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Department of Agricultural Economics

Economic Returns at Varying Levels of Reproductive Efficiency

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ABSTRACT

In recent years many sectors of the livestock industry (e.g., beef, dairy, and swine) have experienced severe financial stress over extended time periods due to extremely volatile markets (prices of both outputs and inputs). As a result, there is a lot of focus and discussion regarding the importance and value of risk management to ensure economic sustainability of livestock operations. However, considerable research has shown that managing year-to-year price risk, which is a significant risk for livestock producers, is difficult to do effectively with existing risk management tools. Thus, one of the best means producers have for managing risk to ensure long-term business survival is by being a low-cost producer, i.e., produce output at the lowest cost per unit as possible, while maintaining the quality of the product such that it is readily marketable. One of the most important methods of being a low cost producer is to have high production, which begins with reproductive efficiency. While reproductive efficiency can be defined a number of ways, from an economic standpoint it basically refers to using an asset (e.g., cow, sow) in an efficient manner such that the costs of obtaining the asset (i.e., purchase cost or development cost) are allocated over as much production as possible. This presentation will review the impact varying key reproductive efficiency measures have on costs of production and economic returns for the beef, dairy, and swine industries through the use of projected budgets and simulations.

Key Words: economic returns, low cost, projected budgets

ASAS Midwestern Section -- Physiology Symposium: Factors Influencing Female Reproductive Efficiency

Physiology Symposium: Factors Influencing Female Reproductive Efficiency
Chair: Jeremy Miles, USDA-ARS

Advancement in understanding the central pathways that underlie the effects of exteroceptive signals on the gonadotropic axis of the female for initiation of puberty and maintenance of normal reproductive cycles.
C. A. Lents*, *USDA-ARS U.S. Meat Animal Research Center*, *Clay Center, NE*.

The oocyte molecular phenotype: Influence of the follicular environment and body condition.
J. R. Wood*, *University of Nebraska*, *Lincoln*.

Pregnancy losses in domestic animals.
D. L. Davis*, *Kansas State University*, *Manhattan*.

Transgenic alteration of milk composition and milk performance in livestock.
M. B. Wheeler*, *University of Illinois*, *Urbana*.

Influence of metabolic pathways on dam longevity.
L. A. Rempel*, *USDA, ARS, USMARC*, *Clay Center, NE*.

Economic returns at varying levels of reproductive efficiency.
K. Dhuyvetter*, *Kansas State University*, *Manhattan*.

ASAS Midwestern Section -- Physiology Symposium: Factors Influencing Female Reproductive Efficiency

Economics of reproductive efficiency…

1. **How is reproductive efficiency defined?**
2. **My simple definition for today ➔ Maximize the output per female on an annual basis (or minimize cost/unit of output)**
3. **Much more complex than I can address at this point (e.g., needs to be a multi-year, stochastic, dynamic analysis)**
4. **Lacking physiological/biological models, many assumptions need to be made…**
5. **Analyses used are to construct partial budgets and look at alternative assumptions regarding production**

ASAS Midwestern Section -- Physiology Symposium: Factors Influencing Female Reproductive Efficiency

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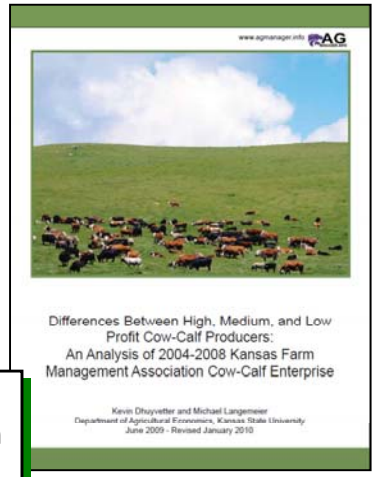
Beef cow-calf

ASAS Midwestern Section -- Physiology Symposium: Factors Influencing Female Reproductive Efficiency

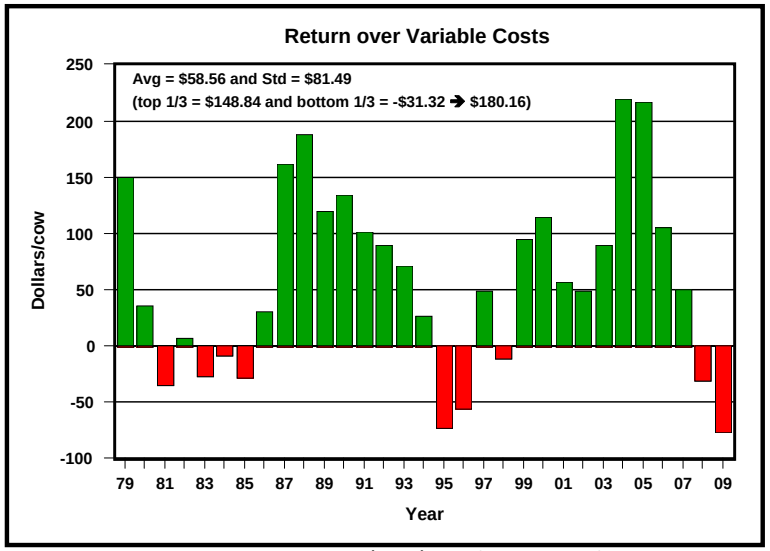
Beef cow-calf profitability drivers…

- **Analysis of KFMA beef cow-calf enterprise analysis returns**
  - **1979-2008 all operations (examine time effect)**
  - **2004-2008 operations with at least three years of data (examine producer effect)**
- **Paper available on web (www.agmanager.info)**



