

# Upgrading and Modernizing Dairy Facilities and Manure Handling

**Kevin A. Jani**

**Professor and Extension Engineer**

**Biosystems and Agricultural Engineering, University of Minnesota, St. Paul**

Many Minnesota dairy producers continue to upgrade and modernize their dairy operations every year. A wide range of changes can be made to improve the dairy including:

- Upgrade stalls, adding mattresses or correcting brisket board and neck rail position
- Add lights and implementing extended day lighting
- Remodel a barn or shed to house more animals, use drive-by feeding, and allow skid loader access
- Put in a step-up, swing, or pit parlor
- Add a freestall barn
- Add transition cow facilities
- Add manure storage
- Other

Producers give many different reasons to upgrade and modernize their operations including:

- Improve working conditions
- Reduce manual labor
- Reduce work time to provide more time for family, management, or rest
- Increase labor efficiency
- Improve cow comfort, cow observation, or management
- Increase milk production per cow or add cows
- Increase income and profitability
- Meet environmental regulations
- Improve manure management and nutrient use

Farm visits with several producers helped identify a few key points for producers considering changes to their operations. The take-home points are:

1. For many producers the biggest step was going from a stall barn to a freestall barn and beginning to feed a TMR. Labor savings were tremendous. Cow comfort increased too.
2. Changes were done in multiple steps over several years and they continue to investigate and make changes today.
3. Watch costs of each upgrade and be sure to get good value and return. They reused equipment and remodeled buildings.
4. It takes time and effort to think about, investigate, and plan changes. Ask lots of questions. Figure out what fits you and your management.
5. Consider heifer raisers to reduce labor and facility requirements.

6. Use daily haul or short-term storage to keep investment costs for manure storage down if permitted by local regulations.

### **Steps to Upgrade and Modernize Your Dairy**

The following ten steps to upgrade your dairy were originally published in the University of Minnesota Dairy Initiatives Newsletter (Summer 2001).

1. **Set a target.** Develop a broad vision, goals, or mission statement to describe your upgraded dairy that fits your values.
2. **Set performance criteria and dimensions.** Define the upgrade, its size, the management plan, and required and desired elements.
3. **Investigate and innovate.** Find innovative ideas by visiting other dairy operations, reading dairy articles, and talking to people.
4. **Evaluate alternatives and options.** Sort through the ideas and information collected and compare them with the required and desired elements.
5. **Select the best option for you.** Remember that there is no single ideal solution. Every design includes trade-offs.
6. **Prepare plans.** Have blueprints prepared and develop bid specifications
7. **Troubleshoot the plans.** Check the plans for accuracy and completeness. Check flows of cows, milk, equipment, feed, water, air, manure, and people.
8. **Implement the plan.** Get bids, select contractors, and modify the operation. Monitor construction to ensure that your plans are followed as specified.
9. **Evaluate the final product.** Make sure that everything was completed as specified. Celebrate your accomplishments. Learn from mistakes.
10. **Do it again.** Identify your operation's next high priority goal or bottleneck and tackle it next.

### **Modernization Ideas and Things to Consider**

Dairy operations are complex systems where a change in one area can impact other aspects (i.e., facility and equipment needs). For example: changing to a manure pack for dry cows requires investment in different manure handling equipment than that needed for a freestall barn cleaned with a skid loader. For each potential upgrade there are numerous options and details to consider, evaluate, and decide upon. Sometimes making a change that improves one part of the operation can cause a new bottleneck or problem in another part. A systems approach to planning is valuable.

### **Upgrade ideas to improve cow comfort:**

- Resting surface (ex. replace or install mattresses or sand bedding)
- Walking surfaces (ex. install geotextile lanes or concrete to reduce mud, roughen slippery surfaces)
- Feed bunks (ex. go to drive by feeding, refurbish feed bunks)
- Waterers (ex. add more or improve access)
- Ventilation (ex. remove siding and install open ridge to naturally ventilate, increase air exchange to improve air quality, add hot weather fans, install sprinkler system)
- Lighting (add lighting to increase light levels, install energy efficient lighting, used extended day lighting)
- Bedding (ex. store conveniently for easy use and protection)

### **Facilities impact cow care and management:**

- Feeding and feed preparation
- Manure removal
- Bedding storage and access
- Observe cows more easily with improved lighting
- Treat cows - special needs, palpation rail, headlock, maternity pens
- Move cows

