Measuring Cow Efficiency and Productivity: What do We Know from the Research?

2014 Beef Improvement Federation Meeting

The Search for the Elusive Optimum Cow

- "The optimum beef cow is indeed an elusive beast. I have searched for her for more than 20 years, and have come up empty handed. But I believe I'm getting close".
  - Harlan Ritchie – 1995 BIF meeting in Sheridan, WY

Cow Efficiency Studies – Wisconsin

- Data collected between 1953 and 1980 from:
  - Identical and fraternal twins females born in 1953, 1954,1959, 1964, and 1969
  - Crossbred females born as singles in 1974
- Analysis I: Dams that weaned at least 1 calf
- Analysis II: Dams that weaned 3 calves
  - 1953, 1954, and 1959 twins: only included in analysis II
    - in these datasets, feed consumption was available only for dams completing 3 lactations

Numbers of Cows

Year of Birth	Analysis I	Analysis II
1953		6
1954		8
1959		8
1964	37	22
1969	45	33
1974	56	33

Cow Efficiency Studies – Wisconsin

Year	Breed Composition of Dams
1953	Hereford
1954	Hereford
1959	Hereford
1964	Hereford (except one twin set each of Hereford x Guernsey, Hereford x Shorthorn, Hereford x Holstein, and Hereford x Brown Swiss)
1969	17 Herefords, 2 Hereford x Shorthorn, 2 Hereford x Charolais, and 24 Holsteins
1974	14 Hereford x Holstein, 14 Angus x Holstein, 15 Simmental x Holstein, 13 Chianina x Holstein

Cow Efficiency Studies – Wisconsin

- Females purchased at 8 to 224 d of age
- Randomly assigned to individual self-feeders where they were tied twice daily
  - Diets differed for the 1953, 1954, and 1959 birth year groups, but the same diet was fed to all females within a group
  - Females purchased in 1964, 1969, and 1974 were assigned to either high (chopped mixed hay + concentrate) or low (chopped mixed hay) energy diets

Cow Efficiency Studies – Wisconsin

- Individual feed consumption measured at 28-d intervals from the time females were placed on the experiments until 3 calves were weaned or the dams reached 5 yr of age
- Calves received creep feed starting at 60 d of age in 1953, 1954, and 1959, and at 28 d of age in the other experiments
  - Ad libitum individual pre- and postweaning feed consumption of progeny was measured

Cow Efficiency Studies – Wisconsin

- Weaning weights of calves adjusted to a 240-d of age basis
- Previous research (Carpenter et al., 1972; Marshall et al., 1976; Wagner, 1978) has shown cows weaning male calves tend to be more efficient than those with female progeny
  - Therefore, progeny weights and feed consumptions were adjusted for sex using additive adjustment factors

Cow Efficiency Studies – Wisconsin

- Twin females bred at 1st observed estrus after 15 mo of age and at each succeeding estrus
- Crossbred females purchased in 1974 were bred at 1st detected estrus (puberty) and at each subsequent estrus
- Following each calving, all dams were bred at 1st estrus and at each subsequent estrus
  - (i.e., year-round calving)

Cow Efficiency Studies – Wisconsin

Year	Breed of Sire
1953	Hereford
1954	Hereford
1959	Hereford
1964	Polled Hereford
1969	Hereford cows mated to Holstein bulls; Holstein cows mated to Hereford bulls
1974	Jersey bulls used to produce 1st parity calves and Charolais bulls used to produce 2nd and 3rd parity calves

Cow Efficiency Studies – Wisconsin

- Milk production estimated at least monthly in each lactation by machine or hand milking

Cow Efficiency Studies – Wisconsin

- Cow efficiency calculated using 2 approaches:
  - Analysis I – life cycle approach
  - Analysis II – actual lifetime approach for cows that weaned 3 calves

Cow Efficiency Studies – Wisconsin

- Analysis I
  - Life cycle cow efficiency expressed as ratio of output to input, where output included weaning weight of all progeny and salvage value of dams, and inputs were feed consumption of all progeny and their dams

$$R1 = \frac{\Sigma k_i PW_i + (0.5714)\,\Sigma l_i DW_i}{\Sigma m_i PF_i + \Sigma n_i DF_i}$$

Weighting factors based on age distribution of the cow herd and % calf crop in a theoretical herd consisting of 100 cows and 20 yearling replacement heifers

