar has been an emerging market for at least a decade and is characterized currently by a few large and many small producers, all pursuing profitable operations. The industry is in a stage of rapid technological developments which appear to offer the potential for a mid-range producer-class to emerge, but the demand for large quantities of biochar has been hampered by reluctant buyers due to the lack of consistent standards, unverified claims, and widely varying price and availability. This report identifies the key next steps in realizing the potential for the US biochar industry including establishing standards, a comprehensive marketing initiative, and testing to validate biochar's application benefits.

## Executive Summary

Biochar is a commercially produced product resulting from the pyrolysis of plant-based biomass. The markets and uses for biochar are rapidly expanding, as are its production technologies and capacities, and its sales.[2]

Biochar feedstocks are woody debris, manure litters, and ag and other organic wastes. Since the largest volume feedstock source is from woody biomass historically, the US Forest Service is interested in biochar as a large scale user of unsalable products from fire salvage, habitat restoration, and wildfire reduction projects. This report summarizes the surveys and analysis of US industrial biochar producers and users.[3]

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[1] The USDA's National Agricultural Statistical Service reported there were 318 million planted cropland acres in 2010. It takes 9.4 tons of carbon per acre to increase soil carbon content by 1%; therefore, almost 3 billion tons (6.1 million railcars) of biochar would be needed to enhance all U.S. cropland. For further discussion of market estimates, see reports listed in footnote 2.

[2] For background information on biochar see past Dovetail reports: *Biochar 101: An Introduction to an Ancient Product Offering Modern Opportunities* www.dovetailinc.org/report_pdfs/2016/dovetailbiochar0316.pdf and *Biochar as an Innovative Wood Product: A Look at Barriers to Realization of its Full Potential* http://www.dovetailinc.org/report_pdfs/2017/dovetailbiocharpotential0517.pdf

[3] The survey questionnaires are appended to this report.

Out of an estimated 135 biochar producers in the US, responses were received from 61, a 45% response rate. The User survey elicited 58 responses from domestic users. The analyses were based on these responses in addition to follow-up interviews by phone and in person. The August 2018 US Biochar Initiative (USBI) Biochar Conference provided additional timely data for our analysis from presentations, posters, as well as group and individual discussions.

The two surveys are complementary in their results and were reinforced by follow-up interviews, presentations, and discussions at the Biochar Conference. Two trends stand out:

- Growth in sales is supported by a general optimism in the strength of the marketplace.
- A widespread desire for more information and support from all resource entities.

The outcomes of the survey, supported by a distillation of Biochar Conference outputs point to a three prong strategy to grow the industry:

1. Both biochar producers and users see the need for more attention to be paid to the characteristics and quality of the end product. Taking steps to develop widely accepted standards are recognized as vitally important.
2. Biochar producers and users see the need for public and customer education—in support of biochar as a desirable and sought after product.
3. Producers and users understand the need to validate scientifically any claims to be made about the benefits of using biochar.

The challenge with implementing this strategy is establishing a credible basis on which to make product claims. However, once the science to back-up claims legally is identified and reinforced by a framework of standardized product characteristics, the industry is poised to capitalize on that research and those standards to support both increased public awareness and sales.

**Methodology**

A survey and analysis of the US biochar industry was conducted by the project team consisting of:

- Kathleen Draper, Finger Lakes Biochar and Ithaka Journal; NY
- Harry Groot, Dovetail Partners, Inc.; Minneapolis MN
- Tom Miles, Tom Miles Consulting, Inc. and US Biochar Initiative; Portland, OR
- Martin Twer, Biomass Program Director, The Watershed Research & Training Center; Hayfork, CA

Two surveys were conducted; one for producers and one for users. The survey was composed online and the US Biochar Initiative mailed the invitations and follow-up requests. The specific survey input was treated as confidential; however, a field was provided to allow individuals to authorize follow-up—which was conducted with selected respondents by project team members.

Out of an estimated 135 biochar producers in the US, responses were received from 61, a 45% response rate. The User survey elicited 58 responses from domestic users in a parallel survey. The analysis was based on these responses in addition to follow-up interviews by phone and in person.

All members of the project team participated in the data compilation, analysis, and reporting. Due to the mailing list used to invite the biochar community's participation in the surveys, there were 69 total respondent producers, but 7 were Canadian and one was German; their data has been segregated. All 58 responding Users were domestic.[4]

**US Biochar Market Background**

Prior to this survey, the US biochar industry production was estimated to be between 15,000-20,000 tons per year (TPY) by USBI. This survey provides data to support an estimate of 35,000 to 70,000 TPY. Based on anecdotal input gathered at the 2018 USBI Biochar Conference about the production rates of some of the larger producers, even that estimate is probably conservative; however, the basis used in this report is 45,000 TPY.

Using a 75% reduction in dry weight from raw feedstock to finished biochar, biochar production of 45,000 TPY would consume about 200,000 bone dry tons (BDT) of biomass as feedstock. Knowing that most feedstock ranges from 20 to 60% moisture content (for woody and ag biomass, the most common feedstocks) it can be extrapolated that the industry uses between 125,000 to 250,000 delivered tons of feedstock.[5]

The users represent a usage of 163 to 200+TPY, less than 1% of industry's projected production capacity. There is no way to know what percentage of all consumers this represents, but the project team solicited their input to better understand issues rather than to gain a comprehensive picture of market demand.

