

Supplementary Material

1 Solar Grazier Survey

The following information was created and distributed for the Solar Grazier Survey.

1.1 Introduction

Thank you for agreeing to participate in our survey. ASGA has been awarded a grant by NYSEDA, the New York State Energy and Research Development Agency, to study solar grazing. The grant goals include contributing to the basis of knowledge for the technical and economic aspects of co-location to inform practitioners how solar grazing can be profitable and beneficial to the environment. We believe that studies such as this one will lead to the foundation of work upon which a generation of farmers and solar companies can draw upon.

You are being asked to participate by completing this survey about your practices as a solar grazier—the economics and practical farming details of your work raising and grazing sheep at solar sites. You are being sent this survey because you previously self-identified as a solar grazier in our screening survey.

1.2 Purpose

The purpose of this study is to gain new insight into the technical aspects of agricultural co-location on solar sites, which can help inform land use management decisions. The results collected through this survey will help establish baseline information regarding future solar array designs, vegetation management processes, and other investments.

1.3 Confidentiality Statement

Any information that is obtained in connection with this study and that can be identified with you will remain confidential. None of your personal information, including financial figures and addresses, will be traceable directly to you and your operation, as we will be using a generic code and nomenclature system for identifying individual operations. You can expect the data you provide us with to be used in a research report summarizing our findings with an identifying code that anonymizes the data you share with us. By filling out this questionnaire you are declaring your agreement with the sharing of the information you provide us and that you understand the information you share will eventually become public for the purposes of disseminating research findings.

1.4 Survey Questions

1. Your name
2. Company name
3. Business website/social media
4. Company mailing address

5. Please provide a secondary contact from your company. Name, phone number, and email please. This provides us with a second point of contact, if needed.

6. When was your first year solar grazing?

Please name the solar sites that you operate

7. Site 1

a. Name

8. Site 2

a. Name

9. Site 3

a. Name

10. Site 4

a. Name

11. Site 5

a. Name

Number of sheep on sites for 2022 grazing season

12. Site 1

a. Maximum number of ewes (regardless of ownership)

b. Maximum number of lambs (regardless of ownership)

c. Maximum number of rams (regardless of ownership)

13. Site 2

a. Maximum number of ewes (regardless of ownership)

b. Maximum number of lambs (regardless of ownership)

c. Maximum number of rams (regardless of ownership)

14. Site 3

a. Maximum number of ewes (regardless of ownership)

b. Maximum number of lambs (regardless of ownership)

c. Maximum number of rams (regardless of ownership)

15. Site 4

a. Maximum number of ewes (regardless of ownership)

b. Maximum number of lambs (regardless of ownership)

- c. Maximum number of rams (regardless of ownership)

16. Site 5

- a. Maximum number of ewes (regardless of ownership)
- b. Maximum number of lambs (regardless of ownership)
- c. Maximum number of rams (regardless of ownership)

17. Dominant breed of sheep on each site (From the list of answer options below, select one for each sub-question)

Dorset; Suffolk; Katahdin; Southdown; Border Leicester; Dorper; Shetland; Romney; Oxford; Hampshire; Crossbreeds; Mix of Breeds

- a. Site 1 (Select one option from the above list)
- b. Site 2 (Select one option from the above list)
- c. Site 3 (Select one option from the above list)
- d. Site 4 (Select one option from the above list)
- e. Site 5 (Select one option from the above list)

For the 2022 grazing season, which approximate dates are your sheep on the sites?

April-September; April-October; April-November; May-September; May-October; May-November; May-December; June-September; June-October

18. Site 1

- a. Date herd on site
- b. Date herd removed for winter

19. Site 2

- a. Date herd on site
- b. Date herd removed for winter

20. Site 3

- a. Date herd on site
- b. Date herd removed for winter

21. Site 4

- a. Date herd on site
- b. Date herd removed for winter

22. Site 5

- a. Date herd on site
- b. Date herd removed for winter

23. What style is the perimeter fence (From the list of answer options below, select one for each sub-question)

Chain link with bottom tension wire; chain link with no bottom tension wire; wildlife friendly (allow wildlife to crawl under or jump over); Other

- a. Site 1 (Select one option from the above list)
- b. Site 2 (Select one option from the above list)
- c. Site 3 (Select one option from the above list)
- d. Site 4 (Select one option from the above list)
- e. Site 5 (Select one option from the above list)

Does the site have interior fencing?

24. Site 1

- a. Permanent (Yes/No)
- b. Temporary (Yes/No)

25. Site 2

- a. Permanent (Yes/No)
- b. Temporary (Yes/No)

26. Site 3

- a. Permanent (Yes/No)
- b. Temporary (Yes/No)

27. Site 4

- a. Permanent (Yes/No)
- b. Temporary (Yes/No)

28. Site 5

- a. Permanent (Yes/No)
- b. Temporary (Yes/No)

29. If yes, explain the style of fence and what it encloses in the array

Does the site have access to a year round, or sufficiently seasonal, source of water?

