TIPS AND TRICKS FOR SEASONAL USE OF COMPOST PACK BARNS

see blue.™ *in the College of Ag*

Jeffrey Bewley
Randi Black
Elizabeth Eckelkamp
Heather Mussell
Joe Taraba
George Day
Flavio Damasceno

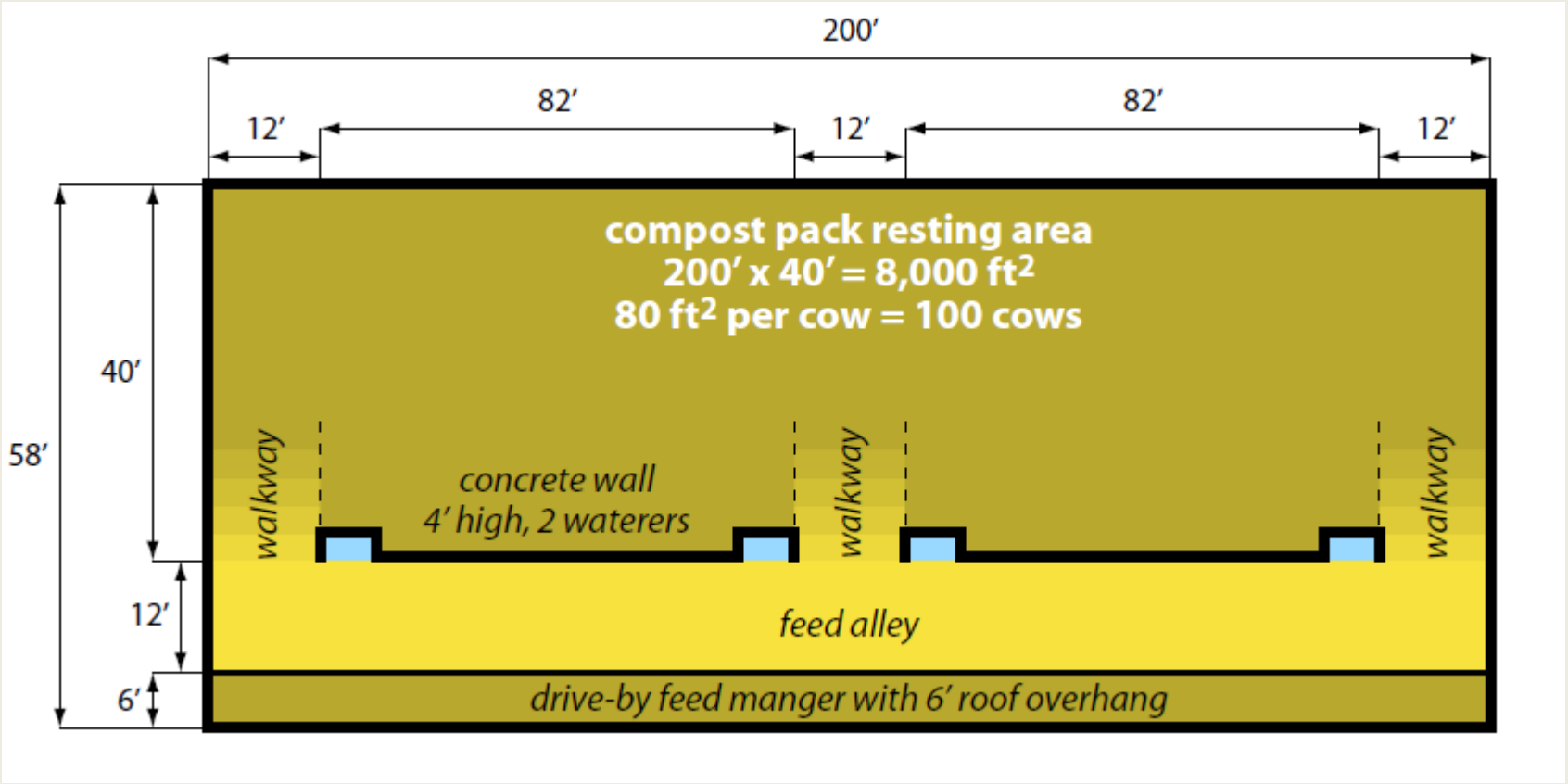
UK KENTUCKY College of Agriculture
PRECISION DAIRY & COW ENVIRONMENT CONSORTIUM

COOPERATIVE EXTENSION SERVICE
UK UNIVERSITY OF KENTUCKY College of Agriculture

Compost Bedded Pack Barn Concept

- Concept developed by Virginia dairy farmers
- Loose-housing with large, open resting area
- Potentially improved cow comfort
- Not your grandfather's bedded pack barn!
- Intensively managed compost process
- Compost temperature can dry bedding

COMPOST BEDDED PACK BARN DESIGN



Janni et al., 2007

WHY COMPOST BARNS MAKE SENSE IN THE SOUTH

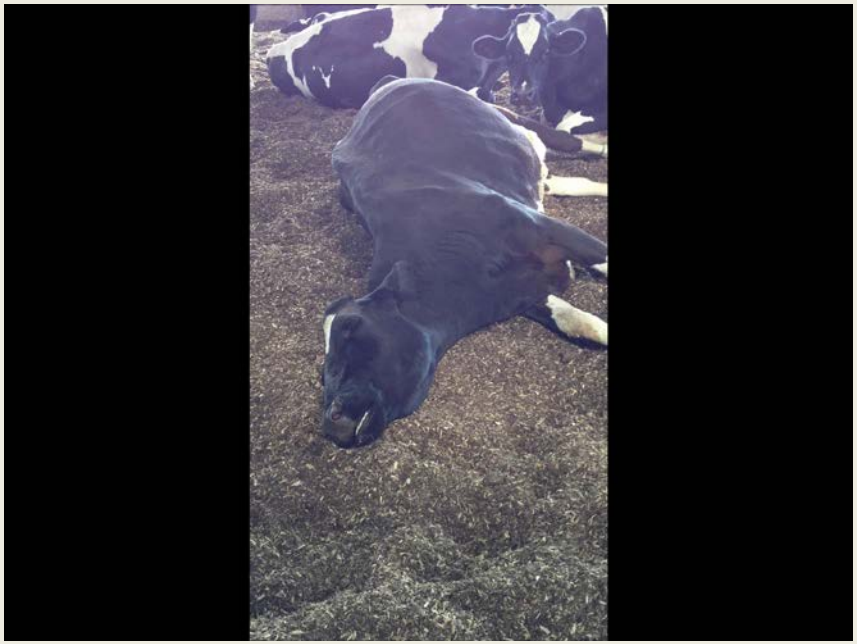
- Short winters
- Long summers
- Access to wood byproduct
- Smaller farms
- Lower investment

Comfortable Resting Surface

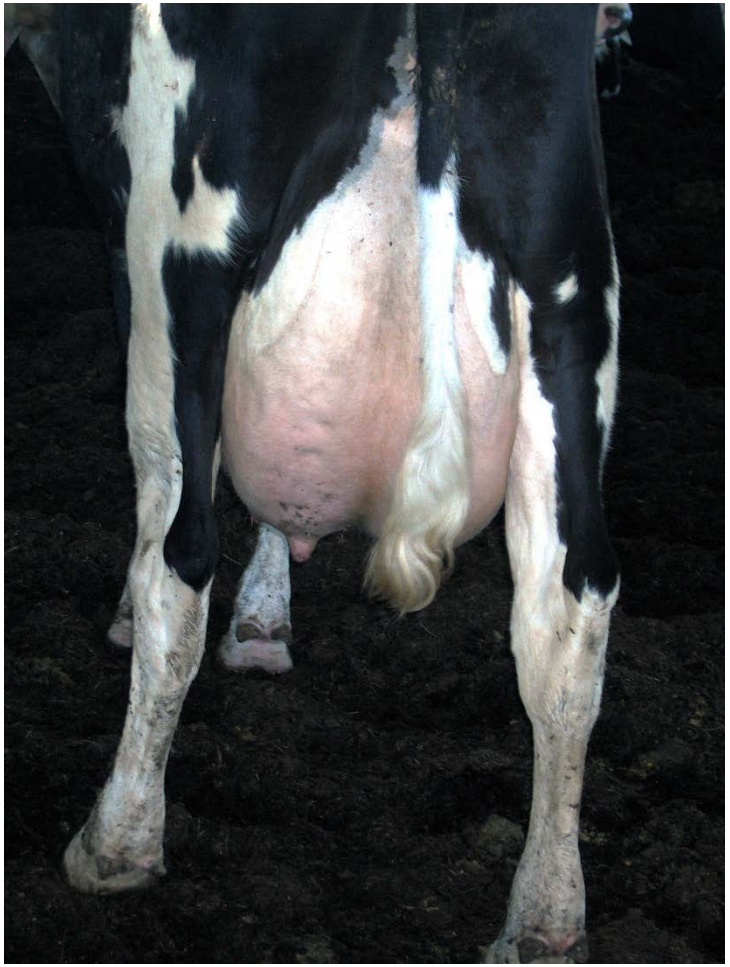
Easy to lay down or rise from resting without restrictions associated with freestall loops

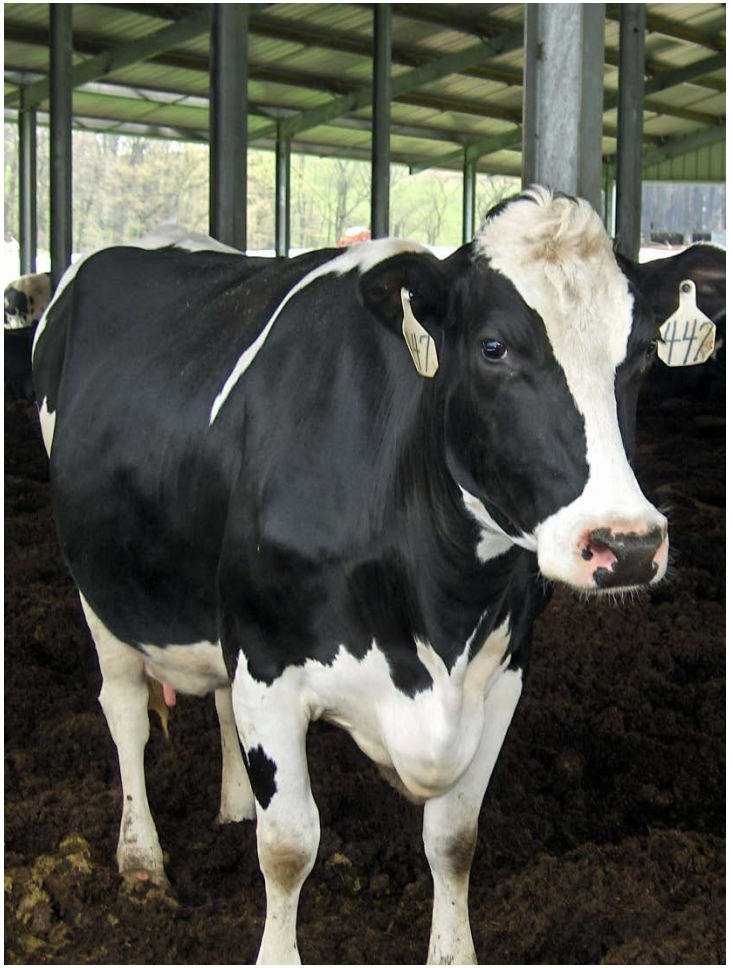
Cows of different breeds and sizes can be housed together easily

