Working with Farmers to Keep Resources in the Loop

Deborah Aller, PhD

NERC webinar

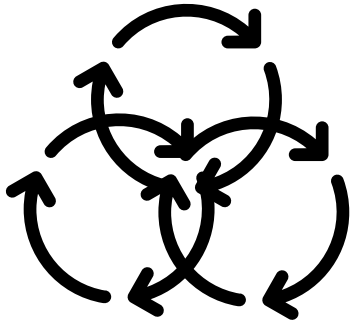
November 20th, 2025

Cornell CALS
College of Agriculture and Life Sciences

About NYCORE

- New York Center for Organics Recycling and Education (NYCORE)
  - Evolution of the Cornell Waste Management Institute (CWMI)
  - Applied research, extension and outreach in NYS and beyond
  - ‘Waste’ → ‘Resources’

- **Mission:** provide NYS stakeholders science-based research, outreach, training, and technical assistance related to organic residuals management



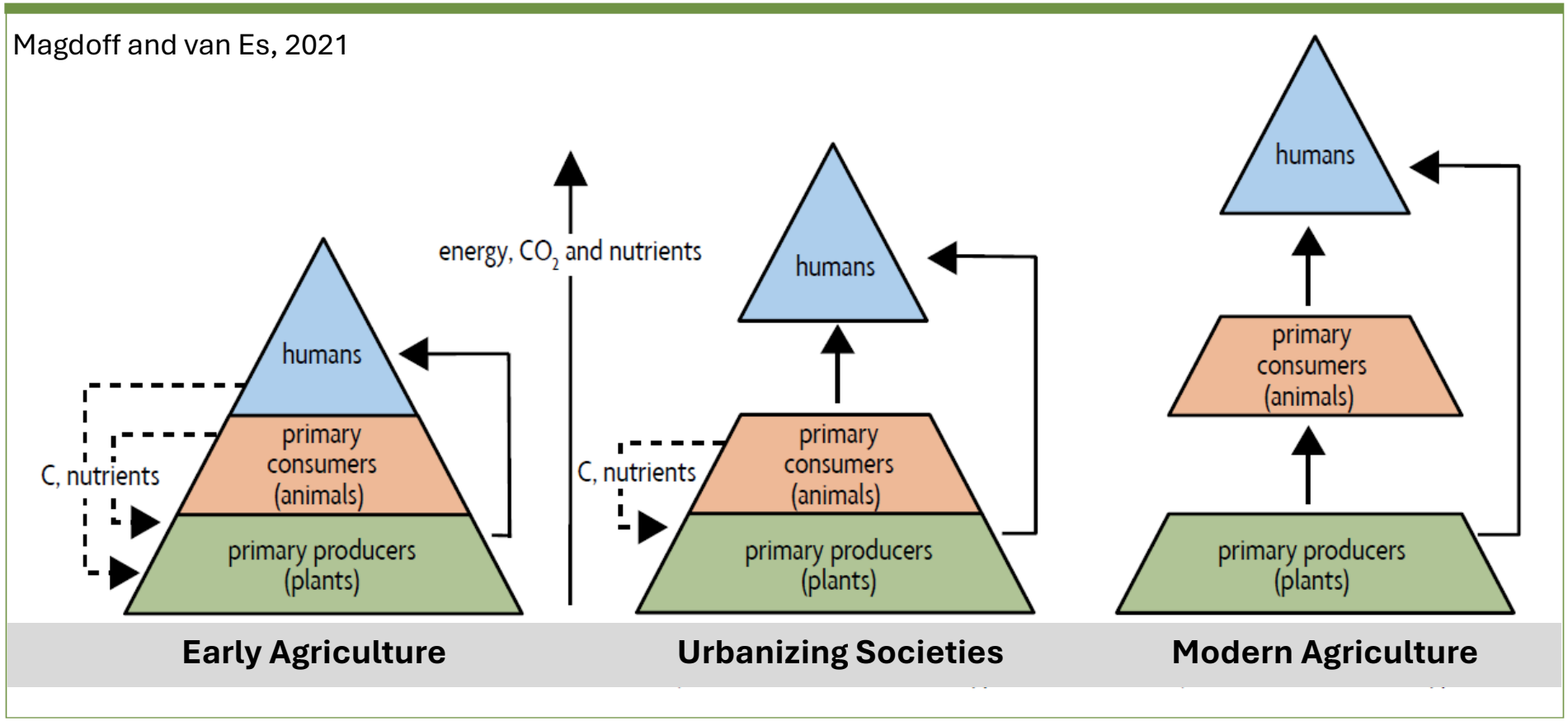
Overall Goals

- Redirect organics (carbon and nutrient rich resources) from landfills to farmland
  - Improved soil health, climate mitigation, waste reduction
  - Do so in a *safe* and *sustainable* manner
