Best Management Practices for Managing Nutrients in the Watershed

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ONTARIO COUNTY
SOIL & WATER CONSERVATION DISTRICT

Have you had your dairy today?

Dairy in New York State

- New York is a national leader in dairy production (Avg. 3rd - 5th in national ranking)
- Milk is the largest share of agricultural sales in New York
- The Finger Lakes Region leads NYS in milk production

Figure 2. U.S. Milk Production by State

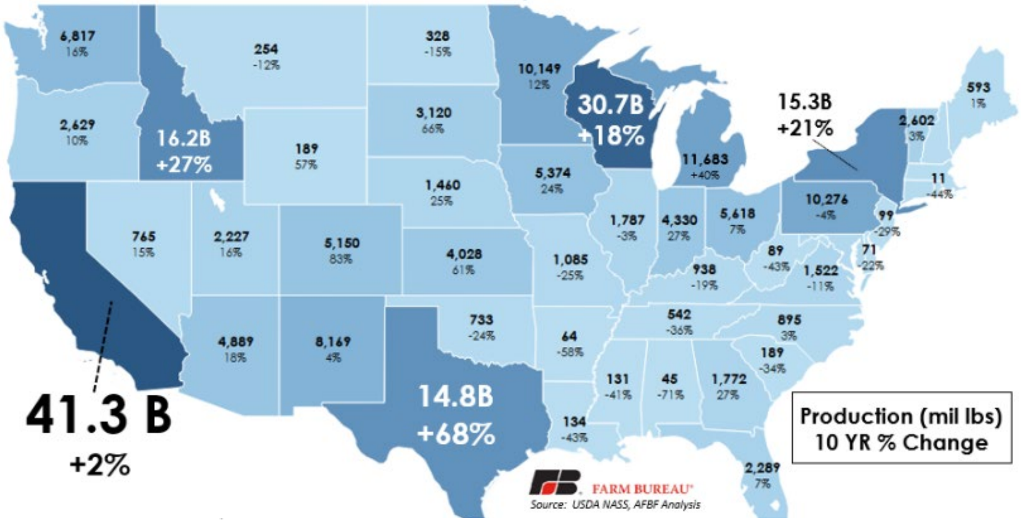


Figure 10
Agricultural Products by Sales, 2022

Product	Sales (millions)	Share of Total	U.S. Rank
Cow Milk	$3,873	48.2%	3
Grains, Dry Beans, Oil Seeds, Dry Peas	$954	11.9%	26
Fruits, Tree Nuts, Berries	$721	9.0%	5
Nursery, Greenhouse, Floriculture, Sod	$538	6.7%	10
Vegetables, Melons, Potatoes, Sweet Potatoes	$500	6.2%	12
Cattle and Calves	$493	6.1%	31
Other Crops and Hay	$410	5.1%	16
Poultry and Eggs	$356	4.4%	29
Horses, Ponies, Mules, Burros, Donkeys	$76	1.0%	5
Other Animals and Animal Products	$32	0.4%	14
Hogs and Pigs	$26	0.3%	30
Aquaculture	$25	0.3%	19
Sheep, Goats, Wool, Mohair, Milk	$17	0.2%	20
Cultivated Christmas Trees, Woody Crops	$15	0.2%	8

Source: U.S. Department of Agriculture

Manure Production on a Dairy Farm

- Managing milk production means managing manure
- Manure production on a dairy farm is highly variable based on:
  - Cow size
  - Bedding materials
  - Weather inputs
  - Cattle diet
  - Flushing inputs

Table 1. MANURE PRODUCTION ESTIMATES† (as excreted)‡

Animal	Size/lb	MANURE PRODUCTION (lb/day)	MANURE PRODUCTION (ft^3/day)	Water, %	N (lbs)	P_2O_5 (lbs)	K_2O (lbs)
Dairy							
Calf	150	12.00	0.185	88	0.06	0.01	0.05
Heifer	750	45.00	0.700	88	0.23	0.08	0.23
Lactating Cow	1,000	111.00	1.790	88	0.72	0.37	0.4
Lactating Cow	1,400	155.00	2.500	88	1.01	0.52	0.57

Table 13. Minimum recommended bedding requirements (lbs per day per 1,000 lb of animal weight).

Housing system	Long straw	Chopped straw	Shavings	Sawdust	Sand
Dairy					
Stanchion barn	5.4	5.7	—	—	—
Freestall housing	—	2.7	3.1	3.1	35
Loose housing bedding area	9.3	11.0	—	—	—
Swine					
(shed lot)	3.5	4.0	—	—	—
Poultry					
(floor level)	—	—	—	1.6	—

Source : Midwest Planning Handbook

Farmstead Manure Collection on a Modern Dairy Farm

- 2,800 cow dairy with 3,400 acres of land base
- Freestall style barn system
  - Animals move freely in a climate controlled, roofed environment
  - Covered barnyards remove the outside weather factor
- 150lbs or 18-20 gallons of manure produced is produced per 1,400lb lactating milk cow per day
  - 20-25lbs of treated manure solids are used for bedding material per cow/per day.
    - 36” avg rain per year in Ontario County
      - 1 inch of rain/acre/day is 27,000+ gallons of clean water added to the system
      - 6 acres of covered barnyards prevents 5.8 million gallons of clean water from entering the manure waste stream each year

