

# COMPOST BEDDED PACK BARN AS A LACTATING COW HOUSING SYSTEM



UNIVERSITY OF  
KENTUCKY®



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COOPERATIVE  
EXTENSION  
SERVICE



# Compost Bedded Pack Barn Concept

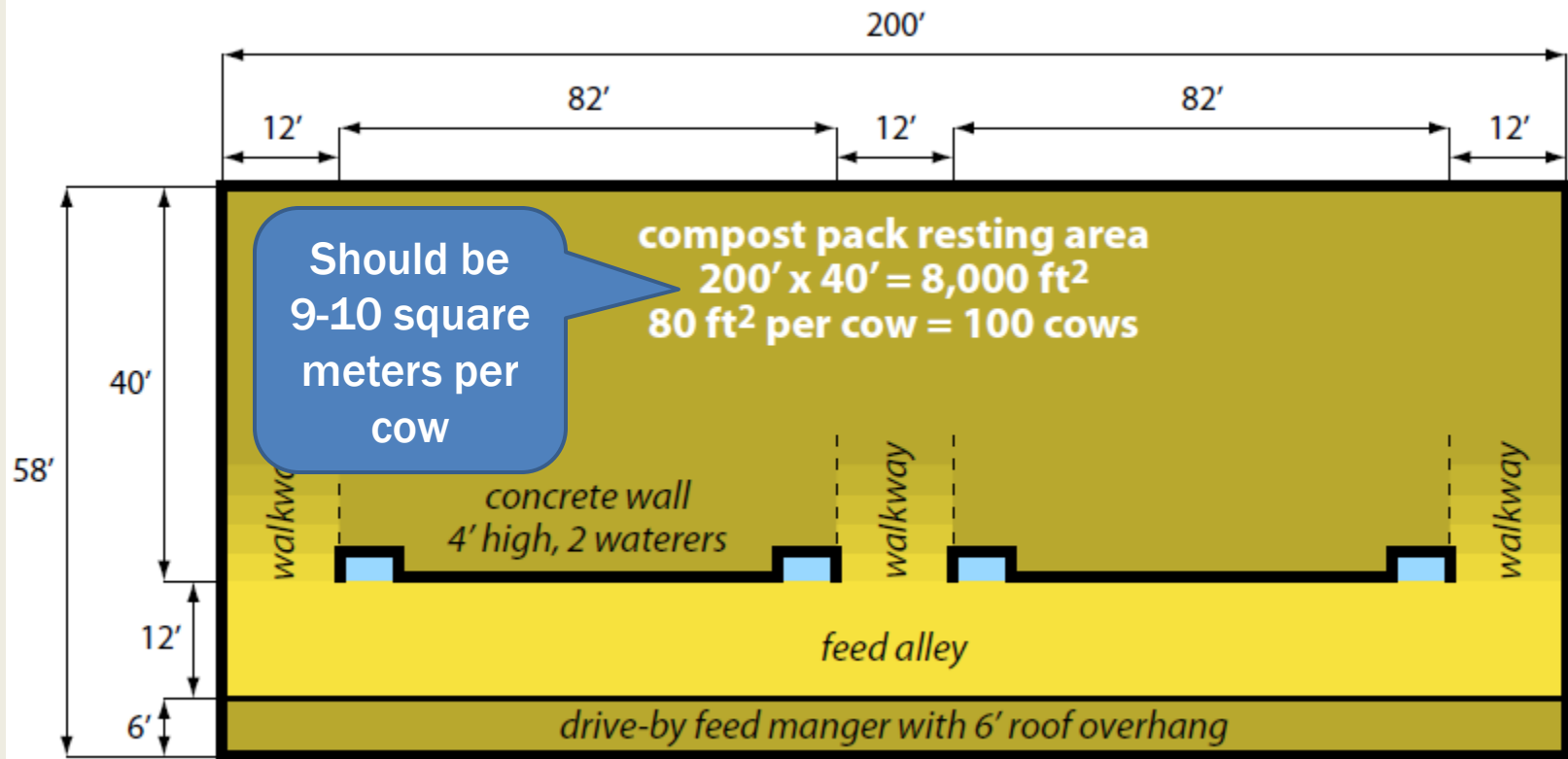
- Loose-housing with large, open resting area
- Not your grandfather's bedded pack barn!
- Intensively managed compost process keeps cows dry and clean
- Risks for mismanagement higher than stall barns
- More management/less labor than stall barns

# COMPOST BARNS TODAY

- **Minnesota:** Foundation work, growth limited by bedding cost
- **Kentucky:** 80 to 90
- **Israel:** predominant system
- **Brazil and Argentina:** starting movement
- **Netherlands, Denmark, Italy:** active research and user groups