### **Elements to consider when planning changes:**

- Total number of cows and young stock and size of groups (Table 1)
- Number of rations to prepare and deliver, number of feed sources
- Health care and treatment, maternity pens, restraint for treatment
- Cow comfort
- Water supply, needs, cleaning, and freezing in winter
- Manure management
- Ventilation management
- Alleys for cow movement from bedded area to feeding area, from stall area to milking area, and between groups
- People and equipment movement (Personnel safety passes, alleys, roads)
- Location
  - “Build on a knoll, not in a hole” (Holmes, 1999)
  - Check local and state setback requirements for siting feedlots from property lines, streams, wetlands, shoreland, community water supplies, and neighbors
- Future changes. How does this change affect long-term plans and dreams?

**Table 1. Typical groups and numbers for three different herd sizes.**

Total herd size	50	100	250
Calves and heifers (total)	50	100	250
0-2 months (150 lb)	4	8	21
3-5 months (250 lb)	6	13	31
6-8 months (400 lb)	6	13	31
9-12 months (600 lb)	8	17	42
13-15 months (800 lb)	6	13	31
16-24 months (1050 lb)	19	38	94
Dry cows (total)	8	17	42
Transition (first 4-14 days)	1	2	4
Next 40 days	5	11	28
Close-up (2-3 wk prepartum)	2	4	10
Maternity (individual pens)	3	5	13
Fresh cows (0-7 days postpartum)	1	2	5
2-year olds (milking)	15	30	75
Older cows (total)	27	53	133
High producers	11	21	53
Medium producers	8	16	40
Low producers	8	16	40
Sick cows (up to 5%)	3	5	13

Assumes year round calving, 12-month calving interval, 305-day lactation, 0% mortality; first calving at 24 months, males sold at birth.

### **Remodeling: New Life for Old Buildings - A Smart Move?**

Many successful upgrades involve remodeling of existing buildings to make them more useful and valuable to the dairy. The key to successful remodeling is making sure that the remodeled building is efficient and provides useful space. The following article was published originally in the University of Minnesota Dairy Initiatives Newsletter (Fall 1999).

Many dairy farmers have buildings they could remodel or recycle to make more useful. Buildings can be remodeled to expand animal capacity and herd size, increase labor efficiency, or improve animal management and care. But is it a smart move?

Maybe - or maybe not. Good planning and a critical eye are needed to make sure the remodeling and recycling produces a cost-effective, labor-efficient, and functional building.

The remodeled building must fit the dairy's management plan. Too often, people don't do enough planning before plunging into a remodeling project. They end up with a space that is hard to use or doesn't provide the environment animals need to do well. In these cases the time and money spent on the project were wasted.

Remodeling and recycling require just as much planning as new construction, if not more. Before remodeling a building, consider its structural soundness, roof condition, and location. Location is important because it affects traffic patterns, natural ventilation, manure management, and other activities. Don't spend money and time on buildings in low or wet areas. Consider how the remodeled building fits into future plans, too.

In the planning stage, think about cow flow to and from the building, manure handling, ventilation in hot and cold weather, labor efficiency, feeding, watering, equipment access, and animal comfort (i.e., stall or pen size). All of these factors affect a building's usefulness. An unsolvable problem with one of these factors might make remodeling a bad option. Be careful when accepting compromises for a remodeling project, especially if you plan to use the remodeled building for more than a few years.

Consider costs. One rule of thumb recommends building a new building if the remodeling costs would be two-thirds or more of the cost of a new building. Be wary if remodeling cost estimates are 50% or more of the cost of a new building.

There are many examples of remodeling and recycling that produced useful, efficient, and cost-effective spaces:

- Many structurally sound stall barns have been converted to parlors and holding areas.
- Many pole barns, machine sheds, and hay sheds have been converted into freestall barns for cows or heifers. This works very well when the building is properly located and has sidewalls 10 to 14 ft high.
- Some producers have converted old two-story stall barns into naturally ventilated barns for young stock by adding inlets and either installing chimneys or removing the haymow floor boards and adding ridge openings.
- Some people have used old corncribs with center alleys as bedded shade and windbreaks for young stock in open lots.

One of the more difficult recycling projects is to convert an old hog barn or chicken house into a calf barn. Such buildings are hard to ventilate properly. Poor ventilation compromises animal health. Also, manure handling and feeding must usually be done by hand, making the building labor intensive.