Farmstead Manure Collection

Almost 100% of manure can be salvaged inside a properly designed covered barnyard environment

- Maintains its overall nutrient value very well

Manure in an open barnyard environment can result in up to 40% of manure being unsalvageable for proper nutrient application

- Losses include salvageable volume from runoff as well as decreased nutrient value due to dilution and leaching

Manure Collection and Transfer

- Manure collected in the covered barn using a scrape alley leading to a reception pit
  - A reception pit will have a pump and pipeline system that may be connected to:
    - A digester facility
    - A separation facility
    - A manure storage
    - A field application site

Transfer

- Direct pump from storage to field, frac tank, or other storage sites.
- Separated manure is very easy to pump
  - 8”-12” SD11 class smooth-wall pipe
  - Many of our farms are pumping manure miles now
- 6.2 miles of buried manure transfer line
  - 3 connected manure storages (15 million gallons total connected storage capacity)
  - Manure can then be pumped another 2-3 miles using temporary movable hose to the final application site
- Manure can be moved through this transfer pipeline system at 800,000 gallons per day

Anaerobic Digestion

- 80,000 gallons of manure treated daily
- Manure stays in the reactor for 30 days
- Biogas and digestate are discharged from the digester as useable products:
    - Biogas = Energy Source
    - Digestate = Nutrient Source
  - System is currently servicing 750 single family homes daily with gas production
  - 5-10% of additional fugitive methane gasses are flared off at the digestor facility during the 30 day process
  - The remaining 40-50% of methane stays with the manure volume that is pumped back to the covered and flared storage facility.

Manure Separation

- Solids are pressed or filtered out of manure on the farm, treated for re-use, sold, or field applied
- In a digester-based system manure is separated AFTER digestion
- Manure stored under a cover <u>must</u> be separated
- 5-15% solids in liquid manure on a dairy farm based on animal diet/bedding material
- The separation system salvages an average of 3% of the 8% solids from raw manure
- The manure is 95% moisture after digestion and separation
- Many separation systems are often only around 50% efficient in salvaging solids
  - Even at a lower efficiency, most farms are still able to produce more than enough bedding materials to meet their needs

Manure Separation Continued…

- Recycling separated solids
  - 28,000lbs/day is recycled for use for cow bedding
  - Up to 14,000lbs/day exported (sold) for compost ingredient products
    - Reduction of 21 total tons of solids that would need to be field applied
- Bedding with solids:
  - Saves the farm $74.50 per cow per year in bedding material cost over purchased sawdust material
    - $293,000 annual savings by using farm produced recycled bedding
  - After the separation facility, the manure is transferred to the covered manure storage



Steps in Building a New 4.1 Million Gallon Covered and Flared Manure Storage Facility - 2023



