

Identifying Barriers to and Opportunities for Adopting Biochar Production on Working Lands to Reduce Fire Risk and Improve Soil Health in Northern New Mexico



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Introduction

Climate change and historic fire suppression have amplified the risk of catastrophic wildfire¹.

Land managers in the Intermountain West thin woody biomass to reduce wildfire risk and increase productivity³.

Slash resulting from thinning can be converted into biochar to serve as a soil amendment, increasing soil health and productivity².



Objectives

- a) Investigate the socio-cultural, economic, and biophysical barriers that impede the adoption of biochar technology.
- b) Identify important factors that will help to expand the scope of biochar production from thinning slash in northern New Mexico.

*Production of Biochar Workshop. Velarde, NM.
Organized by Quivira Coalition. February 2022.*

Sangre de Cristo Region, New Mexico

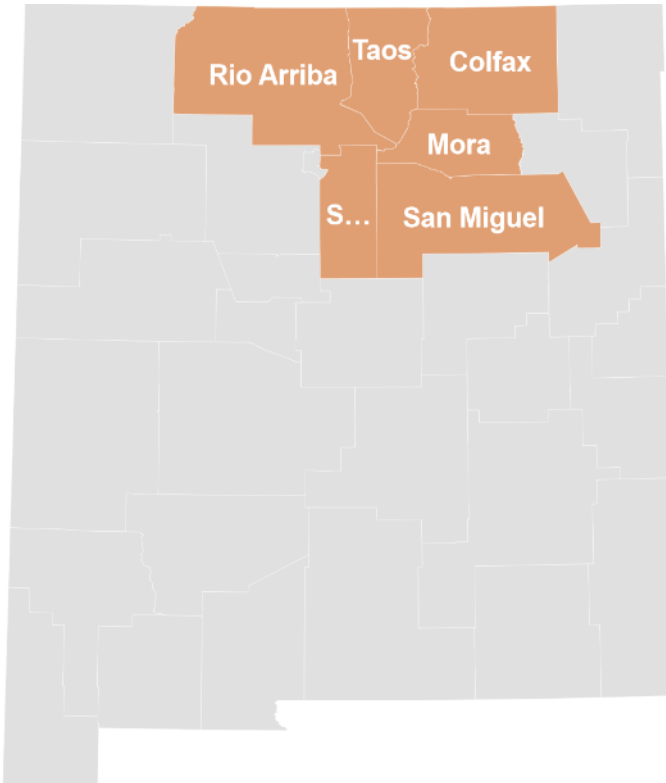


Figure 1. Counties of Sangre de Cristo region, New Mexico.

Scope of the study

Area of the study

- Sangre de Cristo region, Northern New Mexico

Population of interest

- Landowners/managers
- Personnel working in any environment conservation organization

Methodology

Project team

- Tomasz Falkowski (New Mexico Highlands University)
- Rosa Soriano (New Mexico Highlands University)
- Eva Stricker (Quivira Coalition)

Data collection

- Workshops
- Surveys: 4 sections
- Interviews

Data processing

- ONA.IO
- Excel
- RStudio

Data analysis

- Chi-squared & generalized linear mixed models.



Demography of participants

Economic class

- High: 21 (40%)
- Middle: 22 (42%)
- Low: 5 (9%)
- Prefer not say: 5 (9%)

Gender

- Female: 18 (34%)
- Male: 32 (60%)
- Prefer not say: 3 (6%)

Race

- Non-white: 23 (43%)
- White: 26 (49%)
- Prefer not say: 4 (8%)

Age

- 53.84 ± 17.63 (\pm SD)

Total participants: **53**



Biochar Awareness and Production


1. Prevalence of **awareness** and **production** of biochar among land managers 

Table 1. Awareness and production of biochar.

Response	Awareness of Biochar	Production of Biochar
	%	%
Yes	69	16
No	31	84
Total	100	100

 Bias?

Biochar Awareness and Production

1. Prevalence of awareness and production of biochar among land managers 

Table 1. Awareness and production of biochar.