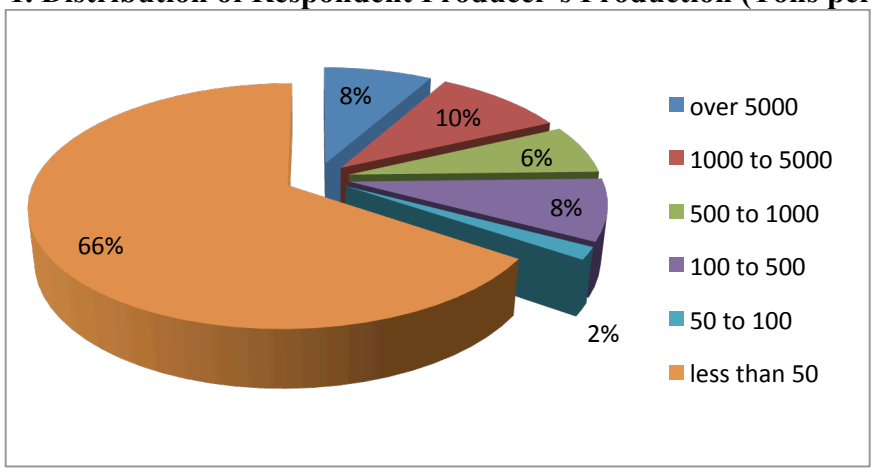
**Producers Survey Results**

The producer responses came from a broad cross section of the industry with the smaller producers being in the majority (Figure 1). The analysis focused on the larger producers (above 100 TPY) to reflect the interest in increased utilization of woody biomass. To date there is no definitive data on the size and distribution of US biochar production, only an estimate based on on-line research, and personal knowledge of consultants familiar with industry players.

[4] Some of the data presented is based on the entire response set and is noted as such; however, to reflect "the industry" most accurately, the higher volume producers and users have been broken out from smaller-scale producers and users who are typically hobbyists and not production oriented. The team's concern is that including the small-scale data skews the industry-focus of this study.

[5] To put this in perspective: A September 2018 fact finding trip by USBI to China, including a tour of one biochar plant, returned with this announcement: *Leading the world in large scale biochar production, China is on their way to building 200 pyrolysis facilities that will each produce 30 kilotons of biochar per year. Using crop waste as their main feedstock, the biochar is processed into slow release fertilizer before being distributed to farmers. Albert Bates, USBI Board Member, sees this as only the beginning, as China will be able to offer new biochar plant designs all along their New Silk Road and expand biochar applications beyond agriculture. [This will be a productive capacity of 6Million Tons of biochar annually, using 24M BDT of biomass*.]
https://myemail.constantcontact.com/IBI-Asia-China-Workshop.html?soid=1130041240013&aid=FL7kdv-OT-M

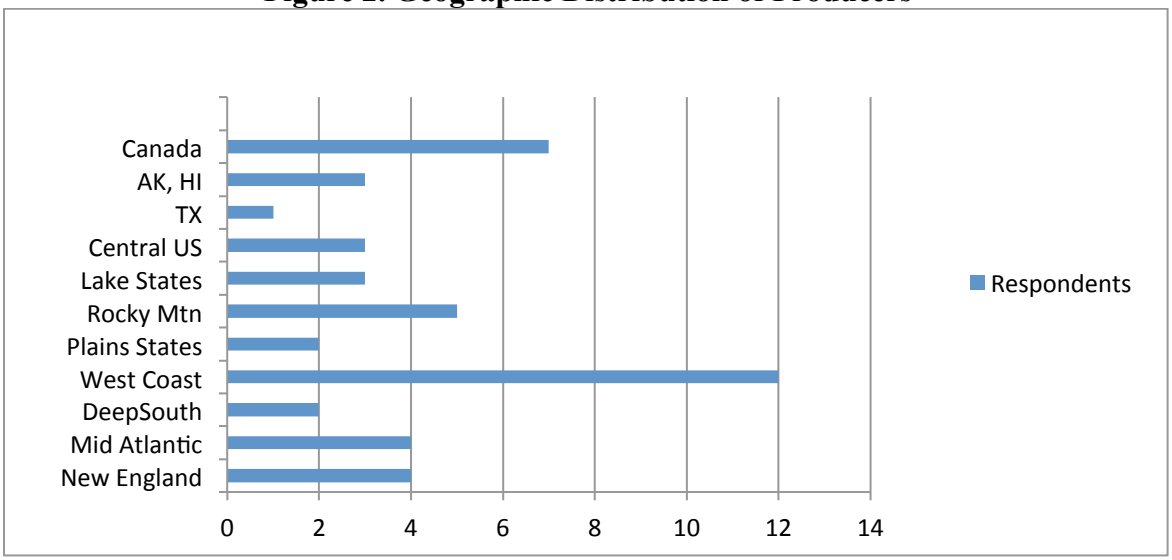
**Figure 1. Distribution of Respondent Producer's Production (Tons per Year)**




The domestic biochar production represented by the survey respondents is between 35,000 and 70,000 Tons per year. The Canadian production adds an additional 1,700 to 6,600 TPY for a North American total of 36,700 to 76,600 TPY.

Figure 2 shows the respondent's geographic distribution and the strength of the industry in the US (and Canadian) West. While there have been news releases announcing intended large scale production projects in the Eastern US, the industry's development has been led by Western US producers since its inception.[6]

**Figure 2. Geographic Distribution of Producers**



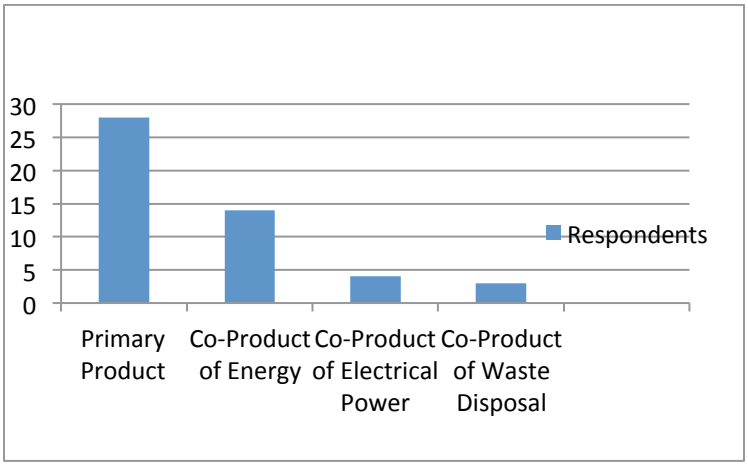

Larger producers have been in business, on average, longer than most of the intermediate sized producers (at over 5 years) however there were 9 firms producing less than 100 TPY with more

[6] *A note about the following data presentation: The larger producers were relatively thorough in responding to the survey questions, so while there is a fairly consistent 25 to 30% non-response rate on a question-by-question basis, it affects the lower 10 to 20% of the volume of biochar producers for the most part. This analysis' focus on volume producers captures that bias.*

than 5 years production experience. Given that experience base, compared to other industries, the relative "newness" of biochar as a commercial product is evident.