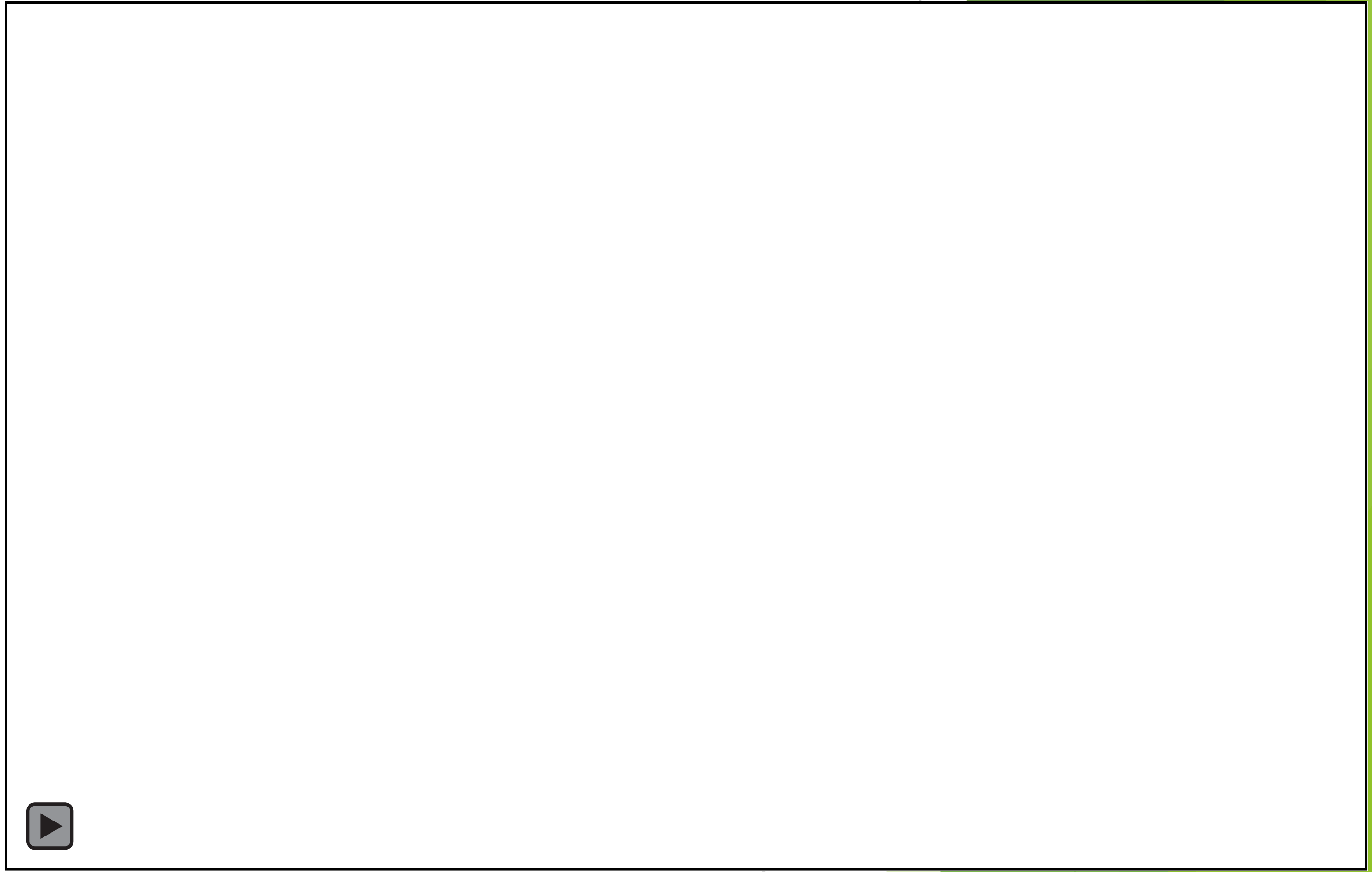

DANGER
LIQUID
MANURE
STORAGE
PELIGRO
ALMACENAJE
DE ESTIERCOL
LIQUIDO

Flaring of Methane Gas

- A flare system uses a flame to burn off collected methane gas before it enters the atmosphere
- Converts CH4(methane) to C02(carbon dioxide)
  - Both are greenhouse gases
    - C02 is much less potent then CH4 (up to 20x less)
  - Flaring alone does not capture the energy off the methane

Clean Water Exclusion & Waste Reduction through Cover and Flaring a Manure Storage

- 1.47 acre covered manure storage area
- 977,540 gallons of clean water is now excluded from the waste storage each year
  - 163 manure tanker loads that does not need to be managed as waste each year
- Preserves nutrient value of the manure
- Why wouldn't you cover?
  - Engineering
  - Management
  - Cost



Field Application of Manure

3,468 acres of tillable cropland

- +-2000-2600 acres corn each year on average
- +-1000-1200 acres of hay/alfalfa/small grains each year on average

- 100% of these acres are under a nutrient management plan
- All fields and nutrient sources are lab tested every 3 years
    - CNMP matches manure source with the crop needs
    - Each field is assessed for nutrient runoff and leaching loss risk
    - Agronomic application rates are assigned to each field
- Average application rates:
    - 8-10,000 gallons per acre/year on corn ground
    - 6-8,000 gallons per acre/year on hay ground
- 100% of manure put on corn acreage is injected into the ground
- Hay/alfalfa ground is top-dressed
    - Sprayed/dribbled directly on top of forage
- 75%-80% of all nutrient needs on this farm are currently met by manure
    - Remainder is primarily starter fertilizer used at planting

A Little More on Manure Injection

- Manure is placed/knifed directly into the ground
- Greatly reduces risk of surface runoff
  - Phosphorus quickly binds to soil
- Does not work well on hay/alfalfa
- Tilling manure into the field after application is another good option for corn/open acreage

Cover Crops on a Modern Dairy Farm

- Cover crops are planted for the purpose of providing erosion control and nutrient scavenging benefits after the harvest of a forage/commercial crop
- Farm planted 1,500+ acres of cover crops in Fall 2025,
  - 25%-35% of the farm cropland is cover cropped in a good year
- A rye grass or winter cereal grain based cover crop can help scavenge and hold 25-100lbs of nitrogen in place over the winter months and reduce soil erosion risk by up to 2 tons/acre/year
- Cover crops use has become widely accepted within the modern dairy community
  - Extremely important in helping dairy farms meet their comprehensive nutrient management plan goals

Nutrient Management on Small Farms

- Fencing/Grazing Management
- Barnyard Management
- Ag Chemical Mixing Facilities
- Cover Crops
- Soil Testing

Weather Inputs are Significant

- Open earthen-based barnyards can lose 15%-20% of annual precipitation as contaminated runoff
- Open concrete-based barnyards can lose 45-50% of annual precipitation as contaminated runoff
- Treatment/capture/elimination of runoff through:
  - Vegetative Treatment Areas(VTA)
  - Concrete curbed barnyards
  - Engineered collection pits
  - Covered barnyards

Barnyard Management Projects

Thank you! Questions?

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