Sustainable Forests and Communities Initiative Grant Report 2017

Program name: From Forest to Farm
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1. Overview of the program's primary activities and objectives. The primary objective of "From Forest to Farm" was to transition and expand our Biochar Demonstration Project from a successful demonstration to a viable, successful commercial operation by funding one-time expenses that would move our biochar production operation closer to our 50,000 acre-forest and launch a profit-making operation to offset the cost of forest restoration. We sought to provide an environmentally-sound, economical, and socially-equitable solution for removing and utilizing excess woody biomass from our Forest.

During an exceptionally severe winter, we moved our biochar conversion unit 45 miles from Branscomb, CA to Piercy, CA to locate it next to our Usal Redwood Forest. This was done to reduce fuel use and costs and emissions associated with transporting feedstock from the forest to the operation site. We conducted extensive site preparation, engaged operating and ancillary workers to operate our machine, including chippers and loaders. Our partners, the Usal Redwood Forest Co., supplied tanoak from forest thinning; engineers from Humboldt State University's Schatz Energy Research Center (SERC) studied, modified and improved our machine's operation and reduced emissions. Our project manager, Raymond Baltar, engaged a four-person sales team that traveled California's North Coast area introducing and selling our product. Our sale effort included paid ads in agricultural brochures, radio and social media. In addition to the advertising campaign, we launched a robust outreach and education program. We conducted on and off-site tours, demonstrations, and presentations of the operation, the project and the product. This was augmented by robust print and electronic media that successfully reached and engaged a global audience Interest in biochar is strong regionally and globally. Our educational outreach generated donations and grants which were used to offset some of the budget over-runs for this project.

2. and 3. Outputs, Outcomes, Adaptations and Accomplishments. The goal of "From Forest to Farm" was to transition RFFI's Biochar Demonstration Project (BDP) into a profitable commercial operation, while improving forest health by utilizing excess forest biomass to produce biochar, a saleable, ecologically sound soil amendment. At this point in our operation, we have not achieved our overriding goal of transitioning the BDP into a profitable commercial operation. As with any startup venture, the project was full of surprises and setbacks. We encountered severe weather conditions, unanticipated site preparation and repair costs, a rapidly changing biochar market and ultimately mechanical failure. While we successfully transitioned to a commercial level of production, these setbacks made it impossible to sustain it and produce and sell a product in a timely manner at a competitive price. The setbacks were partially addressed by a high-level of ingenuity and resolve, accompanied by an infusion of unforeseen donated capital.

*Weather***.** Through near herculean effort, we successfully moved our biochar conversion unit forty-five miles, skirting mammoth landslides that closed Interstate Highway 101 for weeks at a time. The machine is now located at the designated location adjacent to our Usal Redwood Forest, where transportation and environmental costs are reduced as compared to the BDP. The historic winter rains also prevented our scheduled January thinning, which would have provided initial feedstock. Further, 100 days of closure of CA Highway 1, our primary road for delivering feedstock delayed the start of the commercial operation for three months, eliminating our ability to sell during the Spring biochar buying market. In addition, the costs of chipping and transporting the feedstock rose dramatically because of inaccessibility and blockages caused by the same weather conditions. Time limitations and weather prevented us from experimenting with less costly, more plentiful feedstock (slash); we did test available excess redwood chips and Douglas fir as feedstock.

Unanticipated requirements, site preparation and repair costs. Examples of unanticipated required infrastructure improvements and equipment rentals to support operations included: installation of a 5,000 gallon water tank, pipes, and heavy-duty hoses for fire suppression and biochar cooling, a diesel generator (for the first three months until electricity could be installed near the unit), a carport shade structure for staff to shelter staff from 100 degree+ days, a 20' by 40' hoop house to keep the chips dry, sprinklers, and a structure for filling supersacks with the biochar. We also incurred significantly increased transportation and chipping expenses caused by weather and the size of our bridge.

Market conditions. Several market factors impacted our income from sales: (1) Weather delayed production, thereby preventing sales in the spring market when many growers purchase biochar; (2) We could not guarantee continued future production because our operation is funded primarily by short-term grants. Most outlets want to purchase products that will be consistently available on a continuing basis; (3) We entered a market recently flooded by less expensive biochar produced from California's co-gen plants. In 2016, as we prepared this Weyerhaeuser grant proposal, the average price for biochar was about $300/cu. yd. retail or between $150 and $200/cu. yd. wholesale. We projected an average price of $240/cu. yd., which was reasonable at that time. Since then, other companies have entered the market offering large volumes of co-gen plant produced biochar for between $100 and $300 per cu. yd. retail and $50 to $150 wholesale.

This is comparing apples to oranges, however, as North Coast Biochar produced a superior product. Testing by SERC and Control Labs in Watsonville verified that North Coast Biochar's carbon content averaged 85% and the ash content 5%, far exceeding the State of California's 60% carbon content threshold for biochar. Co-gen produced biochar is of considerably lower carbon content, typically 60-65%. There is not sufficient empirical or scientific research to demonstrate the higher agricultural value of a higher carbon product. However, SERC studies of our biochar confirm that the low level of volatiles and high carbon levels create high porosity in our biochar, resulting in very high water holding ability.