Figure 3 provides a look at the biochar production methods represented; 57% of the respondents were biochar producers primarily, with 29% as a byproduct of energy generation and 8% as a byproduct of electricity generation[7].

**Figure 3.**
**Biochar Production Methods**




Eighty-two percent of the respondents were producers and 18% were resellers only. Of the 14 resellers, only two purchased between 1000 and 5000 tons per year while 4 purchased between 100 and 500 Tons, and 8 purchased less than 50 Tons per Year.

Producers sell most of their biochar for agricultural uses: gardens, field crops, orchards, horticultural applications, turf, and landscaping. The table below shows for which applications producers and resellers are selling biochar specifically (Table 1).

Table 1. Biochar Applications

| | |
|---|---|
| *Garden* | *62%* |
| *Horticulture, specialty crops* | *47%* |
| *Field Crops* | *42%* |
| *Orchard or tree crops* | *29%* |
| *Turf* | *20%* |
| *Landscaping* | *36%* |
| Stormwater, filtration | 33% |
| Odor control | 27% |
| Other | 18% |

The *italicized* uses are aggregated under an "Agricultural" class.
The "other" category includes concrete admixture and pigments.

[7] Energy Generation is defined as the process where heat is extracted using air or water for some downstream process; Electrical generation may produce those energy streams, but is considered primarily a process to generate electricity. In order to produce biochar the combustion process of both systems have to be managed differently (and generally at a lower energy efficiency) than producing process heat or power only.

Of the largest volume producers (23 respondents over 100TPY), 43% (10) make biochar for no specific end use. Thirty five percent (9) make biochar for agricultural applications specifically, 9% (2) for drainage, and 13% (3) for odor control specifically.

Five of the largest volume producers sell their biochar as-is. Twelve of them process further (sizing, pelletizing, charging/inoculating/activating, neutralizing pH, and/or mixing with other soil amendments) (see sidebar for discussion).

Biochar is supplied in bag, bucket, or barrel or in bulk as specified by the customer in the following forms (in rank order):

1. Coarse chips
2. Fine powder
3. Fine screened chips
4. Pellets
5. Granules or prills
6. Liquid suspension.

Most of the large suppliers responding (39%, 9) do not pursue any independent certification; however 5 have OMRI (Organic Materials Review Institute) listing or USDA Organic certification and 5 use IBI standards[8].

**Biochar Downstream Processes**

- Biochar is sized to allow optimized field application or mixing with other amendments/products.
- Since biochar is typically basic (higher pH) it may need to be buffered or neutralized.
- Since biochar is a sterile substrate with huge surface area (like activated carbon) it acts as a host for soil microbial growth and for chemical bonds. So users often "charge" the raw biochar to fill those voids with desirable and predictable substances. For instance, a popular technique is to soak the biochar in an activated compost tea.

The majority of biochar is shipped locally and regionally (less than 500 miles), however exports are being made to Europe, Asia, Australia and the Middle East by producers in all production classes. Responding producers and resellers were evenly split on customer requests to know whether the biochar was locally sourced, with smaller scale producers asked most often.

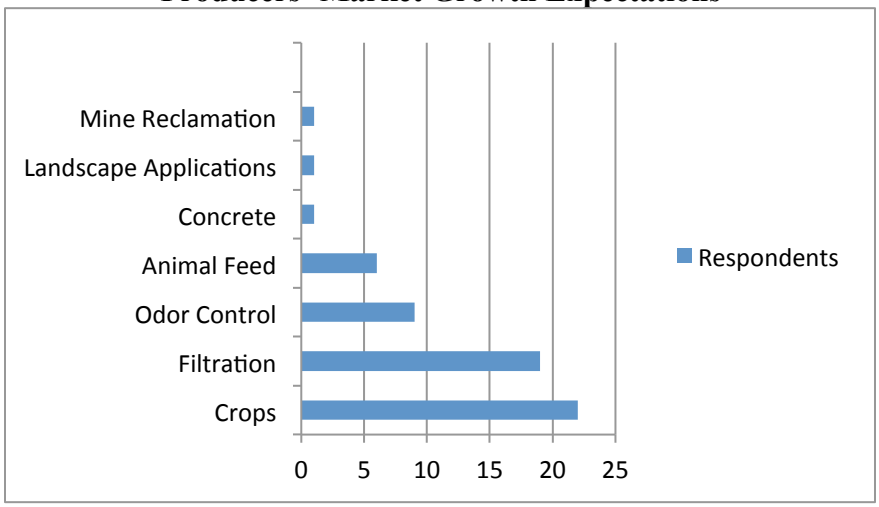
Most producers provide information to customers about their biochar—from analysis results to how-to-use instructions. Only 1 of the large volume producers reported providing no information.

None of the biochar producers—of any size—expect there to be a decrease in demand, with almost 60% of respondents expecting sales to increase more than 10% in the next 5 years. Most of the larger tier producers expect demand to grow modestly to significantly. Only 4 of the 23 upper tier producers anticipate needing to expand capacity to meet growing demand and only three of them expect to have a problem obtaining feedstock. The feedstock sourcing is predominantly woody in nature, but a wide variety of materials are viewed as potential sources, including manures, grasses, ag waste, construction waste, fiber, and food waste.

[8] https://www.omri.org/; https://www.ams.usda.gov/grades-standards/organic-standards; http://www.biochar-international.org/sites/default/files/IBI_Biochar_Standards_V2 0_final_2014.pdf. For more information see also: http://www.dovetailinc.org/report_pdfs/2017/dovetailbiocharpotential0517.pdf

The market segments showing the highest expectations for growth are, in rank order: crops, filtration, odor control and "other," with biochar as an animal feed supplement the most mentioned (Figure 4).

**Figure 4.**
**Producers' Market Growth Expectations**




Advertising biochar was reported to be direct, relatively traditional, and unsophisticated (Table 2).

Table 2. Biochar Advertising

| | |
|---|---|
| Word of mouth | 68% |
| Direct response to inquiries | 46% |
| Google Adwords | 2% |
| Print media | 10% |
| Website and other electronic media | 44% |
| Conference and trade show displays | 29% |

The top producers report having spent millions on research annually, with the level of support declining proportionately as production levels decreased. The degree of decrease was not linear; however without more specific data, relative percentages and trends cannot be determined.