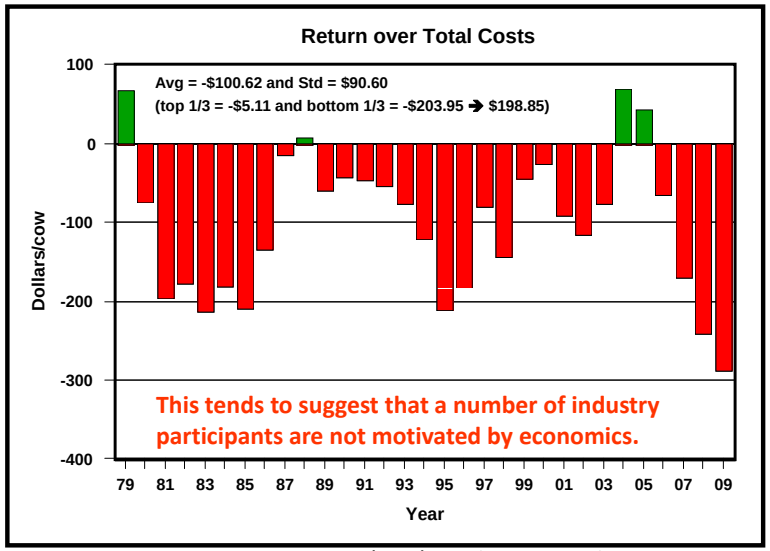
The following charts/table use the same procedure, only they have been updated to include 2009 data.

Average returns are highly variable over time…



Source: Kansas Farm Management Association (KFMA) Annual Enterprise Analysis Reports

Average returns are highly variable over time…



Source: Kansas Farm Management Association (KFMA) Annual Enterprise Analysis Reports

Returns are more variable across producers…

Beef Cow-calf Enterprise, 2005-2009 (min of 3 years)*

	All Farms	Profit Category High 1/3 Head / $	Mid 1/3 Head / $	Low 1/3 Head / $	Difference between High 1/3 and Low 1/3 Absolute	%
Number of Farms	73	24	25	24		
Labor allocated to livestock, %	37.4	50.1	30.8	31.5		
Number of Cows in Herd	137	194	127	92	102	112%
Number of Calves Sold	126	179	118	82	97	118%
		92.2%	92.9%	89.1%		
Weight of Calves Sold	576	582	580	567	15	3%
Calf Sales Price / Cwt	$108.00	$108.44	$108.24	$107.32	$1.12	1%
Gross Income	**$515.19**	**$566.24**	**$522.26**	**$456.77**	**$109.47**	**24%**
				30.6%		
Feed	$321.39	$279.22	$322.23	$362.69	-$83.47	-23%
Interest	$112.94	$94.66	$112.09	$132.11	-$37.45	-28%
Vet Medicine / Drugs	$16.32	$16.26	$15.63	$17.11	-$0.85	-5%
Livestock Marketing / Breeding	$11.79	$11.19	$12.29	$11.86	-$0.66	-6%
Depreciation	$30.91	$25.56	$24.88	$42.53	-$16.97	-40%
Machinery	$66.52	$50.32	$65.02	$84.27	-$33.95	-40%
Labor	$92.16	$66.57	$87.08	$123.03	-$56.46	-46%
Other	$33.35	$22.51	$36.84	$40.56	-$18.05	-45%
				69.4%		
Total Cost	**$685.38**	**$566.30**	**$676.07**	**$814.16**	**-$247.86**	**-30%**
Net Return to Management	**-$170.19**	**-$0.06**	**-$153.81**	**-$357.39**	**$357.33**	

* Sorted by Net Return to Management (Returns over Total Costs) per Cow

Compared to $180-$200 between top and bottom third years.

Beef cow-calf…

- **Main problems in beef cattle reproduction are low calf crop and long calving season. Another concern is how long female stays in herd** (often conflicts with first two issues)

Income Gained by Culling Rather than Keeping Open (but otherwise sound) Cows, $/cow in herd

First service conception rate	Length of Breeding Season, days 45	70	120
50%	$44.64	$22.59	$9.27
60%	$41.61	$17.45	$2.95
70%	$21.75	$8.06	$7.80
80%	$10.61	$5.44	$0.67

Source: Pfeiffer et al., 1990

"… the tradition of culling open cows is usually sound."