# COMPOST BEDDED PACK BARN DESIGN





**Comfortable Resting Surface**



**Easy to lay down or rise from resting without restrictions associated with freestall loops**



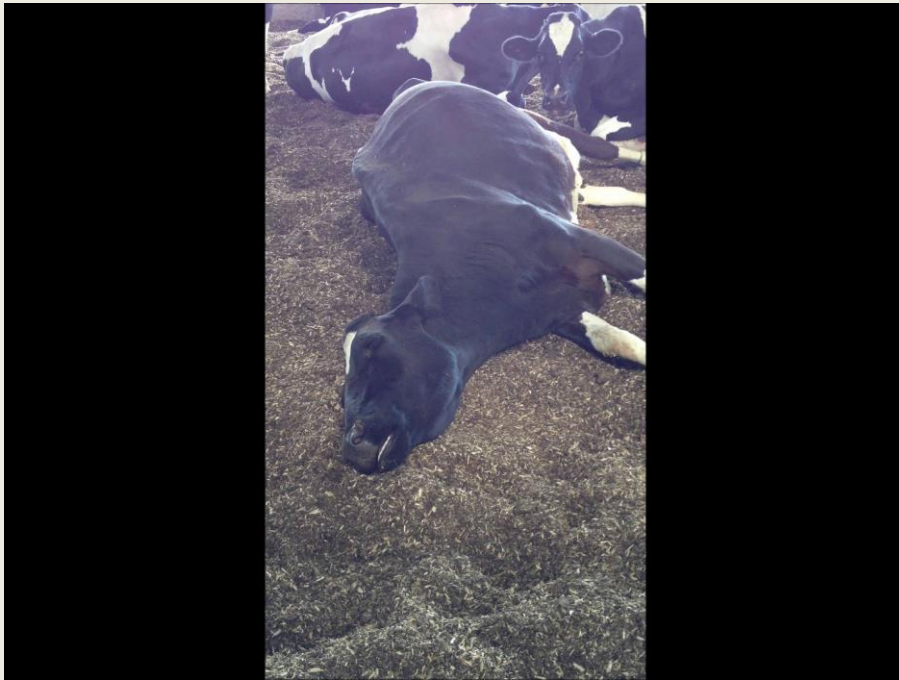
**Cows of different breeds and sizes can be housed together easily**

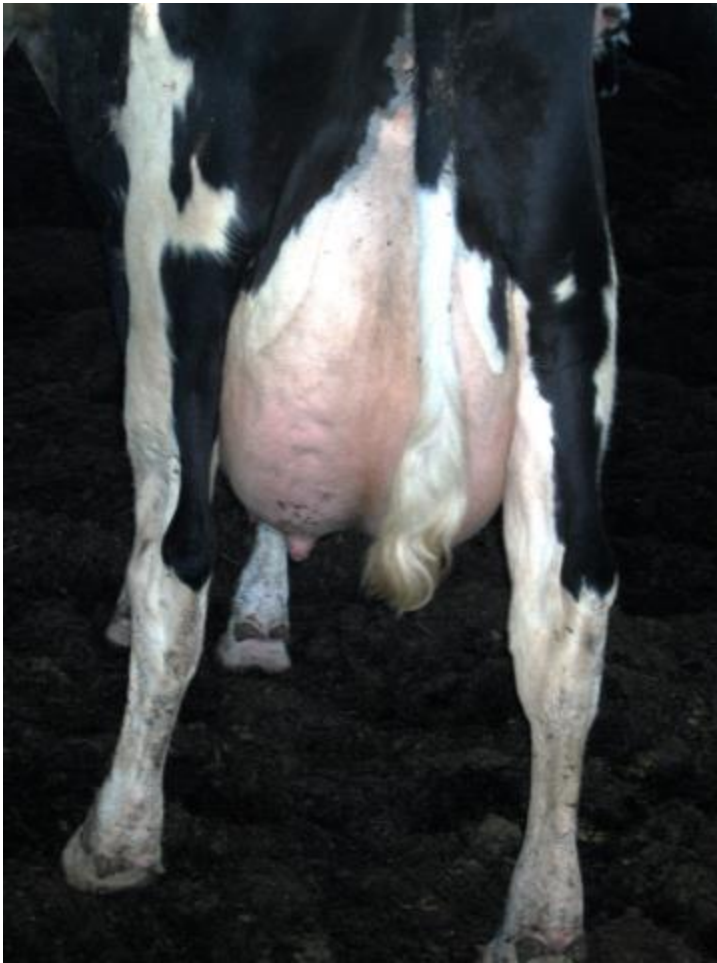


**Cows exhibit heat well because of improved footing compared to concrete**



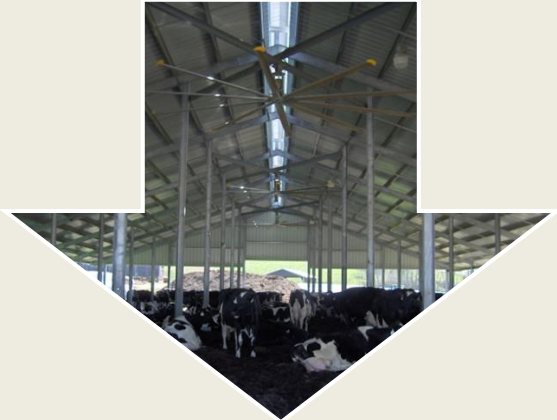
# NATURAL COW BEHAVIOR





**When managed properly, compost bedded pack barns provide a dry resting surface for cows resulting in clean cows and udders**