- Provide research-based knowledge to stakeholders on organics recycling & reuse
- Provide training and technical support to all actors involved in organics → generators, collectors, processors and users (farms, businesses, municipalities, communities & individuals)
- Conduct research, develop, and document BMPs of organics recycling to assist in responding to emerging threats and opportunities
  - E.g., - biosolids and PFAS

Major Focus Areas

- Composting
  - Food scraps
  - Animal mortality
  - Butcher waste
  - Manure
- Biochar
  - Application
  - Blends
- Biosolids (+PFAS)
- Mulching
- Other organic soil amendments
- Recycling and Reuse

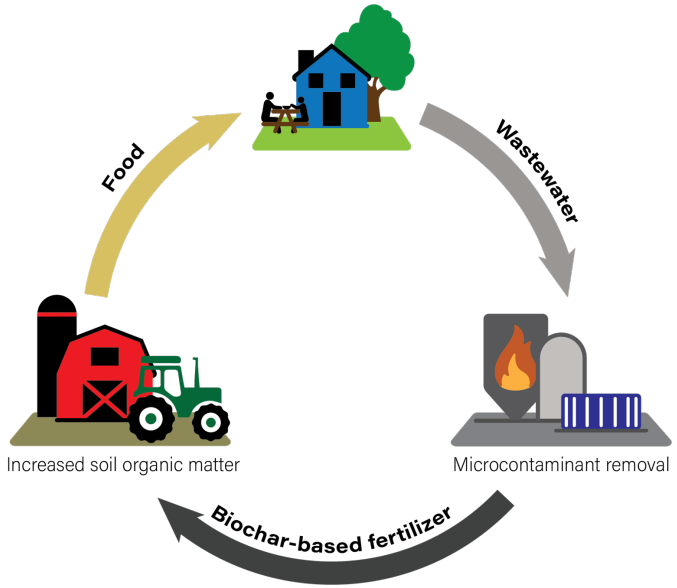
Anthropogenic influence on carbon & nutrients flows



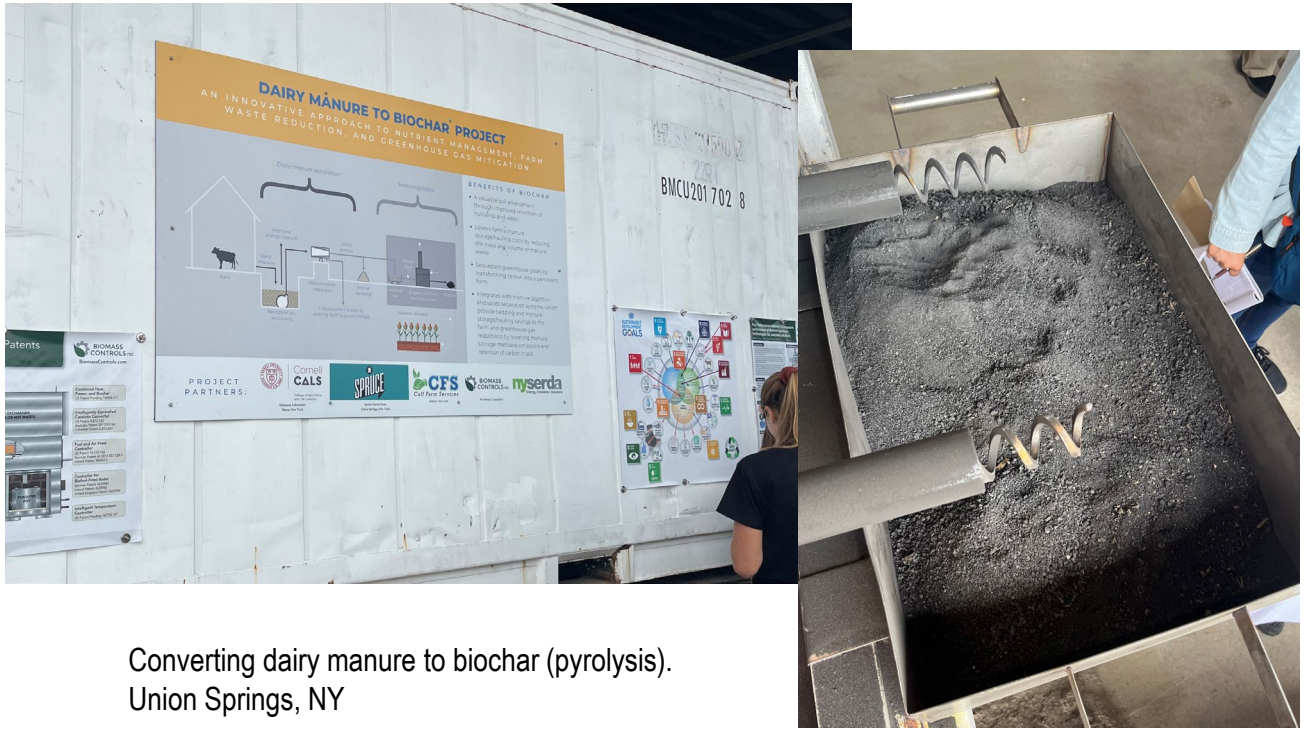
- Less **cycling** reduces nutrient and organic matter return to soils
- More **flow** creates areas of deficiency and excess