The survey's last section asked open-ended questions about policy and opportunities for support that provided wide ranging responses. There were many thoughtful suggestions and a few common threads, which will be captured and discussed in the analysis section.

## Users Survey Results

The following figures (Figures 5 and 6) show the disparity in volume between the producer and user respondents. As noted above, the users represent less than 1% of the estimated domestic production of biochar.

**Figure 5.**

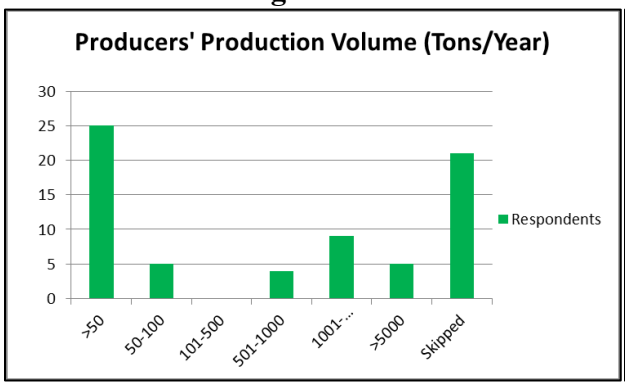
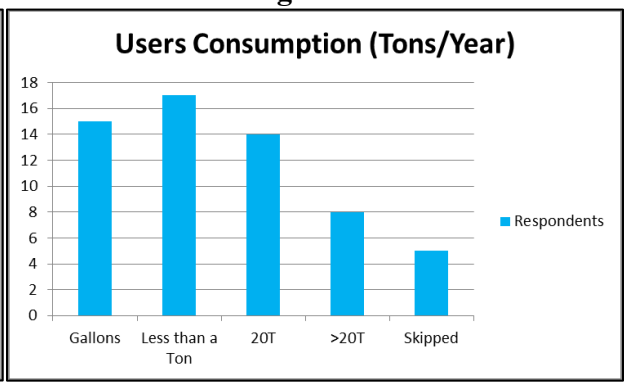



**Figure 6.**




The breakdown of users was:

- 5 users consuming more than 20 Tons per year of biochar (TPY)
- 10 users consuming between 5 and 20 TPY
- 11 users consuming less than 1 TPY
- 25 users consuming a few gallons per year (at 7.5#/gal.)
- 6 users didn't specify quantity.

Most user respondents classified themselves as gardeners, farmers or landscape contractors. In the larger users, most were resellers. The motivation for using biochar was fairly consistent and multi-faceted, including: modifying soil texture, improving air/water porosity, improving water management, and increasing soil carbon. There was modest motivation to change soil chemistry or modify pH and/or to improve disease resistance.[9]

The majority of respondents (55%) use the biochar dry. 38% use it inoculated and 39% blend it, most commonly with soil and/or other soil amendments.

The biochar users bought the material in the following forms (in rank order) :

1. Fine powder
2. Fine screened chips
3. Coarse chips
4. Pellets
5. Granules or prills
6. Liquid suspension

[9] For more discussion about biochar uses and benefits see the Dovetail Report: *Biochar As An Innovative Wood Product: A Look At Barriers To Realization Of Its Full Potential*; http://www.dovetailinc.org/report_pdfs/2017/dovetailbiocharpotential0517.pdf

As seems reasonable, larger volume users have been in business longer than smaller users, however 49% of all respondents have been using biochar for at least two years and most of the top tiers have over 5 years experience.

Of the 54 respondents, there was a notable increase in current volume used versus expectations for the coming year (Table 3).

Table 3. Biochar Usage Rates

| **Usage** | **Last Year** | **This Year** |
|---|---|---|
| Less than a ton | 49% | 28% |
| More than a Ton | 23% | 31% |
| A Semi-Truckload (20T) | 19% | 26% |
| Multiple Truckloads | 9% | 15% |

There seems to be broad satisfaction with suppliers in that 81% of users have not changed from whom they buy; 10% had changed suppliers due to quality issues and 8% due to availability issues.

Organic/OMRI Certification was important to 31% of respondents; IBI to 9%; State-level certification to 15%; and no certification was noted as important by 36%. A total of 92% of respondents said the climate impact of biochar was of importance to them. Only 4 of the 26 upper tier producers (15%) said the climate impact of biochar was unimportant.

Most top tier users get their supply from a 100 to 500 mile shipping distance, but 27% of them experience shipping distances of over 1500 miles. With few exceptions, respondents indicated the fact the biochar is produced locally was an important criteria (94%).

When asked whether they knew or cared from what or how their biochar was made only one respondent answered "no." Four percent said that information was not disclosed and 85% said they knew the details despite responses to a question about receiving an analysis where only 43% responded "yes". All the recurrent large volume buyers received analyses of their biochar while only 40% of the truckload volume buyers received analyses.

Reported prices paid for biochar ranged widely depending on the packaging and volume purchased. For the larger scale users the lowest cited cost was $75/ cubic yard (CY), the average price was $129/CY, with $200/CY FOB the most often cited price (or $1600/Ton). [10]