# COMPOST BEDDED PACK



## Advantages

- Excellent cow comfort
- Low investment
- Good milk quality
- Manure handling

## Disadvantages

- Sawdust availability
- Sawdust availability
- Higher variable costs
- Management ability
- Does not work well in retrofits
- Building footprint



# FREESTALL



## Advantages

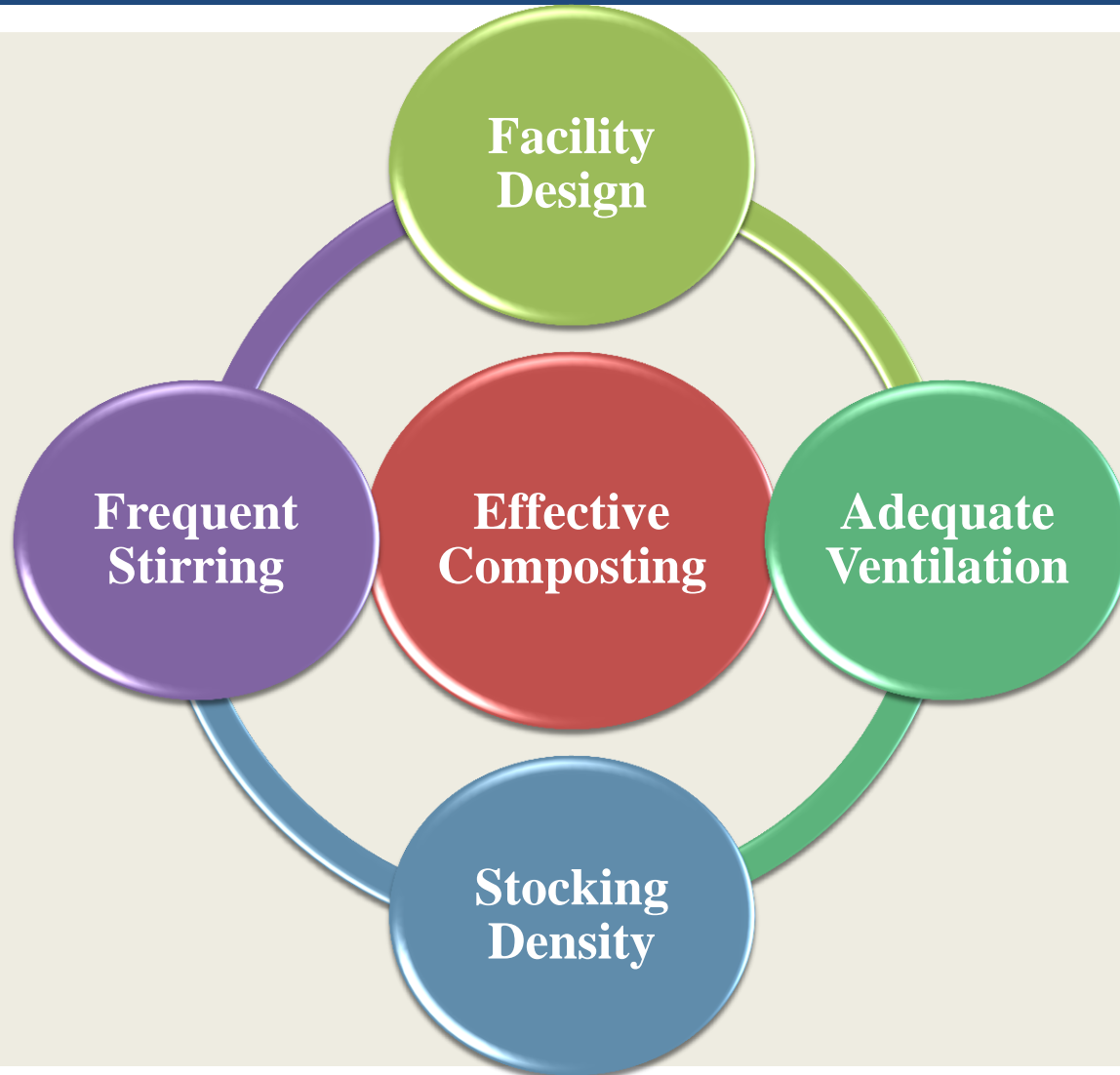
- Cow comfort can be excellent
- More environmental control
- More animals per square feet of barn
- Automation/management options