Circular Bionutrient Economy

- Greater circularity in agrifood systems is essential for a sustainable future
- Processing, re-using, and re-distributing nutrients and carbon provides great potential to simultaneously improve agriculture productivity and sustainability, alleviate injustice in food production, and mitigate negative environmental impacts



Source: Rich Earth Institute (Vermont, USA)



Converting dairy manure to biochar (pyrolysis).
Union Springs, NY

Project 1

Biosolids Biochar and other Novel Soil Amendments

Biosolids

- The solid or semi-solid organic materials resulting from wastewater treatment.
  - liquid effluent is discharged to nearby waterways
  - biosolids are disposed of through landfilling, incineration, long-term storage, or deemed safe for ‘beneficial use’.
- ‘Beneficial use’ includes application to agricultural lands to provide nutrient and OM additions, while offsetting input costs for farmers and disposal expenses for municipalities.
- Roughly 16% of biosolids produced annually in NYS qualify as beneficial use with roughly 12,888 dry tons (<5%) land applied across about 30,000 permitted acres (NYSDEC, 2018).

Regulation and Safety – land application

- Regulations vary by state
  - Banned in Maine and Connecticut
  - Strict sampling and monitoring in New Hampshire and Massachusetts
  - In NYS, the Dept. of Environmental Conservation (DEC) regulates the beneficial use of biosolids under 6 NYCRR Part 361. Permit is required
- Biosolids are designated as either “Class A”, “Class A-EQ” (exceptional quality) or “Class B” based on pathogen treatment methods
- In NYS, “Class A-EQ” requires nondetectable levels of fecal coliform and salmonella and meeting the regulatory thresholds for 9 toxic metals.
  - Deemed safe for land application
  - Often sold directly for use in gardens and lawns
- Currently, *few safety thresholds exist for emerging pollutants or persistent organic contaminants* coming from per- and polyfluoroalkyl substances (PFAS) compounds, microplastics, and other substances that are known to be found in biosolids and detrimental to environmental and human health.

PFAS – ‘forever chemicals’

- PFAS are a group of thousands of man-made compounds with carbon and fluorine (C-F) bonds
- Widely used, found in numerous everyday products (e.g., non-stick cookware)
- Extremely stable, resistant to most degradation processes, and bioaccumulate in the environment
- Exposure to PFAS linked to detrimental health effects
- There are thousands of PFAS chemicals, which makes it challenging to study these health risks
- https://pfasrisk.org/

Guidance

- It remains a "**case for caution**" when it comes to applying biosolids to farmland (Harrison and McBride, 2009)
  - *“Case for Caution Revisited: Health and Environmental Impacts of Application of Sewage Sludges to Agricultural Land”*
  - www.cwmi.css.cornell.edu/case.pdf
- Very high uncertainty regarding the removal of persistent organic pollutants such as PFAS during the treatment process.
- Crops and animals can take up chemicals from biosolids following land application and their toxicity is often unknown when it comes to the short and long -term impacts on humans, animals, and the environment.