Mechanical failures. Once we reached full production, the machine experienced a number of mechanical problems. SERC and our talented operators made many successful modifications to keep us running. However, as we neared the end of production for the year, the flare finally failed, requiring an investment of capital we did not have. The flare is now damaged beyond repair and the heat exchanger

appears to be rotted on the inside. Both need to be replaced. In general, the original design did not take into consideration ease of regular maintenance, making repairs much more time consuming and costly than necessary. The poor design and fabrication of this early version of the Biochar Solutions unit was unable to withstand even our somewhat limited operation time. We have operated it a total of twelve weeks of run time (21 days in Branscomb, 38 days in Piercy), with considerable time off in between. When purchased, this was one of the few forest based biochar units on the market, located close enough for transport to Northern California. It makes excellent char.

Positive Adaptations. We successfully modified and expanded the biochar operation and took it to scale commercially, albeit, not profitably nor with the promise of being enduring. Our project captured international attention from those interested in addressing global soil depletion and those wanting to use biochar as a means to mitigate climate change. Unfortunately, there is no existing market for these uses. We are working with organizations interested in other uses of our biochar. Because of the high porosity of our biochar, further testing is underway by potential users in the winery industry. Sonoma State University is testing North Coast Biochar for possible use in the water and filtration industry.

Outcome Achievement. As reflected in the chart below, we did not meet our biochar production and sales outcomes. The volume of tanoak utilized and of biochar produced was significantly lower than projected. While the average price per yard exceeded the projections the total income fell short. Our independent evaluation, as well as SERC's, will be completed by March, addressing some of the currently unreported outcome measures. The financial figures in the chart below, as well as, in the attached budget are based on preliminary 2017 budget figures and may change when our annual audit is done.

On the other hand the chart confirms that we achieved or surpassed many outcomes. We created more jobs than projected. RFFI and our partners evaluated and improved our operation throughout the project. We conducted more tours, generated much local and regional excitement about biochar, and provided much more information about the program than projected. We extended our outreach and education beyond the site. his outreach and our social media presence generated global interest in the project. We receive regular, ongoing inquiries and interest regionally and from around the world. The project attracted significant, serious interest accompanied by additional donations, allowing us to continue despite the unexpected financial demands.

An example of our successful outreach is that RFFI's biochar operation and other aspects of our forestry practices will be featured in "Ice on Fire", a Leo DiCaprio HBO documentary, in 2018. (Filming above)

Ultimately, we provided a replicable model for managing excess woody biomass and increased our production to a commercial level, but could not sustain commercial production because of factors detailed above.

QUANTIFIABLE ECONOMIC OUTCOMES	Proposed	Actual
Tons of Biochar Produced from slash	10.8	0
Yards of Biochar Produced from slash	90	0
Dollars in Water Savings Average	14%*	0
Dollars in Reduced CO2e release	$354.03	0
Tons of Biochar Produced from tanoak	54.6	13.70
Yards of Biochar Produced from tanoak	455	137
Yards of Biochar sold (not in proposal)		*40.5*
Price/ yard Biochar	$240	**$262 (average)**
Price/ Lb. Biochar *(Dry Mass Basis)*	$1.00	**$1.31 (average)**
Dollars - Gross Sales (Inc. tax and shipping)	$109,200	**$14,807**
Dollars - Net Sales	TBD	**$10,611**
Dollars in Water Savings Average	14%	Evaluation in progress
Dollars in Reduced CO2e release	$1776.68	Evaluation in progress
QUANTIFIABLE ECOLOGICAL OUTCOMES	**Proposed**	**Actual**
Acres of Forest Thinned	280	255
Water Benefits from Thinning	TBD**	Evaluation in progress
Water Benefits from Thinning- Increased minimum flow	3-6%	Evaluation in progress
Water Benefits from Biochar (Gals- life of biochar)	412,284.6	Evaluation in progress
CO2e Reduction Benefits of Biochar -tons CO2e**	241 tons	Evaluation in progress
CO2e Reduction from Severe Forest Fires Avoided	TBD ***	*Awaiting CalFire figures*
Carbon Sequestration Capacity of Biochar C:H ratio	***3.7***	***Check this***
QUANTIFIABLE COMMUNITY OUTCOMES	**Proposed**	**Actual**
# Jobs Provided 1 business mgr; 2 publishers; 1 loggers; 1 chippers; 6 transport; 1 bookkeeper; 2 machine operators; 2 site prep; 4 sales.	10	20
# Tours/Demos Conducted Onsite tour operation	2	3
# Tour/Demo Participants Off-Site – (Added project outcome)	75	34 271
# Informational eBlasts (SEC,SBI, RFFI) # Facebook Posts	4	5 15
# of eBlast Recipients # Facebook Followers	4,400	12,350 2021 per post
# of Newsletter Articles	2	2 RFFI
# of Newsletter Recipients	3,600	4488 RFFI
# of e-Newsletter Articles	2	4 (2 SEC) (2RFFI)
# of e-Newsletter Recipients	2,200	8424 (5600 SEC) *(2824 RFFI)*
# of Webpage Postings	4	7 (2 SEC) (5RFFI)
# of Webpage Readers Visitors from Website Analytics	100	8,390
Legend: *items in red= added.* * *decrease in farm water use at local water rates; ** Gallons/ year H2O savings Using SF Eel Watershed numbers; was 97,000 and 285,000 acre feet in Feather River WS.)* *** *Awaiting CDF findings;* C:H 4.0 Carbon: Hydrogen Ratio of 4.0 locks carbon into the soil for over 100 years; our biochar tested at 3.7.		