30. Site 1

- a. Yes or no

31. Site 2

- a. Yes or no

32. Site 3

- a. Yes or no

33. Site 4

- a. Yes or no

34. Site 5

- a. Yes or no

35. If yes, what is the source of water? (From the list of answer options below, select one for each sub-question.)

On-site well; Hauling water; Pond, creek, stream

- a. Site 1 (Select one option from the above list)
- b. Site 2 (Select one option from the above list)
- c. Site 3 (Select one option from the above list)
- d. Site 4 (Select one option from the above list)
- e. Site 5 (Select one option from the above list)

36. Are your sites primary leases from the solar company or subleases from other farmers? (From the list of answer options below, select one for each sub-question.)

Primary lease; sublease

- a. Site 1 (Select one option from the above list)
- b. Site 2 (Select one option from the above list)
- c. Site 3 (Select one option from the above list)
- d. Site 4 (Select one option from the above list)
- e. Site 5 (Select one option from the above list)

Sheep health (Please just write a numerical value without words or units for these questions).

37. Site 1

- a. Number of sheep deaths on site in a given year as a result of natural causes
- b. Number of sheep deaths in a given year as a result of predators
- c. Number of parasite treatments necessary in one year (multiple or single)
- d. If yes, please explain the parasite problem

38. Site 2

- a. Number of sheep deaths on site in a given year as a result of natural causes
- b. Number of sheep deaths in a given year as a result of predators

- c. Number of parasite treatments necessary in one year (multiple or single)
- d. If yes, please explain the parasite problem

39. Site 3

- a. Number of sheep deaths on site in a given year as a result of natural causes
- b. Number of sheep deaths in a given year as a result of predators
- c. Number of parasite treatments necessary in one year (multiple or single)
- d. If yes, please explain the parasite problem

40. Site 4

- a. Number of sheep deaths on site in a given year as a result of natural causes
- b. Number of sheep deaths in a given year as a result of predators
- c. Number of parasite treatments necessary in one year (multiple or single)
- d. If yes, please explain the parasite problem

41. Site 5

- a. Number of sheep deaths on site in a given year as a result of natural causes
- b. Number of sheep deaths in a given year as a result of predators
- c. Number of parasite treatments necessary in one year (multiple or single)
- d. If yes, please explain the parasite problem

For the upcoming sections, please just write a numerical value in the space provided without units (\$, hours, lbs, etc.) so that we can analyze the data with efficiency. For example, in the “Operating costs” section question b) “50” is what we are looking for, not “\$50” or “50 lbs”

Operating costs for the solar grazing season, total cost in dollars for each category (Please just insert numerical values here).

42. Site 1

- a. Number of lambs purchased
- b. Average price of lambs purchased (\$ per head)
- c. Sheep feed, salt, other minerals
- d. Veterinary costs
- e. Estimated transport cost

43. Site 2

- a. Number of lambs purchased
- b. Average price of lambs purchased (\$ per head)

- c. Sheep feed, salt, other minerals
- d. Veterinary costs
- e. Estimated transport cost

44. Site 3

- a. Number of lambs purchased
- b. Average price of lambs purchased (\$ per head)
- c. Sheep feed, salt, other minerals
- d. Veterinary costs
- e. Estimated transport cost

45. Site 4

- a. Number of lambs purchased
- b. Average price of lambs purchased (\$ per head)
- c. Sheep feed, salt, other minerals
- d. Veterinary costs
- e. Estimated transport cost

46. Site 5

- a. Number of lambs purchased
- b. Average price of lambs purchased (\$ per head)
- c. Sheep feed, salt, other minerals
- d. Veterinary costs
- e. Estimated transport cost

47. Do you lease sheep? (Yes or No)

48. How many sheep do you lease?

In the hopes of understanding more about the cost requirements for managing these sites, please give your best estimate of total cost for these support operations to fulfill grazing contracts.

49. Site 1

- a. Site preparation (gaining access to site, fencing, water)
- b. Rotating flock (include preparation of new paddock fencing if applicable)
- c. Conduct soil and/or forage tests
- d. Mechanically mow and/or trim weeds/grasses

50. Site 2

- a. Site preparation (gaining access to site, fencing, water)
- b. Rotating flock (include preparation of new paddock fencing if applicable)
- c. Conduct soil and/or forage tests
- d. Mechanically mow and/or trim weeds/grasses

51. Site 3

- a. Site preparation (gaining access to site, fencing, water)
- b. Rotating flock (include preparation of new paddock fencing if applicable)
- c. Conduct soil and/or forage tests
- d. Mechanically mow and/or trim weeds/grasses

52. Site 4

- a. Site preparation (gaining access to site, fencing, water)
- b. Rotating flock (include preparation of new paddock fencing if applicable)
- c. Conduct soil and/or forage tests
- d. Mechanically mow and/or trim weeds/grasses

53. Site 5

- a. Site preparation (gaining access to site, fencing, water)
- b. Rotating flock (include preparation of new paddock fencing if applicable)
- c. Conduct soil and/or forage tests
- d. Mechanically mow and/or trim weeds/grasses

Startup capital costs- livestock and equipment. What items did you purchase in order to start solar grazing?