Promising Technology

- **Pyrolysis**, the controlled heating of organic materials in the absence of oxygen, is one of the most promising technologies and an active area of research in NYS and elsewhere.
- Pyrolysis can destroy PFAS substances and produces biochar, a solid, carbon-rich material that can be used as a long-lasting soil amendment
- Research has shown PFAS removal rates of 74 to 99.9% from pyrolysis (Kundu et al., 2021; Thoma et al., 2021; McNamara et al., 2023).

'Biochar from biosolids and source separated human urine: Soil health and farmer perspectives'

- Evaluating the potential for adoption of novel human waste-derived soil amendments through a field experiment measuring the effect of amendments on soil health and crop yields, and through social research on farmer attitudes and perceptions.
- Amendments: biosolids-derived biochar & source separated human urine
- Field Trials: Vermont and New York

https://projects.sare.org/sare_project/lne22-453r/

NORTHEAST SARE Sustainable Agriculture Research & Education

RICH EARTH INSTITUTE

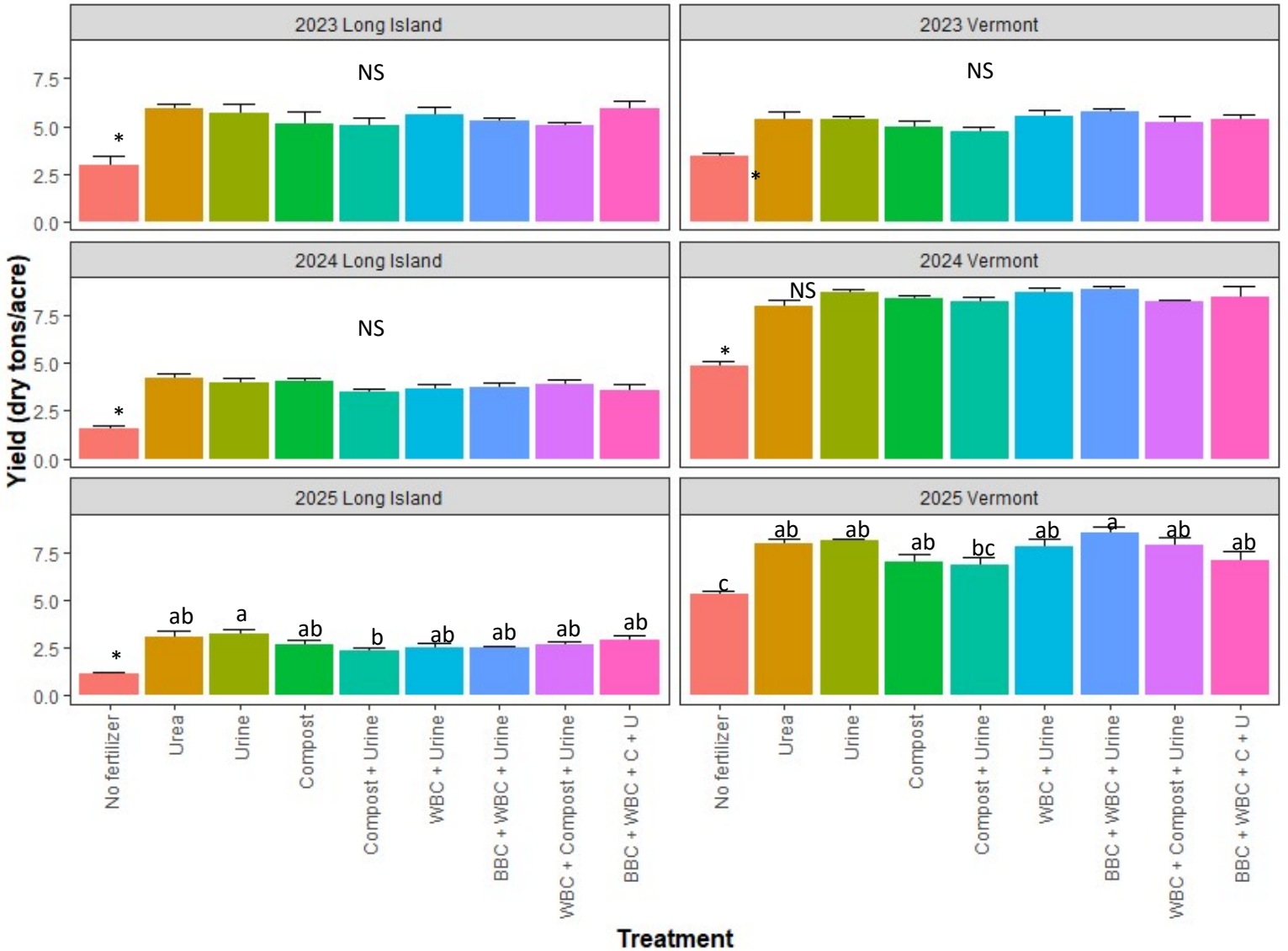
Cornell Cooperative Extension Suffolk County