NATURAL COW BEHAVIOR



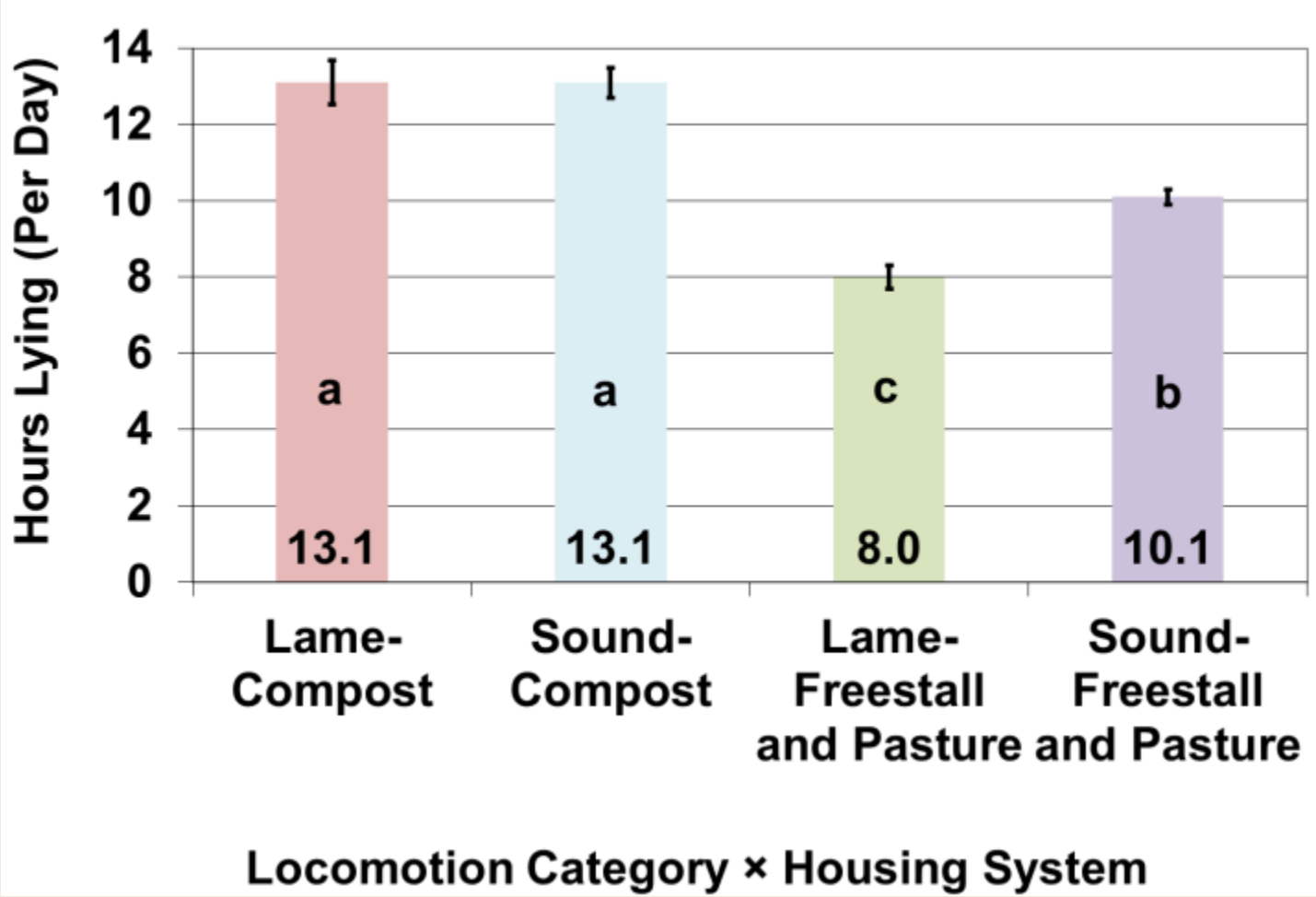
Cows exhibit heat well because of improved footing compared to concrete





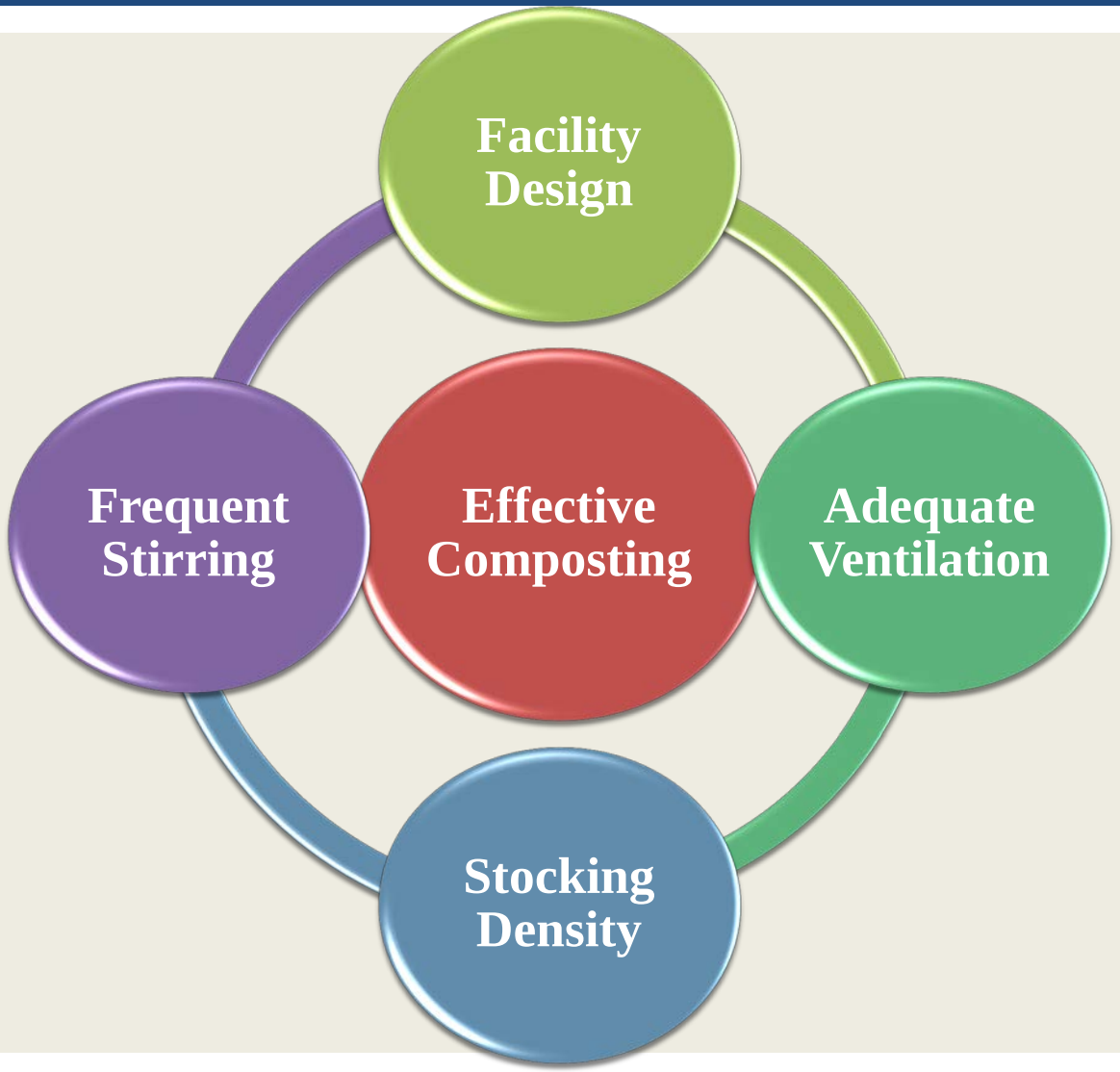
When managed properly, compost bedded pack barns provide a dry resting surface for cows resulting in clean cows and udders

FACILITY TRANSITION CASE STUDY



Eckelkamp et al., 2014

KEYS TO MANAGING A CBP BARN



PACK MANAGEMENT

- 1.5 to 2 feet of bedding to start, may take 2-4 semi-loads of sawdust
- New bedding (2-8”) 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)
- Leave 6-12” (top layer)of old material to help start microbial activity

AERATION

- When cows are out of the barn during milking
- Start as soon as new sawdust is added
- Aerate at least 10-12”

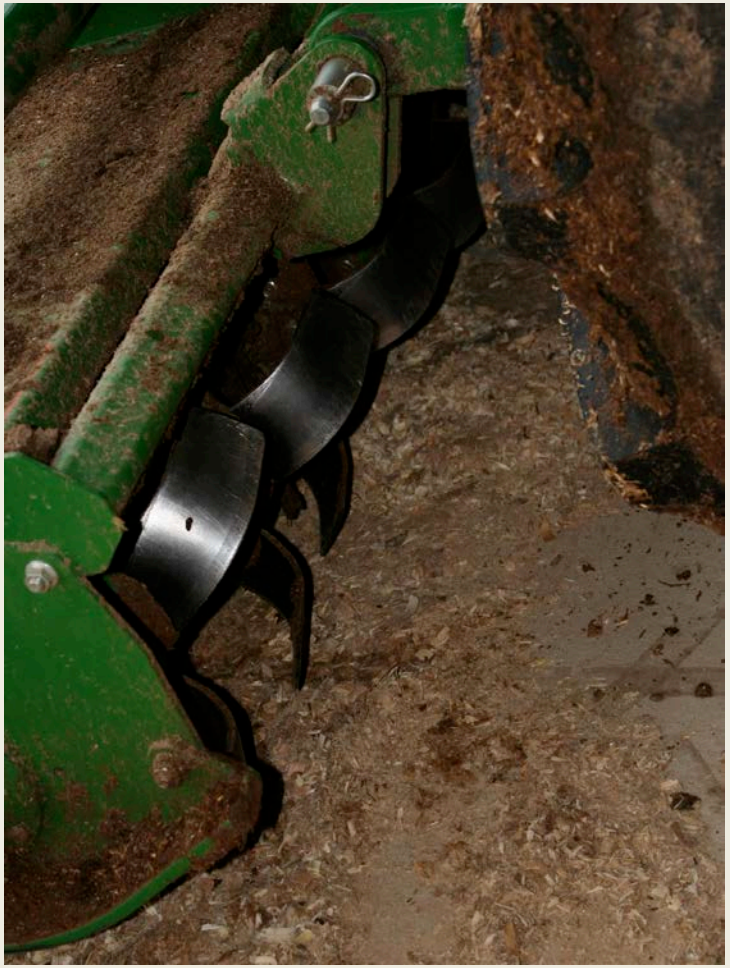
Stirring Equipment Examples

Stirring Equipment Examples

Sweeps or Shovels Increase Mixing

Roto-tillers break up clumps of bedding material

Uniform Bedding with Roto-Tiller



Steam is Good But Doesn't Mean Pack is Composting

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

Too many posts within the barn can make pack stirring difficult

Heavy Tractors Compact Bedding Material

MANAGEMENT CHECKS

- Temperature: 110 to 150° F 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 and dry material.

Example of compost that is too wet with insufficient temperature.