Response	Awareness of Biochar		Production of Biochar	
	N	%	N	%
Yes	35	69	8	16
No	16	31	43	84
Total	51	100	51	100

2. **Method of biochar production** most favored among land managers? 

Table 2. Biochar production methods.

Biochar Production Method	N	%
Covered pit burn	1	13
Retort kiln	1	13
Open fire kiln	3	38
Open pit burn	2	25
Top lit pile burn	1	13
Total	8	100

Biochar benefits

3. Main **benefits** of biochar that land managers are intrigued by

Land managers are intrigued more about some benefits than others (X-squared = 52.23, P-value = 0.0002).

1. Holding of water
2. Holding of nutrients

Benefit	Likert score			
	Very.unimportant	Unimportant	Important	Very.important
Holding of water	2		6	37
Holding of nutrients	3	4	10	31
Increase productivity	7	5	7	28
Fuel load reduction	5	11	8	27
Carbon sequestration	2	8	8	25
Improving soil tilth	3	5	13	24
Treating manure			9	17
Energy co-production		10	13	11

Figure 2. Biochar benefits and relative importance to land managers.

Barriers for biochar adoption

4. Most significant **barriers** to biochar adoption among land managers

Land managers indicated prevalence of some barriers over others

(X-squared = 117.20, P-value < 0.0001).

1. No knowledge of biochar production
2. No knowledge of biochar application
3. No access to equipment

Barriers	Likert score	Likert score		
		Not a barrier	Minor barrier	Major barrier
No knowledge of biochar production	6	17	26	
No knowledge of biochar application	7	18	24	
No access to equipment	4	18	24	
No knowledge of biochar benefits	10	20	19	
No time to produce biochar	13	15	18	
Concern regarding fire risk	14	18	15	
Too much slash to process	12	17	14	
Too expensive	14	18	13	
Concern regarding air pollution	18	17	11	
Nobody around using biochar	17	21	10	
Using slash for other purposes	13	24	9	
No time to learn about biochar	19	20	9	
Seems too complicated	20	19	6	
No interest regarding biochar	23	18	5	
No benefit perception	30	11	5	
No fit into management approach	28	14	4	

Figure 3. Barriers to biochar adoption and relative relevance to land managers.

Approaches for biochar adoption

5. Mechanisms preferred by land managers to learn about biochar

Land managers indicated prevalence of some mechanisms over others (X-squared = 58.085, P-value = 0.0007).

1. Demonstrations/Field days
2. Workshops

Approaches	Likert score				
	Very.unlikely	Unlikely	Indiferent	Likely	Very.likely
Demonstrations/Field days		2	3	9	33
Workshops		4	2	14	28
Extension agents	3	5	3	12	25
Information online	2	5	3	13	24
Cooperatives	2	8	5	12	22
Technical reports	4	10	5	11	18
Personal network	2	14	2	13	17
Trade publications	7	15	5	13	8

Figure 4. Approaches to encourage biochar adoption and preferences among land managers.

Demography & Responses

Table 3. Modeling responses regarding relevant barriers to adoption as a function of respondent demographics.

Description	¹ Participant race	² Participant class	³ Biochar knowledge	Participant age
Barriers				
Lack of knowledge of biochar benefits	--	$\beta = -2.85$ $P = 0.03$	--	--
Seems too complicated	$\beta = -1.33$ $P = 0.05$	--	--	--
Concern regarding air pollution	$\beta = -1.55$ $P = 0.03$	--	--	--
Lack of interest regarding biochar	$\beta = -1.92$ $P = 0.01$	--	--	--
Does not seem to be beneficial	--	--	$\beta = -2.53$ $P = 0.01$	--

¹P values and β coefficients compare non-white (reference) to white respondent responses.

²P values and β coefficients compare low-income households (reference) to middle- and high-income household responses.

³P values and β coefficients compare respondents without prior knowledge of biochar (reference) to those who were aware of biochar.

Demography & Responses

Table 4. Modeling responses regarding preferred approaches to encourage adoption as a function of respondent demographics.