## Disadvantages

- Poorly designed/maintained freestalls= poor cow comfort
- Concrete, loops, mattresses can be expensive
- Manure management



# KEYS TO MANAGING A CBP BARN



# PACK MANAGEMENT

- 0.5 to 0.6 m of bedding to start, may take 2-4 semi-loads of sawdust
- New bedding (5-20 cm) added when pack starts looking moist
- New bedding added every 1-8 weeks (more when humid or wet and in winter)
- Packs cleaned 1-2 times per year (fall & spring)

# Stirring Equipment Examples



# Stirring Equipment Examples





# Sweeps or Shovels Increase Mixing



# Roto-tillers break up clumps of bedding material



# Uniform Bedding with Roto-Tiller



# UK TILLAGE TOOL



# Steam is Good But Doesn't Mean Pack is Heating





**Stirring in multiple directions or in circles increases air infiltration and helps break up clumps**



UK Dairy

**Too many posts within the barn can make pack stirring difficult**

# Heavy Tractors Compact Bedding Material





# MANAGEMENT CHECKS

- **Temperature: 43 to 66 ° C or “just hot enough you don’t want to touch it”**
- **Moisture: 45 to 55% or can you form a ball without too much water**
- **Fluffiness: subjective (looking for give in bedding as you walk across it)**
- **Distribution of cows within barn**
- **Dirty cows (next to last resort)**
- **SCC or clinical mastitis (last resort)**

# Temperature Monitoring

Example of compost heating well with high temperature



Example of compost heating well with high temperature and dry material.



Example of compost that is too wet with insufficient temperature.



Example of compost that is too dry with insufficient temperature

**A dedicated thermometer, easily accessible within the barn, is recommended**



# Dry, Fluffy Compost



# High moisture, clumps, lack of uniformity



# 2011 COMPOST STUDY

- 43 Kentucky farms (51 barns)
- October 2010 to March 2011
- Compost samples collected from 9 equally distributed locations throughout each barn to produce a composite sample
- Producer questionnaire
- DHIA data



# PRODUCER CITED BENEFITS OF COMPOST BEDDED PACK BARN

Improved cow  
comfort  
(n = 28)

Improved cow  
cleanliness (n = 14)

Low maintenance  
(n = 11)

Good for heifers,  
lame, fresh, problem,  
and old cows  
(n = 10)

Natural resting  
position (no stalls)  
(n = 9)

Improved feet and  
legs  
(n = 8)

Proximity to parlor  
(compared to  
pasture) (n = 8)

Decreased SCC  
(n = 6)

# PRODUCER CITED BENEFITS OF COMPOST BEDDED PACK BARNES

Increased heat  
detection  
(n = 6)

Ease of  
manure  
handling  
(n = 3)

Increased dry  
matter intake  
(compared to  
pasture) (n = 3)

Increased  
production  
(n = 3)

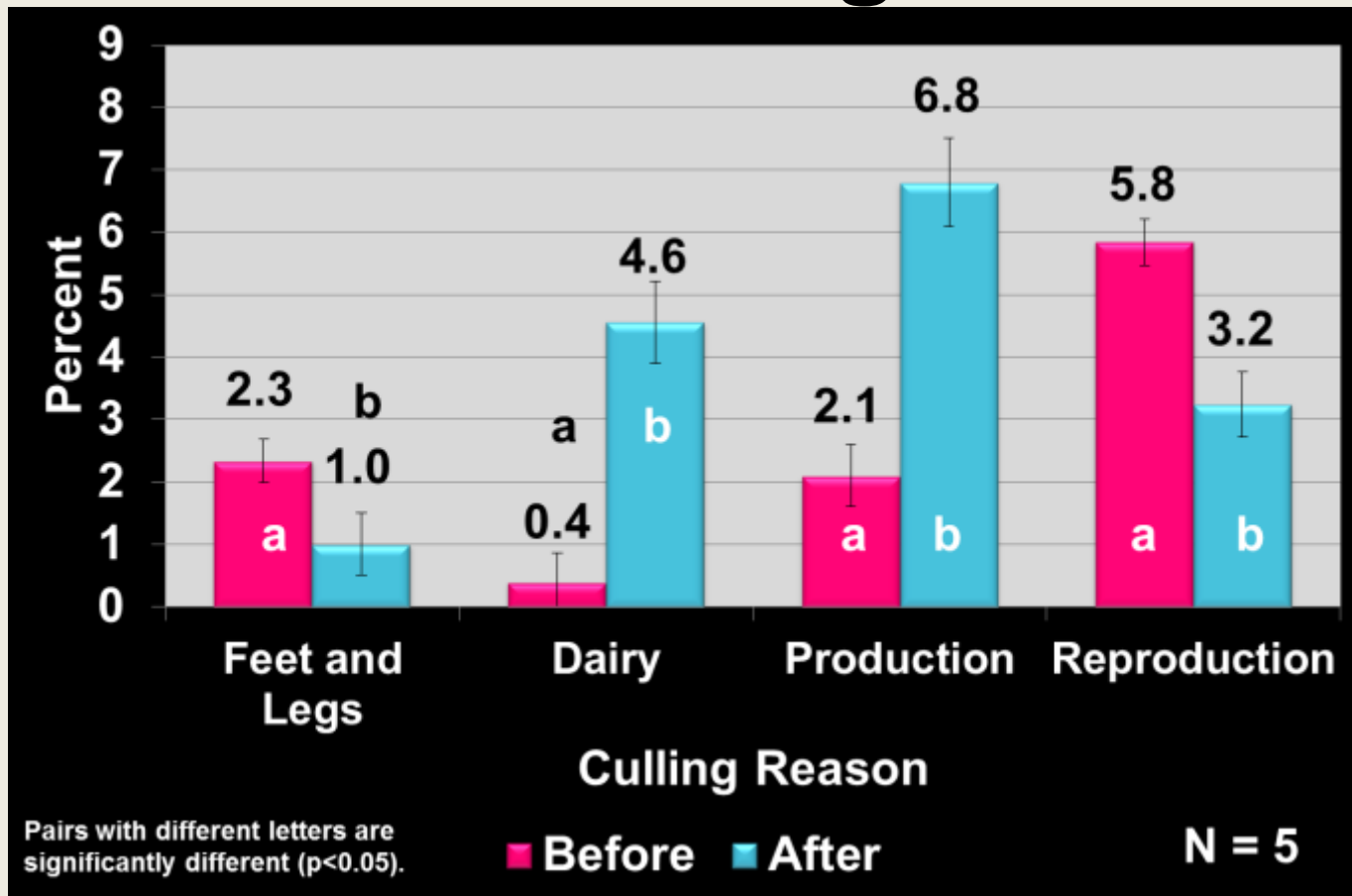
Increased  
longevity  
(n = 3)

