CASE STUDY

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EAGLEVIEW COMPOST DAIRY BARN

FUNDED BY: NY farm viability INSTITUTE

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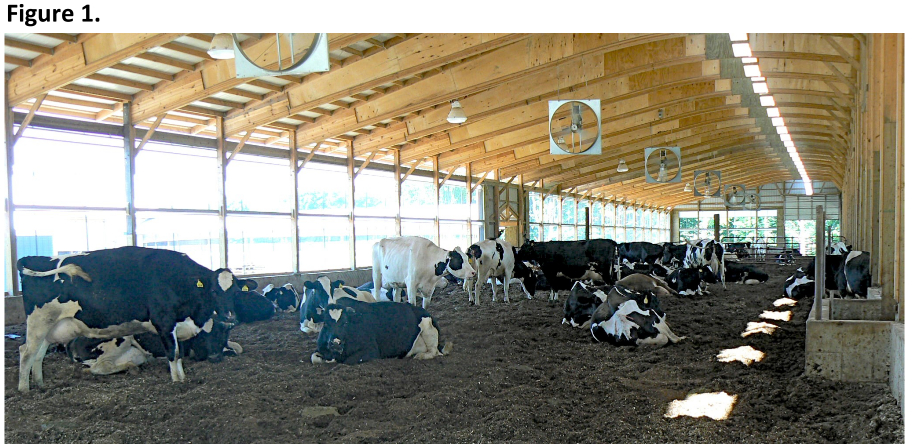
THE HISTORY

Eagleview Dairy, LLC located in Bliss, New York was formed in 2006 by combining two separate herds. Many factors were considered when deciding to build a compost dairy barn. Primarily, the Boldt and Luders family hoped the barn would provide their herd with maximum cow comfort as well as create environmental benefits. Neighbor relations also stood to be bolstered by the reduction of odors. Additional benefits identified along the way included using the pack as an alternative to current manure storage and the possibility of marketing the composted material to generate an additional line of revenue for the business.

Construction of the facility began in the summer of 2006 and was completed by the spring of 2007.

Figure 1.



Compost bedded pack barn provides Eagleview's cows with a dry, comfortable place to rest and ruminate.

THE CONCEPT

Wyoming County, located in western New York State, is home to 47,700 dairy cows and 43,000 residents. The county ranks 32nd among counties in the nation for dairy production. With more than 60 Concentrated Animal Feeding Operation (CAFO) sized farms, it is the number one dairy county in New York State.

Many of the farms in the county utilize waste storage structures, the most common being a liquid manure system. These systems, when properly managed, afford certain advantages: capture and retention of nutrients, timing of applications, and avoidance of spreading during inclement weather (a real plus in an area located near Buffalo, New York).

Unfortunately, these systems are not without their shortcomings. The most notorious being the odors associated with agitation and spreading. Lagoons, SlurryStores®, and underground tanks are largely stagnant, anaerobic environments that when disturbed release methane, ammonia, hydrogen sulfide, various other volatile organic compounds (VOCs), and even some particulate matter. Methane is a known green-house gas, ammonia stings the eyes and nostrils of the neighbors, and hydrogen sulfide is deadly in confined spaces or may otherwise cause respiratory distress.

Moreover, these are open structures exposed to the elements catching all manner of precipitation. Here in western New York that means an extra 40.2 inches of water per year – 40.2 inches that has to be agitated, pumped, hauled, and spread, but that would otherwise be clean water!

Spills and runoff are secondary hazards associated with these systems, especially those that are improperly designed and/or maintained. We've seen first hand evidence of this with the massive spill, ~3 million gallons, in the summer of 2005 in Lewis County, NY resulting in the temporary shutdown of the City of Watertown's water treatment plant; 200,000 fish killed; and the loss of tourism dollars to the local economy.

The compost bedded pack system, however, seeks to exploit the benefits of storage – nutrient retention and application timing – while minimizing or eliminating the liabilities – odor, runoff and spills. This is a relatively new technology (<8 years), and initial installations have been successful. Unfortunately, not a great deal is known about operational costs, necessary management, economic and environmental benefits, or why it works. Until this time, the system had never been tried in the northeast.

Originating in Virginia, the concept was brought to Minnesota in 2001 by Tom and Mark Portner of Sleepy Eye, MN. The compost bedded pack is not a conventional manure bedded pack. In the conventional pack new bedding is added simply to cover a soiled surface. Any oxygen in the covered layer is rapidly depleted so the environment becomes anaerobic resulting in a slimy, fetid mess that becomes increasingly difficult to maintain. Conversely, the compost bedded pack is actively managed by tilling frequently. This introduces oxygen into the top layers which promotes an aerobic microbial degradation and the resulting heat aids in drying the surface. The tilling also helps to capture nutrients by mixing the carbon of the sawdust with the nitrogen of the feces and urine.