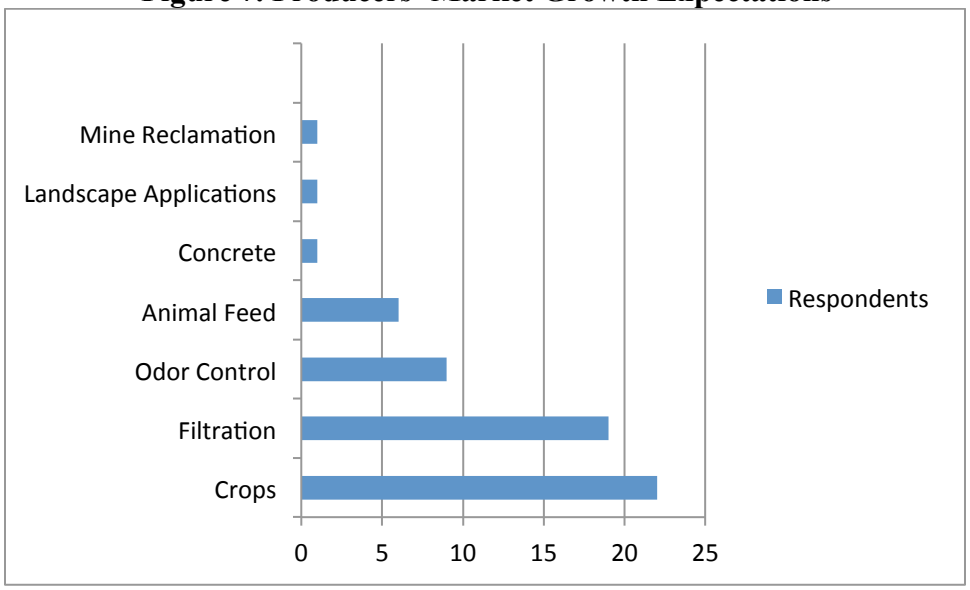
As with the producers, the input offered from open-ended questions will be discussed in the analysis section.

[10] Conversions used: 8CY/ton or 216 CF/ton; 9.25#/CF; 1CY = ~22gallon

**Analysis of Producers Survey Data**

Two trends stand out: expected growth in production based on optimism about the strength of the marketplace and a desire for more information and support from all categories of resource providers. As shown in Figure 7, producers have market growth expectations in many segments, including crops, water filtration, odor control applications, and animal feed.

**Figure 7. Producers' Market Growth Expectations**




The responses in growth of year-to-year production were confusing. On one hand, producers expected there would be stable to lower market prices for biochar, which was countered by Users expectations that prices would rise. Producers largely expected there to be geographically widespread availability of feedstocks at affordable prices. However muddy the economic picture is, the attitude that there would be positive movement in biochar sales was widespread with both survey groups.

Responses to questions about how the industry/trade association, public policy, and the USFS specifically can support and grow the market provided particular insight. The most oft cited historic support comes from IBI and USFS Wood Innovation Grants. In response to the question asking which policy or research initiatives have been helpful, five of the 12 largest producers cited collaborative research projects with State and International Research Institutions. No details were offered, but a look at the IBI website provides a sense of the scope and scale of current research efforts.[11] Additionally, IBI offers a bibliography of all known biochar related publications to members; there are currently thousands of citations.

From a policy standpoint, help would come from recognizing biochar as carbon negative (and getting some financial credit for it); as mentioned by almost 25% of the respondents. The second most repeated support need was to certify biochar as an animal feed supplement—by six of the larger producers (23%). Both USDA and FDA were cited as important players in opening that

[11]For collaborating biochar research organizations worldwide: https://biochar-international.org/research/

market. It was noted by a number of respondents that biochar as a feed supplement is allowed in Europe already.[12] In all but 4 EU countries, biochar is an approved animal feed ingredient. Dairy cows are the livestock using this supplement the most.

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There was frustration expressed with EPA regulations by two mid-sized operations, but no specifics were provided as to what actions would help ease their concern.

A number of producers noted the need for stronger definition of biochar "grades" and improved standards[13]. Others made mention of the desire for more support to get the word out to users (the public and farmers specifically) about the benefits of biochar.

Responses to a question about how USBI or a trade association could best support producers were very similar to the question about what policy initiatives would help most: advocacy for carbon credits, education of the public and farmers specifically, marketing, and research leadership.

Two notable actions were suggested for USBI (US Biochar Initiative.) The first is to participate more in long-term research which (hopefully) shows the benefits of biochar in soil and mixed amendment systems. The second notable suggestion was for market research which "compares biochar to existing products (like compost and potting/soil blends) to determine price points and pain points of buyers that use other [soil amendment] products.

In response to a question how the USFS and Federal Agencies could support the biochar industry a number of responses cited they could increase purchasing biochar for forest and mine reclamation. Improved accessibility to, and the increased use of stewardship contracts to provide feedstock was mentioned by a number of producers, while compliments were given to USFS for the use of stewardship contracts by other producers. Streamlined regulations to acquire woody biomass were mentioned by multiple respondents. One insightful respondent suggested a cost/benefit analysis: "Quantify in $ terms the benefits of avoided slash piling burning, irrigation water availability from juniper treatments and thinning." As well as "Economic and enterprise models that help build an investment case for biochar production."

One interesting response was the amount spent on research internally. Three of the five largest firms claim to be spending in excess of $1M/year; 2 currently mid-sized operations report spending similarly, and four others were in the $250K to $500K range. These commitments are impressive and, for a relatively young industry with a relatively small market, can be interpreted as indicative of optimism for stronger demand for biochar products.

[12] Ithaka Institute presentation (2011) http://vec.vsb.cz/katalog-obrazku/clanek-135/245-schmidt.pdf

[13] This was identified as a high priority during the 2018 USBI Biochar Conference and is discussed in more depth in the "Follow-up Interview…" Section below.

**Analysis of Users Survey Data**

The users survey provided a snapshot of an optimistic marketplace. Many of the smaller users left comments expressing their interest in learning more about biochar (which was taken to mean interest in technical information), about the broader biochar marketplace, about how to market more effectively to grow their businesses, and for more in-depth information about research results (which could help their understanding and marketing).

One respondent expressed interest in using biochar as a concrete additive and as a component in other building materials (unspecified), which coincidently is being done by one of the large producers, suggesting a potential for collaboration.

Shipping and handling costs were cited by two users as being of more concern than the raw biochar costs even though their shipping distance was less than 500 miles for truckload volumes.

As in the producers' survey responses, users wanted more information about the animal feed and stormwater filtration markets.

**Follow-up Interviews and Input from the 2018 USBI Biochar Conference**

The 2018 Biochar Conference held in Wilmington, DE on August 21-23 provided an opportunity to gather input from both presentations and follow-up interviews with attendees. There were approximately 300 total attendees at the annual conference. The information gathered reinforced the conclusions drawn from the surveys, but also clarified the issues of most pressing interest.