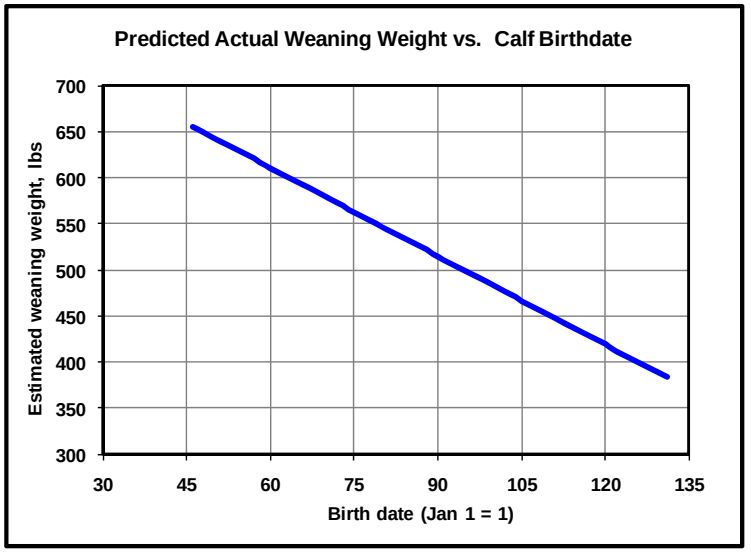
Beef cow-calf…

What I'm going to look at:

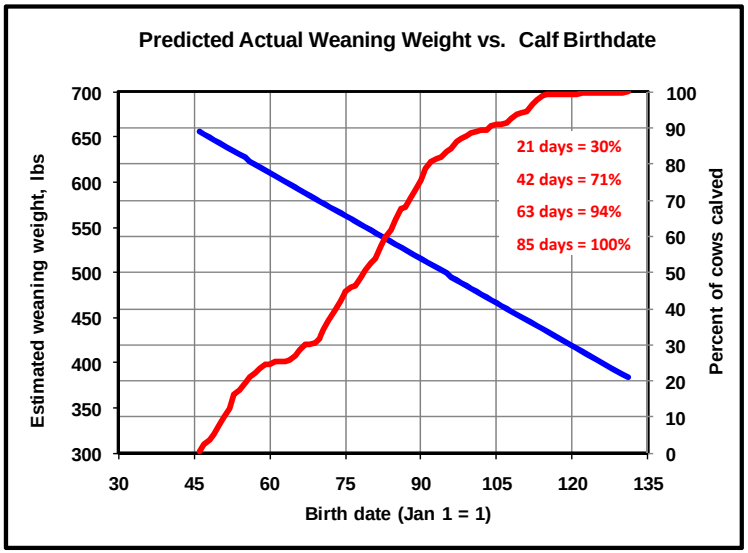
- **Impact of weaning weight of calves versus date of birth in calving season (i.e., length of breeding season)**
- **Economics of "length of life" female is in herd**
- **Impact percent calf crop, culling rate, and weaning weight have on net returns**

Weaning weight versus age at weaning

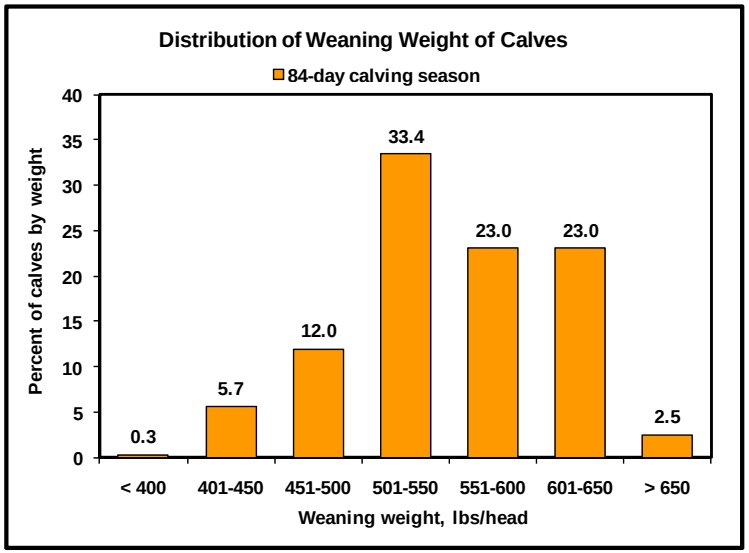
(estimated from cowherd with 213 calves, weaning date = 11/1)



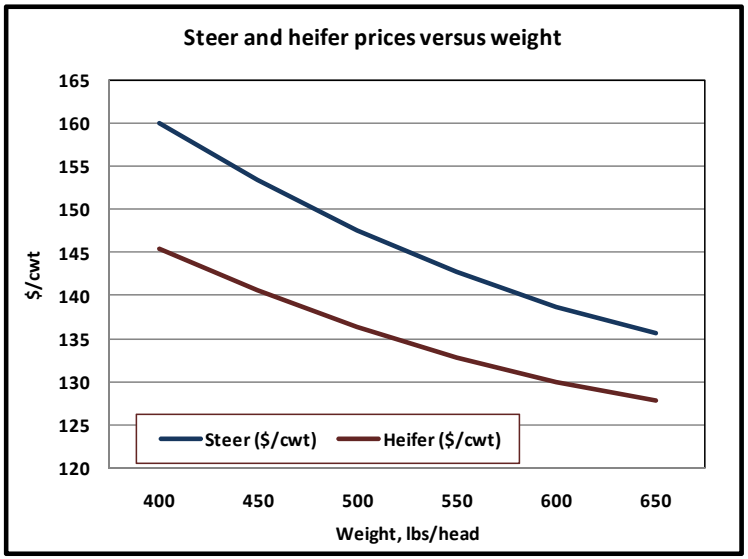
Weaning weight versus age at weaning
(estimated from cowherd with 213 calves, weaning date = 11/1)