Figure 2.

With a layout similar to a 3-row freestall barn, the compost bedded pack barn provides 18" to 24" of feed bunk space per cow depending upon the stocking density.

Figure 3.

Nuisance birds are discouraged by eliminating perches and nesting places with closed web trusses, flush mounting purlins and roof deck, and covering bracing members with netting.

THE EAGLEVIEW FACILITY

Two compost bedded pack barns, 80' x 300' and 80' x 275', were constructed to house approximately 350 dairy cows. The structure is very similar to a 3-row freestall barn (Figure 2), but instead of stall beds and dividers a 50' wide pack area was installed. This pack area is surrounded by a 4' high x 10" thick concrete retaining wall to confine the bedding and animal waste. Beneath the pack is a 12" thick clay liner constructed to Natural Resource Conservation Service (NRCS) specifications.

The laminated truss design of the roof structure and a central ridge vent allow for natural ventilation. However, the closed webs of the trusses and the flush mounting of the purlins and roof deck discourage habitation of nuisance avian species such as starlings. Additionally, all cross bracing members are covered with a nylon bird netting to preclude any nesting sites without compromising natural air flow. (Figure 3)

Twelve foot high, curtain sided walls facilitate the natural ventilation and aid in maintaining a dry pack surface. Fans are strategically placed to supplement ventilation during tilling and/or periods with little or no wind. A 3' roof overhang and a French perimeter drain along the outside of the wall keep rain and surface water from entering the facility. (Figure 4)

Additionally, the cows themselves reap the benefits of increased comfort. The pack area is easier to get into and out of than a conventional freestall. Lame and geriatric animals function better, somatic cells counts are lower, overall stress is reduced, and production is increased. Heats (estrus) are more actively expressed due to the improved footing. The drier conditions, in combination with a foot bath, have effectively eliminated digital dermatitis (hairy heel warts). *(See section on herd health and mobility on page 6).*

Figure 4.

Generous 3' roof overhang and perimeter French drains work in concert to prevent rain and surface water from entering the pack area.

CONSTRUCTION COSTS

Eagleview Dairy, LLC tracked construction costs for the compost barns independently of the costs of constructing the milking center, bunker silo and commodity shed. The total cost of compost dairy barn construction, $731,700, is detailed in Table 1. According to local agricultural lenders, this cost is on par with local costs for free stall barn construction. Because of the attributes of this facility for protecting the environments, the farm was able to tap into a NRCS Conservation Innovation Grant. Additionally, a New York State Environmental Protection Fund Grant has been approved for construction of an additional 30'x100' compost bedded pack barn behind the existing parlor and holding area for dry and transition cows.

Table 1.

Eagleview Compost Dairy Barn Construction Costs

2 Pack Barns Without Milking Center 2006-2007

	Total Cost	Cost Per Cow: 294 cows 100 Ft^2/cow	327 cows 90 Ft^2/cow	368 cows 80 Ft^2/cow
General Construction with Curtain Sidewalls	$460,000	$1,565	$1,407	$1,250
Excavation & Drainage	$65,000	$221	$199	$177
Clay Lining	$15,000	$51	$46	$41
Concrete	$138,500	$471	$424	$376
Electrical & Plumbing	$35,000	$119	$107	$95
Overhead Doors	$18,200	$62	$56	$49
Total	**$731,700**	**$2,489**	**$2,239**	**$1,988**

20/20 HINDSIGHT

Following the implementation of any new design, there is always an element of "woulda, shoulda, coulda". In other words, now that it has been put into practice, "Maybe we should have ...", or "We wish we would have...". A few of these laments, as they relate to the physical facility, are:

1. **Raise the entrances to the pack.** Each pack has a concrete pad where the animals enter the pack from the feed alley. The elevation of the pads is the same as the feed alley, however, they are separated by a 12" high curb. Moisture, feces, etc. become trapped on the bedded side of the curb (as shown in Figure 5) and contribute to accelerated soiling of the bedding in these high traffic areas. A possible alternative would be to raise the pad 12" so that it is flush with the curb and slope it ~1% up into the pack area. Then, as animals enter or leave the pack, urine and accumulated solids on the pad would be worked (walked) off into the feed alley. Unfortunately, this would also mean that the retaining wall between the pack and feed alley would also have to be increased 12" in order to maintain a minimum 4' height on the pack side.
2. **Decrease the width of the pack ~20% – from 50' to 40'—while increasing the length by 20%.** The management team at Eagleview has noticed that even with only a neck rail (no lock-ups), animal performance is best when the stocking rate in each pen equals two lineal feet of manger space per head. At 80 ft^2./cow and a 50' wide pack, that equates to only 19" per head, but 80 $ft.^2$/cow on a 40' wide pack yields 24" per head.
3. **More fans.** For 10+ months each year the existing fans and natural ventilation system adequately cool and ventilate the barns. Unfortunately, during the "dog days" of summer, when even the evenings don't cool down, additional air movement is required.

An interesting phenomenon was noted in the summer of 2008. When the air temperatures were high (>80°F), the animals would congregate near the center of the barn, but as soon as the temperatures decreased the herd was evenly dispersed across the pack. It was later determined that the alley connecting the centers of the two barns with the milking complex was acting as a wind tunnel, and the animals were taking advantage of the accelerated air flow.

This grouping phenomenon caused wet areas where the cows congregated. Compost activity diminished in these saturated areas due to lack of oxygen. Saturated areas required more frequent addition of new bedding material, often twice daily, and additional tilling to keep the compost process active and provide a clean environment for the herd.

Both winter and summer ventilation must be adequate for evaporation to dry the pack.

Figure 5.

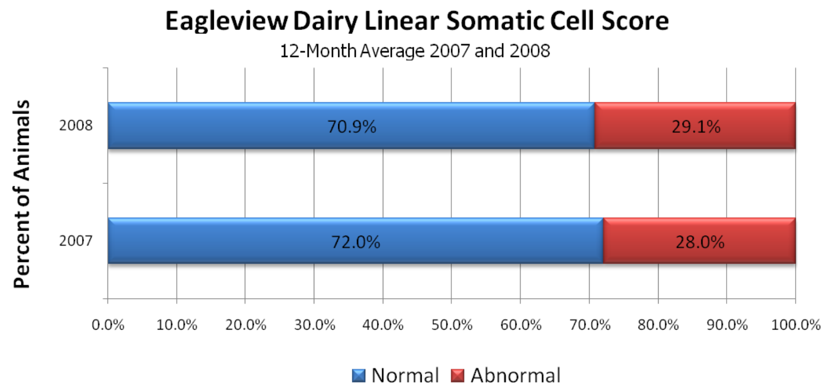
Sloping the pad at pack entrances to the top of the curb could have avoided build-up of wet material where animals enter the pack.

MILK QUALITY

Somatic Cell Count

Because mastitis is frequently sub-clinical, a number of tests have been developed for detecting mastitis. Most tests estimate the somatic cell count (SCC) of a milk sample. All milk contains white blood cells, known as leucocytes, which constitute the majority of somatic (derived from the body) cells. It has been generally accepted that the cell count for "normal" milk in cows is nearly always less than 200,000 cells/ml and, in heifers, is nearly always less than 100,000 cells/ml. Higher counts are considered abnormal or excessive and indicate probable infection. SCC can be done on individual cows or on bulk tank milk samples.

Figure 6.



Eagleview Dairy linear scores show the number of animals with normal milk was the same in August 2007 and August 2008 indicating the compost bedded pack had no impact on milk quality.

Linear score (LS) is another measurement of SCC that is less variable than raw SCC. It is calculated based on the raw values, and each doubling of raw values increases the linear score by 1. A somatic cell count of 25,000 is equal to a linear score of 1; 50,000 equals 2; 100,000 equals 3; 200,000 equals 4; 400,000 equals 5 and so on. Therefore, a linear score that is greater than 4 for cows and greater than 3 for heifers, indicates a possible intramammary infection.

Individual cow linear score was determined by Dairy One and those records were used to calculate a 12 month average LS for 2007 and 2008 on the same 254 lactating animals. The number of animals with normal milk in 2008 (180 or 70.9%) was statistically the same in 2007 (183 or 72.0%), which is illustrated in Figure 6.

Siblings Candi Luders and Scott Boldt, who do the milking at Eagleview Dairy, have noted that it is important to flame udders on a regular basis. This helps to keep the udders cleaner and reduces the labor involved in cleaning and sanitizing teats for milking.