0.5714 = ratio of price/lb for cull cows to price/lb for feeder calves

Cow Efficiency Studies – Wisconsin

- R1 = kg of weaning weight equivalent of beef produced per Mcal of ME consumed
- Differences in R1due to differences in:
  - Fertility
  - Weaning weight of progeny
  - Salvage weight of dams
  - Feed consumption of progeny
  - Feed consumption of dams
- R2 = same as R1 except that salvage value of dams was not considered

Cow Efficiency Studies – Wisconsin

- Analysis II
  - R3 = actual lifetime cow efficiency calculated for dams that weaned 3 calves (all components weighted equally)
  - R4 = same as R3 except that salvage value of dams not included
    - Variation associated with reproductive rate and calf survival not included in R3 and R4

Effect of Diet on Cow Efficiency

	R1	R2	R3	R4
Year-diet	P= 0.03	P < 0.001	P = 0.56	P < 0.01
1964-high	0.0230	0.0177	0.0299	0.0200
1964-low	0.0261	0.0218	0.0314	0.0232
1969-high	0.0254	0.0211	0.0303	0.0218
1969-low	0.0258	0.0218	0.0308	0.0231

Effect of Diet on Cow Efficiency

	R1	R2	R3	R4
Year-diet	P = 0.14	P = 0.14	P= 0.19	P = 0.43
1974-high	0.0238	0.0196	0.0302	0.0219
1974-low	0.0249	0.0207	0.0291	0.0213

Effect of Diet on Cow Efficiency

- No advantage to feeding dams in excess of their energy requirements
  - Cows on the high energy diet had greater salvage value, but did not wean progeny of sufficient size to offset their own increased ME intake

Effect of Diet on Cow Efficiency

- Same conclusion when slaughter weights, carcass weights, or weight of trimmed wholesale cuts were used as outputs
  - Cows receiving low energy diets generally had lifetime efficiencies greater than or equal to those fed high energy diets

Effect of Diet on Cow Efficiency

- Bowden (1980) – JAS 51:304
  - Cows fed a diet that provided 10% more energy than required to produce a "normal" growth curve produced more milk and weaned heavier calves than cows fed at a level sufficient to give "normal" growth, but the advantage was not great enough to offset the greater feed consumption by the dams on the higher energy level

Effect of Diet on Cow Efficiency

- Holloway et al. (1975) – JAS 41:855
  - Level of winter supplement of dam generally did not affect the efficiency of conversion of DE intake by dam or by dam and progeny into weaning weight of progeny

Breed Group Effects – 1964, 1969

	R1	R2	R3	R4
Breed Group	$P < 0.01$	$P = 0.01$	$P < 0.01$	$P < 0.01$
Hereford	0.0257	0.0209	0.0317	0.0227
Hereford x dairy	0.0247	0.0205	0.0304	0.0219
Hereford x beef	0.0273	0.0227	0.0321	0.0234
Holstein	0.0225	0.0184	0.0281	0.0202

Breed Group Effects – 1964, 1969

- Hereford x beef dams were most efficient, followed in order by Herefords, Hereford x dairy, and Holstein dams
  - Holstein cows least efficient
    - Even though they produced progeny with heavier weaning weights and lower creep feed consumption, and had greater salvage value than the other breed groups
    - Low efficiency ratios of the Holstein dams were associated with their large ME intake
    - Efficiency of Holstein dams likely would improve if they were mated to a larger breed of sire to produce progeny with sufficient growth potential to utilize their milk output
      - Were mated to Hereford bulls in this study

Breed Group Effects – 1964, 1969

- Hereford or Hereford x beef dams were also most efficient, followed by Hereford x dairy and Holstein dams when slaughter weights, carcass weights, or trimmed wholesale cut weights were used as output

Breed Effects on Cow Efficiency

- Holloway et al. (1975) – JAS 41:855
  - No significant differences in ability of Hereford, Hereford x Holstein, or Holstein dams mated to Angus and Charolais sires for their first and second calves, respectively, to convert DE of cow or of cow and calf into weaning weight of calf

Breed Group Effects – 1974

	R1	R2	R3	R4
Breed Group	P = 0.22	P = 0.15	P = 0.59	P = 0.48
Hereford x Holstein	0.0256	0.0215	0.0305	0.0224
Angus x Holstein	0.0241	0.0198	0.0294	0.0214
Simmental x Holstein	0.0243	0.0202	0.0297	0.0217
Chianina x Holstein	0.0234	0.0191	0.0290	0.0208