Fewer leg and  
teat injuries  
(n = 2)

Minimizes time  
standing on  
concrete  
(n = 2)



# Culling rate before and after moving into a CBP barn used as primary housing



Calculated using 12 months before move in and 6 to 12 months after move in  
Black et al., Journal of Dairy Science (2013): 96: 8060-8074



**Hygiene  
depends on  
management!**



# HYGIENE



- Heat generated by composting process dries bedding material creating a drier lying surface
- Drier packs decrease hygiene score which may reduce exposure to mastitis pathogens
- Effective composting more critical to cow hygiene during winter

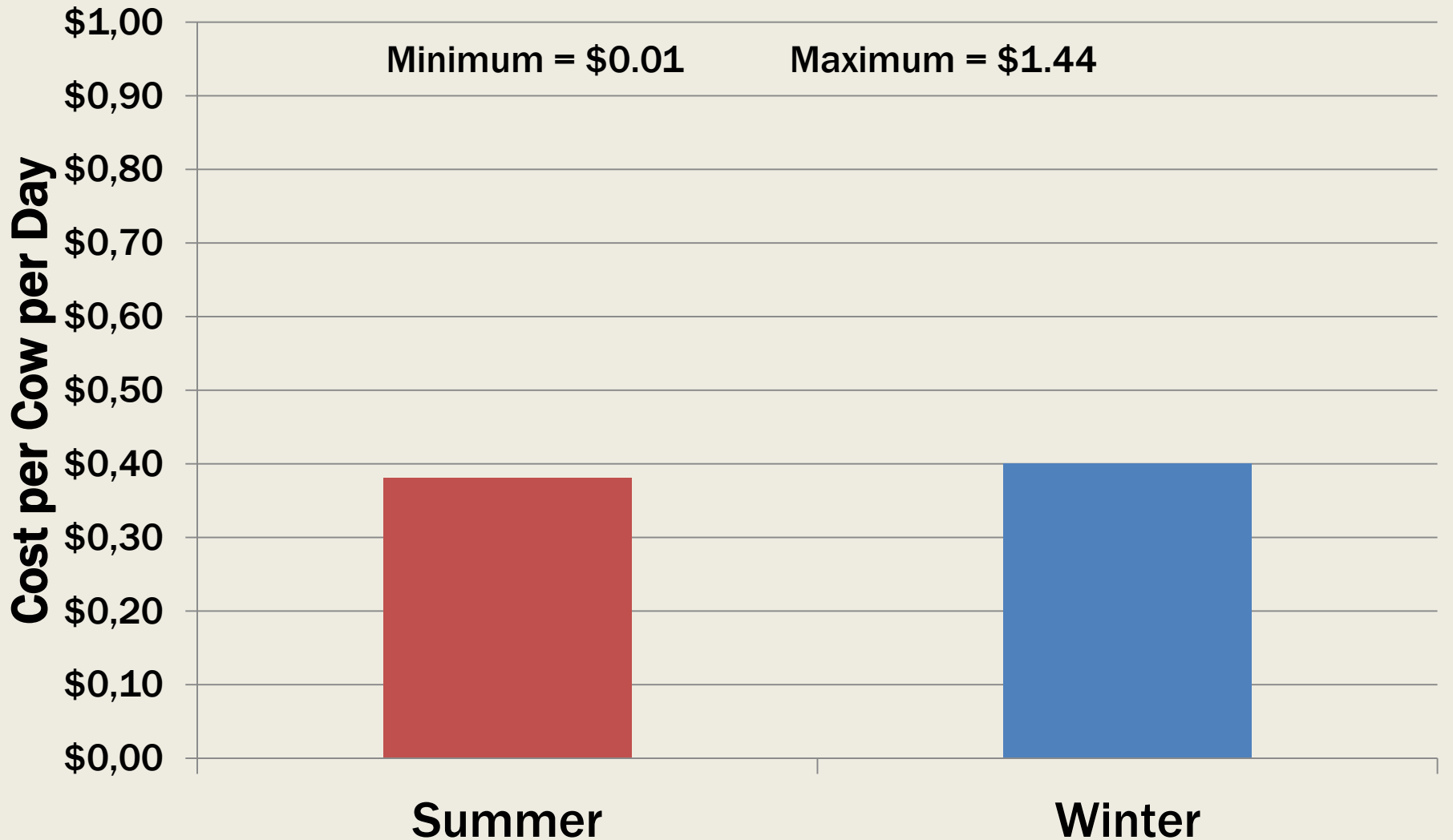
# BACTERIA

- **Bacteria load high in all compost bedded packs**
- **Coliform and Staphylococcal species seem to thrive in optimal composting conditions**
- **Streptococcal species may be more susceptible to composting heat**
- **Bacteria likely flourish in warmer ambient conditions**

# INVESTMENT COSTS

	Average	Minimum	Maximum
<b>All Barns</b>			
Barn cost	\$85,362	\$10,900	\$300,000
Cost/cow @ 9 sq meters/cow	\$855	\$215	\$1,875
<b>Barns with Attached Feed Bunk</b>			
Barn cost	\$103,729	\$30,000	\$300,000
Cost/cow @ 9 sq meters/cow	\$1,051	\$421	\$1,876
<b>Barns without Attached Feed Bunk</b>			
Barn cost	\$51,454	\$10,900	\$155,000
Cost/cow @ 9 sq meters/cow	\$493	\$196	\$833

# DAILY BEDDING COSTS



# University of Kentucky New Dairy Housing Facility Investment Analysis Dashboard

Created By: Randi Black and Dr. Jeffrey Bewley  