Description	¹ Participant race	² Participant class	³ Biochar knowledge	Participant age
Approaches				
Extension agents professionals	$\beta = -2.18$ P = 0.01	$\beta = -1.75$ P = 0.04	--	--
Trade publications	$\beta = -1.53$ P = 0.02	$\beta = -2.19$ P = 0.01	--	$\beta = 0.06$ P = 0.01
Workshops	--	--	$\beta = 2.12$ P = 0.01	--
Technical reports	--	$\beta = -2.17$ P = 0.01	--	--

¹P values and β coefficients compare non-white (reference) to white respondent responses.

²P values and β coefficients compare low-income households (reference) to middle- and high-income household responses.

³P values and β coefficients compare respondents without prior knowledge of biochar (reference) to those who were aware of biochar.



Soil Health Workshop, October 2022.

Discussion & Conclusion

- Most respondents were familiar with biochar. The recruitment process may have influenced these results.
- Knowledge is not equal to production. Only 16% of those who knew about biochar were producing it.
- Relative importance of biochar benefits was not influenced by demographic factors.
- Overall barriers to adopting biochar production focusses lack of knowledge and access to equipment.

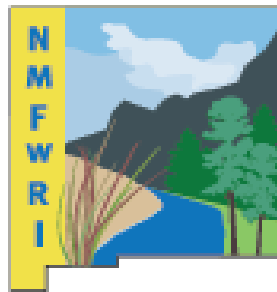


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Discussion & Conclusion

- Hispanic and Native respondents indicated less interest in biochar than White participants.
- Low-income respondents indicated less knowledge about biochar.
- Most preferred learning source: demonstrations, field days, and workshops.
- The results of this research will be complemented with more surveys and data from interviews.

Acknowledgments



A grayscale photograph showing several pairs of hands cupped together, holding a dark, rich soil. The hands are positioned in a circle, creating a sense of unity and care. The soil is piled in the center of each hand. The background is dark and out of focus. The word "Questions?" is written in a large, white, sans-serif font across the middle of the image, with a thin white horizontal line above and below the text.

Questions?

References

1. Burke, M., Driscoll, A., Heft-Neal, S., Xue, J., Burney, J., & Wara, M. (2021). The changing risk and burden of wildfire in the United States. *Proceedings of the National Academy of Sciences*, 118(2), e2011048118. <https://doi.org/10.1073/pnas.2011048118>
2. Lehmann, J., & Joseph, S. (Eds.). (2015). *Biochar for environmental management: Science, technology and implementation (Second edition)*. Routledge, Taylor & Francis Group.
3. Wiedinmyer, C., & Hurteau, M. D. (2010). Prescribed Fire As a Means of Reducing Forest Carbon Emissions in the Western United States. *Environmental Science & Technology*, 44(6), 1926–1932. <https://doi.org/10.1021/es902455e>