Cornell CALS College of Agriculture and Life Sciences

NEW YORK SOIL HEALTH

Long Island, NY Trial 2023

Amendments performed as well as synthetic fertilizer on crop yield



'Toward a circular bionutrient economy: new methods of managing excreta for improved soil health, carbon sequestration, contaminant removal, and social acceptability'

- Additional support provided by FFAR (2023-2028) to evaluate:
  - organic **pollutant removal via pyrolysis**
  - ability of biosolids biochar to filter **PFAS** and **pharmaceuticals**
  - producing **biochar-based fertilizers**

FOUNDATION FOR FOOD & AGRICULTURE RESEARCH

UNIVERSITY OF MICHIGAN

Project 2

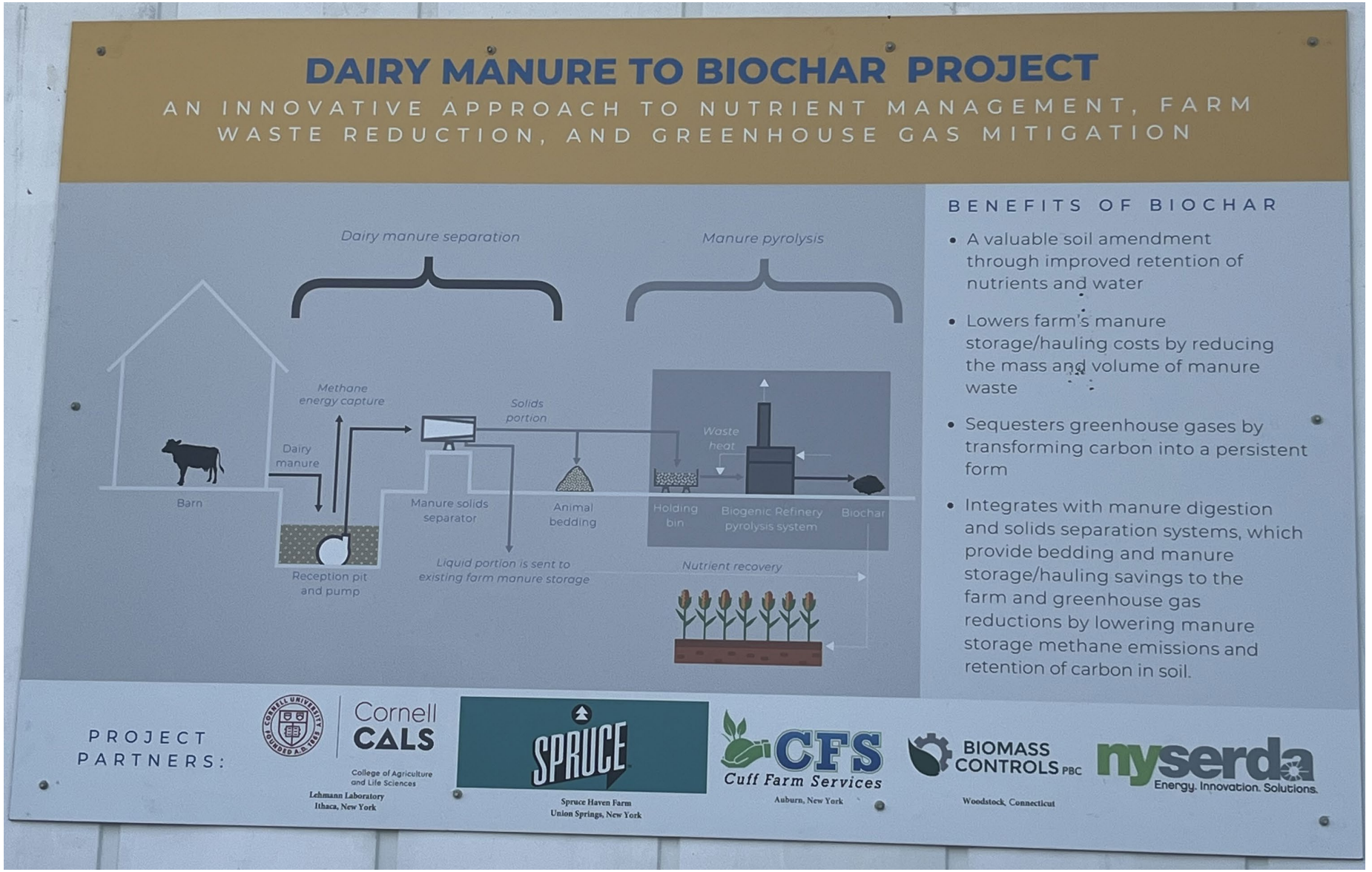
Dairy Manure to Biochar

Current Manure Management at a NY Dairy

Anaerobic Digester

Manure Lagoon

Converting Dairy Manure to Biochar



Spruce Haven Farm

Union Springs, NY

Project led by Johannes Lehmann (Cornell)