Pathogens in Bedding

With the temperatures generated by the compost process, periodically there is a reduction of pathogens. The bed is never sufficiently heated in a uniform manner to sanitize the bed completely. Literature indicates that it may not be good to have pathogen free bedding because if the cows' feces contain pathogens, those organisms could colonize the bed without competition from other organisms in the bed. Since you cannot keep a bed sterile, it is better to keep a balance of organisms. Organism levels were tested in this project and were found to be typical of cow habitats in the Northeast. Table 2 details the pathogens found in the compost beds at Eagleview Dairy.

Table 2.

Pathogens Found in Compost Bed Samples June 2007 to June 2008
Strep Species
Staphylococcus Species
Gram Negative Bacillus
E. coli
Klebsiella
Gram Positive Bacillus

HERD HEALTH

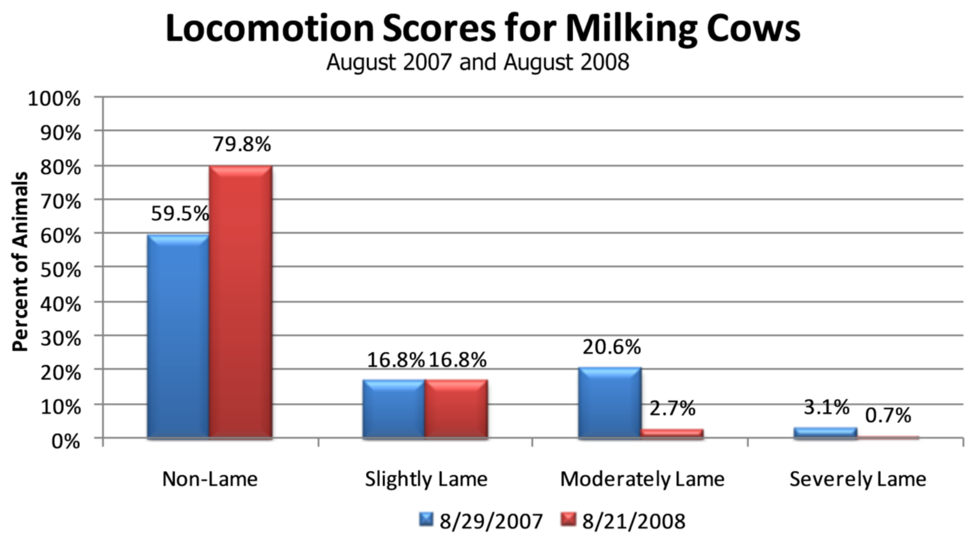
Lameness

Compost Dairy Barns have been reported to improve cow comfort and the condition of feet and legs. In an effort to see if this were true, lactating cows and first calf heifers at Eagleview were observed in August of 2007, and then again in August of 2008 and given a locomotion score based on a 4-point scale:

- 1 = **Non-lame:** the cow stands and walks with a flat back
- 2 = **Slightly lame:** the cow stands with an arched back, but walks with a flat back
- 3 = **Moderately lame:** the cow stands and walks with an arched back and takes short strides on one or more legs
- 4 = **Severely lame:** the cow stands and walks with an arched back, and one or more limbs are physically lame or non-weight bearing.

In 2007, the average locomotion score for first-calf heifers was 1.4 and for cows it was 1.8. After one year on the bedded pack, the average locomotion score for heifers had decreased significantly to 1.0 and for cows had decreased significantly to 1.3 ($p < .0001$). The use of the compost bedded pack helped to improve mobility for Eagleview Dairy's cows (Figure 7).

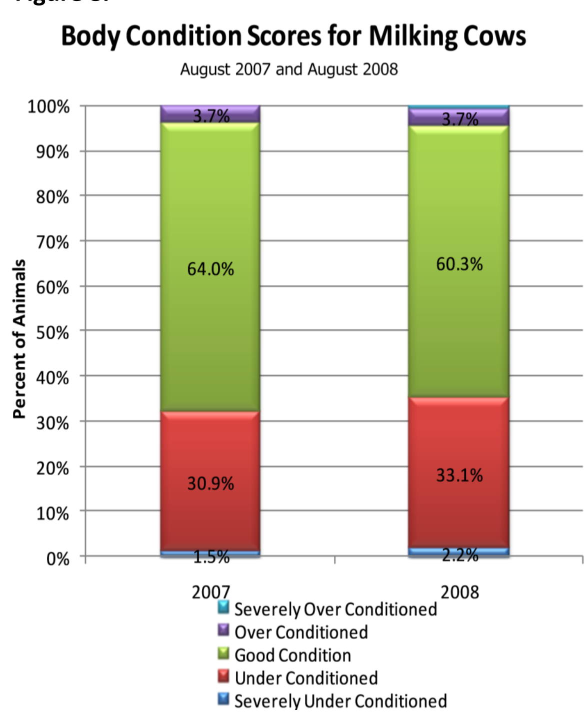
Figure 7.