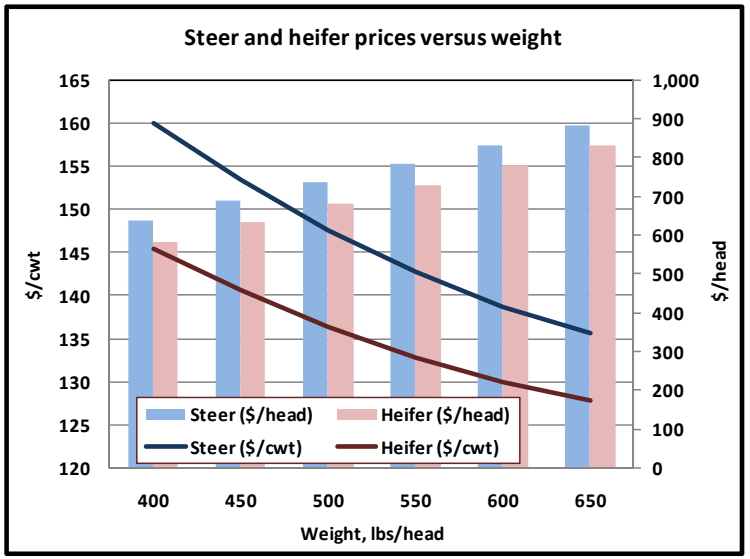
Even with relatively tight calving season considerable variability exists (avg = 554, range = 384-656)



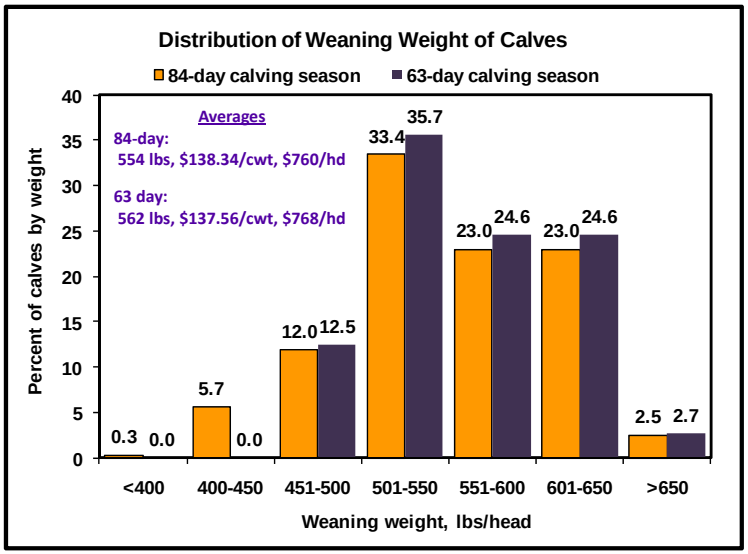
Price slide reduces effect of varying weight…



…, but heavier cattle are worth more per head.



Result of tightening up calving season…



Weight uniformity is important…

Feeder Cattle Trait	2001	2002	2003
Uniformity			
Uniform Lot	Base	Base	Base
Uneven Lot	-1.948	-3.154	-3.174

Source: Oklahoma Quality Beef Network (OQBN) auction sales, AGEC 602

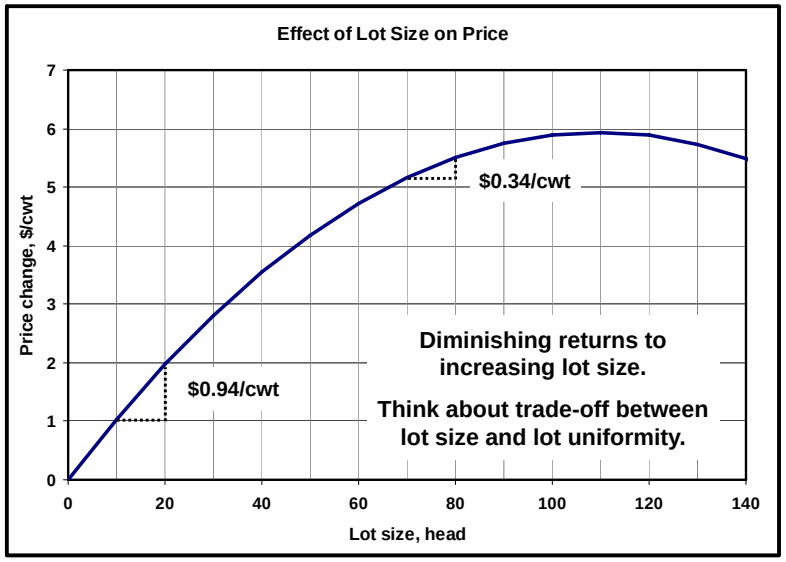
Characteristic	% of Pens	Price Change ($/cwt)
Weight Uniformity		
Uniform lot	98.8	Base
Non-uniform lot	1.2	-2.11*

Source: KS/MO Sale Barn Study (Schulz et al., 2009)

Characteristic	Steers	Heifers
Weight Variation		
Even to fairly even	0.529*	1.352*
Uneven	Base	Base