1

2

3

4

5

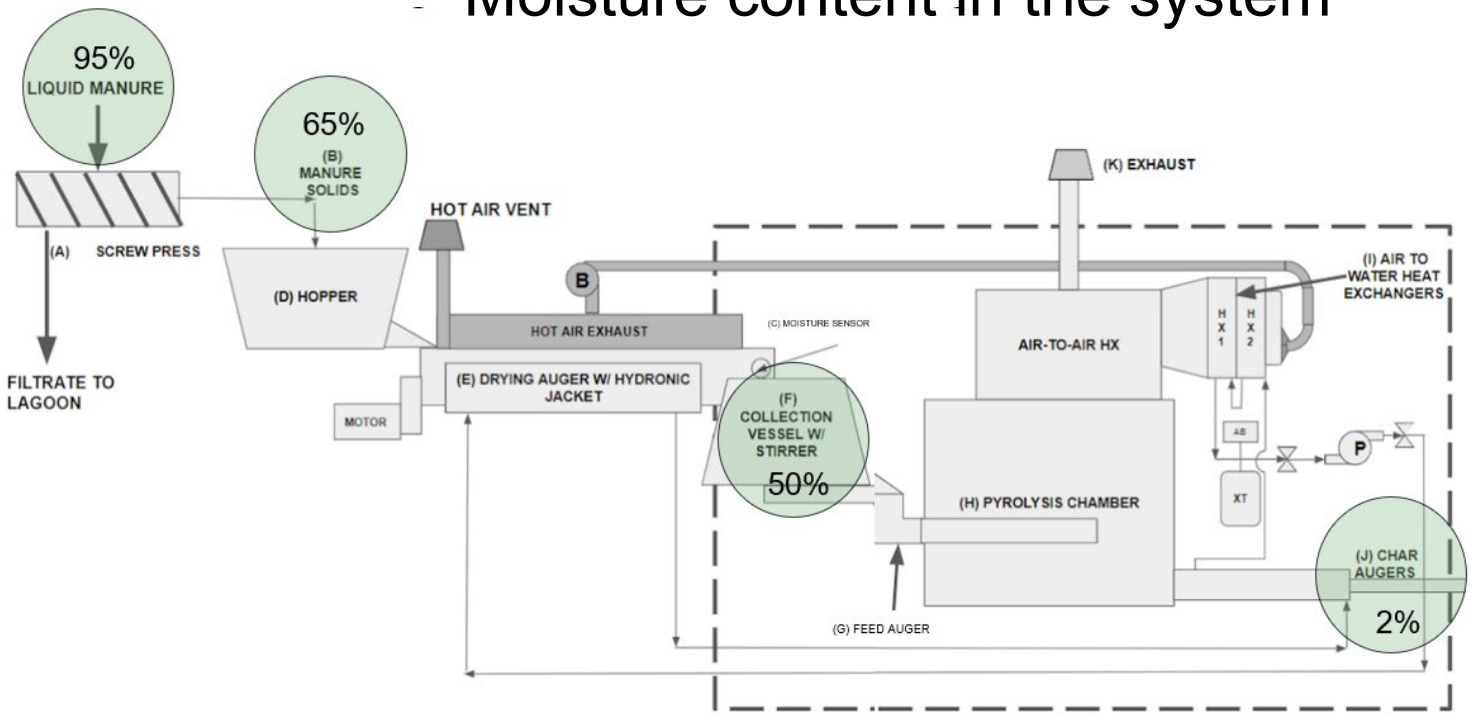
6

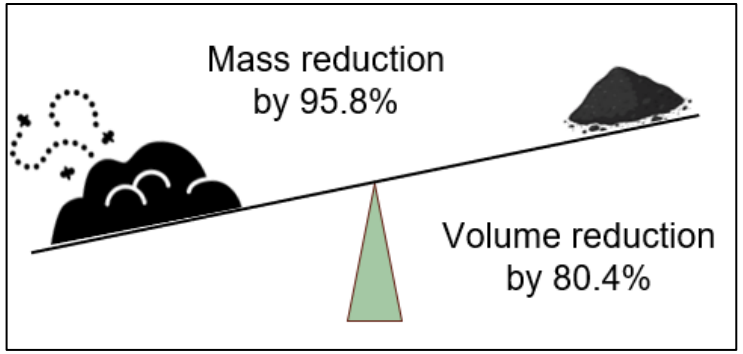
3

7

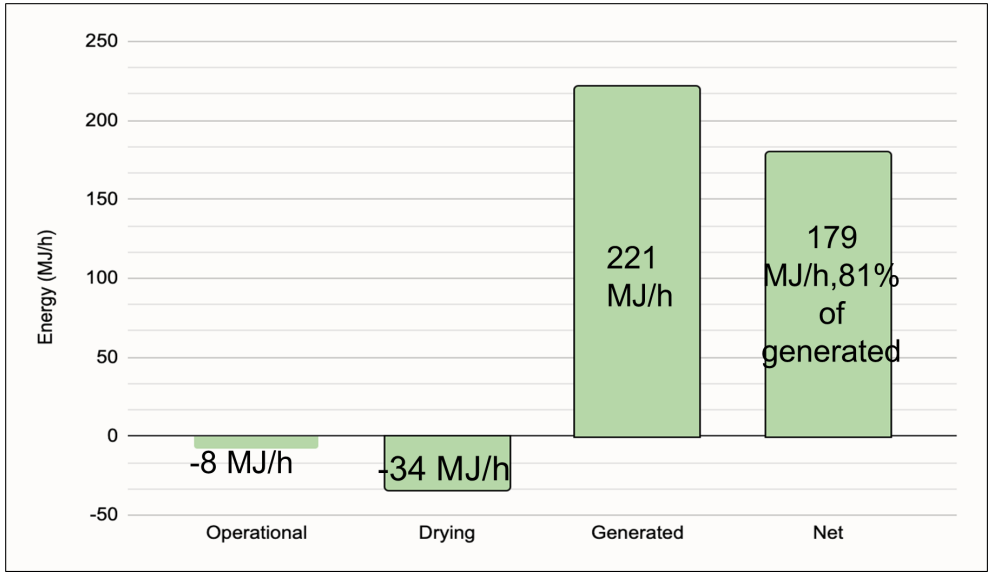
The Energy Story

- Moisture content in the system





Energy Balance

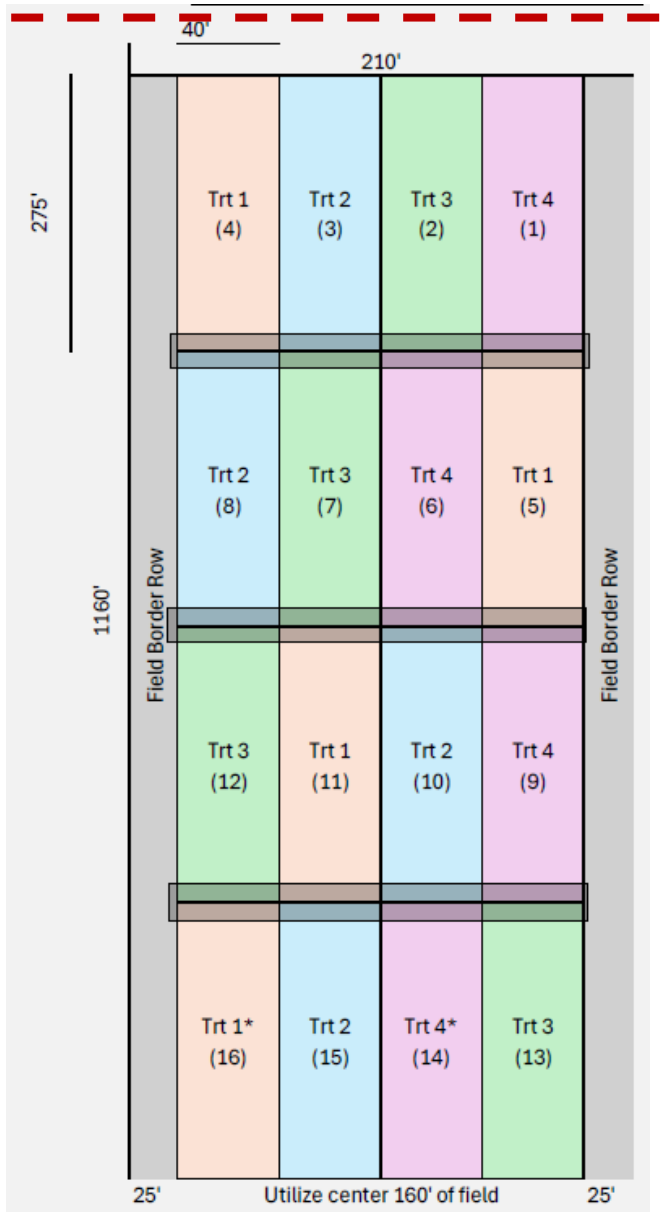


Credit: Lucinda Li and Johannes Lehmann

Field Trials 2025

Treatment	Product	Rate
1. Biochar + Fert.	Biochar Potash (0-0-60) 10-20-20 Urea (sidedress)	1 ton/ac 120 lb/ac 200 lb/ac 280 lb/ac
2. Manure + Fert.	Manure 10-20-20 Urea (sidedress)	7000 gal/ac 200 lb/ac 130 lb/ac
3. No additions	10-20-20	200 lb/ac