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

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

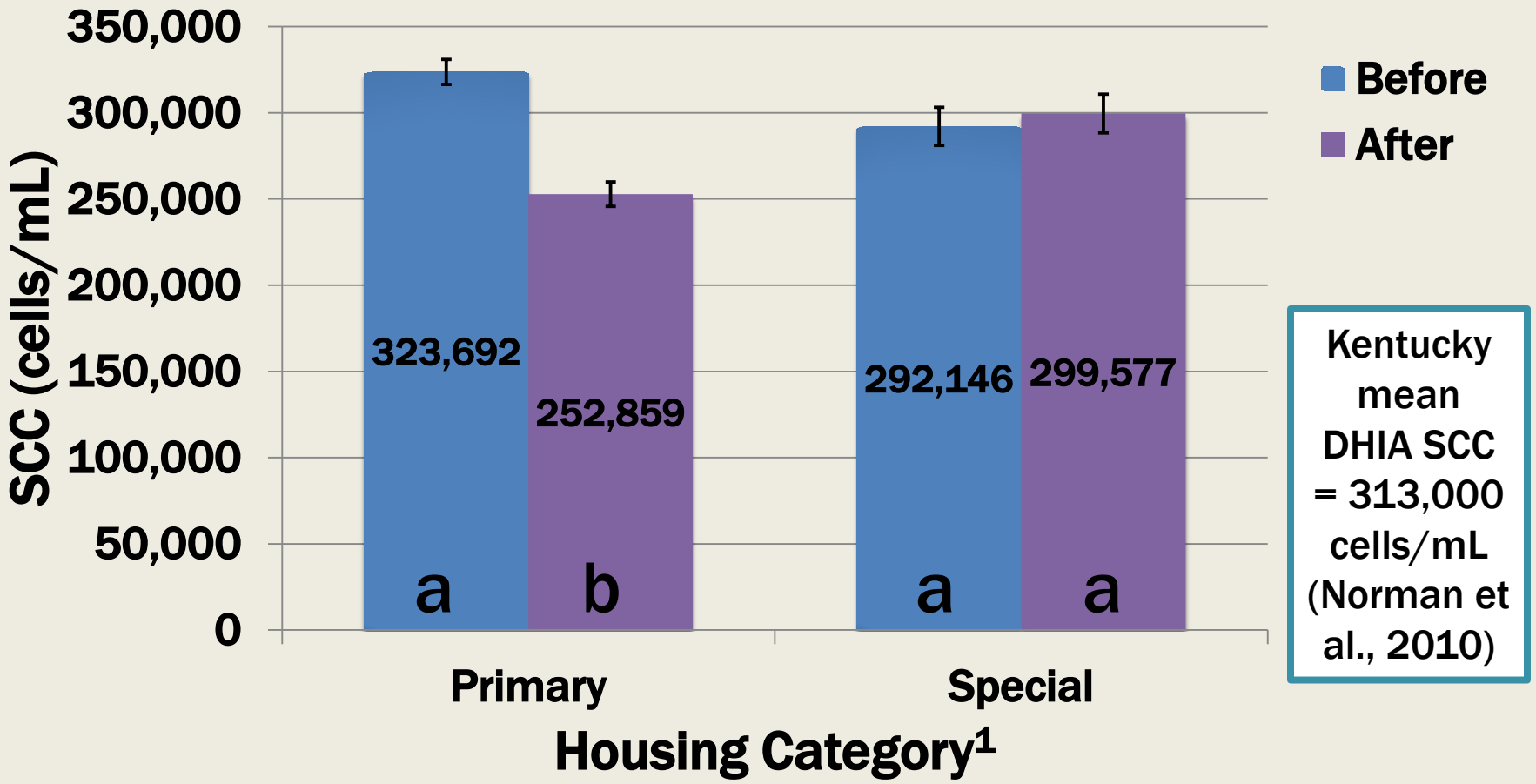
PRODUCER CITED BENEFITS OF COMPOST BEDDED PACK BARNS

- 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 BARNS

- 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)

SOMATIC CELL COUNT



Kentucky mean DHIA SCC = 313,000 cells/mL (Norman et al., 2010)

[1]Primary housing = CBP acts as primary housing facility
Special housing = CBP houses portion of herd, typically lame, fresh, or sick cows

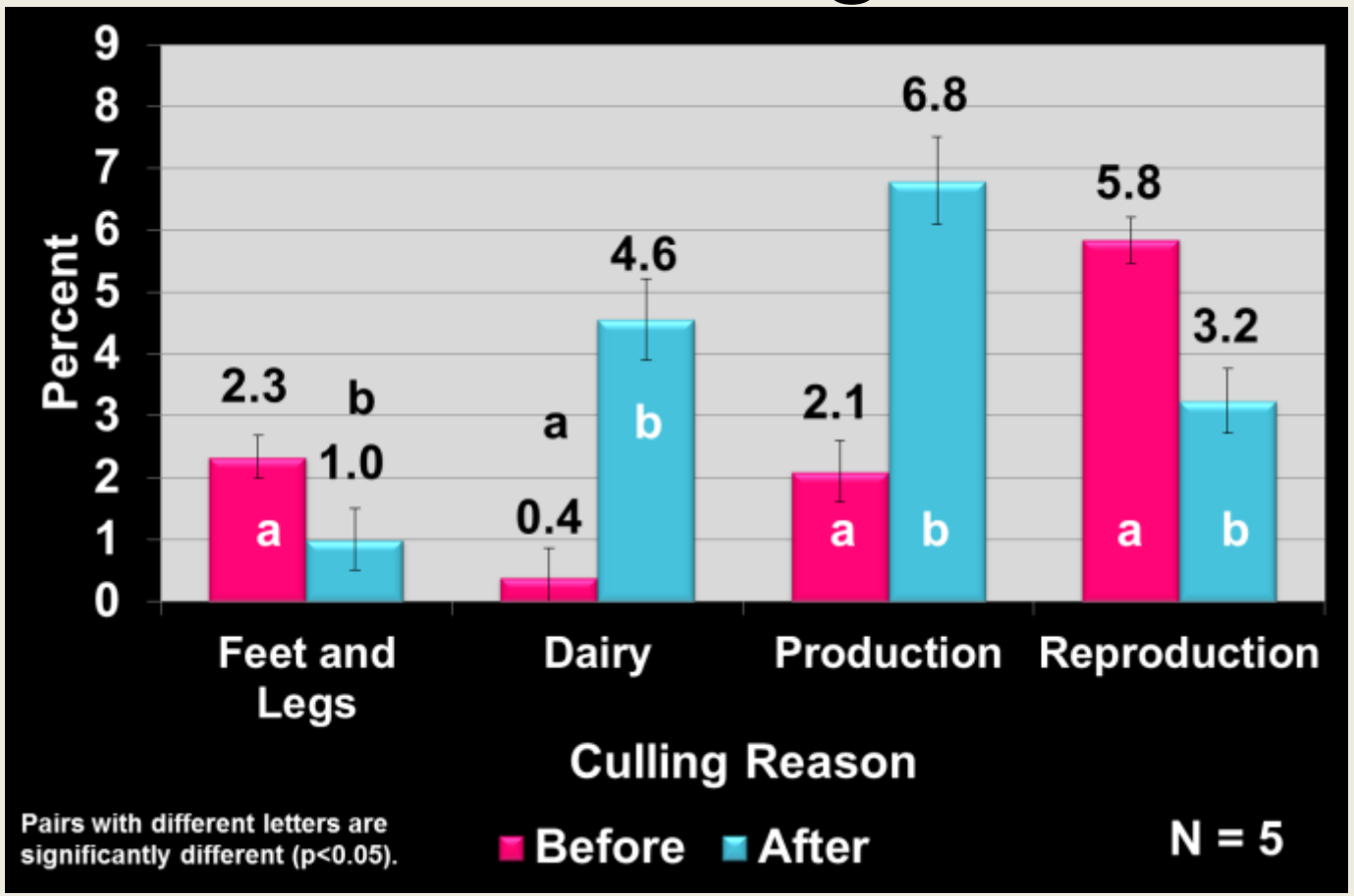
DHIA PRODUCTION AND SCC

Changes in productive parameters for primary housing farms before and after moving into a CBP

Parameter	Before[1]	Transition[2]	After[3]
Daily milk production, lbs	64.5 ± 0.6[a]	66.2 ± 0.6[ab]	67.5 ± 0.6[b]
Rolling herd average, lbs	19,661 ± 174[a]	20,227 ± 161[b]	20,687 ± 163[b]
SCC, cells/mL	411,230 ± 20,209[a]	305,410 ± 19,704[b]	275,510 ± 20,080[b]

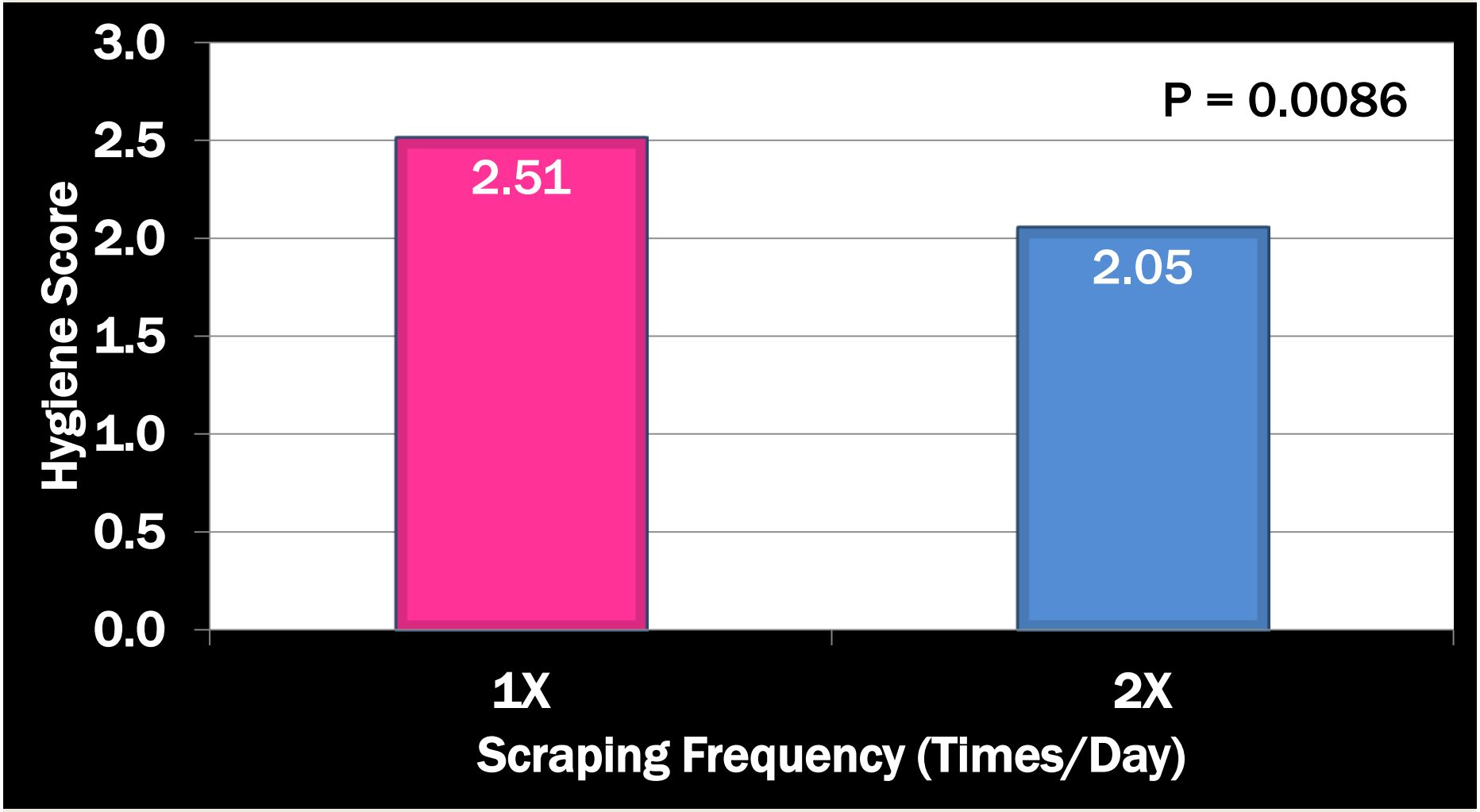
[1]Before represents the 12 m before moving into the CBP
[2]Transition represents the 12 m after moving into the CBP
[3]After represents the 13 to 24 m after moving into the CBP
[4]Different subscripts within a row denote a significant difference ($P < 0.05$)

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

SCRAPING FREQUENCY EFFECT ON HYGIENE



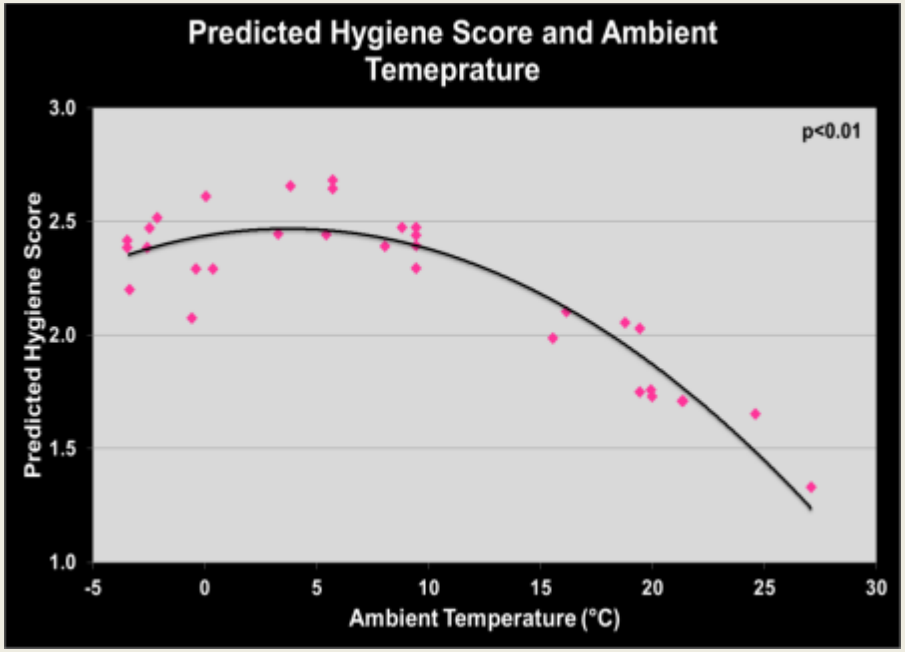
Hygiene depends on management!