Breed Group Effects – 1974

- Breed differences not significant
  - Hereford x Holstein dams ranked highest for all 4 measures of efficiency, followed in order by Simmental x Holstein, Angus x Holstein, and Chianina x Holstein dams
    - Progeny of Simmental x Holstein and Chianina x Holstein dams were most efficient in conversion of feed into postweaning gain
    - Very similar life cycle and actual lifetime efficiency ratios for 1974 breed groups when pre- and postweaning periods were combined

Breed Effects on Cow Efficiency

- Carpenter et al. (1972) – Texas Agr. Exp. Sta. Prog. Rep. 3118, pp. 27-30
  - Charolais cows slightly more efficient than Hereford cows when feed efficiency was measured as the ratio of calf weaning weight to feed consumption of the cow and calf during lactation

Breed Effects on Cow Efficiency

- Marshall et al. (1976) – JAS 43:1176
  - No significant breed of dam effects for cow efficiency at weaning, although Angus dams tended to have efficiency ratios superior to those of Charolais or crossbred dams
- Wagner (1978) – Ph.D. Dissertation
  - Breed of dam not an important source of variation for weaning efficiency of Angus, Hereford, Charolais, and reciprocal cross dams

Breed Effects on Cow Efficiency

- Bowden (1980) – JAS 51:304
  - No significant differences in DE intake of dams or dams plus calves per kilogram of weaning weight of calf for 2-yr-old Simmental x Angus, Charolais x Angus, Hereford x Angus, and Jersey x Angus dams mated to the same Red Poll sire

Breed Effects on Cow Efficiency

- Breed of dam does not appear to be an important source of variation in efficiency of straightbred dams or of crossbred dams when mated to the same sires of a different breed

Breed Effects on Cow Efficiency

- A number of reports have discussed the effect of mating small dams to large terminal sire breeds on efficiency of production
  - Cartwright (1970) – JAS 30:706
  - Long and Fitzhugh (1970) – Texas Agr. Exp. Sta. Prog. Rep. 2789
  - Thomas and Cartwright (1971) – Texas Agr. Exp. Sta. Prog. Rep. 2980
  - Fitzhugh et al. (1975) – JAS 40:421
  - Smith (1976, 1979) – JAS 43:1163; JAS 48:966
  - Notter et al. (1979) – JAS 49:92
  - Gregory and Cundiff (1980) – JAS 51:1224

Breed Effects on Cow Efficiency

- Wisconsin study – mating Hereford x Holstein dams to small Jersey sires in the first parity to minimize calving difficulty and to large Charolais sires in subsequent parities to exploit complementarity may result in superior biological efficiency
  - Appears to be advantageous to challenge a cow by mating her to as large a bull as possible within the limitations imposed by calving difficulty

Effect of Weaning Rate on Cow Efficiency

- Weaning rate had a highly significant effect on life cycle cow efficiency (R1 and R2)
  - As weaning rate increased, R1 and R2 increased
  - Emphasizes the importance of fertility and calf survival
  - Dams weaning less than the maximum number of progeny allowable are unlikely to exhibit superior life cycle efficiencies

Residual Correlations between Cow Efficiency Ratios and Dam Weights

Trait	R1	R2	R3	R4
DW_1	-0.36^{**}	-0.41^{**}	-0.24^{**}	-0.46^{**}
DW_2	-0.31^{**}	-0.36^{**}	-0.27^{**}	-0.47^{**}
DW_3	-0.42^{**}	-0.47^{**}	-0.24^{**}	-0.50^{**}

Residual Correlations between Cow Efficiency Ratios and Dam Weights

- Smaller dams within breeds more efficient
  - Within a breed, a small cow mated to a large sire would wean a larger calf relative to her body size than a large cow of the same breed mated to the same sire
  - Smaller dams have lower maintenance requirements and lower feed consumption

Relationship between Cow Size and Efficiency

- Excellent review by Morris and Wilton (1976) – JAS 56:613
- Melton et al. (1967) – Texas Agr. Exp. Sta. Prog. Rep. 2485, pp 11–13
  - Within both Herefords and Charolais, small cows were more efficient
- Kress et al. (1969) – JAS 29:373
  - Light and heavy cows about equal in efficiency when salvage weight of cow considered
  - Lighter cows more efficient when salvage value ignored

Relationship between Cow Size and Efficiency

- Carpenter et al. (1972) – Texas Agr. Exp. Sta. Prog. Rep. 3118, pp 27–30
  - Measured cow efficiency as the ratio of calf weaning weight to feed consumption of cow and calf during lactation
  - Trend existed within breeds for cows with smaller mature weights to be more efficient