The topic of Biochar Characterization and "Standards" was of sufficient importance that about 60 people attended a pre-conference session to hear a presentation about making product claims (and the necessity to have a solid relationship to proven facts,) and to discuss how to move forward with establishing the science and the claims. This issue arose repeatedly during the three day conference, in both plenary and concurrent track sessions, and was a frequent topic of informal conversations leading to the conclusion that—as a growing industry—the topic is widely seen as a high priority.

The Conference also provided input on a market segment which was not captured well in the Producer Survey:

> *There was considerable interest among attendees in "appropriately scaled" biochar production. This included potential producers wanting to generate biochar as a primary end product or as a co-product in the generation of thermal and electrical energy. There were a number of attendees interviewed who expressed particular interest in units which could fit into their operations which required portability, simplicity of operation, and capability of producing quality biochar economically.*
>
> *One "technology" which had widespread interest by landowners, smaller scale forest restoration operators, and USFS personnel was a simple open-top, pit-style, sheet-steel*

*portable kiln. It enables the operator to quickly produce relatively high-quality biochar on-site, using (and adding value to) woody debris primarily*[14].

*Most of these potential producers had not completed the survey (or had done so as small users). Therefore this "data point" is one which was not highlighted in the surveys since the focus was on volume users. This "class" of producer could be significant in terms of soil improvement and forest restoration acres treated, just as small-scale intensive agriculture and non-industrial private forest landowners contribute significantly to the production of high-value products in the broader natural resource-based industry.*

Other technologies appropriate for smaller scale applications are portable or semi-portable units using gasification processes. Some of these units also provide thermal energy for process use, and one developer planned to test a 25KW Rankine-cycle electrical generator as an option.

A general observation from the Conference's attendees, exhibitors, and presenters is that there is considerable development at the equipment, process, and product levels. The question which hung over these discussions (from the attendees interviewed) was how economical these "appropriately scaled" technologies were actually. A secondary concern was the carbon footprint of these units and whether they would truly sequester more carbon than they generated.

One West Coast Producer noted the "opportune environment" in California, where there's the need for so much active forestry occurring in decent proximity to lots of agricultural customers. When looking at National Forests and ag operations nationwide, there are numerous opportunities for utilizing a variety of feedstocks to make biochar and supply end users locally. Feedlot and poultry houses are good examples of concurrent potential suppliers and users—especially poultry houses in northern climates which require heat and which could use odor control, ammonia reduction for health purposes, and animal feed supplementation, as well as additional income streams. The issues of scale and economics will have to be satisfied by appropriately sized and productive equipment. There is extensive R&D work going into these areas as evidenced by the vendors and suppliers present at the conference.

One plenary presenter[15] noted the rapidly developing interest in soil health. He went on to say that interest has outpaced the understanding of what it takes to operationalize the implementation of improving soils (by which he meant increasing soil carbon.) Biochar is an ideal soil carbon enhancer given its proven benefits of nutrient and water retention and it's longevity in the soil.

The same presenter highlighted his perspective that a major benefit of biochar-in-soil is as a home for the soil microbial ecosystem. Biochar provides the habitat and the inoculation process

[14] For detailed descriptions, see the Conference presentations: https://www.dropbox.com/sh/bib7loivcofsbue/AACMb3ywhS1UghJqTffHbNDda/Commercial/Session%202A%20-%20Commercial?dl=0&preview=2.1.3+Forest+Restoration+Using+Simple+Kilns+Darren+McAvoy.pdf&subfolder_nav_tracking=1 and https://www.dropbox.com/sh/bib7loivcofsbue/AACOQCWxuYKZUklhZXdQD7_Xa/Agriculture/Session%201A%20-%20Agriculture?dl=0&preview=1.1.2+Biochar+for+Small+Woodland+Owners+Kelpie+Wilson.pdf&subfolder_nav_tracking=1

[15] https://www.dropbox.com/sh/bib7loivcofsbue/AACml7h0fW6k_nMTM9YQlOfra/Main%20Stage/Keynote%20Speaker?dl=0&preview=Montgomery+Biochar+2018.pdf&subfolder_nav_tracking=1

populates those spaces. What was not said overtly is that the quality of the biochar is crucial to optimizing the habitat, and that the inoculation process is important, but has to be designed appropriately for the application.

Another attendee noted that without a carbon credit market, the industry is being driven to focus on educating farmers and stormwater managers about the other benefits of biochar. What would seriously advance those marketing efforts is verification of biochar's sequestration capability because (as was seen in the User survey responses) even without economic carbon credits, sequestering carbon is an important criteria for many buyers.

One high profile user—who exhaustively sought a consistent product for their use—advised the industry attendees to "Test your product." The eventual supplier to that user reinforced that message by saying, "Know what your biochar will do. Test your biochar." In a panel, it was noted that, "So many research projects have used poor [untested] biochar that it's done significant damage to the industry's credibility."

In the closing session, Tom Miles, USBI Chair and a team member of this project, referring to this survey noted the general optimism of the industry and his personal observation that the sophistication of the producers is steadily increasing. He counseled the attendees to understand what their customers want as opposed to offering what they could produce. His closing admonition was to "set a high bar for quality."

One comment made by numerous presenters, which coincides with survey input, is to highlight successes (as part of the education and marketing efforts). Individual producers, as well as the wider producers and users have many stories of successful applications and experiences which need to be compiled, organized, and shared.

**Conclusions and Next Steps**

The two surveys are complementary in their results and reinforced by the follow-up interviews and the tenor of the Biochar Conference. Both producers and users see a growing demand. There are different expectations in price points between the two groups, which will be worked out over time as production is balanced with usage.

The new market segment of biochar as an animal feed supplement is of considerable interest and its potential could have a significant impact on both producers and resellers. Resellers may see less opportunity since volume sales seem to be provided mostly by producers; however, a value added opportunity may exist for resellers to produce a branded or customized end-product, which producers could be reluctant to take on. More information on this market (current European experience, domestic customer interest, price points, and value added opportunities) is needed to better predict how significant it could be. There also needs to be a concerted effort to collect and share success stories about biochar uses and applications.

There was a difference between the form of the biochar being provided by producers and the form being purchased by the users. This knowledge may be useful to producers in aligning

better with buyers of their finished product. Future research should explore this facet more closely.