Source: Superior Livestock Video Auction Study (Zimmerman, 2010)

Lot size is important…



Beef cow-calf – Length of breeding season

- **Short breeding season increases returns by**
  - **Increasing weight of calves**
  - **Increasing ability to have larger lots of uniform calves**
  - **Increase probability of cows getting bred back**

It pays to keep female producing and in herd…

Input Assumptions

Number of replacements purchased	100	Percent marketable calves (1 - death loss)	96.0%
Year of purchase	2011	Annual cow death loss	0.5%
First year for calf sales	2011	Cows culled for non-breeding reason (health)	3.5%
Cull cow weight, lbs/hd	1,250		
Annual cow costs, $/year	$500	Annual inflation rate on costs	0.0%
Price scenario to use (1-4) (FAPRI (adjusted))	4	Annual increase in average weaning weight	0.0%
Weaning weight scenario to use (1-3)	1	Discount rate (interest rate)	7.5%

Net Present Value Analysis

Year	Cows at BOY*	Calf	Calf wt	Prices, $/cwt Calf	Cull	Calf Income	Cull Income Health	Quality	Cost	Cost Adj.	Net Income	Discount factor	NPV**
2011	100.0	1	530	$115.95	$56.66	$590	$24.79	$680	$500	$0	$115	1.0000	$795
2012	96.0	2	540	$127.00	$59.53	$632	$25.00	$685	$480	$0	$177	0.9302	$916
2013	92.2	3	550	$129.98	$60.75	$632	$24.49	$668	$461	$0	$196	0.8653	$1,027
2014	88.5	4	555	$131.83	$61.69	$621	$23.88	$655	$442	$0	$203	0.8050	$1,140
2015	84.9	5	560	$128.53	$59.17	$587	$21.99	$606	$425	$0	$184	0.7488	$1,205
2016	81.5	6	560	$125.85	$56.64	$552	$20.20	$552	$408	$0	$164	0.6966	$1,249
2017	78.3	7	555	$123.71	$54.57	$516	$18.69	$512	$391	$0	$143	0.6480	$1,289
2018	75.1	8	553	$122.66	$53.79	$489	$17.68	$484	$376	$0	$131	0.6028	$1,328
2019	72.1	9	550	$122.05	$52.98	$465	$16.72	$457	$361	$0	$121	0.5607	$1,361
2020	69.3	10	548	$124.30	$53.41	$452	$16.18	$441	$346	$0	$122	0.5216	$1,398
* BOY = Beginning of year			550	$125.19	$56.92							** Net present value if replacement is sold in this year	

But, not much if you have high annual costs…

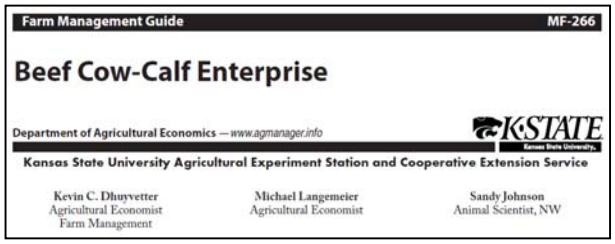
Net Present Value Analysis

		Annual cost = $500		Annual cost = $400		Annual cost = $600	
Year	Calf	NPV*	Calf 2 NPV diff**	NPV*	Calf 2 NPV diff**	NPV*	Calf 2 NPV diff**
2011	1	$795	-$122	$895	-$211	$695	-$32
2012	2	$916	$0	$1,106	$0	$727	$0
2013	3	$1,027	$111	$1,297	$191	$758	$31
2014	4	$1,140	$224	$1,480	$375	$800	$73
2015	5	$1,205	$288	$1,608	$503	$801	$74
2016	6	$1,249	$333	$1,710	$605	$789	$62
2017	7	$1,289	$373	$1,801	$695	$778	$51
2018	8	$1,328	$412	$1,885	$779	$772	$45
2019	9	$1,361	$444	$1,958	$852	$763	$36
2020	10	$1,398	$482	$2,031	$926	$765	$38

* Net present value if replacement is sold in this year

** Difference in NPV between selling in this year versus after the second calf

Projected livestock budget used in analysis…


Farm Management Guide MF-266

Beef Cow-Calf Enterprise

Department of Agricultural Economics — www.agmanager.info

K-STATE Research and Extension

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

Kevin C. Dhuyvetter, Agricultural Economist, Farm Management

Michael Langemeier, Agricultural Economist

Sandy Johnson, Animal Scientist, NW

Values from MF-266 used as starting point, focus is on changes in net returns due to various assumptions related to reproductive traits.

Reproductive trait		Current calf prices*	80% of current prices (5-yr avg)
	Change	$/cow in herd	
Weaning percentage^	1% chg	$7.58	$6.06
Culling rate^	1% chg	$3.64	$2.14
Weaning weight	+20 lbs	$5.49	$4.39
Weaning weight	-20 lbs	-$5.90	-$4.72

* 560 lbs steer = $141.96/cwt and 540 lb heifer = $133.59/cwt (BeefBasis.com)

^ Impact will be linear for small changes, but for large change will become nonlinear.