In summary, buildings can be successfully remodeled and recycled into useful spaces after careful planning and evaluation. Remodeling can breathe new life into an underutilized building. The key to successful building remodel and recycling is good planning to ensure that the remodeled building will be efficient and provide a useful space.

## **Manure Handling Systems**

Manure systems include collection and transport, storage, and land application. While it is common to scrape freestall barns alleys with a skid loader and put the manure into a long-term storage for annual land application, this may not necessarily be the best system for you. The "best" system is a compromise that depends on personal preferences, available labor and capital, soil type, cropping practices, amount of manure produced, and numerous other factors.

Many producers continue to use daily hauling or short-term storage to minimize the capital investment until income and labor required increase to the point where long-term storage becomes more viable.

Manure handling systems and nutrient management are regulated at local, state, and federal levels. Make sure that proposed upgrades and changes meet all applicable regulations. Try to use cost-share funds to reduce the cost to the dairy.

**Collection and transport:**

- Collect manure from every animal stall and pen
- Manure can be scraped and pitched by hand, with gutter cleaners, or skid loaders
- Skid loaders can reduce manual labor
- Flush systems are another option
- Remember milkhouse and parlor wastewater

**Manure storage:**

- None - daily haul
- Short-term with mini-pit, stacks or stockpiles
- Long-term with earthen clay-lined pit, concrete tank, above ground tank, stack

Manure storage costs depend on numerous factors including, depth to seasonally high water table, soil type, and storage type. Typical values based on NRCS data from 1994 to 1997 are:

Storage	Cost per unit storage volume, \$/ft <sup>3</sup>
Lined storage pond	0.38
Storage pond with membrane liner	0.64
Storage pond hauled clay liner	0.72
Concrete tank	1.53
Metal tank	1.43

**Land application options:**

- Surface apply
- Surface apply with incorporation
- Injection
- Use custom applicators to reduce equipment costs

Be sure to follow state and local regulations regarding manure applications in special protection areas, within 300 ft of lakes, streams, public waters and wetlands, and drainage ditches without berms.

**Siting manure storage units:**

Be sure to check state and local restrictions for siting feedlots and manure storage units. Areas with restrictions include:

- Shoreland
- Floodplain
- Sinkhole
- Private well
- Community water supply well(s) serving a school or licensed childcare center

**Milkhouse wastewater:**

- Must be handled or treated properly to minimize pollution potential.

**Anaerobic digestion with electrical generation:**

- Rough rule of thumb suggests that it is not economical with less than 400 cows
- Reduces odor emissions
- Stabilizes nutrients
- Generate heat and electricity

Composting is an option for treating solid manure. Composting stabilizes the organic matter, which some producers market as a value-added product to gardeners.

**Resources for Planning Dairy Facility Changes**

Producers thinking about making changes need reliable information and data as they put together their plans. Producers can get ideas and information from many sources including; publications, Extension conferences and workshops, open houses, dairy tours, and people. MidWest Plan Service (MWPS) is another well-respected source of valuable and reliable information that dairy producers will want to tap into.

MWPS is a cooperative effort of the North Central Region land-grant universities that produces and publishes objective and application-oriented handbooks and pamphlets for the agricultural community. MWPS has over 37 titles that provide design recommendations and information. Dairy producers thinking about making changes will find MWPS publications invaluable resources.

**MWPS publications:**

- Dairy Freestall Housing and Equipment Handbook, MWPS-7 (2000)
- Manure Storages, MWPS-18 Section 2 (2001)
- Greenhouse Barns for Dairy Housing, AED 40 (1996)
- Managing and Designing Bunker and Trench Silos, AED 43 (1997)
- Using All-Weather Geotextile Lanes and Pads, AED 45 (1999)

**NRAES publications:**

- Guidelines for Planning Dairy Freestall Barns, NRAES-76 (1995)
- Natural Ventilation for Dairy Tie Stall Barns, NRAES-119 (1998)
- Tunnel Ventilation for Dairy Tie Stall Barns, NRAES-120 (1998)
- Guideline for Dairy Manure Management from Barn to Storage, NRAES-108 (1998)

For more information about MWPS and NRAES publications, check the Biosystems and Agricultural Engineering web site at <http://www.bae.umn.edu/extens/mwps/index.html>.

To order MWPS or NRAES publications, call the University of Minnesota Biosystems and Agricultural Engineering Department at (612-625-9733) or use the order form on the web.

---

## **NOTES**

---