Contact: [rablac3.com](http://rablac3.com) or [jeffrey.bewley@uky.edu](mailto:jeffrey.bewley@uky.edu)



This dashboard has been developed as a decision support tool for dairy farmers considering building a new dairy housing facility using their personal situation and housing goals. Everything in this dashboard is changable, allowing parameters to be set to those values appropriate for a particular situation or different from the default values. However, default values are those found in scientific literature or from expert opinion and can be used in situations when a value is not available for the farmer's personal situation.

Reset



Roll over these these  
white buttons to learn  
more about an input or  
output

The white buttons are located throughout the dashboard. They may be used to better define a particular input or output in this dashboard. Simply roll the mouse over the button to obtain additional information.

The reset button on this page may be used to reset all values to the defaults.



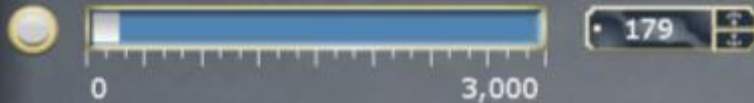
## Herd Characteristics

## Benefits Observed

## SCC Bonus Structure

## Financial Measures

Herd Size (Milking plus Dry Cows)



Current Lameness Incidence Rate



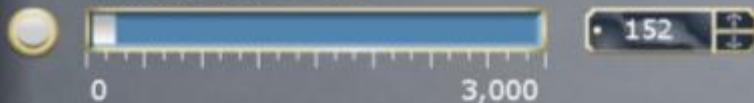
Percent Herd in Milk



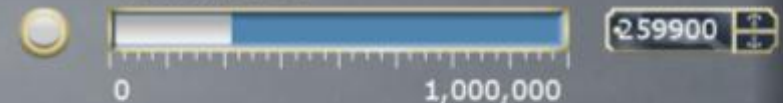
Current % Clinical Mastitis Cases per Year



Milking Herd Size



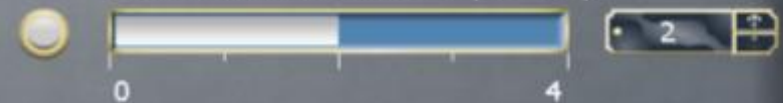
Current SCC



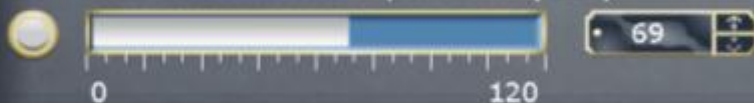
Rolling Herd Average (lbs.)



