Livestock, Pasture, Soil, & WATER: Some Issues to Consider, and Possible Opportunities for New England NGOs

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Aquatic Ecologist
Harvard Forest
- Erosion and sedimentation
- Manure runoff and nutrient
- Manure management
- Land Use Change
Current Water Quality Issues in New England

1. Coastal Water Quality – Nitrogen
   • Salt marsh decline
   • Coastal eutrophication and hypoxia

2. Groundwater Quality – Nitrogen
   • Drinking water contamination
   • Surface waters – inland & coastal eutrophication

3. Inland Water Quality – Phosphorus
   • Groundwater discharges and surface runoff
   • Lake, pond, and river eutrophication and hypoxia
   • Water supply reservoir eutrophication and filtration/water treatment requirements
New England Agriculture is a Contributor to These Problems
Figure 1: Maximum area and duration of hypoxia (DO < 3.0 mg/L) in LIS, 1987-2013 (Welsh, 1990 and CTDEEP, 2013)
c. 47% of N inputs are from MA, NH, VT sources. Non-forest inputs are largely through urban and agricultural runoff and wastewater treatment plant discharges.
Land Cover Change in Long Island Sound Watershed
2001-2006 (National Land Cover Database)

Map showing the distribution of Impervious, Agriculture, and Forest areas in the Long Island Sound Watershed from 2001 to 2006.
### Table 2: Summary of agricultural land cover and land use indicator data provided in the state sections

<table>
<thead>
<tr>
<th>Indicators</th>
<th>CT</th>
<th>MA</th>
<th>NH</th>
<th>NY</th>
<th>VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Fertilizer Spread</td>
<td>-38%</td>
<td>Not Provided</td>
<td>-25%</td>
<td>Not Provided</td>
<td>-32%</td>
</tr>
<tr>
<td>Number of Farms</td>
<td>+37%</td>
<td>Not Provided</td>
<td>+68%</td>
<td>Not Provided</td>
<td>Not Provided</td>
</tr>
<tr>
<td>Farm Acres</td>
<td>+2%</td>
<td>-29%</td>
<td>+28%</td>
<td>Not Provided</td>
<td>-8%</td>
</tr>
<tr>
<td>Agricultural Field (CLEAR, 1985-2010)</td>
<td>-1.3% (-0.8% riparian)</td>
<td>Not Provided</td>
<td>Not Provided</td>
<td>0%</td>
<td>Not Provided</td>
</tr>
<tr>
<td>Cropland</td>
<td>Not Provided</td>
<td>Not Provided</td>
<td>-7%</td>
<td>Not Provided</td>
<td>-25%</td>
</tr>
<tr>
<td>Other Agricultural Uses</td>
<td>Not Provided</td>
<td>Not Provided</td>
<td>-14%</td>
<td>Not Provided</td>
<td>Not Provided</td>
</tr>
<tr>
<td>Pasture</td>
<td>Not Provided</td>
<td>Not Provided</td>
<td>+259%</td>
<td>Not Provided</td>
<td>Not Provided</td>
</tr>
<tr>
<td>Woodland</td>
<td>Not Provided</td>
<td>Not Provided</td>
<td>+47%</td>
<td>Not Provided</td>
<td>Not Provided</td>
</tr>
<tr>
<td>Total Farm Animals (all listed below)</td>
<td>Not Provided</td>
<td>Not Provided</td>
<td>-17%</td>
<td>Not Provided</td>
<td>Not Provided</td>
</tr>
</tbody>
</table>
Chart 59. Changes in Relative Numbers of Livestock, 1850–1945. Census Data (Logarithmic) (Animal units used as a measure of total livestock numbers)

(Black 1950)
ANEFV 2060 Projections Compared with 1880

- 4 times as many New Englanders
- 1.7 times as many Livestock
- 43% as much Farmland
- 34% as much Pasture
- 5-fold increase for pasture, 4-fold for farmland overall
High N loadings: 500-1000 kg N per km² of watershed area

4.5 lb N per acre

N production in manure per year per animal (lbs)

Pig 12
Cattle 90-370
Layers 0.7
Turkeys 3
Control livestock access to water bodies (Appendix with Fencing information)

Control runoff from barnyards and feedlots

Divert roof runoff away from barnyards and feedlots

Manage pastures to reduce manure concentration
  • Placement of watering facilities
  • Herd management area placement
  • Paddock layout

When possible, compost manure

Manure storage and application guidelines
CHALLENGES AND OPPORTUNITIES

1. Siting of New Pastured Livestock Operations

2. Best Management Practices for Runoff from Pastures


4. BMPs for Manure
OPPORTUNITIES FOR NGOS AND ACADEMIA

Model operations on NGO or academic land
Watershed and site assessment methods and decision trees
Conservation restrictions and easements
Education and outreach
Model bylaws and regulations
Public policy
How to link new operations to BMP implementation
1. Siting of New Pastured Livestock Operations
   • Farm-specific conditions (streams, wetlands, soils)
   • Watershed conditions
   • Water quality status and issues
   • Effect of inputs
   • Forest-clearing implications?
   • Permitting Criteria?