Locomotion scores show a decline in percent of lame cows, from August 2007 to August 2008, after first year experience.

According to a 2003 Wisconsin study by Cook, the incidence of clinical lameness (scores 3 or 4) during the summer in the 30 herds housed in free stall and tie stall barns he studied was 21.1%. Eagleview Dairy has documented a reduction in the incidence of lameness since their herd has been housed on the compost bedded pack. Between August 2007 and August 2008, the percent of lame cows declined from 23.7% to 3.4% of the herd. For their 375 cow dairy, this translated to 75 fewer cases of lameness each year. The typical cost, in terms of lost milk revenue and treatment cost for an incidence of lameness, has been documented by industry experts to be about $450.

Figure 8.



Eagleview Dairy body condition scores remain unchanged with compost bedded pack housing compared to freestall or tie stall environments.

For Eagleview, this translates to an increase of $33,000 in net revenue.

Body Condition Score

Body condition scoring is a method of evaluating fatness or thinness of dairy cows according to a five-point scale. Body condition influences productivity, reproduction, health and longevity of the dairy cow. Over conditioned animals are more susceptible to metabolic problems and infections and are more likely to have difficulty at calving.

Thin cows often do not show heat or conceive until they maintain body weight. A cow in good condition will have a score of between 2.75 and 3.75, giving the cow adequate, but not excessive, body fat reserves. At the same time locomotion scoring was done, a body condition score was given to each of the lactating animals using the five-point scale with 0.25 increments:

- **1 – 1.75:** Severely under conditioned, emaciated
- **2 – 2.5:** Under conditioned, frame obvious
- **2.75 – 3.75:** Good condition, frame and covering well balanced
- **4 – 4.75:** Over conditioned, frame not as visible as covering
- **5:** Severely over conditioned, obese

The average body condition score in 2007 was 2.9 and in 2008, it was 2.8. Average body condition scores did not change significantly between 2007 and 2008. (Figure 8)

COMPOST ASPECTS OF THE BEDDED PACK

How does composting work?

A carbon source, like sawdust, is put in the bedded pack barn to start the pack. About 24” of material is added to create the initial bed. Then cows are put on the bed, adding feces and urine. The manure adds nitrogen to the bed. After a few layers build, the micro-organisms have the capacity to generate heat. When the bed gets wet and soiled, more carbon is added to the pack to maintain the required carbon:nitrogen ratio and bulk density for composting and to keep the cows clean. The pack is turned on an “as needed” basis and varies seasonally. The pack might be turned as often as twice per day to every other day. In winter the pack may be turned less frequently depending on climatic conditions to conserve heat and promote compost activity.

If the compost process is working optimally, it produces temperatures in the range of 120-150°F. This temperature range would be very uncomfortable for cows. However, compaction from the weight of the cows, in combination with turning according to a prescribed protocol, controls the process. In this case, the process is managed to strike a balance between optimizing compost performance and cow comfort with temperatures maintained in the 70-110°F range. The turner (deep shank cultivator) is pulled through the bedding mix, aerating about 24” of the pack. (Figure 9) This turning generates more heat, until the collective weight of the cows sufficiently compresses the air out of the pack. At that point, turning will be required to keep the heat in

Figure 9.

Deep shank cultivator tills pack to depth of about 12 inches twice daily unless temperatures dip below 10°F.

Table 3.

Compost Analysis Eagleview Dairy Fall 2007 - Spring 2009	Average	Range	
pH	8.3	7.9-8.6	
Soluble Salts	9.1	6.6-13.7	mmhos/cm
Solids	37.1	28.7-49.7	%
Moisture	62.9	50.3-71.3	%
Organic Matter*	91.2	77.3-94.2	%
Total Nitrogen-(N)*	1.6	1.0-1.8	%
Organic Nitrogen*	1.4	0.5-1.8	%
Ammonia N (NH_4-N) *	1629.5	73.0-4985.2	mg/kg
Carbon*	44.6	38.1-49.0	%
Carbon: Nitrogen (C:N) Ratio*	29.1	21.5-45.1	
Phosphorus*	0.68	0.42-0.98	%
Potassium*	1.61	1.25-2.05	%

*** Dry Weight Basis**

the range of 85-90°F in summer months and 50-70°F in the colder months. Managing the pack requires a fine balance between moisture level, carbon (bedding) to nitrogen (manure) ratio, and aeration. Eagleview Dairy has fine-tuned aeration, or turning, to use it as the throttle on the composting process. The heat generated in the packs helps to evaporate moisture.