Relationship between Cow Size and Efficiency

- Klosterman et al. (1974) – Ohio Agr. Res. Devel. Center Bull. No. 77, pp 77–80
  - Found no significant differences in efficiency to weaning among small, medium, and large cows, although small cows tended to be more efficient
- Marshall et al. (1976) – JAS 43:1176
  - Found no relationship between cow weight and efficiency

Relationship of Cow Efficiency with Feed Intake of Dams

Trait	R1	R2	R3	R4
DF_0	−0.06	−0.07	−0.04	−0.13
DF_1	−0.29**	−0.29**	−0.63**	−0.64**
DF_2	−0.19*	−0.17*	−0.51**	−0.43**
DF_3	−0.58**	−0.49**	−0.41**	−0.44**

Relationship of Cow Efficiency with Feed Intake of Dams

- Kress et al. (1969) – JAS 29:373
  - Dams that ate less during lactation were more efficient
- Carpenter et al. (1972) – Texas Agr. Exp. Sta. Prog. Rep. 3118, pp 27–30
  - Reported a correlation of −0.43 between efficiency and feed consumption of dam during lactation
- Marshall et al. (1976) – JAS 43:1176
  - Reported a small undesirable correlation between efficiency and cow TDN intake from weaning of one calf to weaning of next calf

Relationship of Cow Efficiency with Progeny Weights

Trait	R1	R2	R3	R4
PW_1	0.14	0.13	0.18	0.25**
PW_2	0.07	0.10	0.13	0.20*
PW_3	0.16	0.17*	0.15	0.23*
ΣPW_i	0.64**	0.70**	0.20*	0.31**

Relationship of Cow Efficiency with Progeny Weights

- Sum of progeny weights was more highly correlated with R1 (r = 0.64) and R2 (r = 0.70) than the sum of dam weights, dam feed consumption, or progeny feed consumption
- Marshall et al. (1976) reported a large favorable association between weaning weight and efficiency (r = 0.87), as did Carpenter et al. (1972; r = 0.71)

Relationship of Cow Efficiency with Progeny Creep Feed Consumption

Trait	R1	R2	R3	R4
PF_1	0.03	0.02	0.05	0.03
PF_2	0.08	0.09	0.21*	0.16
PF_3	0.04	0.04	0.07	0.11
ΣPF_i	0.43**	0.47**	0.15	0.15

Relationship of Cow Efficiency with Progeny Creep Feed Consumption

- Within parity correlations of progeny creep feed consumption with efficiency were not significant
- ME intake of progeny summed over all parities had significant positive correlations with life cycle efficiency (R1 and R2)
  - Efficiency improved as creep intake of progeny increased
- Carpenter et al. (1972) and Marshall et al. (1976) found small favorable correlations between feed intake of progeny and weaning efficiency

Relationship of Cow Efficiency with Age at Puberty and Age at Calving

Trait	R1	R2	R3	R4
Age at puberty	−0.13	−0.14	−0.55**	−0.54**
Age at 1st calving	−0.10	−0.11	−0.51**	−0.49**
Age at 2nd calving	−0.09	−0.08	−0.60**	−0.51**
Age at 3rd calving	−0.35**	−0.29**	−0.67**	−0.60**

Relationship of Cow Efficiency with Age at Puberty and Age at Calving

- Only dams born in 1974 were bred at puberty
  - Residual correlations of age at puberty with actual lifetime efficiency (R3 and R4) were highly significant
- Decreased age at 1st, 2nd, and 3rd calving had large favorable relationships with R3 and R4
- Cows that reached puberty at an early age and calved at early ages throughout their lives were most efficient

Residual Correlations of Cow Efficiency with Weaning Rate

Trait	R1	R2
Weaning rate	0.62**	0.68**

Residual Correlations of Cow Efficiency with Weaning Rate

- Weaning rate was closely related to life cycle efficiency (R1 and R2)
- Hard for a cow to be efficient if she does not conceive and raise a calf each year

Relationship of Cow Efficiency with Feed Consumption and Gain:Feed from 240 Days to First Calving

Trait	R1	R2	R3	R4
Feed intake (240 d to 1st calving)	−0.29**	−0.30**	−0.61**	−0.61**
Gain:feed (240 d to 1st calving)	0.14	0.12	0.32**	0.17

Relationship of Cow Efficiency with Feed Consumption and Gain:Feed from 240 Days to First Calving