54. Number of sheep or dogs purchased

- a. Adult ewe
- b. Lamb
- c. Ram
- d. Guardian animals
- e. Fencing
- f. Feed bunks, water troughs, grain storage facilities, signage, gate locks, other
- g. Site equipment

55. Total spent (\$)

- a. Adult ewe
 - b. Lamb
 - c. Ram
 - d. Guardian animals
 - e. Fencing
 - f. Feed bunks, water troughs, grain storage facilities, signage, gate locks, other
 - g. Site equipment
56. What challenges have you encountered while solar grazing and how have you overcome them?
57. What could be done to further strengthen the relationship between sheep grazer and solar site?

2 Solar Company Survey

The following information was created and distributed for the Solar Company Survey.

2.1 Introduction

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2.2 Purpose

The purpose of this study is to gain new insight into the technical aspects of agricultural co-location on solar sites, which can help inform land use management decisions. The results collected through this survey will help establish baseline information regarding future solar array designs, vegetation management processes, and other investments.

2.3 Confidentiality Statement

Any information that is obtained in connection with this study and that can be identified with you will remain confidential. None of your personal information, including financial figures and addresses, will be traceable directly to you and your operation, as we will be using a generic code and nomenclature system for identifying individual operations. You can expect the data you provide us with to be used in a research report summarizing our findings with an identifying code that anonymizes the data you share with us. By filling out this questionnaire you are declaring your agreement with the sharing of the information you provide us and that you understand the information you share will eventually become public for the purposes of disseminating research findings.

2.4 Survey Questions

1. Your name
2. Company name
3. Company mailing address
4. Your title or position
5. Phone number
6. Email address
7. Please provide a secondary contact from your company. Name, phone number, and email please. This provides us with a second point of contact, if needed.
8. Site 1
 - a. Site name
 - b. Is the racking fixed or single-axis tracking?
 - c. Total acres of managed vegetation
 - d. Type of perimeter fence (chain link with tension bottom wire, wildlife friendly, etc)
 - e. Do you have site history (land use history, such as farming history) information? Please share.
9. Site 2
 - a. Site name
 - b. Is the racking fixed or single-axis tracking?
 - c. Total acres of managed vegetation
 - d. Type of perimeter fence (chain link with tension bottom wire, wildlife friendly, etc)
 - e. Do you have site history (land use history, such as farming history) information? Please share.
10. Site 3
 - a. Site name
 - b. Is the racking fixed or single-axis tracking?
 - c. Total acres of managed vegetation
 - d. Type of perimeter fence (chain link with tension bottom wire, wildlife friendly, etc)

- e. Do you have site history (land use history, such as farming history) information?
Please share.

11. Site 4

- a. Site name
- b. Is the racking fixed or single-axis tracking?
- c. Total acres of managed vegetation
- d. Type of perimeter fence (chain link with tension bottom wire, wildlife friendly, etc)
- e. Do you have site history (land use history, such as farming history) information?
Please share.

12. Site 5:

- a. Site name
- b. Is the racking fixed or single-axis tracking?
- c. Total acres of managed vegetation
- d. Type of perimeter fence (chain link with tension bottom wire, wildlife friendly, etc)
- e. Do you have site history (land use history, such as farming history) information?
Please share.

13. First year sites were producing power to the grid:

- a. Site 1
- b. Site 2
- c. Site 3
- d. Site 4
- e. Site 5

14. First year sites were grazed:

- a. Site 1
- b. Site 2
- c. Site 3
- d. Site 4

e. Site 5

15. Site 1

- a. Were accommodations made to the site to allow for grazing?
- b. Please explain in detail the accommodations. We will ask about the cost of the modifications below

16. Site 2

- a. Were accommodations made to the site to allow for grazing?
- b. Please explain in detail the accommodations. We will ask about the cost of the modifications below

17. Site 3

- a. Were accommodations made to the site to allow for grazing?
- b. Please explain in detail the accommodations. We will ask about the cost of the modifications below

18. Site 4

- a. Were accommodations made to the site to allow for grazing?
- b. Please explain in detail the accommodations. We will ask about the cost of the modifications below