4. Full Synthetic	10-20-20 Potash (0-0-60) Urea (sidedress)	400 lb/ac 200 lb/ac 240 lb/ac

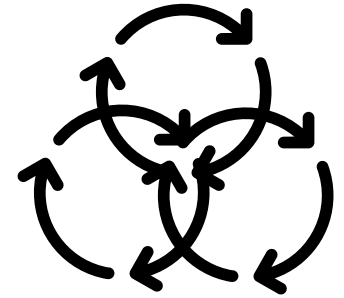
Treatments designed to meet P_2O_5 needs of a corn silage crop and then balanced with fertilizer for N and K_2O



Photos: Kirsten Workman

Stakeholder Engagement is Critical

Summary



- Organic residuals are carbon and nutrient rich resources that when safely and sustainably applied offer numerous benefits to farms and beyond
- Caution is needed when it comes to land application of biosolids, septage, etc., but alternatives to landfilling are needed and PFAS and other contaminants are *everyone's problem*
- Need exists for greater basic and applied research on PFAS and emerging contaminants
- Working directly with farmers and other relevant stakeholders is essential for acceptance and adoption of new practices
- More data can help us make more informed decisions that protect both human and environmental health

Thank you!

CornellCALS
College of Agriculture and Life Sciences

Resources:
https://cwmi.css.cornell.edu/

Deborah Aller, PhD – da352@cornell.edu