At current prices, a 100 head cow herd with 4% higher weaning percentage, 3% lower culling rate, and 20-lb heavier weaning weight will have a $46.73 per cow advantage.

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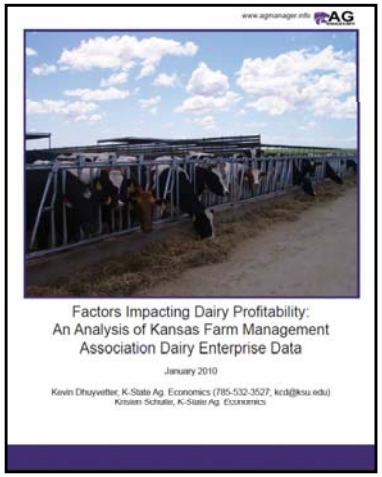
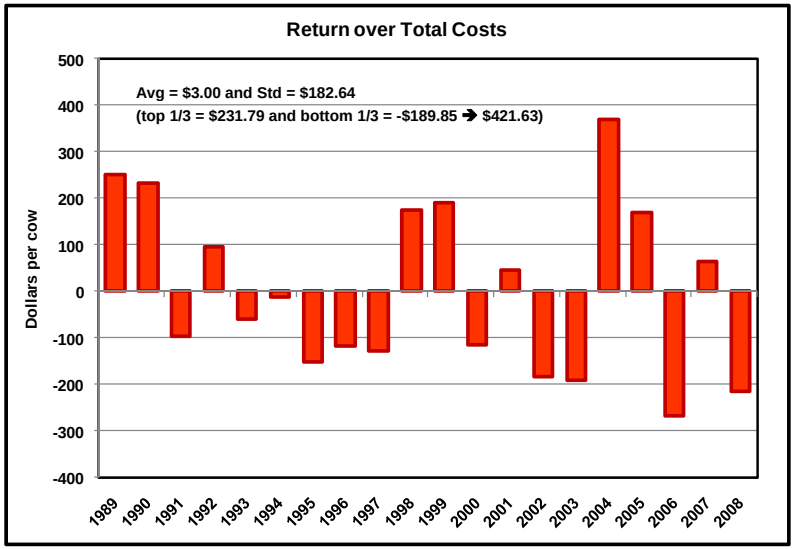
Dairy

Dairy profitability drivers…

- **Analysis of KFMA dairy enterprise analysis returns**
  - **1989-2008 all operations (examine time effect)**
  - **2004-2008 operations with at least three years of data (examine producer effect)**
- **Paper available on web (www.agmanager.info)**



Average returns are highly variable over time…



Source: Kansas Farm Management Association (KFMA) Annual Enterprise Analysis Reports

Returns are more variable across producers…

Dairy Cow-calf Enterprise, 2004-2008 (min of 3 years)*

	All	Profit Category			Difference between	
		High 1/3	Mid 1/3	Low 1/3	High 1/3 and Low 1/3	
	Farms	Head / $	Head / $	Head / $	Absolute	%
Number of Farms	40	13	14	13		
Number of Cows in Herd	115	135	130	79	57	72%
Cull rate, %	25.6	28.13	20.99	28.00	0.13	0%
Pounds of milk/cow	20,610	22,966	21,129	17,697	5,268	30%
Milk price, $/cwt	$16.48	$16.32	$16.25	$16.88	-$0.56	-3%
Milk sales, $/cow	$3,369	$3,731	$3,420	$2,951	$780	26%
Net cattle sales, $/cow	$267	$440	$209	$156	$284	183%
Other income, $/cow	$59	$59	$60	$58	$0.89	2%
Gross Income	**$3,695**	**$4,230**	**$3,689**	**$3,165**	**$1,065**	**34%**
Feed	$1,749	$1,763	$1,807	$1,672	$90.91	5%
Labor	$596	$594	$528	$672	-$78.19	-12%
Vet	$115	$113	$128	$102	$10.47	10%
Dairy supplies	$300	$354	$321	$224	$130.32	58%
Marketing / breeding	$93	$86	$111	$82	$4.05	5%
Machinery	$323	$308	$304	$358	-$49.71	-14%
Utilities and fuel	$158	$151	$143	$182	-$30.64	-17%
Interest	$319	$335	$291	$332	$3.00	1%
Other	$76	$76	$60	$93	-$17.59	-19%
Total Cost	**$3,729**	**$3,779**	**$3,694**	**$3,716**	**$62.63**	**2%**
Net Return to Management	**-$34.34**	**$451.06**	**-$5.04**	**-$551.31**	**$1,002**	

106%

-6%

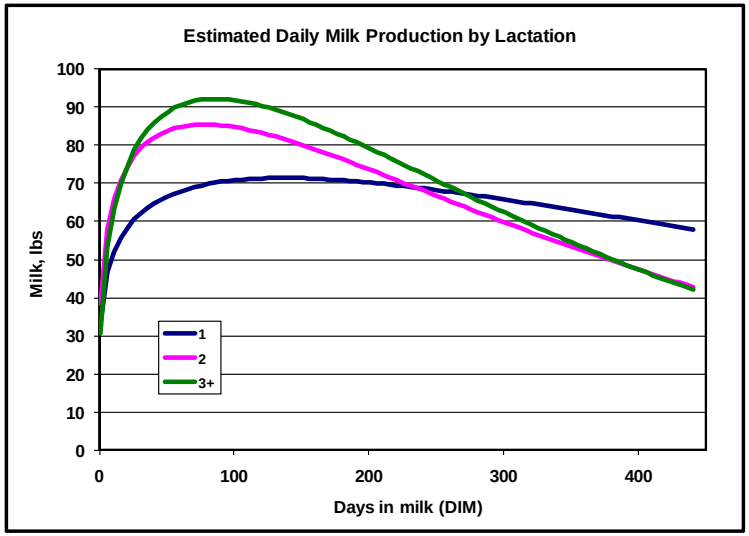
* Sorted by Net Return to Management (Returns over

Compared to $420 between top and bottom third years.