If there is too much moisture and/or too much compaction, the organisms in the pack that produce heat will not be able to function. In summer, these organisms function in a diminished capacity to keep beds cool. In winter, because of cold ambient temperatures, snow, ice and relative humidity, the organisms work very hard to keep pack temperatures at 50-70°F. Samples taken during the May 2009 cleanout, at three depths in each pack, clearly showed diminished compost action during the coldest part of the winter.

Physical properties of the pack at cleanout:

⇒ **Bottom layer (from late fall)** - dry and crumbly with an earthy odor

⇒ **Middle layer (from winter)** - wet and putrid smelling

⇒ **Top layer (from spring)** - dry crumbly texture and earthy odor

When the material is removed from the barn it can either be land spread as is, or composted further to produce a product suitable for horticulture, organic agriculture, and home gardens. As it comes out of the barn, the bedded pack material is about 50% composted or stable (see Table 3 for compost analysis). It still has a high C:N ratio, is high in soluble salts, and has pathogens in it, but it works well for meeting the nutrient requirements of field crops.

When the goal is to sell a compost product, it will need to be windrowed and turned to finish the compost. The finishing process takes care of pathogens and weed seeds and produces a more stable product for horticulture, organic agriculture and home gardens. To have a saleable product for horticulture purposes, composting should be done outside to allow the salts to leach out of the compost material. Otherwise, it will need to be blended with topsoil to reduce salt concentrations.

Alternative Bedding Materials

With the cost of kiln dried sawdust nearly doubling since their new barn was

Table 4.

Winter Compost Turning Protocol	
Winter 2007/2008	
PRACTICE:	Tilled pack twice daily
	Added bedding to pack (add carbon material) two or more times per week
RESULT:	January, February and March pack temperatures dipped into the 50°F to 60°F range
Winter 2008/2009	
PRACTICE:	If ambient temperature >25°F; tilled pack twice daily and added bedding as needed, generally twice per week
	If ambient temperature <25° but >10°F; tilled pack once daily and added bedding as needed, generally once per day
	If ambient temperatures <10°F; did not till pack; added bedding as needed generally once per day
RESULT:	Pack temperatures maintained in the mid-70's °F throughout winter

built, Eagleview Dairy has explored the suitability of alternative bedding materials for their compost bedded pack system. Sawdust is clearly the "gold standard" in dairy bedding materials. The combination of absorbency and structure make it an ideal material for this system. In order to provide a clean dry bed for the cows, the bedding must absorb urine and the moisture from the feces excreted. For the composting process to be effective, the organic bedding material must have rigid enough cell wall structure to provide porosity to allow aeration throughout the actively composting layer.

Cereal grain straw, chipped pallets, coarse hay, soybean straw and corn stover were evaluated. Soybean straw and chipped pallet material worked well in combination with sawdust in the compost bedded pack system. Both materials provided the absorbency and bulk density necessary to meet cow comfort and the porosity required to foster an aerobic compost process. Chopped cereal grain straw and hay, although relatively absorbent, tended to mat and clump making it more difficult to maintain the fluffy porous bed needed for aeration. Corn stover was less absorbent and once wet tended to "liquify" rather than holding the coarse particle size needed for aeration.

Analysis of a limited number of samples of the resulting partially composted manure, showed essentially no difference in fertility value or compost process indicators among the sawdust only, sawdust/chipped pallet combination or sawdust/ soybean straw combination. For cleanliness and cow comfort reasons, use of cereal grain straw and corn stover combinations were discontinued before enough manure volume had accumulated for testing.

Table 5.