19. Site 5

- a. Were accommodations made to the site to allow for grazing?
- b. Please explain in detail the accommodations. We will ask about the cost of the modifications below

20. Site 1

- a. If known, what was the cost for one year of conventional vegetation management in dollars per acre? (mowing and herbicide spraying)
- b. What was the cost for one year of sheep grazing vegetation management in dollars per acre? In other words, how much did you pay the solar grazer for one year of their services?
- c. Total cost of additional interior fencing
- d. Total cost of any water feature upgrades (pumps, wells, or spigots)

- e. Total cost of any signage on fences related to sheep grazing activities
- f. Total cost of any storage facilities on site (a shed for example)

21. Site 2

- a. If known, what was the cost for one year of conventional vegetation management in dollars per acre? (mowing and herbicide spraying)
- b. What was the cost for one year of sheep grazing vegetation management in dollars per acre? In other words, how much did you pay the solar grazer for one year of their services?
- c. Total cost of additional interior fencing
- d. Total cost of any water feature upgrades (pumps, wells, or spigots)
- e. Total cost of any signage on fences related to sheep grazing activities
- f. Total cost of any storage facilities on site (a shed for example)

22. Site 3

- a. If known, what was the cost for one year of conventional vegetation management in dollars per acre? (mowing and herbicide spraying)
- b. What was the cost for one year of sheep grazing vegetation management in dollars per acre? In other words, how much did you pay the solar grazer for one year of their services?
- c. Total cost of additional interior fencing
- d. Total cost of any water feature upgrades (pumps, wells, or spigots)
- e. Total cost of any signage on fences related to sheep grazing activities
- f. Total cost of any storage facilities on site (a shed for example)

23. Site 4

- a. If known, what was the cost for one year of conventional vegetation management in dollars per acre? (mowing and herbicide spraying)
- b. What was the cost for one year of sheep grazing vegetation management in dollars per acre? In other words, how much did you pay the solar grazer for one year of their services?
- c. Total cost of additional interior fencing
- d. Total cost of any water feature upgrades (pumps, wells, or spigots)

- e. Total cost of any signage on fences related to sheep grazing activities
- f. Total cost of any storage facilities on site (a shed for example)

24. Site 5

- a. If known, what was the cost for one year of conventional vegetation management in dollars per acre? (mowing and herbicide spraying)
- b. What was the cost for one year of sheep grazing vegetation management in dollars per acre? In other words, how much did you pay the solar grazer for one year of their services?
- c. Total cost of additional interior fencing
- d. Total cost of any water feature upgrades (pumps, wells, or spigots)
- e. Total cost of any signage on fences related to sheep grazing activities
- f. Total cost of any storage facilities on site (a shed for example)

25. Have you experienced additional risk or equipment damage as a result of the land management activities or agricultural practices being performed at a given site? This includes, but is not limited to: damage to solar panels, fencing, racking, electronics, vegetation, personnel, or animals.

26. If you answered yes to question 25, answer the following questions for Site 1:

- a. Describe the incident
- b. Estimated cost of repair

27. If you answered yes to question 25, answer the following questions for Site 2:

- a. Describe the incident
- b. Estimated cost of repair

28. If you answered yes to question 25, answer the following questions for Site 3:

- a. Describe the incident
- b. Estimated cost of repair

29. If you answered yes to question 25, answer the following questions for Site 4:

- a. Describe the incident
- b. Estimated cost of repair

30. If you answered yes to question 25, answer the following questions for Site 5:

- a. Describe the incident
- b. Estimated cost of repair

31. Site 1

- a. Annual cost savings of solar grazing
- b. Please describe your overall satisfaction of the O&M service provided by the livestock grazing in comparison to conventional vegetation management
- c. Does your grazing partner provide supplemental mowing or is there a separate contract for that service?

32. Site 2

- a. Annual cost savings of solar grazing
- b. Please describe your overall satisfaction of the O&M service provided by the livestock grazing in comparison to conventional vegetation management
- c. Does your grazing partner provide supplemental mowing or is there a separate contract for that service?

33. Site 3

- a. Annual cost savings of solar grazing
- b. Please describe your overall satisfaction of the O&M service provided by the livestock grazing in comparison to conventional vegetation management
- c. Does your grazing partner provide supplemental mowing or is there a separate contract for that service?

34. Site 4

- a. Annual cost savings of solar grazing
- b. Please describe your overall satisfaction of the O&M service provided by the livestock grazing in comparison to conventional vegetation management
- c. Does your grazing partner provide supplemental mowing or is there a separate contract for that service?

35. Site 5

- a. Annual cost savings of solar grazing

- b. Please describe your overall satisfaction of the O&M service provided by the livestock grazing in comparison to conventional vegetation management
- c. Does your grazing partner provide supplemental mowing or is there a separate contract for that service?