Dairy…

- **Main problem in dairy production is cows not getting bred back in a reasonable time such that you have increased days in milk (i.e., reduced milk yield).**
- **Increased days in milk also leads to other problems with involuntary culling in subsequent lactations due to health and disease issues…**
- **Considerable work has been done on this in the past and it continues to be a major area of focus in dairy industry (e.g., ADSA Discover Conference on topic in May)**

Dairy lactation curves used in analysis…



305 ME: 1 = 24,866; 2 = 26,657; 3+ = 25,939

Dairy lactation curves used in analysis…

Analysis / assumptions:

- **Repeated lactation curves through 1334 days**
  (day 1 = first DIM for lactation 1, 50 day dry period)
- **Assumed breeding on 61, 82, 103, 124, 145, and 156 DIM**
- **Best case scenario – cow gets bred at 61 DIM for four lactation in a row** (dry off day at end of 4th lactation = 1334)
- **Worst case scenario – cow gets bred at 166 DIM for four lactations in a row** (dry off day at end of 4th lactation = 1754)
- **Economic assumptions** – milk price = $16/cwt; feed price = $0.12/lb; breeding and heat detection = $30/breeding; discount rate = 10%; all other costs and income held constant

Economic impact of when cow gets bred*

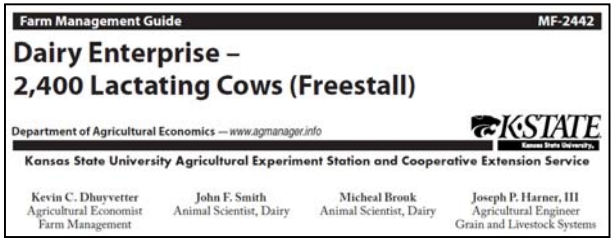
Economic Assumptions:	
Milk price, $/cwt	$16.00
Feed price, $/cwt	$12.00
Direct breeding cost, $/insemination	$12.00
Estrus detection cost, $/breeding	$18.00
Discount rate	10.00%

DIM of cow conception						Average DIM of	$/cow/yr
61	82	103	124	145	166	conception	IOF&BC
Percent of cows conceiving at each time period							
100%	0%	0%	0%	0%	0%	61.0	$1,646
33%	33%	33%	0%	0%	0%	82.0	$1,602
25%	30%	30%	10%	5%	0%	90.4	$1,581
20%	20%	20%	20%	20%	0%	103.0	$1,547
20%	19%	18%	17%	16%	10%	107.2	$1,539
0%	0%	0%	0%	0%	100%	166.0	$1,413

* Based solely on milk production, feed costs, and breeding charges (other health issues ignored)

Reduction of 17 days increases returns $42/cow in herd
(increases ~$5/cow for every $2/cwt increase in milk price and $2.40/cow for every $5/head increase in breeding cost)

Projected livestock budget used in analysis…


Farm Management Guide MF-2442

Dairy Enterprise –
2,400 Lactating Cows (Freestall)

Department of Agricultural Economics — www.agmanager.info

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

Kevin C. Dhuyvetter, Agricultural Economist, Farm Management
John F. Smith, Animal Scientist, Dairy
Micheal Brouk, Animal Scientist, Dairy
Joseph P. Harner, III, Agricultural Engineer, Grain and Livestock Systems

Values for average production from MF-2442 used as starting point, focus is on changes in net returns due to various assumptions.

Reproductive-related trait		Milk price $16/cwt*	Milk price $18/cwt*
	Change	$/cow in herd	
Milk production	1% chg	$18.30	$22.30
Culling rate	1% chg	$7.20	$7.20

* Gross price before hauling and other deductions.

All else equal culling rates should be minimized. However, because of interaction with culling rate and milk production a low culling rate is not always optimal.