Number Times Milked per Day



Current Milk Yield per Cow (lbs.)



Time to Bring Cows to Holding Pen (min)



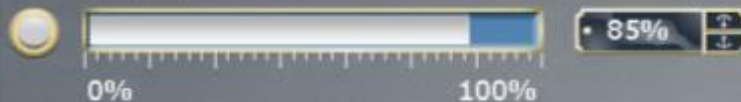


The full extent of benefits are not typically realized immediately. Indicate the percentage of the full amount of benefits that will be experienced in each year.

Year 1



Year 2



Year 3



Year 4



Year 5



Year 6



Year 7



Year 8



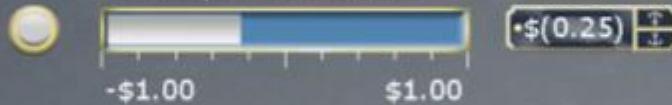
Year 9



Year 10



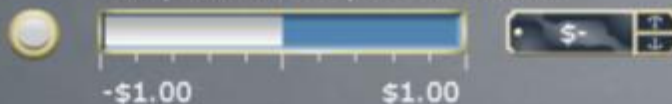
> 400,000 cells/mL



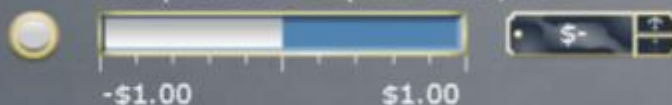
350,000 to 400,000 cells/mL



300,000 to 350,000 cells/mL



250,000 to 300,000 cells/mL



200,000 to 250,000 cells/mL



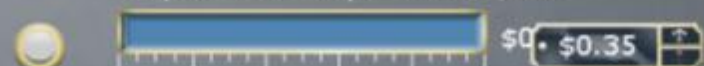
150,000 to 200,000 cells/mL



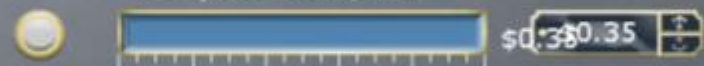
100,000 to 150,000 cells/mL



50,000 to 100,000 cells/mL



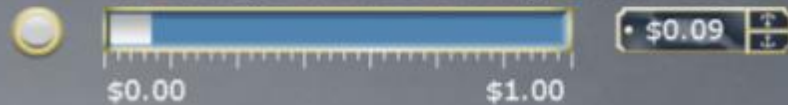
< 50,000 cells/mL



Discount Rate



Lactating Cow Feed Cost (per lb. Feed DM)



Interest Rate



Long-Term Milk Price (per cwt.)



Tax Rate



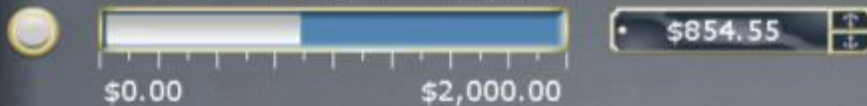
Labor Cost per Hour



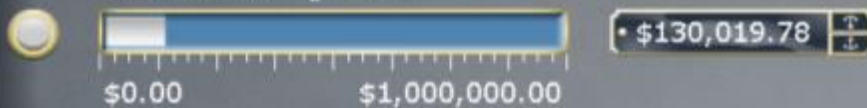
## Barn Measures

## Animal Measures

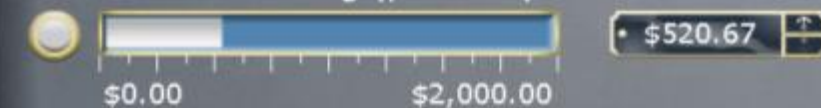
Cost of Barn (per cow space)



Total Building Cost



Cost of Bedding (per load)



Days to Use One Load of Bedding



Time to Move Cows to Holding Pen (min)



Number of Times Stir the Pack per Day



Predicted Time Spent to Stir Pack (min)



Intro

Farm Inputs

Compost

Mattress Freestall

Sand Freestall

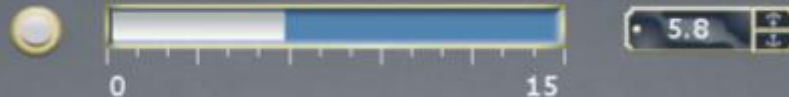
Benefits

Investment Anal...