- Feed consumption of heifers from start of test at 240 d of age until 1st calving was an important component of lifetime efficiency
- Heifers that had more efficient weight gains from the start of test until 1st calving were more efficient producers of weaned calves
  - Also true when slaughter weights, carcass weights, and trimmed wholesale cut weights used as outputs
  - Kress et al. (1969) reported favorable correlations between feed efficiency from 240 d to 15 mo of age and cow efficiency in each lactation

Relationship of Cow Efficiency with 240-Day Heifer Traits

Trait	R1	R2	R3	R4
240-d wt	−0.07	−0.08	−0.06	−0.14
240-d ht	−0.08	−0.08	−0.10	−0.17
240-d wt/ht	−0.06	−0.08	−0.04	−0.12

Relationship of Cow Efficiency with 240-Day Heifer Traits

- Correlations with 240-d weight, height, and weight:height ratio were small and nonsignificant
  - These traits would not be good indicators of subsequent efficiency as a cow
  - Hawkins et al. (1965) – JAS 24:848 (Abstract)
    - Did not find a significant relationship between yearling weight of a heifer and her subsequent calf production

Relationship of Cow Efficiency with Cow Weight and Height at Calving

Trait	R1	R2	R3	R4
Wt – 1st calv.	−0.25**	−0.28**	−0.39**	−0.51**
Wt – 2nd calv.	−0.34**	−0.36**	−0.44**	−0.59**
Wt – 3rd calv.	−0.52**	−0.53**	−0.39**	−0.56**
Ht – 1st calv.	−0.22**	−0.24**	−0.15	−0.23*
Ht – 2nd calv.	−0.34**	−0.37**	−0.26**	−0.33**
Ht – 3rd calv.	−0.29**	−0.31**	−0.16	−0.26**

Relationship of Cow Efficiency with Cow Weight and Height at Calving

- Residual correlations of efficiency ratios with weight at calving were negative and highly significant in all instances
  - Smaller dams were more efficient even when cow salvage value was included in the efficiency ratio
- Correlations between efficiency estimates and height at calving ranged from −0.15 to −0.37
  - Kress et al. (1969) found that cow height had only a small association with efficiency

Relationship of Cow Efficiency with Weight:Height Ratio at Calving

Trait	R1	R2	R3	R4
Wt:ht ratio – 1st calving	−0.22**	−0.25**	−0.42**	−0.53**
Wt:ht ratio – 2nd calving	−0.28**	−0.31**	−0.44**	−0.58**
Wt:ht ratio – 3rd calving	−0.52**	−0.53**	−0.40**	−0.58**

Relationship of Cow Efficiency with Weight:Height Ratio at Calving

- Weight:height ratio at calving was negatively and significantly correlated with efficiency
- Inclusion of salvage weight of cow in the efficiency ratios tended to reduce the degree of association with weight:height ratio
  - Fatter cows were heavier and had greater salvage value

Relationship of Cow Efficiency with Weight:Height Ratio

- Kress et al. (1969)
  - Cows with greater weight:height ratios were less efficient
- Marshall et al. (1976)
  - More highly conditioned cows tended to wean lighter calves and were less efficient when cow weight and milk production were held constant

Relationship of Cow Efficiency with Change in Weight:Height Ratio

Trait	R1	R2	R3	R4
Change in wt:ht, lact. 1	0.00	−0.03	0.37**	0.18
Change in wt:ht, lact. 2	0.06	0.00	0.35**	0.24*
Change in wt:ht, lact. 3	0.14	0.08	0.21*	0.05

Relationship of Efficiency with Change in Weight:Height Ratio

- Correlations between cow efficiency and change in weight:height ratio from calving to weaning were generally positive but small
  - Tendency for dams that gained in condition during lactation to be more efficient
- Gregory et al. (1950), Brinks et al. (1962), Todd et al. (1968), and Hohenboken et al. (1973) all reported negative correlations between preweaning ADG of calf and weight gain of dam during lactation

Relationship of Efficiency with Change in Weight:Height Ratio

- Kress et al. (1969)
  - Cows that gained less weight during lactation were more efficient
- Wagner (1978)
  - Cows exhibiting significant positive changes in weight:height ratios from the time they entered the study until they weaned their calves were less efficient
- Carpenter et al. (1972)
  - Weight change during lactation was negatively correlated with efficiency (r = −0.51)
    - Cows that gained less were more efficient