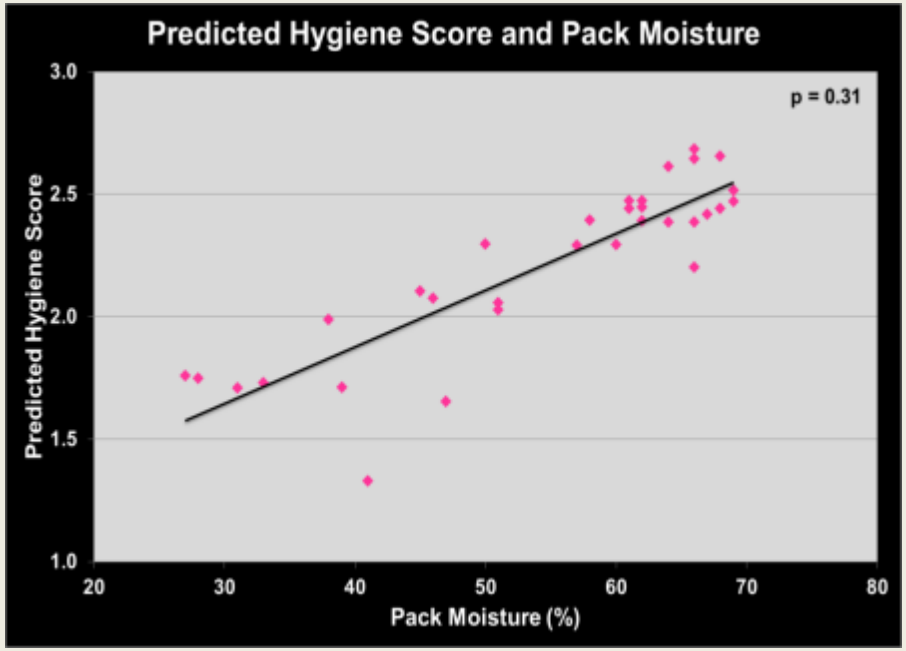
HYGIENE SCORING

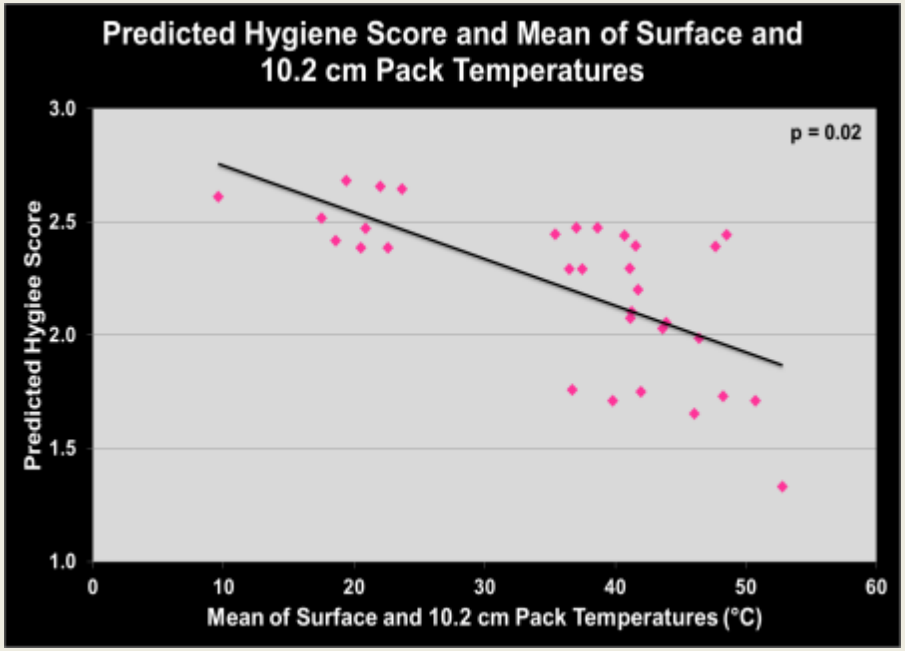
- Four hygiene categories (Cook, 2007)
  - 1: clean, little or no evidence of manure
  - 2: clean, only slight manure splashing
  - 3: dirty, distinct pieces of manure
  - 4: filthy, confluent pieces of manure
- At least 50 cows per barn
  - If fewer than 50 cows, every cow was scored
- Cows randomly selected based on tag number (i.e. multiples of 3, even tag number)

http://www.infodairy.com/infodairy_upload_files/Cows_heifers_calves/Milk%20Quality/0111hygiene%20scoring%20card.pdf

Hygiene Score Relationships







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 LEVELS

Bacteria	N	Mean	Standard Deviation
Escherichia coli	43	13.31 $\log_{10}$cfu/g	1.44
Coliform	43	14.07 $\log_{10}$cfu/g	1.30
Streptococcal species	43	16.04 $\log_{10}$cfu/g	1.63
Staphylococcal species	43	17.54 $\log_{10}$cfu/g	1.09

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

BACTERIA

- Managing the CBP moisture and temperature can improve cow hygiene, which may help in the prevention of mastitis
- Each bacteria acts differently in the composting environment (Streptococcal species most affected)
- Mechanism for reduced SCC in CBP cannot be explained by bacteria content:
  - Dry resting surface
  - Immune function???
  - Clinical mastitis incidence and milk culture study needed

RECOMMENDED FACILITY CHANGES

Increase size or capacity of the barn (n = 15)

Larger ridge vent (n = 5)

Higher sidewalls and improved ventilation (n = 12)

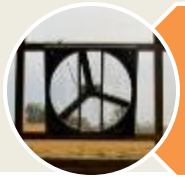
No posts in pack (n = 4)

Add a retaining wall (n = 6)

Change number or location of waterers (n = 4)

Add Curtains (n = 5)

Change location or size of feed bunk (n = 4)



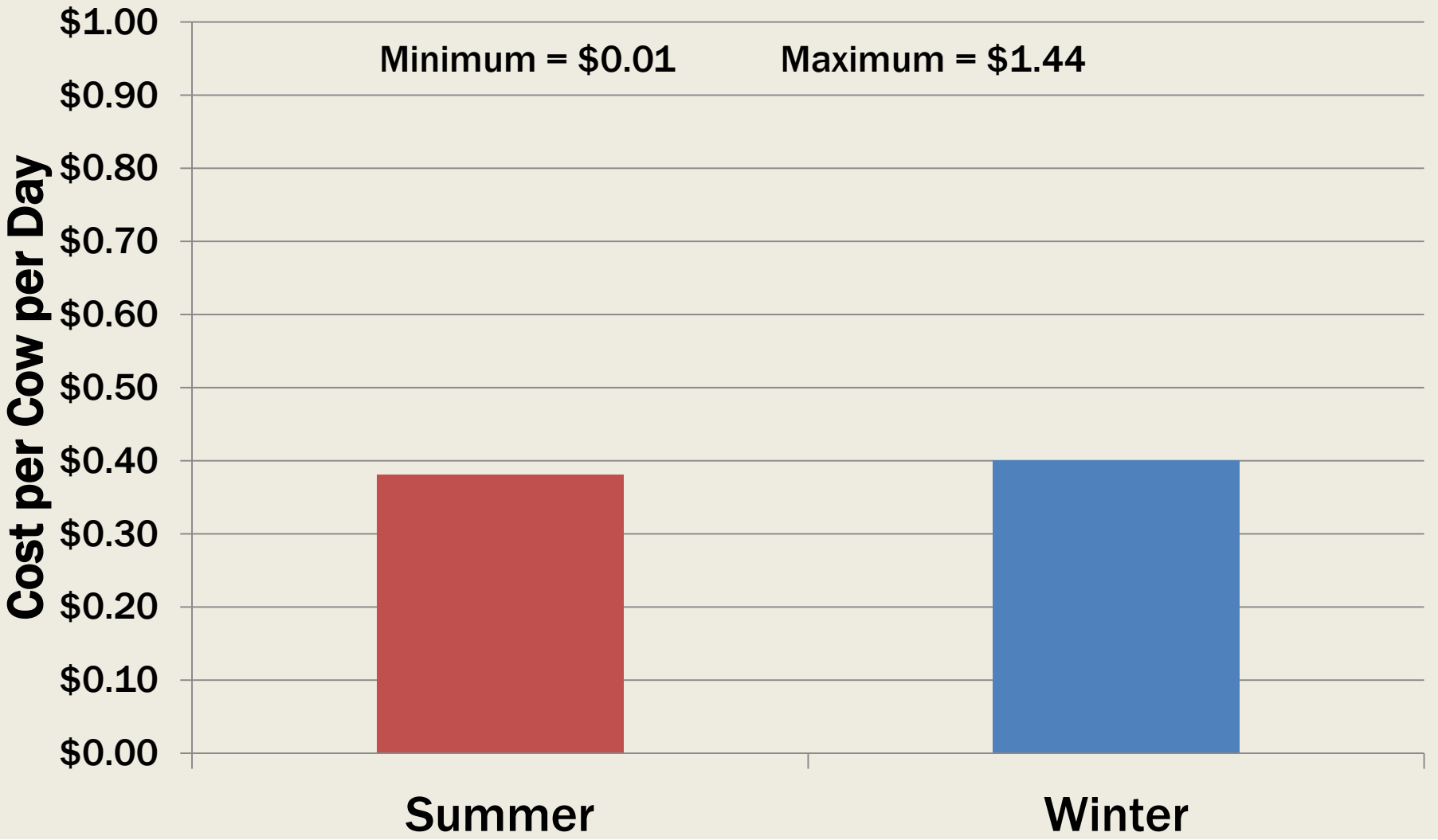
More fans (n = 5)

Length of overhang or eaves (n = 3)

INVESTMENT COSTS

	Average	Minimum	Maximum
All Barns			
Barn cost	$85,362	$10,900	$300,000
Cost/cow @ 100 sqft/cow	$855	$215	$1,875
Barns with Attached Feed Bunk			
Barn cost	$103,729	$30,000	$300,000
Cost/cow @ 100 sqft/cow	$1,051	$421	$1,876
Barns without Attached Feed Bunk			
Barn cost	$51,454	$10,900	$155,000
Cost/cow @ 100 sqft/cow	$493	$196	$833

DAILY BEDDING COSTS



Intro | Farm Inputs | Compost | Mattress Freestall | Sand Freestall | Benefits | Investment Anal...

University of Kentucky New Dairy Housing Facility Investment Analysis Dashboard

Created By: Randi Black and Dr. Jeffrey Bewley
Contact: rablac3.com or 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 t y be used to better define a particular input or output in this dashboard. Simply roll the mouse over the button to obtain additional information.