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Swine

ASAS Midwestern Section -- Physiology Symposium: Factors Influencing Female Reproductive Efficiency

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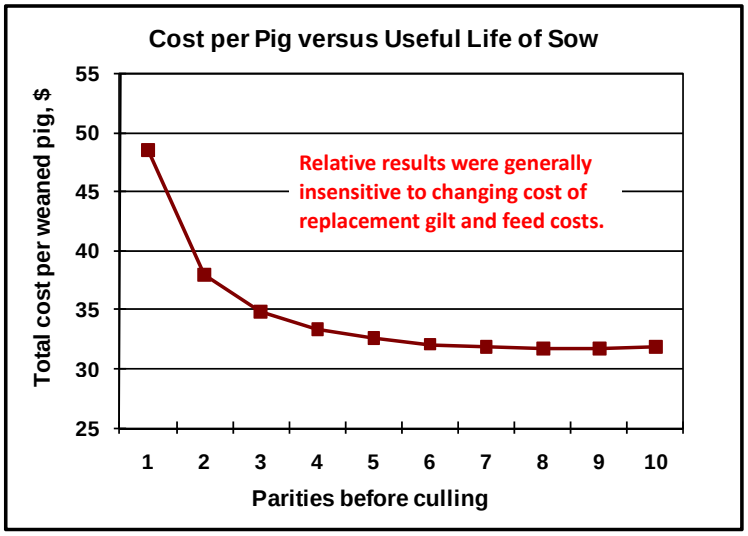
What is the cost of sow attrition - and is it worth reducing?

Kevin Dhuyvetter, Ph.D.
Dept. of Agricultural Economics
Kansas State University

Allen D. Leman Swine Conference, August 11-15, 2000, Minneapolis, MN.

AG ECON Agribusiness

Important to keep sow in herd past two parities...



Source: Dhuyvetter, Leman Conference. Aug 2000.

Summary/conclusions from 2000 study...

- **Newer genetics/systems have probably made old recommendations about optimal parity distribution obsolete.**
- **It may not be optimal to keep older sows even if they rebreed, however, cost of doing so appears quite small.**
- **Productivity is extremely important, but "fine tuning" for optimal parity distribution (i.e., reducing attrition) may be of marginal value.**

➔ **Focus management efforts on "big areas" first.**

Projected livestock budgets used in analysis…

Farm Management Guide — MF-2153

Farrow-to-Weaned Pig Cost-Return Budget

Department of Agricultural Economics — www.agmanager.info

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Values from MF-2153 used as starting point, focus is on changes in costs of producing a weaned pig due to various assumptions related to reproductive traits.

Weaned pigs sold/sow/yr*	19.0	21.5	24.0
Breakeven price, $/hd	$43.41	$38.76	$35.02
Culling percent (+5%)	+$0.19	+$0.16	+$0.15
Replacement gilt (+$50)	+$0.13	+$0.12	+$0.10

* If reason for difference in p/s/y is due to more gilts in mix (i.e., higher cull rate), the difference in breakeven price will be larger.

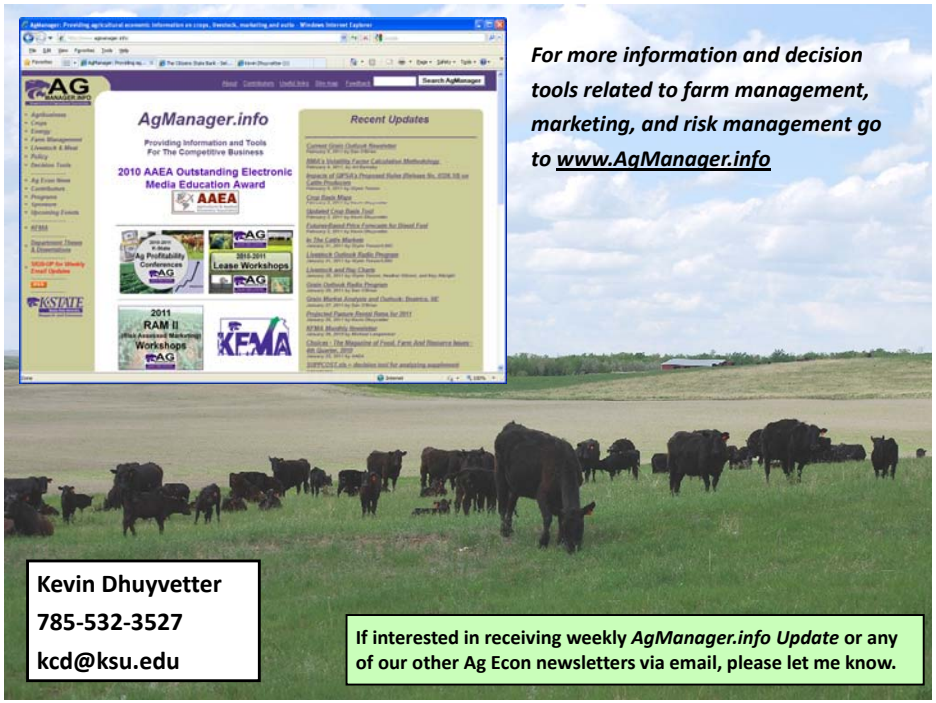
Trade-off between factors…

p/s/y	19.0	21.5	24.0
cull rate	63%	53%	43%
$/gilt	$185	$285	$385
Cost	$40.26	$38.76	$36.68

Spending additional money to properly develop gilts is profitable if it results in higher production.

Summary…

- More variability in returns between producers at a point in time than on average for an industry over time
  ➔ management is more important than "cycles"
- Costs of production (per unit of output) are generally lower at higher levels of production
  ➔ reproductive efficiency is needed for high production
- When reproductive efficiency is "low," high cull rates are not necessarily bad economically
  ➔ cull rate is less important than production economically



For more information and decision tools related to farm management, marketing, and risk management go to www.AgManager.info

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