Manure Analysis

Eagleview Dairy Fall 2007 - Spring 2009

	Percentage		Pounds Per Ton	
	Average	**Range**	**Average**	**Range**
Nitrogen (N)	0.577%	0.413% - 0.807%	11.6 lbs./ton	8.3 - 11.6 lbs./ton
Ammonia Nitrogen	0.116%	0.051% - 0.193%	2.3 lbs./ton	1.0 - 3.9 lbs./ton
Organic Nitrogen	0.462%	0.220% - 0.683%	9.2 lbs./ton	4.4 - 13.7 lbs./ton
Phosphorus (P)	0.091%	0.055% - 0.147%	1.8 lbs./ton	1.1 - 2.9 lbs./ton
Phosphate Equivalent (P_2O_5)	0.208%	0.127% - 0.337%	4.2 lbs./ton	2.5 - 6.7 lbs./ton
Potassium (K)	0.452%	0.356% - 0.802%	9.0 lbs./ton	7.1 - 16.0 lbs./ton
Potash Equivalent (K_2O)	0.545%	0429% - 0.966%	10.9 lbs./ton	8.6 - 19.3 lbs./ton
Total Solids	33.560%	29.420% - 42.470%		
	Kg/L		**Lbs/CuFT**	
Density	0.8 Kg/L	0.6-1.0 Kg/L	52.28 Lbs/CuFT	37.9-63.8 Lbs/CuFT

FERTILITY VALUE OF COMPOST BEDDED PACK MANURE

Eagleview Dairy, LLC farms with about 235 acres of moderately well to well drained soils and about 80 acres of somewhat poorly drained soils. Their rotation typically includes 80 acres of grass, 171 acres of corn and 64 acres of alfalfa/grass hay. All their acreage is dedicated to forage production. They purchase additional forage to support the dairy and custom board heifers over 12 months of age because they lack the land base to grow enough forage for the whole herd.

The average compost bedded pack manure sample (Table 5) yielded 2.3 pounds of ammonia nitrogen, 9.2 pounds of organic nitrogen, 4.2 pounds of phosphate equivalent (P_2O_5) and 10.9 pounds of potash (K_2O) per ton. This is approximately one third of the amount of ammonia nitrogen, four times the amount of phosphorus and organic nitrogen and one and a half times the amount of potash that 1000 gallons of a lagoon liquid manure would provide. The organic nitrogen breaks down over a span of about three years. About 25% of the organic nitrogen spread will be available to the plant the first year, about 12% the second year and 5% the third year. The compost bedded pack manure is high in organic matter which increases soil health.

However, the use of this type of manure has changed the cropping recommendations from nitrogen based to crop removal based. This is due to the amount of phosphorus that is being spread per ton. If 25 tons of compost bedded pack manure is spread prior to corn planting, that application will provide 105 pounds of phosphorus toward the current year corn crop. Average phosphorus removal is 105 pounds for 21-ton corn silage. This will give the crop exactly what it is going to remove from the soil.

Phosphorus level is an important consideration because, if the phosphorus index on CAFO sized farms reaches very high, then manure can no longer be applied to that field. An eight-year rotation, with four years of corn and four years of alfalfa/grass hay, would need about 720 pounds of phosphorus and 1840 pounds of potash. Using this assumption, if 35 tons of compost bedded pack manure is spread on 2nd, 3rd and 4th year corn and in the seeding year, it will provide 588 pounds of phosphorus and 1526 pounds of potash. This will allow a farm to keep spreading manure on corn ground and 4th year hay without raising phosphorus index levels to very high. In summary, if a farm does not have the land base to spread all of their manure, then they will have to resort to exporting manure.

Figure 10.

Composted pack manure is light and fluffy. It holds more of the nitrogen in the more stable organic form compared to fresh or liquid manure.

The compost bedded pack manure is very light and fluffy and spreads evenly as you can see in Figure 10. It does not spread in chunks. Eagleview Dairy is able to just broadcast the cover crop seed and then spread the composted manure on top. It does not need to be worked in making it the perfect fertility source for use with no-till or zone-till tillage systems.

Valuing manure can be a challenge when one considers all the factors, including storage, hauling, and spreading, and is highly variable depending upon the distance involved and the nutrient content of the manure. In Table 6, the value is calculated based upon what it would have cost the farm to replace the nutrients available from the manure with purchased fertilizer for the 2009 cropping season.

Table 6.

Calculation of Compost Bedded Pack Manure Values

Component		Calculation**		Value
Organic N-Year 1	=	9.2 lbs/Ton x 10 Ton = 92 lbs/10 Ton x .25 available in year 1 = 23 lbs/10 Ton x .21 /unit of N	=	$4.83
Organic N-Year 2	=	9.2 lbs/Ton x 10 Ton = 92 lbs/10 Ton x .12 available in year 2 = 11 lbs/10 Ton x .21/unit of N	=	$2.31
Ammonia N	=	2.3 lbs/Ton x 10 Ton = 23 lbs/10 Ton x 0 (All ammonia volatized due to surface spreading)	=	$0.00
Solid P_2O_5	=	4.2 lbs/Ton x 10 Ton = 42 lbs/10 Ton x .23/ unit of P_2O_5	=	$9.66
Solid K_2O	=	10.9 lbs/Ton x 10 Ton = 109 lbs/10 Ton x .75/ unit of K_2O	=	$81.75
		Fertility Value of 10 Ton of Manure:		**$98.55**
		Fertility Value of 20 Ton of Manure:		**$197.10**
		Fertility Value of 30 Ton of Manure:		**$295.65**

**These calculations are based on local Spring 2009 fertilizer values at $460 per ton for MAP (monoammonium phosphate); $420 per ton for urea, and $925 per ton for potash.