Opportunities
   Model operations on NGO or academic land
   Research
   Watershed and site assessment methods and decision trees
   Conservation restrictions and easements
   Education and outreach
   Model bylaws and regulations
   Public policy
2. Best Management Practices for Runoff from Pastures
   • What Practices, Where?
   • Should they be Optional?
   • Financing – initiation and ongoing implementation
   • Monitoring for effectiveness
   • Adaptive change as needed

OPPORTUNITIES
Demonstration projects
Research
Education and outreach
Public Policy and Regulations
   • Stocking density
   • Rotation intervals
   • Stock condition
   • Forage condition and monitoring
   • Soil assessment
   • Access
   • Watering
   • Resting areas
   • Winter grazing/feeding

OPPORTUNITIES
   Demonstration projects
   Research
   Education and outreach
   Public Policy and Regulations
CHALLENGES AND OPPORTUNITIES

4. BMPs for Manure
   • Spreading
   • Winter management of livestock
   • Stockpiling and Composting
   • Lagoons

Opportunities
   Research
   Demonstration projects
   Education and outreach
   Policy and regulations
Land Base
Hydrology, Erosion, Sediment Loss
Social, Political, and Economic Changes
Best Management Practices
Pasture Retention
Livestock
Manure – Nutrients, Organic Load
WATER
Grazing Livestock and Water Quality

Forages, such as hay and pasture, are indispensable to humans. For centuries, grazing animals have benefitted mankind by their ability to convert forage into meat, milk, leather, and wool. However, poor grazing management can reduce animal production and degrade grasslands, rangelands, and water resources.

How can livestock grazing affect soil and water quality?

Poor grazing management can result in contamination of surface and subsurface waters through bacterial contamination, nutrient over-enrichment, and soil erosion from pastures. Recent research on the effects of fertilizer, manure, and urine on nitrogen cycling provides some surprising information. In pastures receiving 180 to 225 pounds of nitrogen fertilizer per acre, the nitrogen that was returned to the soil surface as urine or manure ranged from 338 pounds per acre for beef steers to 268 pounds per acre for dairy cows. In grass-clover pastures receiving no nitrogen fertilizer, the value was slightly less at 118 pounds per acre. Considering that a manure pile covers less than 1 square foot and a urine spot covers 4 to 7 square feet, it is interesting to note that the soil under each dairy cow manure pile or urine spot receives the equivalent of 500 to 1,000 pounds of nitrogen per acre.

The nitrogen in urine is immediately available to the plants, and most plants are overfed with the high concentration of this nutrient around a urine spot. Some of the nitrogen may be lost to the atmosphere. In contrast, the nitrogen in manure is released more slowly than the nitrogen in urine. The ability of plants to take up this much nitrogen is limited—they simply cannot use such heavy rates of nitrogen efficiently.
Livestock --100% to be produced in New England, primarily on pasture and hay, with grain ration imported

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dairy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption</td>
<td>1.5 cups/day</td>
<td>1.5 cups/day</td>
</tr>
<tr>
<td><strong>Production (number of animals)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dairy herd</td>
<td>225,000</td>
<td>1,860,000</td>
</tr>
<tr>
<td></td>
<td>(700,000 cows)</td>
<td></td>
</tr>
<tr>
<td><strong>Production (acres)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasture</td>
<td>na</td>
<td>1,800,000 ac</td>
</tr>
<tr>
<td>Hay</td>
<td>na</td>
<td>900,000 ac</td>
</tr>
<tr>
<td>(Grain -- Imported)</td>
<td>na</td>
<td>(174,000) ac</td>
</tr>
<tr>
<td>Meat and eggs</td>
<td>2010</td>
<td>2060</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>Consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red meat (beef &amp; lamb)</td>
<td>1.72 oz/day</td>
<td>0.6 oz/day</td>
</tr>
<tr>
<td>Pork</td>
<td>1.2 oz/day</td>
<td>0.6 oz/day</td>
</tr>
<tr>
<td>Poultry</td>
<td>1.9 oz/day</td>
<td>1.9 oz/day</td>
</tr>
<tr>
<td>Eggs</td>
<td>0.5 oz/day</td>
<td>0.5 oz/day</td>
</tr>
</tbody>
</table>
## Meat and Eggs