Relationship of Efficiency with Change in Weight:Height Ratio

- Why contrasting results between Wisconsin study and others reported in the literature?
  - May reflect differences between accumulative lifetime efficiency (Wisconsin study) and efficiency within individual lactations (other studies)
    - Dams that gained condition during lactation may have had better rebreeding performance and were more efficient on a lifetime basis
  - Dams in the Wisconsin study were bred at each postpartum estrus, whereas dams in most other studies were on a yearly calving season

Relationship of Efficiency with Change in Weight:Height Ratio

- Change in condition during lactation needed to maximize biological efficiency may also be related to milk production levels of breeds involved in the different studies

Residual Correlations of Cow Efficiency with Milk Production

Trait	R1	R2	R3	R4
Lactation 1	−0.24*	−0.23*	−0.29**	−0.11
Lactation 2	−0.17	−0.13	−0.19	−0.01
Lactation 3	−0.05	0.00	−0.08	0.11

Residual Correlations of Cow Efficiency with Milk Production

- Relationship between 4% fat-corrected milk production and efficiency tended to be negative
  - However, correlations of R3 and R4 with milk production tended to be positive for 1950's twin cows
    - Correlations between R4 and milk production in the 1st, 2nd, and 3rd lactations were 0.59, 0.47, and 0.70, respectively

Residual Correlations of Cow Efficiency with Milk Production

- Milk production was negatively correlated with efficiency of 1964 and 1969 twin dams
  - Correlations ranged from:
    - −0.33 to −0.67 for Holstein dams
    - −0.69 to −0.99 for Hereford x dairy dams
    - −0.76 to −0.99 for Hereford x beef dams
  - Correlations for Hereford dams were near zero

Relationship of Cow Efficiency with Milk Production

- Hereford x dairy, Hereford x beef, and Holstein dams may have had milk production potential that their progeny could not utilize
- Heavier milking breeds calved at later ages:

Breed Combination	Age at 3rd Calving, days
Hereford	1,490
Hereford x dairy	1,526
Hereford x beef	1,476
Holstein	1,552

Residual Correlations of Cow Efficiency with Milk Production

- In the 1974 crossbred dams, significant negative correlations were observed between milk production in the 1st lactation and efficiency
  - r = −0.30, −0.31, −0.49, and −0.42 for R1, R2, R3, and R4, respectively
  - First parity progeny sired by Jersey bulls may not have had sufficient growth potential to utilize the milk production potential of their Holstein-cross dams

Residual Correlations of Cow Efficiency with Milk Production

- Residual correlations of milk production in the 2nd and 3rd lactations with efficiency of 1974 crossbred dams were near zero
  - 2nd and 3rd calves were progeny of Charolais sires and would be expected to have greater growth potential than Jersey-sired calves
    - Apparently they were able to more fully utilize the milk production potential of their dams

Relationship of Cow Efficiency with Milk Production

- Kress et al. (1969), Carpenter et al. (1972), Marshall et al. (1976)
  - Reported greater efficiency in heavier milking cows
- Holloway et al. (1975)
  - No significant differences in efficiency among Hereford, Holstein, and Hereford x Holstein cows
- K. C. Davis et al. (1994) – JAS 72:2591
  - For northern range production systems, breed groups of moderate mature size and milk production will be more profitable than extreme types for growth and milk production

Relationship of Cow Efficiency with Milk Production

- Increased milk production only desirable if the extra milk can be consumed and converted into weaning weights of sufficient magnitude to offset the increased energy intake required by the dams to produce the milk

Relationship of Cow Efficiency with Milk Production

- Willham (1972) – JAS 34:864
  - If feed resources are fixed, milk production should not exceed a level that prevents sufficient nutrients for successful rebreeding
- Notter et al. (1979) – JAS 49:70
  - Increases in milk production that reduced weaning weight per cow exposed by decreasing pregnancy rates reduced economic efficiency
  - Increased milk levels improved biological efficiency only if they resulted in improved weaning rates

Relationship between Weaning and Slaughter Efficiency

- Dams that were efficient in the production of weaning weight were also efficient producers of slaughter weight, carcass weight, and trimmed wholesale cut weight
  - Correlations among efficiency estimates calculated at weaning and slaughter endpoints were 0.88 or above

Relationship among Efficiency Estimates at Slaughter

- Correlations among efficiency estimates based on slaughter weights, carcass weights, and trimmed wholesale cut weights were large (0.93 or above)

Relationship between Weaning and Slaughter Efficiency

- No serious antagonisms appear to exist between pre- and postweaning efficiency
  - Systems of production that maximize weaning efficiency should be effective in maximizing efficiency to the slaughter endpoint

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Questions?