POSITIVE ASPECTS OF COMPOST BEDDED PACK

The compost bedded pack provides a very comfortable environment for dairy cows. Pack temperatures are able to be maintained in the summer at 85°F to 100°F. During the winter, with careful attention to ambient temperatures and turning protocols, composting can continue with pack temperatures in the mid-70's °F. The pathogen load in the environment is similar to other housing systems. Milk quality is acceptable with somatic cell counts in the acceptable range. Finally, the level of lameness in the herd decreased significantly from when they were housed in free stalls or tie stalls.

Compost bedded pack manure is an excellent nutrient source to use with zone-till and no-till cropping systems. This is because more of the nitrogen is in its stable organic form, compared to liquid or fresh

Odors are reduced and more of the nitrogen is captured as organic nitrogen, making the compost bedded pack manure more neighbor and environmentally friendly than other dairy manure handling systems.

CHALLENGES OF THE COMPOST BEDDED PACK

Securing a suitable carbon source for bedding at a reasonable cost is a challenge with the demand for sawdust for alternative uses increasing. Balancing the moisture in the pack during the summer is also a challenge because the cows group to take advantage of a breeze created by wind through the covered alley, which connects the pack barns to the milking center. During the winter, when temperatures drop below 25°F, moisture can also be a problem, because evaporation slows and the turning and bedding process must be managed carefully to prevent pack temperatures from dropping. Too frequent turning, when it is extremely cold, cools the pack and reduces the microbial population's ability to effectively compost.

Care must be taken to manage nutrients within CAFO guidelines, exporting composted manure if needed.

NEEDS FOR FURTHER STUDY

The biggest threat to the long-term success of compost bedded pack technology is the ability to secure bedding at a reasonable cost. Trials with alternative bedding sources, like coarse grasses, need to be conducted. Another alternative that should be explored is the potential for finishing the compost and reusing dry compost in combination with new bedding material to reduce the amount of new bedding that must be purchased. This will require the construction of a covered area for composting and investment in a compost turner. The covered area could be used to stockpile new bedding during seasons when it is most readily available or finishing compost for reuse or export. This might also allow feed alley manure to be composted rather than being spread daily, which is the current practice employed.

The use of fans, both for summer cooling of cattle and for increased evaporation during the winter, needs to be examined. The placement, direction of air flow and number of fans can impact both the summer bunching issue during hot weather and rate of evaporation from the pack during the cold winter months. Trials are needed to learn if there is an optimal configuration of fans to address these issues.

Soil health is expected to be positively impacted by repeat application of composted manure. A study will be needed to quantify the specific changes to soil health indicators.

http://counties.cce.cornell.edu/wyoming

CASE STUDY

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Wyoming County

PUTTING KNOWLEDGE TO WORK

THE BOLDT AND LUDERS FAMILY AT EAGLEVIEW DAIRY

Eagleview Dairy, LLC owners (l to r): Marvin and Candi Luders, Robert and Elaine Boldt, and Scott Boldt

Bob and Elaine Boldt moved their dairy to Eagle in the mid-1980's. Their son Scott, who had returned home to farm after high school, made the move with them. Bob and Scott grew their dairy in two tie-stall barns to about 125 cows on over 300 acres. Bob and Elaine's daughter Candida married Marvin Luders. They developed their own farming operation moving from Elma, New York to Virginia for a few years and then relocating back to Wyoming, New York in the early 1990's. In 2005, they decided to join forces.

Eagleview Dairy, LLC was established to combine the two businesses and build a new dairy complex in 2006. The family's concern for cow comfort, neighbor relations, and protecting the environment, led them to choose the compost bedded pack barn. They were proactive in working with Cornell University Cooperative Extension of Wyoming County, the Wyoming County Soil and Water Conservation District and USDA NRCS to develop a plan and funding for their new facility. New York Farm Viability Institute funding was tapped to help the management team at Eagleview Dairy to implement this, new to the Northeast, technology and share their lessons with the dairy community.