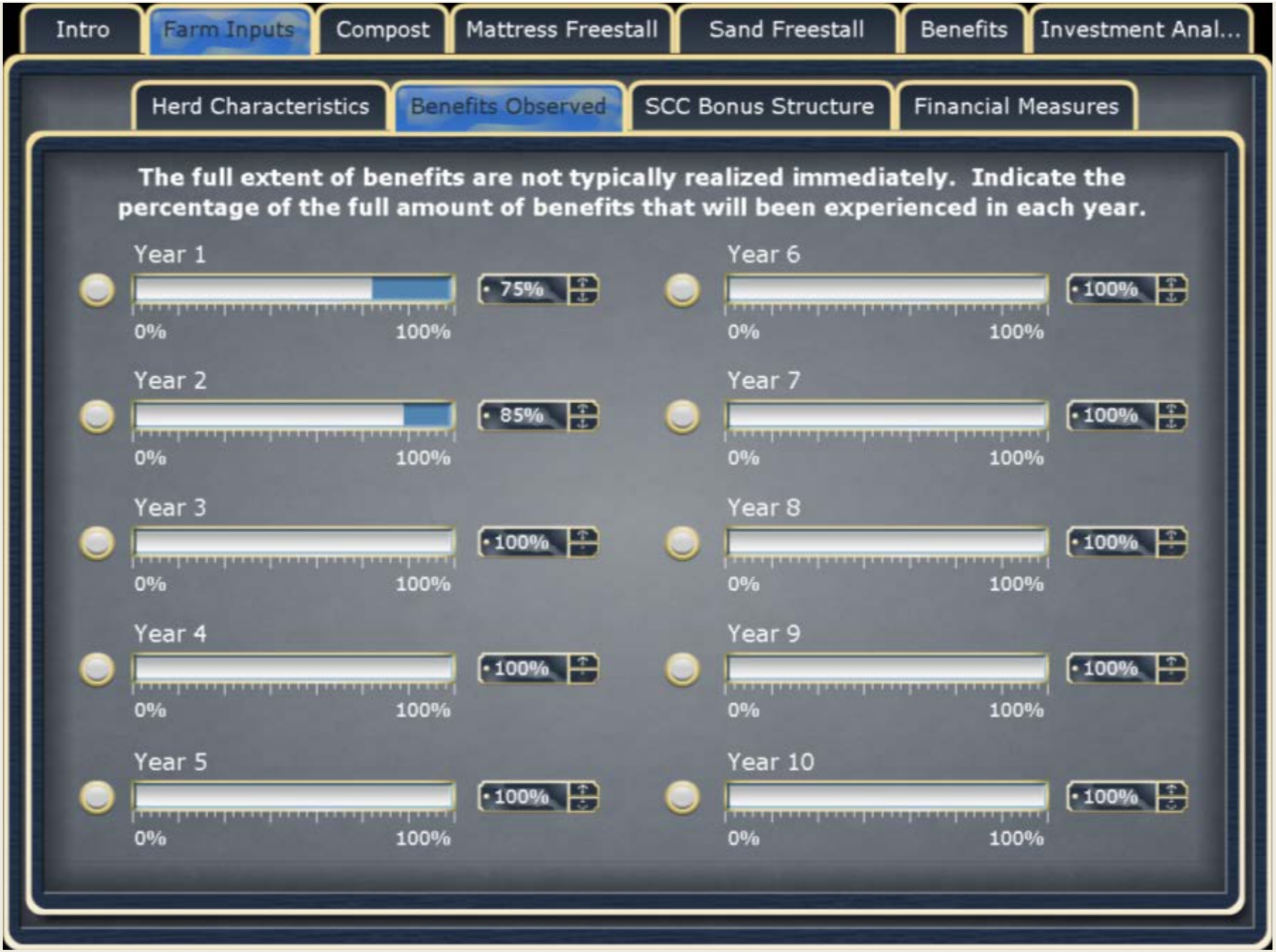
The reset button on this page may be used to reset all values to the defaults.

UK UNIVERSITY OF KENTUCKY

see blue. in everything we do.

http://www2.ca.uky.edu/afsdairy/DairyHousingInvestment

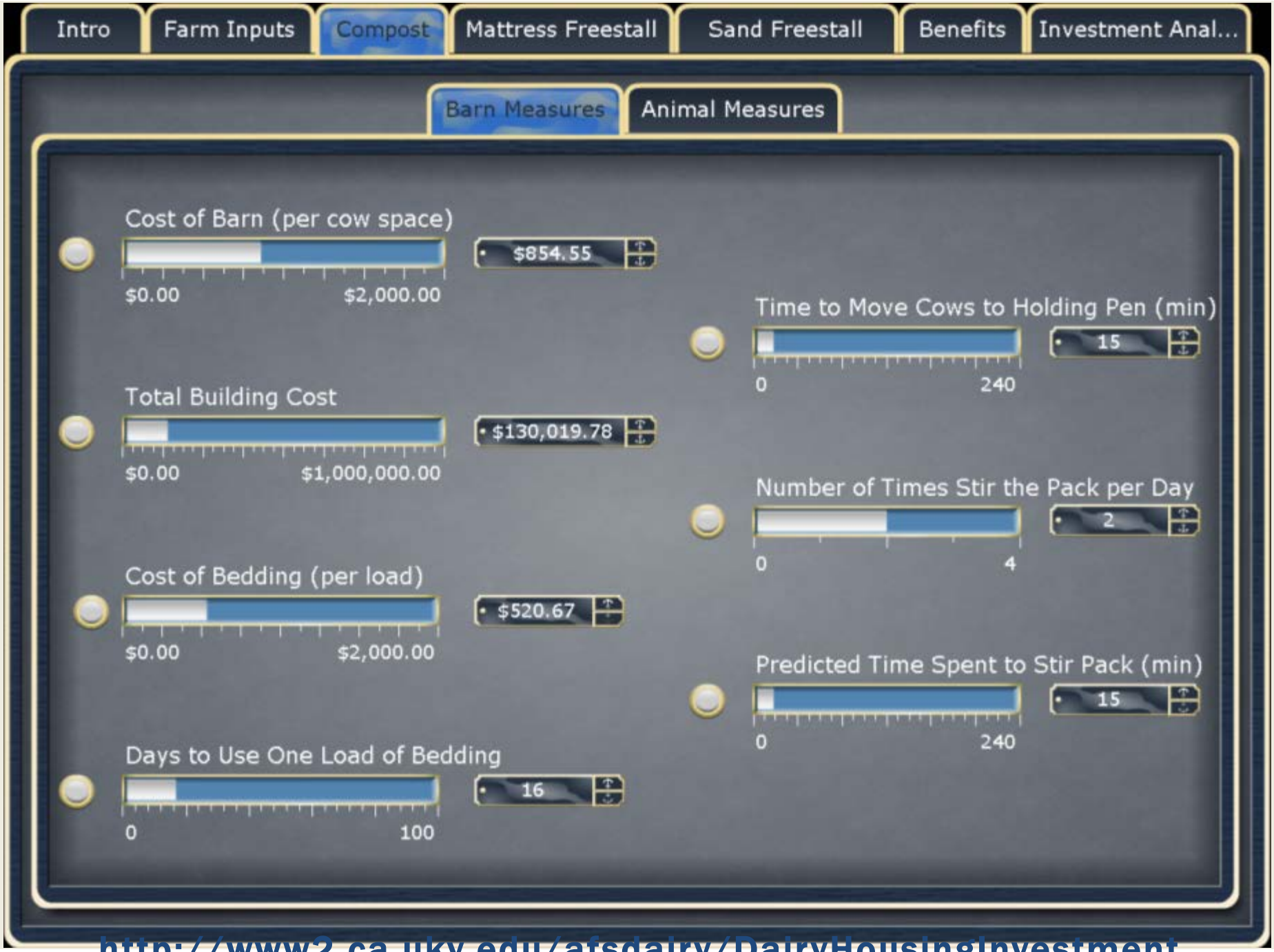
http://www2.ca.uky.edu/afsdairy/DairyHousingInvestment



http://www2.ca.uky.edu/afsdairy/DairyHousingInvestment

http://www2.ca.uky.edu/afsdairy/DairyHousingInvestment

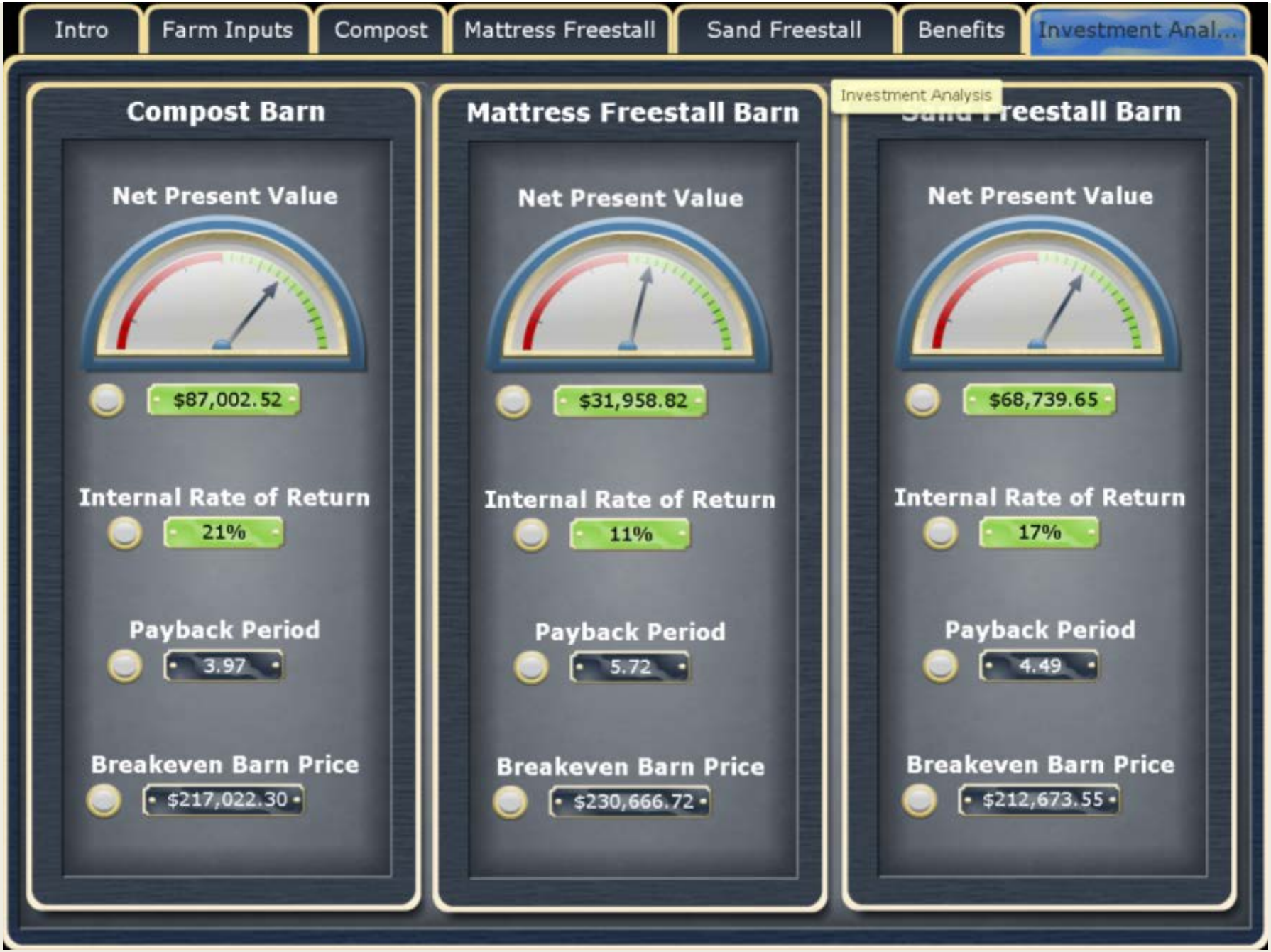
http://www2.ca.uky.edu/afsdairy/DairyHousingInvestment



http://www2.ca.uky.edu/afsdairy/DairyHousingInvestment

http://www2.ca.uky.edu/afsdairy/DairyHousingInvestment

http://www2.ca.uky.edu/afsdairy/DairyHousingInvestment



http://www2.ca.uky.edu/afsdairy/DairyHousingInvestment

CURRENT HOUSING (PASTURE) DEFAULT VALUES
HERD CHARACTERISTICS

Parameter	Default Value	Source
Herd Size (Including Dry Cows)	179 cows	NASS, 2012
Rolling Herd Average	21,300 lbs	NASS, 2012
Current Clinical Lameness Incidence Rate	17.4%	Olmos, 2009