Barn Measures

Animal Measures

Predicted Daily Increase in Production per Cow



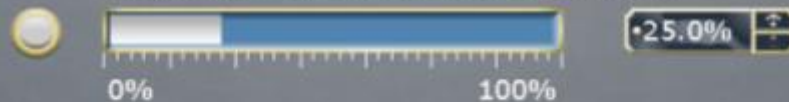
Predicted % Reduction in SCC



Predicted SCC



Predicted % Clinical Mastitis Cases



Predicted Lameness Incidence Rate



Compost Barn

Mattress Freestall Barn

Sand Freestall Barn

### Annual Milk Yield Revenue Change

Year 1

• \$44,456.68 •

Year 2

• \$50,384.24 •

Year 3

• \$59,275.57 •

Year 4

• \$59,275.57 •

Year 5

• \$59,275.57 •

Year 6

• \$59,275.57 •

Year 7

• \$59,275.57 •

Year 8

• \$59,275.57 •

Year 9

• \$59,275.57 •

Year 10

• \$59,275.57 •

### Annual SCC Bonus Revenue Change

Year 1

• \$12,162.00 •

Year 2

• \$12,255.30 •

Year 3

• \$12,395.25 •

Year 4

• \$12,395.25 •

Year 5

• \$12,395.25 •

Year 6

• \$12,395.25 •

Year 7

• \$12,395.25 •

Year 8

• \$12,395.25 •

Year 9

• \$12,395.25 •

Year 10

• \$12,395.25 •

### Annual Change in Lameness Treatment Cost

Year 1

• \$312.4 •

Year 2

• \$354.0 •

Year 3

• \$416.5 •

Year 4

• \$416.5 •

Year 5

• \$416.5 •

Year 6

• \$416.5 •

Year 7

• \$416.5 •

Year 8

• \$416.5 •

Year 9

• \$416.5 •

Year 10

• \$416.5 •

**Compost Barn****Net Present Value**

• \$87,002.52 •

**Internal Rate of Return**

• 21% •

**Payback Period**

• 3.97 •

**Breakeven Barn Price**

• \$217,022.30 •

**Mattress Freestall Barn****Net Present Value**

• \$31,958.82 •

**Internal Rate of Return**

• 11% •

**Payback Period**

• 5.72 •

**Breakeven Barn Price**

• \$230,666.72 •

## Investment Analysis

**Sand Freestall Barn****Net Present Value**

• \$68,739.65 •

**Internal Rate of Return**

• 17% •

**Payback Period**

• 4.49 •

**Breakeven Barn Price**

• \$212,673.55 •

A black and white cow is the central focus of the image, standing in a barn. The cow has a dark coat with white patches on its legs and lower body. The background shows the interior of a barn with wooden walls and a metal fence. The text is overlaid on the cow's body.

# WHY DON'T ALL PACKS WORK?

- Barn design flaws
- Stocking density (too many cows!)
- Material used (straw, cedar)
- Stirring frequency/depth
- Inadequate/ineffective stirring
- Starting pack in the winter
- No curtains in winter



# UK Compost Resources

COOPERATIVE EXTENSION SERVICE - UNIVERSITY OF KENTUCKY COLLEGE OF AGRICULTURE, LEXINGTON, KY, 40546

ED-206



## Compost Bedded Pack Barn Design Features and Management Considerations

Jeffrey Bewley, Animal and Food Sciences, Joe Taraba and George Dry, Biosystems and Agricultural Engineering,  
Randi Black, Animal and Food Sciences and Flavio Damasceno, Biosystems and Agricultural Engineering



COOPERATIVE EXTENSION SERVICE - UNIVERSITY OF KENTUCKY COLLEGE OF AGRICULTURE, LEXINGTON

ID-178

## Compost-Bedded Pack Barns in Kentucky

Jeffrey M. Bewley, Animal and Food Sciences, and Joseph L. Taraba, Biosystems and Agricultural Engineering

COOPERATIVE EXTENSION SERVICE - UNIVERSITY OF KENTUCKY COLLEGE OF AGRICULTURE, LEXINGTON, KY, 40546

ID-213

## Kentucky Compost-Bedded Pack Barn Project

Randi Black and Jeffrey Bewley, Animal and Food Sciences; Joe Taraba and George Dry, Biosystems and Agricultural Engineering;  
and Flavio A. Damasceno, Agricultural Engineering, Federal University of Viçosa, Brazil



Intro Farm Inputs Compost Inputs Freestall Inputs Investment Analysis Benefits

### University of Kentucky New Dairy Housing Investment Analysis

The decision to build a housing facility is one that is not easy, nor is it to be taken lightly. This tool is to be used to help make that decision easier.

Choose between a new compost bedded pack barn and a new freestall barn using this simple to use net present value tool.

Use your current herd performance and management, coupled with predicted outcomes of the two housing facilities.

Based on a 10 year investment period and assumes barn has no salvage value.

Mouse over the white buttons for more information on an input or output.

Results not guaranteed. Calculations based on assumptions.



College of Agriculture  
Created by Randi Black and [unintelligible]

# QUESTIONS

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