Learning. RFFI learned a great deal from this experience. We identified and met the requirements for moving and establishing this complex operation closer to our forest. We produced an exceptionally high-quality biochar and became familiar with a quickly changing marketplace. In addition, we built or enhanced several partnership relationships with landowners, forestry professionals, academics and community leaders. We have determined, however, that our present machine is not robust enough to sustain ongoing profitable, commercial production.

Simultaneously, we are confronting many questions. We are evaluating whether biochar production can be a viable adjunct to our forest restoration activities. We are conferring with our existing University and engineering partnerships regarding machine design. We are searching for funding sources that would allow continued biochar production by RFFI, partners, a lessee or concessionaire. While our current location has some severe access limitations, its proximity to our forest and a planned bridge with our partners, Lost Coast Forestlands, LLC, would give us direct and less expensive access to our forest for more months of each year. We have established relationships with Sonoma State University and wineries that our testing our product for its use in water

treatment and filtration, a market sector that may require the higher carbon content biochar we are producing.

Finally, we have learned that we need to take a step back. On the one hand it is time to develop a business plan based on an assessment of the current market. On the other, we must assess the economic and ecological costs and benefits of various methods of dealing with removal and treatment of the excess biomass that is choking our forests. This comprehensive assessment will put us in a better position to determine the level of cost that can be borne to support biochar production.

4. Level of Success. 'From Forest to Farm' is currently viewed as marginally successful. We did not produce enough biochar to be commercially successful, even after we sell our remaining stock. On the other hand, we established one of the few forest-based biochar production operations in the nation. We have identified what is necessary to establish an environmentally-sound method of converting forest waste into an ecologically desirable soil amendment. Most biochar is being produced at co-gen plants, an option that is not viable on California's north coast where large timberlands are located in sparsely populated areas.

In many ways, it seems as if we are "ahead of the times." In other words, we entered a rapidly changing marketplace that is positioned to experience global and regional changes. There are several promising, emerging biochar markets. They may well eclipse the current agricultural market for biochar use as a soil amendment. We have provided our biochar for study to representatives of these sectors, e.g., biochar to be used to filter agricultural field nutrient runoff, biochar use in storm water treatment biofilters, and biochar use in fire recovery or other disaster recovery situations to mitigate heavy metal releases into local streams. In each of these cases, regulations already mandate, or will likely soon mandate, mitigation BMP's to minimize damage to local ecosystems. While cost is always a consideration it may be less so for these industrial uses than it is for the local farmer.

5. Collaboration. A cornerstone of the enduring success of this project is that the program's contributions will continue to be of regional and global benefit, in part, because of our principal partners: Humboldt State University's Schatz Energy Research Center (SERC), Usal Redwood Forest Company, LLC (URFC); Lost Coast Forestlands, LLC (LCF), and the Sonoma Biochar Initiative (SBI). SERC supplied a unit for channeling waste heat back into the biochar unit to dry chips and improve efficiency. They also played a critical role in testing and modifying our biochar conversion unit. The results of their present evaluation and their continuing advice will provide guidance for our upcoming program decisions. Their findings reach a global audience. URFC provided feedstock from their fuels reduction forest restoration and timber harvesting operations. They played a crucial role in helping us to deliver feedstock despite the 100-day road closure and forest inaccessibility. They are interested in continuing this role if biochar can attain at least a break-even fiscal level. Lost Coast Forestlands, LLC (LCF) is our land-lessor and is moving forward with co-locating community-scale forest products processing operations at the site, e.g., a firewood operation (tanoak logs) and a niche conifer lumber milling operation. These compatible operations offer opportunities for sharing equipment and workers in the future and offer future economic benefit to the region. SBI's Director Raymond Baltar served as FFTF's Project Director and led the activities of our sales and promotion team. SBI will provide ongoing connectivity to numerous organizations interested in using biochar, biochar research and developing emerging sales markets.

6. **Probability of continuing.** The probability that this program will continue for at least the next five years is unknown. It is probable that some version of the project will be conducted by RFFI, a partner, lessor or concessionaire or subsequent owner. It is likely to be funded by a variety of sources including revenue from the sale of our current machine, venture capital, grants, donations and partnerships with a university or corporate partner who will help design and build a more robust biochar conversion unit.