Thanks to David for the unique opportunity

Thanks for including me

My background is Forest Ecosystems
Recent USDA SARE grant

Humbled by expertise in the room!

UNH Organic Dairy Research Farm - a unique facility

Will offer a few observations and results – some on water!
Organic Dairy Research Farm

- First in the Nation (only? - why?)
- Support: four largest US organic dairy processors
  - Stonyfield
  - Aurora
  - Horizon
  - Organic Valley
- Inspiration
  - Chuck Schwab
  - Rick Kersbergen
  - Tom Kelly
  - John Carroll
“This could not come at a better time, as the organic dairy market in general and New England in particular is in need of more organic farmers. We believe organic dairy farming has the promise of saving New Hampshire and New England family farmers,”

~Gary Hirshberg,
- President and CEO, Stonyfield Farm
- Co-founder, New Alchemy Institute (1970s)
The Farm and Forest Resource

~100 acres certified organic pasture
  • 40-50 milkers, 100 total
  • ~100 animals total

~160 acres (~64 ha) of typical old-Field New England woodland

Research on nutrition, pasture productivity, silvopasture, Water quality, Nitrogen balance, GHG emissions…

Department of Natural Resources and Environment
NH Agricultural Experiment Station
We Got to Ask the Question:

What are the Biggest Challenges to Organic Milk Providers In New England?

- Financial Viability
  - Imported Commodities
    - Bedding
    - Energy
    - Grains
  - Most Successful Farms Have Diversified Income and/or Value Added Processing

- Environmental Impact
  - GHG emissions
  - Runoff and Water Quality
  - Manure Management
    - Composting
    - Spreading

Role of Land-grant Institutions
Research – Increasing the Resilience of New England Agriculture - An Example

A Closed-System, Energy Independent Organic Dairy Farm for the Northeastern U.S.

Principal Investigator:
  John Aber
Co-Principals:
  Bill McDowell, Matt Davis, Matt Smith, Allison Leach
An Integrated System to Provide Bedding, Manure Composting and Energy and CO₂ for a Greenhouse Operation

Woodchips

Wood Shavings

Woodlands

Bedding

Bedding/Manure

Compost

Heat, CO₂, N to Greenhouse

[Diagram of integrated system showing flow of materials from woodlands to woodchips, wood shavings, bedding/manure, compost, and greenhouse with heat and CO₂ flow]

[Images of woodlands, woodchips, bedding, manure, compost, and greenhouse]

United States Department of Agriculture

United Nations Department of Natural Resources and Environment

NH Agricultural Experiment Station
But First – Kudos to Matt Smith, Ph.D. Student  
The Brains and Brawn Behind the Project!
First Step: Sustainable Harvesting of Low Quality Softwoods

Measured Productivity and Biomass
- About 40 hectares of manageable, low-quality old field woods
- Need to harvest .4 hectare/year or 1/6th of total annual wood production
Second Step: Producing Bedding from Harvested Wood

Data show yield of 3 “cords” of shavings for 1 “cord” of wood
(1 cord = ~ 4 m³)
Third Step: Bedding use in the Barn
Fourth Step: Composting the Bedding/Manure Mixture: A High-End Research Facility
Another Alternative: Static Pile Aerobic Composting (SPAC)
1. Blower pulls air through compost
2. Hot, moist air passes over isobars; heat captured in phase change to gas in isobars
3. Heat transferred to bulk water tank as phase change back to liquid in isobars
4. Hot water used for heating, washing, etc.
This is NOT Anaerobic Methane Generation!

http://www.cornerstoneeg.com/2013/06/05/organics-anaerobic-digester-septic-tank/
Schematic Diagram Energy Capture and Transfer using AGRILAB Isobar system

Brian Jerose
The Future: Energy, CO$_2$ and ammonia for a High-Tunnel Greenhouse Operation

Compost

Number of composting operations Growing rapidly in New England

http://www.farmtek.com/wcsstore/EngineeringServices/allbizunits/prodimages/zoom/1x/103083d.jpg
Water Quality Work

Before: Bedding/manure stockpiled for months-years
Ave. Total Dissolved Nitrogen (mg N/L) from 2008-2012

- Yellow: 1.1 - 5
- Orange: 5.1 - 10
- Dark orange: 10.1 - 25
- Red: 25.1 - 50
- Dark red: 50.1 - 135
Total Dissolved Nitrogen (TDN) Over Time in Groundwater

McDowell and Shattuck, et al.

- Compost (30)
- Pig Lagoon (80)
- Barn (Deep) (70)
- Field (4)
- Near stream (5)
- All barns (50)
J. Matthew Davis. Water Footprint of the Organic Dairy Research Farm, University of New Hampshire Report 2014

Liters of water per Liter of milk
The Land Use Challenge for New England Agriculture

Alternate Visions of the Future?

A New England Food Vision

- Healthy Food for All
- Sustainable Farming and Fishing
- Thriving Communities
The Land Use Challenge for New England Agriculture

Wildlands and Woodlands

• 70% woods (7% Wildlands)
• 5% water and wetlands
• 25% developed and agriculture

http://www.wildlandsandwoodlands.org/
The Land Use Challenge for New England Agriculture

Food Solutions New England
What fraction of calories can be grown in the region?
• Current diet –
  • 40%, need 6M acres
• Omnivore’s Delight diet –
  • 50%, need 6M acres
• Self Reliance diet –
  • 70%, need 7M acres

• Total acres in New England: ~46M (current ag ~2M acres)
• Can we Intensify Agricultural Production?

http://www.foodsolutionsne.org/new-england-food-vision
Can We Intensify and “Harden” New England Agriculture?

UNH Research
- High tunnels (Sideman, Ogden…)
  - Grow produce for dining services
  - Species trials
  - Energy efficiency enhanced with heat pumps
  - Heating with Compost (more later)
- Extending grazing season and increasing pasture productivity with novel species mixtures (Smith)
- Organic dairy nutrition (Brito)
- Another opportunity?
- Espalier fruit
Unbundling the Process – Multiple Sources of Revenue

Woodlands → Wood Shavings → Bedding → Bedding/Manure → Compost → Heat and CO2 to Greenhouse