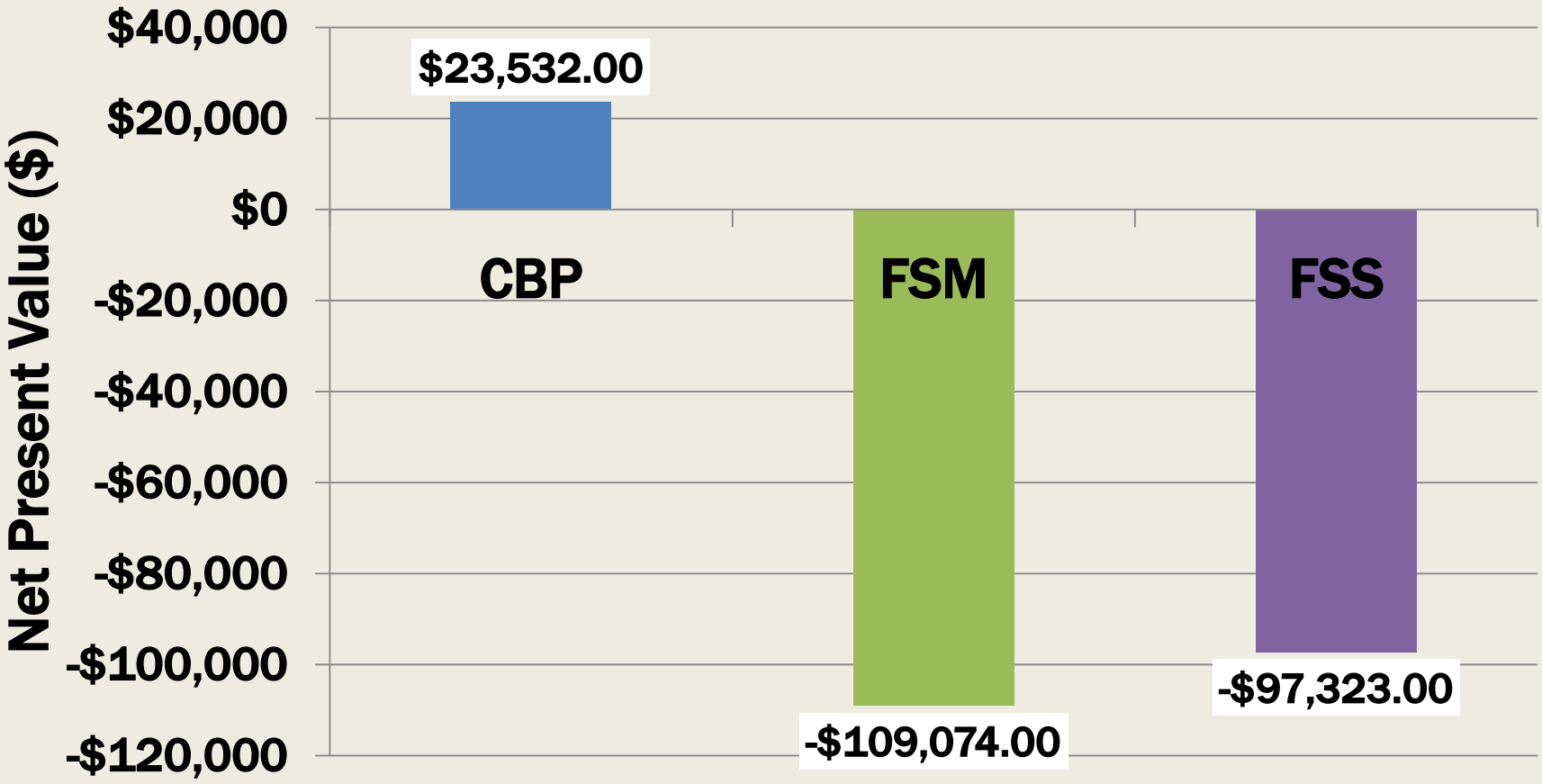
CURRENT HOUSING (PASTURE) DEFAULT VALUES
FINANCIAL VALUES

Parameter	Default Value	Source
Long-Term Milk Price	$0.19/lb	Westhoff et al., 2012
Lactating Cow Feed Cost	$0.09/lb DM	FAPRI, 2012; Bailey and Ishler, 2008
Labor Cost	$10.00/hr.	Billikopf, 2009
Discount Rate	8.0%	Bewley et al., 2010
Interest Rate	6.0%	Personal Communication
Tax Rate	30.8%	Personal Communication
Length of Loan	10 yr.	Model Assumption

Comparison of Default Values Among Housing Systems

Parameter	Compost	Mattress Freestall	Sand Freestall
Cost of Barn	$1,050/cow Black et al., 2012	$1,950/stall Horner et al., 2007	$1,800/stall Horner et al., 2007
Cost of Bedding	$20.34/day	$19.31/day	$27.52/day
Predicted SCC	252,860 cells/mL Black et al., 2012	357,000 cells/mL USDA, 2012	272,000 cells/mL USDA, 2012
Predicted Lameness Incidence Rate	12.0% Black et al., 2012	30.3% Cook, 2003	19.8% Cook, 2003

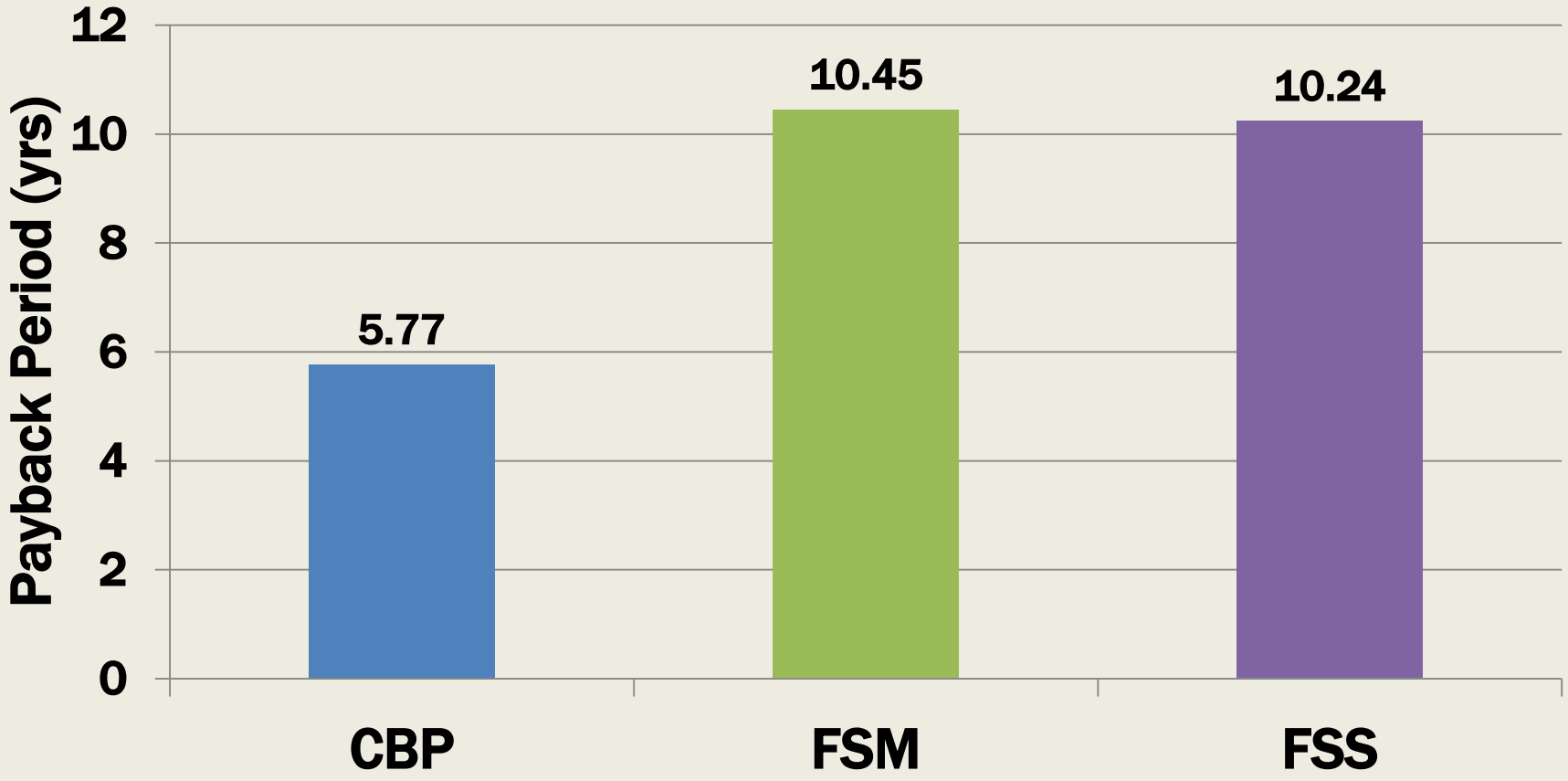
INVESTMENT ANALYSIS – NET PRESENT VALUE



All input values held at defaults

CBP = Compost bedded pack FSM = Mattress freestall FSS = Sand freestall

INVESTMENT ANALYSIS – PAYBACK PERIOD



All input values held at defaults

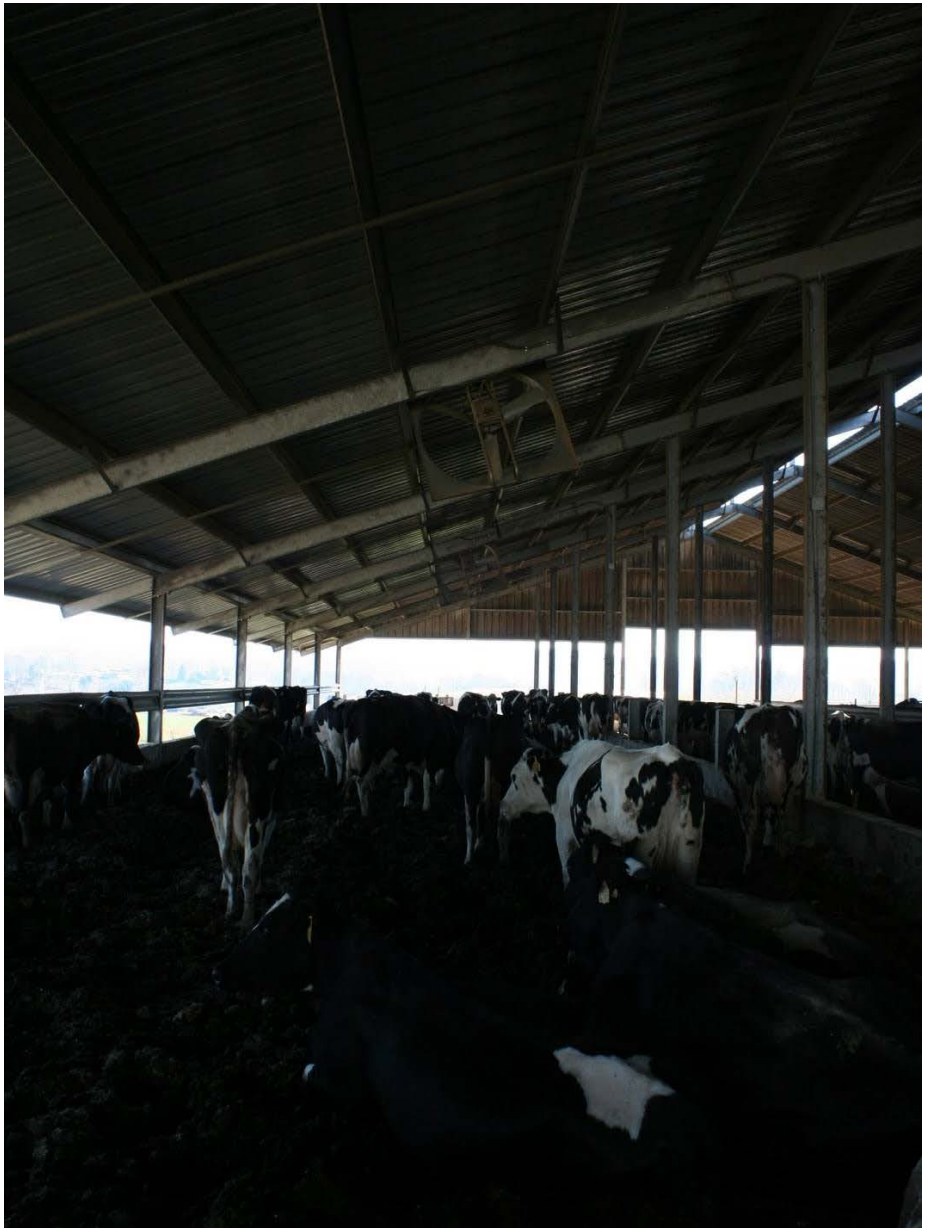
CBP = Compost bedded pack FSM = Mattress freestall FSS = Sand freestall