Biochar production methods



Gasifier



Retort kiln



Open fire kiln

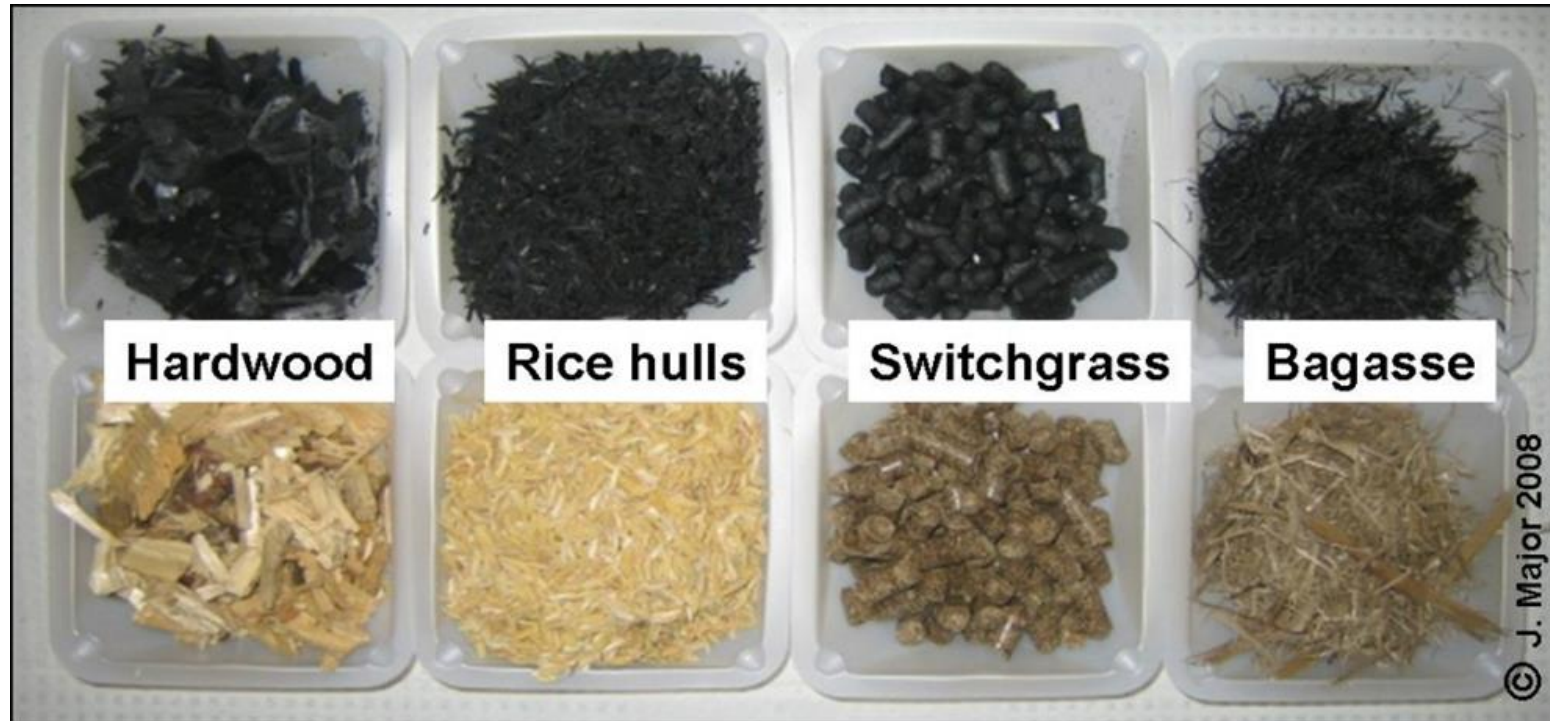


Open pit burn



Covered pit burn

Different biochar feedstocks



26. Are you interested in participating in a follow-up interview as part of this project later this year?

Yes

No

Please provide your contact information

26.1 Name:

26.2 Phone number:

26.3 Email address:

27. Preferred mode of correspondence:

Phone

Email

28. Preferred interview format (select all that apply):

Select all that apply.



Likert Scale

Survey

BIOCHAR RESEARCH INTERVIEW

1. To get started, could you tell us/me what you know about biochar?
2. In your view, what are the main benefits biochar offers for your land management?
3. Could you tell me/us how you have learned about biochar? What is the best way to educate people about biochar?
4. Since learning about biochar, how, if at all, have you integrated biochar into your land management? What has been your experience doing so?
 0. *If they have not integrated biochar into land management: how would you envision biochar fitting into your or your community's land management?*
5. What were some of the main challenges to integrating biochar into your land management?
 0. *If they have not integrated biochar into their management: What are the main barriers that have prevented you from integrating biochar into your land management?*
6. What ultimately convinced you to integrate biochar into your land management?
 0. *If they have not integrated biochar into management: What would ultimately convince you to integrate biochar? into your land management. In other words, what would need to happen for you to go through with it?*
7. What are some of the ways educational, government, and non-governmental organizations could help address those obstacles for yourself? What would you say are the most effective ways to incentivize the adoption of biochar?
8. What kind of disconnects or gaps do you see related to biochar between private landowners and agencies?
9. How were your properties affected by the Calf Canyon/Hermit's Peak Fire, if at all?
10. Do you think your opinion about biochar has changed due to the fires?
11. Is there anything else you would like to add? Anything you think is important that I have not asked about?

Many thanks for your contribution today!

Interview