### Production (number of animals)

<table>
<thead>
<tr>
<th>Animal Type</th>
<th>2010</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef cows &amp; cattle</td>
<td>100,100</td>
<td>412,000</td>
</tr>
<tr>
<td>Sheep</td>
<td>51,500</td>
<td>2,240,000</td>
</tr>
<tr>
<td>Pigs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- sows</td>
<td>?</td>
<td>160,000</td>
</tr>
<tr>
<td>- pigs</td>
<td>52,800</td>
<td>2,600,000</td>
</tr>
<tr>
<td>Poultry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- layers</td>
<td>1,200,000</td>
<td>18,000,000</td>
</tr>
<tr>
<td>- broilers</td>
<td>55,000,000</td>
<td>335,000,000</td>
</tr>
<tr>
<td>- turkeys</td>
<td>145,000</td>
<td>17,200,000</td>
</tr>
</tbody>
</table>

### Production (acres)

<table>
<thead>
<tr>
<th>Type</th>
<th>2010</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture – New England</td>
<td>na</td>
<td>1,200,000 ac</td>
</tr>
<tr>
<td>Hay – New England</td>
<td>na</td>
<td>1,580,000 ac</td>
</tr>
<tr>
<td>(Grain – Imported)</td>
<td>na</td>
<td>(2,368,000) ac</td>
</tr>
</tbody>
</table>
## Meat and Eggs

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<tr>
<td>Pigs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– sows</td>
<td>?</td>
<td>160,000</td>
</tr>
<tr>
<td>– pigs</td>
<td>52,800</td>
<td>2,600,000</td>
</tr>
<tr>
<td>Poultry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– layers</td>
<td>1,200,000</td>
<td>18,000,000</td>
</tr>
<tr>
<td>– broilers</td>
<td>55,000,000</td>
<td>335,000,000</td>
</tr>
<tr>
<td>– turkeys</td>
<td>145,000</td>
<td>17,200,000</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Type</th>
<th>2010</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture -- New England</td>
<td>na</td>
<td>3,000,000 ac</td>
</tr>
<tr>
<td>Hay -- New England</td>
<td>na</td>
<td>1,580,000 ac</td>
</tr>
<tr>
<td>(Grain -- Imported)</td>
<td>na</td>
<td>(2,368,000) ac</td>
</tr>
<tr>
<td>Year</td>
<td>Number of Farms</td>
<td>Farmland Acres (to nearest 1 million acres)</td>
</tr>
<tr>
<td>------</td>
<td>-----------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>1880</td>
<td>205,000</td>
<td>14,000,000</td>
</tr>
<tr>
<td>1945</td>
<td>7,000,000</td>
<td>2,250,000</td>
</tr>
<tr>
<td>2010</td>
<td>2,000,000</td>
<td>360,000</td>
</tr>
<tr>
<td>2060</td>
<td>6,000,000</td>
<td>4,580,000</td>
</tr>
</tbody>
</table>

1945 and 2010 pasture data from NEFV spreadsheets

<table>
<thead>
<tr>
<th>## animals</th>
<th>Dairy cows</th>
<th>sheep</th>
<th>Beef cows</th>
<th>Sows</th>
<th>pigs</th>
<th>layers</th>
<th>broilers</th>
<th>turkeys</th>
<th>Poultry total ##</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>225,000</td>
<td>51,500</td>
<td>100,100</td>
<td>3,300</td>
<td>52,800</td>
<td>1,200,000</td>
<td>55,000,000</td>
<td>145,000</td>
<td>56,345,000</td>
</tr>
<tr>
<td>2060</td>
<td>1,860,000</td>
<td>2,240,000</td>
<td>412,000</td>
<td>52,800</td>
<td>2,600,000</td>
<td>18,000,000</td>
<td>335,000,000</td>
<td>17,200,000</td>
<td>370,200,000</td>
</tr>
</tbody>
</table>

animal units | Dairy cows | sheep | Beef cows | Sows | pigs | layers | broilers | turkeys | TOTAL A.U. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>3,605</td>
<td>75,075</td>
<td>1,452</td>
<td>8,976</td>
<td>20,400</td>
<td>93,500</td>
<td>725</td>
<td>430,743</td>
<td></td>
</tr>
<tr>
<td>2060</td>
<td>156,800</td>
<td>309,000</td>
<td>23,232</td>
<td>442,000</td>
<td>306,000</td>
<td>569,500</td>
<td>86,000</td>
<td>3,754,592</td>
<td></td>
</tr>
</tbody>
</table>