While the surveys were technologically blind, from conference interviews, the issue of technology was one of concern to many interested producers, most of whom were looking for a cost-neutral to marginally profitable way to generate biochar. More demonstrations, data, and analysis are needed to quantify operations of all sizes and technologies. Identifying the most "important or promising" technologies could provide the priorities for further research and analysis.

Biochar as a confirmed carbon-sequestering product was expected to have the greatest potential to enhance its demand. However, it's an unlikely driver in the near term without a solid scientific validation (and/or legislation). There are a wide variety of production technologies and, therefore, a wide range of carbon balances to consider. This variability complicates the certification of carbon sequestration capability and considerable collaboration, funding, and effort will be necessary to establish a credible calculation schema. Political considerations also come into play considerably in this process, as there are already a number of skeptical organizations actively questioning the entire system of woody biomass production and conversion. Collaborating in the biomass energy producer's efforts to quell the skepticism and quantify the potential could be a cost effective strategy.

**The Bottom Line**

Both biochar producers and users see the need for more attention to the qualities and characteristics of the end product. This message became the mantra for the Biochar Conference which echoed input from the surveys. Further steps toward widely accepted standards are recognized as vitally important and a strategy to develop, disseminate, and implement those standards is an industry priority to allow the market to grow and the industry to mature responsibly.

Biochar producers and users also see the need for much higher profile public and customer education—in support of biochar as a desirable and sought after product. These two objectives are parts of a holistic marketing initiative and have become a high priority.

The third leg of a successful marketing strategy is to validate scientifically any claims to be made about biochar's application benefits. For instance, increased water retention has been a consistently observed phenomenon in research and can easily be claimed. Biochar's carbon sequestration capability is currently under-proven and needs further effort.

*For future information on this project check the USBI website: http://biochar-us.org/news/us-biochar-market-survey-0 or visit the Dovetail Partners Report website: http://www.dovetailinc.org/reports.*

*Special thanks to the Ithaka Institute for use of the image on the coverpage.*

**Appendix: Survey Questions**

Biochar Producer Survey

This survey is underwritten by the US Forest Service to learn more about the biochar industry and its potential to use woody biomass, particularly from National Forests. The individual inputs of this survey will remain confidential and only the aggregated data will be released or used for further analysis. The project team includes USBI and IBI representatives in collaboration with Dovetail Partners, Inc., a non-profit dedicated to the analysis of natural resource and land use issues. Thanks for taking the time to share your expertise.

1. Are you a biochar producer or re-seller? (For the purpose of this survey, a producer makes biochar; a reseller buys biochar for re-sale or as a feedstock for other products.)
   - Producer
   - Reseller

2. How would you categorize your biochar production?
   - Primary Product
   - Co-Product of Energy
   - Co-Product of Electrical power
   - Co-Product of Waste disposal

3. What is your annual production of biochar? (Tons per Year)
   - <50
   - 50-100
   - 101-500
   - 501-1000
   - 1001-5000
   - >5000

4. Where do your feedstocks come from? (Check all that apply.)
   - Wood Waste from Federally controlled Lands (National Forests, BLM)
   - Wood Waste from State controlled Lands
   - Wood Waste from Private lands
   - As Forest residue
   - As Mill residue
   - As Urban Waste
   - Dairy Manures
   - Poultry Manures
   - Hog Manures
   - Crop Residues
   - Sewage Sludge
   - Other (please specify)

5. (For resellers) What is your annual purchase of biochar? (Tons per Year)

- <50
- 50-100
- 101-500
- 501-1000
- 1001-5000
- >5000
- not a reseller

6. To what uses does your biochar go? (Check all that apply.)

- Garden
- Horticulture, specialty crops
- Field Crops
- Orchard or tree crops
- Turf
- Landscaping
- Drainage, filtration
- Odor control
- To Re-sellers; don't know end uses
- Other (please specify)

7. Do you make biochar specifically for certain applications?

- No
- Garden
- Horticulture, specialty crops
- Field Crops
- Orchard or tree crops
- Turf
- Landscaping
- Drainage, filtration
- Odor control
- To Re-sellers; don't know end uses
- Other (please specify)

8. Do you process the biochar after production? (Check all that apply.)

- No; sold as is
- Inoculated or "Charged"
- Screened or sized
- Blended with other amendments (e.g. compost)
- Activated (e.g. steamed or chemical)
- Agglomerated or pelletized
- Other (please specify)

9. Please Rank on a dry weight basis in what form your biochar is sold/bought?
    Fine powder
    Fine screened chips
    Coarse chips
    Pellets
    Granules or prills
    Liquid suspension

10. How long have you been producing or selling biochar commercially?
    <1 year
    > 1 <2 years
    > 2 < 5 years
    > 5 years

11. What certifications do you have or use?
    Organic/OMRI
    State Registration
    IBI
    None
    Other (please specify)
    Locally: < 10
    Regionally: <500 miles
    More than 1500 miles
    Internationally

12. What percentage of your biochar is shipped:

13. If you ship internationally, to what countries?

14. Do customers ask whether the biochar is produced locally?
    Often
    Occasionally
    Rarely
    Never
15. What kind of information do you provide to your customers?

    What your biochar is made from and how it is made
    Lab analysis
    How to use it (as in how much and how to apply)
    Extensive discussion to match analysis to application
    None

16. Rank how you sell your biochar:
    retail package
    bulk retail or wholesale (i.e. pallet loads)
    bulk packaged (like a Supersack)
    bulk (truckload, rail car, barge)

17. Do you foresee the price of biochar changing in the short term?
    No, it will be stable for the next few years.
    Yes, it will probably drop as more producers come on line.
    Yes, we think it may increase for different types of end users.