DESIGN CONSIDERATIONS

- Site selection
  - Maximize natural ventilation (summer winds)
  - Slightly elevated (minimize runoff)
- Clay or concrete base
- Modified freestall barn designs
- Barn dimensions account for feed and water space

BUILDING DESIGN: NEW RECOMMENDATIONS

- Think about summer and winter as different systems
- Build for number of cows milking
- Consider milk production and cow size
- Start thinking about feed and water space early
- Packs must be stirred twice per day every day, no exceptions
- Green sawdust is OK (just use more of it)
- Use e.coli vaccines (J5, J-VAC, or ENDOVAC-BOVI)

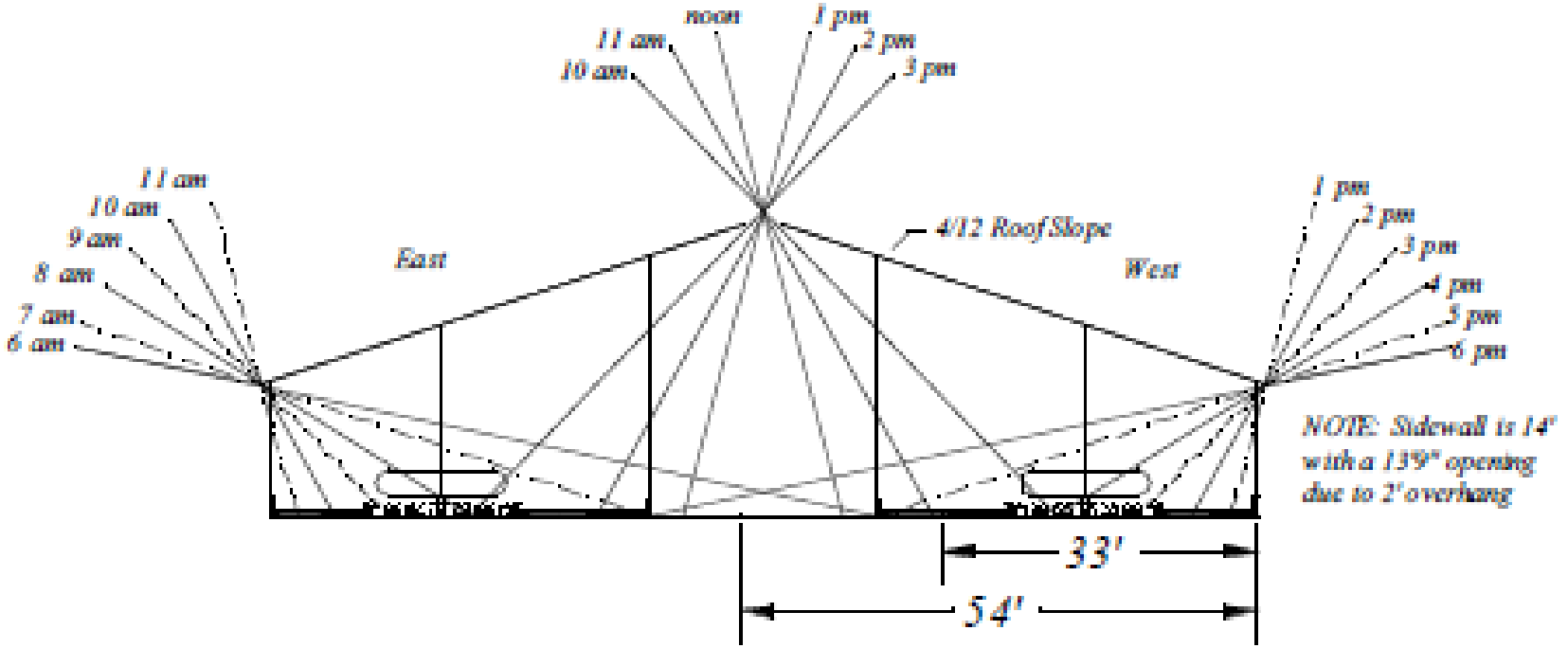


- The system is unforgiving to overstocking
- Providing less than 100 square feet of resting area per cow is a recipe for disappointment
- The amount of moisture deposited through urine and manure is too much to overcome

BARN ORIENTATION

- Most winds come from the south
- Long side of the barn should be oriented east-west to
  - Minimizes the time with direct sunlight entering the barn (see diagrams below)
  - Maximizes natural ventilation in the summer
- Of course, the lay of the land doesn't always allow for correct orientation

SUN ANGLES: NORTH-SOUTH BARN

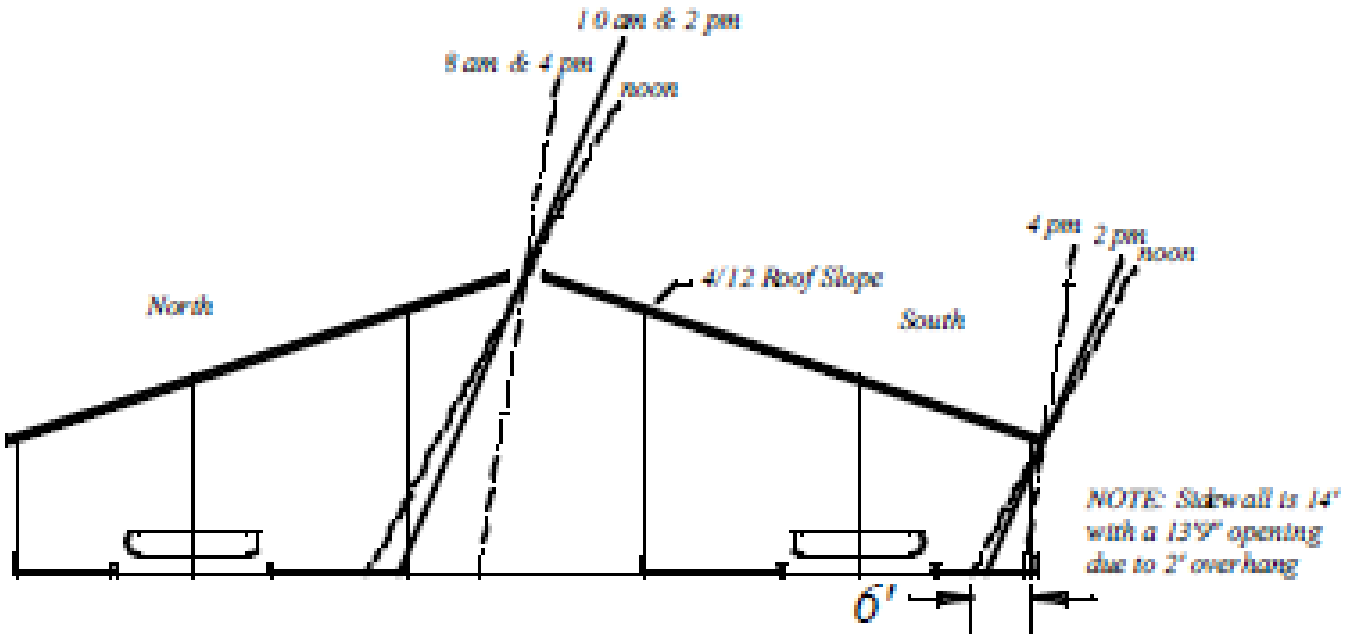


Sun Angles for N-S Freestall - August 21st

40 Degrees North Latitude (Omaha - Springfield)

Brouk et al, 2001

SUN ANGLES: EAST-WEST BARN



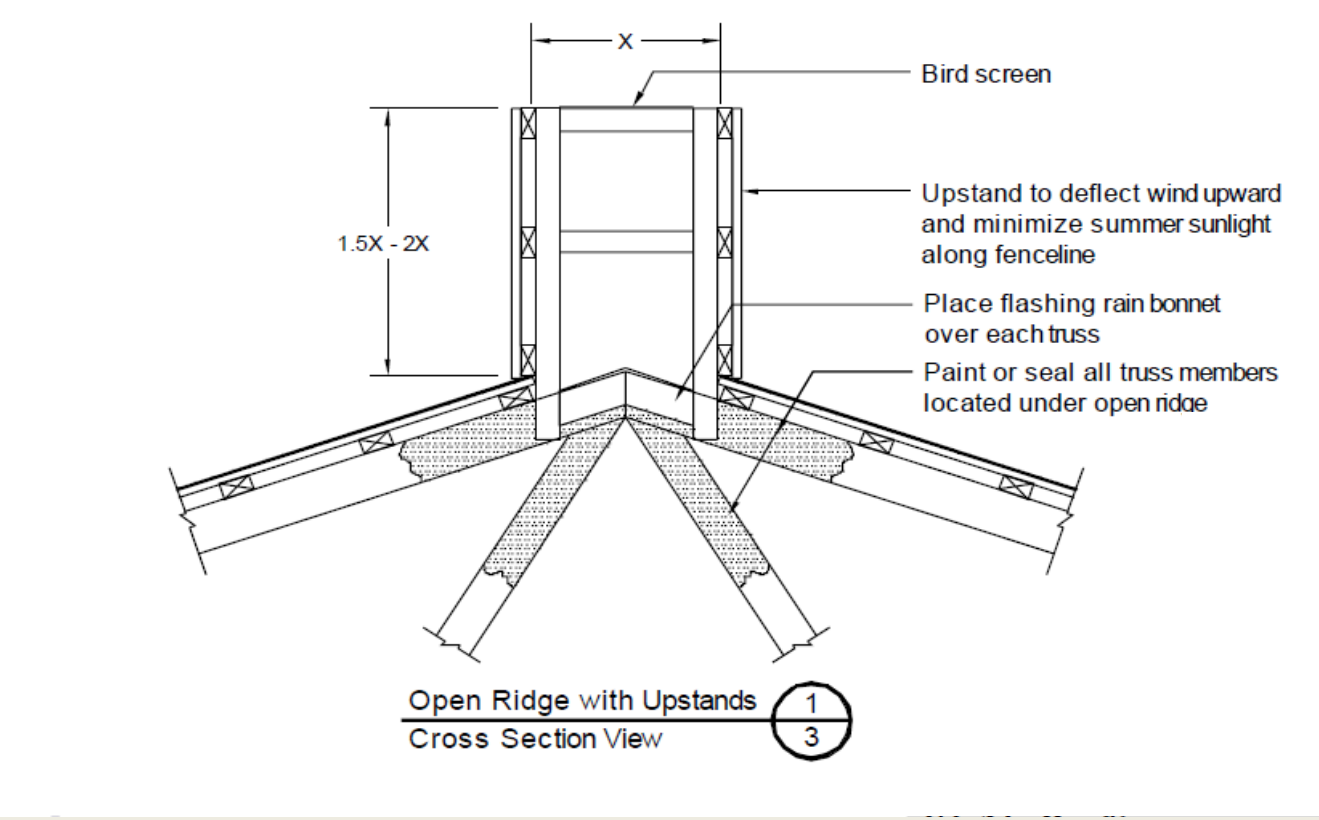
Sun Angles for E-W Freestall - August 21st