18. Do you expect sales for your biochar to change in the 1- 5 year?
    Yes increase somewhat (~10%)
    Yes increase a lot (>10%)
    Stay the same
    Depends on many factors
    Decrease

19. Do you anticipate needing to expand capacity to meet demand?
    Yes
    No

20. Do you have adequate feedstock supply to meet increased demand?
    Yes
    No

21. Do you expect obtaining additional feedstock to be a problem?
    Yes
    No

22. From what sources do you expect to get additional feedstock?

23. Please rank the market segment growth you expect over the next year:
    Crops
    Filtration
    Odor control
    Other (Please specify in next question)

24. If "Other", please elaborate

25. What market segment growth do you expect over the next 5 years:
    Crops
    Filtration
    Odor control
    Other (please specify)

26. How do you market/sell/promote your biochar?
    Word of mouth
    Direct response to inquiries
    Google Adwords
    Print media
    Website and other electronic media
    Conference and trade show displays
    Other (please specify)

27. What biochar-related policy or research initiatives have been helpful to your enterprise? (For example: Local or Regional initiatives, Extension or NRCS events, Wood Innovation Grants)

28. What policy initiatives would be most helpful to your business and/or to the biochar industry?

29. Roughly, how much do you spend on research internally?

30. What initiatives by USBI or a trade association would be most beneficial to your business and/or the biochar industry as a whole?

31. How can the US Forest Service or other land managers assist your biochar production?

32. In what region are you located?
    New England (ME to NY)
    Mid Atlantic (PA to SC)
    Deep South (GA to LA)
    West Coast (WA to CA)
    Plains States (ND to OK)
    Rocky Mtn States (ID , MT, WY, CO)
    Lake States (MN, MI, WI)
    Central US (IA, MO, AR, IL, IN, OH, TN, KY, WV)
    TX
    AK, HI
    CANADA

33. Can we follow up with you?
    Yes (Space for contact info below)
    Prefer not

Thank you for your time and participation. We will provide results of this survey directly, as well as further analyses and reports, if you provide contact info below. We will ONLY use the contact information for sharing this information unless you give permission for follow-up. Alternately you can look for announcements by USBI, IBI, and Dovetail Partners. Again, thanks for your support.

Biochar User Survey

This survey is underwritten by the US Forest Service to learn more about the biochar market and the potential to use woody biomass to make biochar, particularly from National Forests. Individual inputs to this survey will remain confidential and only the aggregated data will be released or used for further analysis. The project team includes USBI and IBI representatives in collaboration with Dovetail Partners, Inc., a non-profit dedicated to the analysis of natural resource and land use issues. Thank you for taking the time to share your input and expertise.

1. How would you categorize yourself from a biochar user/buyer perspective? (Check all that apply.)

- Gardener
- Farmer
- Landscape- contractor
- Golf course manager
- Remediation specialist
- Filtration specialist
- Stormwater
- Industrial process
- Odor
- Ag waste
- Green house Grower
- Biochar reseller (please also take our producer survey)
- Other (please elaborate)

2. If you use biochar for soil purposes, please rank the reasons:

- To modify soil texture
- To change soil chemistry, pH modification
- To improve Air/water porosity
- To improve water management
- To improve disease resistance
- Increase Soil carbon
- Other (please elaborate)

3. How do you use biochar? (Check all that apply.)

- Dry
- Inoculated
- Blended
- With other soil amendments
- Specifically, with Compost
- Specifically, with Peat or coconut fiber
- As a granulated fertilizer
- As a liquid for injection or spraying

4. What is your preferred form of biochar?
   - Fine powder
   - Fine screened chips
   - Coarse chips
   - Pellets
   - Granules or prills
   - Liquid suspension

5. How long have you been using biochar?
   - <1 year
   - > 1 <2 years
   - > 2 < 5 years
   - > 5 years – about 5 years

6. Approximately how much biochar have you used to date?
   - Small amounts: several gallons
   - Medium: under a ton
   - Large: truck load
   - Recurring large buyer

7. Approximately how much biochar did you use last year?
   - Small amounts: several gallons
   - Medium: under a ton
   - Large: truck load
   - Multiple truck loads

8. How much biochar do you expect to use during the next year?
   - Small amounts: several gallons
   - Medium: under a ton
   - Large: truck load
   - Multiple truck loads

9. Have you switched suppliers due to availability or quality issues?
   - Yes, due to availability issues
   - Yes, due to quality issues
   - No, I generally buy from the same vendor.

10. What certifications or registrations are important to you?
   - None
   - Organic/OMRI
   - State Registration
   - IBI
   - Other (please specify)

11. How would you rate your level of knowledge about biochar?
    Expert: keep up with research and attend webinars and conferences
    Knowledgeable: am fairly conversant with state of the art and applications
    Know enough for my own use.
    Novice: Just getting started and have lots to learn.

12. How far is your biochar shipped?
    Locally: <100
    Regionally: <500 miles
    Cross country: i.e., more than 1500 miles
    Internationally
    Which country/countries?

13. Is locally produced biochar preferable to you?
    Yes
    No

14. Do you know or care what your biochar is made from and how it is made?
    I know what it is made from but not how (i.e. what technology or process parameters)
    I know both how and from what it is made.
    This information is not disclosed.
    This information is not important to me.

15. Is the climate impact of biochar important to you?
    Yes, very important.
    Somewhat important
    Not really important

16. Do you receive an analysis of the biochar you purchase?
    Yes
    No

17. Please indicate what you're paying for the biochar? (If it's a blended product, please include the biochar component percentage?)

18. If the current cost of biochar is a barrier, at what price point would you consider purchasing large(r) amounts of biochar? (unblended biochar only)
    $50/cubic yard (i.e. ~202 gallons)
    $100/cubic yard
    $500/ton
    $1000/ton
    Other

19. What additional information would you like to know about biochar?

20. Is your reason for using biochar:
Personal (a non-income-producing use, like a garden, orchard, or houseplants)
Commercial (such as for crops, landscaping, or creating commercial products)
Mitigation (solving a problem, but not necessarily generating revenue)

21. In what region are you located?
New England (ME to NY)
Mid Atlantic (PA to SC)
Deep South (GA to LA)
West Coast (WA to CA)
Plains States (ND to OK)
Rocky Mtn States (ID , MT, WY, CO)
Lake States (MN, MI, WI)
Central US (IA, MO, AR, IL, IN, OH, TN, KY, WV)
TX
AK, HI
CANADA

22. Can we follow up with you?
Yes (space for contact info below)
Prefer not.

Thank you for your time and participation. We will provide results of this survey directly, as well as further analyses and reports, if you provide contact info below. We will ONLY use the contact information for sharing this information unless you give permission for follow-up. Alternately you can look for announcements by USBI, IBI, and Dovetail Partners. Again, thanks for your support.



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