40 Degrees North Latitude (Omaha - Springfield)

Brouk et al, 2001

Open Ridge, High Sidewalls

OPEN RIDGE WITH UPSTAND

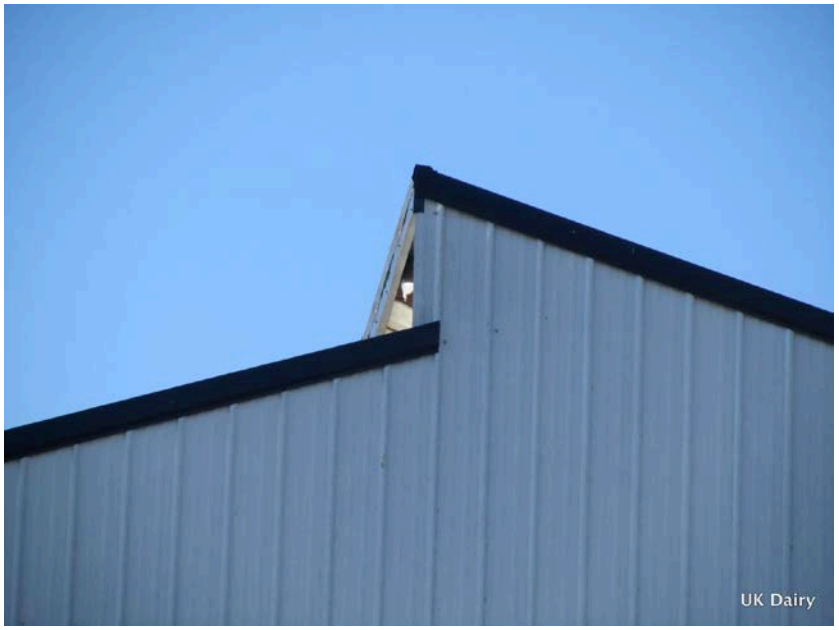


- 3” of opening (X) for every 10 feet of building width (minimum 12”)

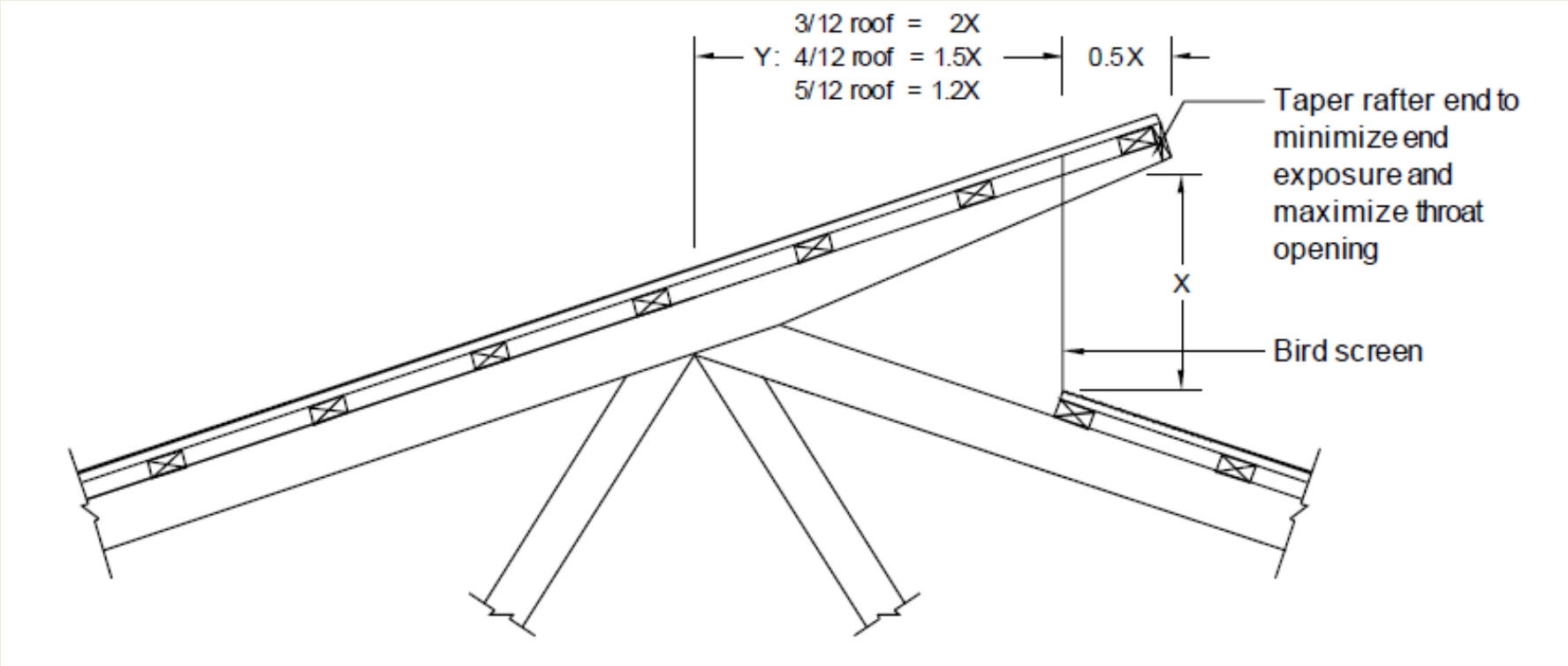
McFarland et al, 2007

Overshot Ridge Less Desirable

- An overshot roof can provide reasonable air removal when the opening is high enough as depicted in these barns
- However, good air removal only occurs when wind moves across the higher side
- When wind moves toward the opening, the wind actually forces air back into the barn



BEST OVERSHOT RIDGE DESIGN

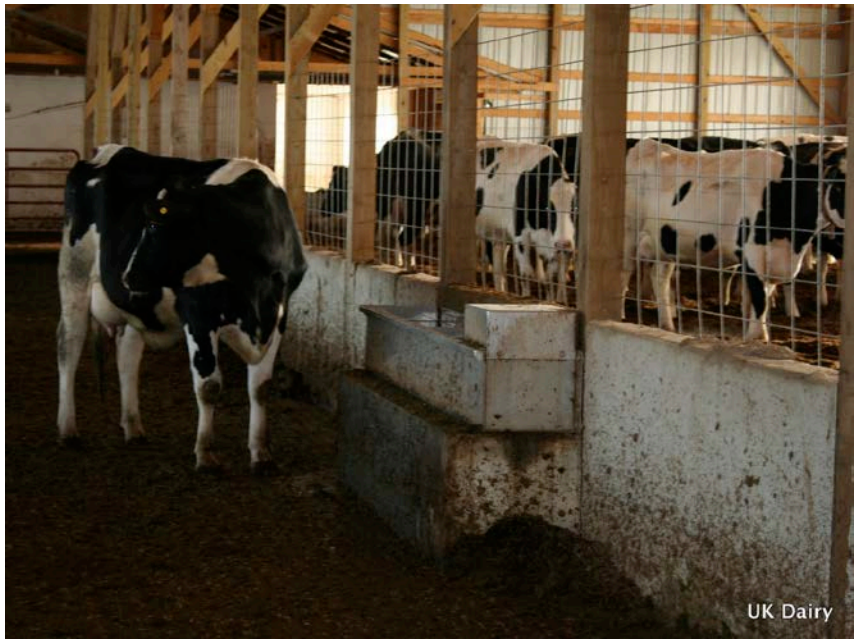


- 3” of opening (X) for every 10 feet of building width (minimum 12”)

McFarland et al, 2007

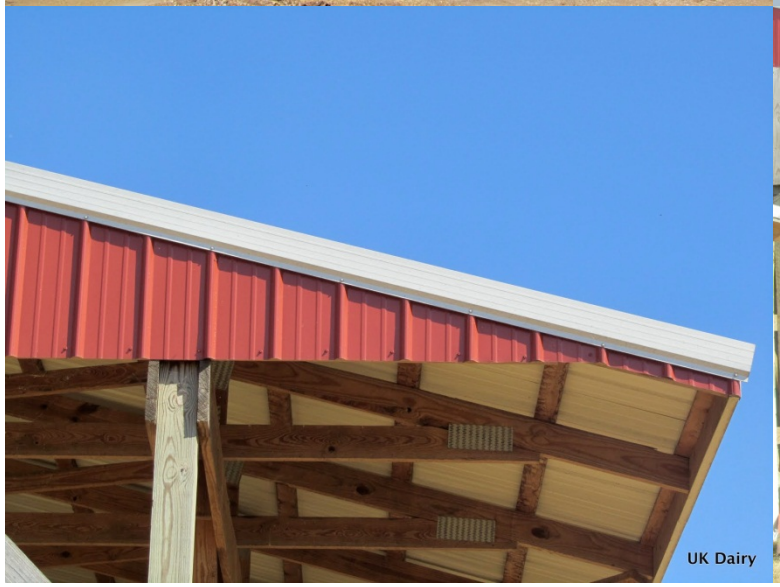
- High, open sidewalls like those depicted in the pictures above maximize cross ventilation
- A minimum of 14 feet of opening should remain between the top of the retaining wall and the bottom of the barn eave

Hoop structures don't provide enough ventilation for cows or pack



A concrete retaining wall provides separation between the feed alley and the pack area (A) which is helpful in managing pack moisture. Additionally, on the outside of the barn (B), the retaining wall keeps bedding material within the barn

Wide alleys (14 foot recommended) improve cow flow, minimize chances for cow injuries, and allow for easy access to feed and water



Eave overhangs can help minimize the amount of wind, precipitation, and sunlight entering the barn. Overhangs should be 1/3 of the eave height.

Properly positioned fans help cool cows and dry bedding material


UK Dairy


UK Dairy


UK Dairy

High volume low speed fans (HVLS) have been added to many compost bedded pack barns. These fans distribute air well across a wide area.

Bunching can be a challenge without proper consideration of air and light flow

Curtains Can Help in Winter

No access to water from pack

Restricted Water Access

Wide Entrances and Entrances on Short End of Barn are Too Wet

To minimize this effect, multiple, build narrow entrances along the long side of the barn. Entrances should be spaced every 50 feet.

Dedicating a storage area for sawdust supplies helps keep bedding supplies dry and allows for stockpiling of bedding material for times of high demand or low supply.

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

COMPOST BARNS AND GRAZING OPERATIONS OPPORTUNITIES

- Lowers operating cost of compost barn
  - Less bedding
  - Less moisture deposited in barn
- Potentially lower investment cost without feed alley
- Potential performance improvements
  - Cow cooling in summer
  - Dry resting surface during wet weather
  - Protection from elements during winter

COMPOST BARNS AND GRAZING OPERATIONS CHALLENGES

- Keeping compost active
- Seasonal grazing may be challenging
  - Start pack before weather cools off
- Need to continue stirring
  - Possibly once per day without cows on pack
- Adding moisture during times of non-use may help

UK Compost Resources

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

ID-206

UK UNIVERSITY OF KENTUCKY College of Agriculture

Compost Bedded Pack Barn Design

Features and Management Considerations

Jeffrey Bewley, Animal and Food Sciences, Joe Taraba and George Day, 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

UK UNIVERSITY OF KENTUCKY College of Agriculture

Kentucky Compost-Bedded Pack Barn Project

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

QUESTIONS

Jeffrey Bewley, PhD, PAS
407 W.P. Garrigus Building
Lexington, KY 40546-0215
Phone: 859-257-7543
Fax: 859-257-7537
jbewley@uky.edu