# Economics of Reproduction Efficiency in Beef Cow Herds

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### Introduction

As of January 1, 1990 the nation's cattle herd was made up of 43.854 million beef and dairy cows. The nation's cow herd is currently down 13.1 million head from the peak in 1975 of 56.9 million head. The total number of cows and replacement heifers projected to calve in 1990 is 51.2 million head. These 51.2 million bred cows and heifers, however, are projected to have 40.7 million calves in 1990. This suggests a 79.5 percent calf crop based on calves weaned divided by cows and heifers exposed to bulls.

North Dakota financial records indicate that participants are experiencing a calf death rate from birth to weaning of 3.7 - 5.0 percent. If this death rate is indicative of the national death rate, the national percent calf crop based on calves born, to the number of cows and heifers exposed is 84.5 percent. This percentage is based on live calves born, divided by cows and heifers exposed. I believe that an 85 percent live calf crop would be typical for North Dakota.

Using percent calf crop weaned as a proxy for "reproductive efficiency" suggests that the nation's beef farmers and ranchers somehow are losing out on the potential production of 10.5 million calves in 1990. At today's projected fall 1990 prices of $95 per hundred weight, this suggests that beef farmers and ranchers will lose a potential $4 billion due to reproduction efficiencies in 1990.

One set of scientists suggests that the problem is management.

> Stated simply, development and adoption of management technology has not kept pace with scientific knowledge. This has occurred because of our chronic inability to link scientific strategy to economic reality. (Williams & Harms, pg 50)

They go on to say:

> Most technology is targeted for technically complex production systems, but these systems do not predominate in the cow-calf industry.

Are they suggesting many of our technologies are not applicable at the on-farm level? Or, could it be that the economic reality is that many of the technologies are not economically viable on the farm?

The national data suggests that percent calf crop is affected, to some extent, by management as the nation's percent calf crop goes up when beef prices go up (see Figure 1). Changing percent calf crop in response to changing calf prices suggests that beef farmers and ranchers change their reproduction practices in response to economic stimuli. This even suggests that beef farmers' and ranchers' economic reality is that they use some technologies when prices are high and do not use some technologies when prices are low. This suggests that the economic reality might be that beef farmers will use more veterinary services when calf prices are high and they will use less veterinarian services when calf prices are low.

Figure 1. National Percent Calf Crop



Beef Cows
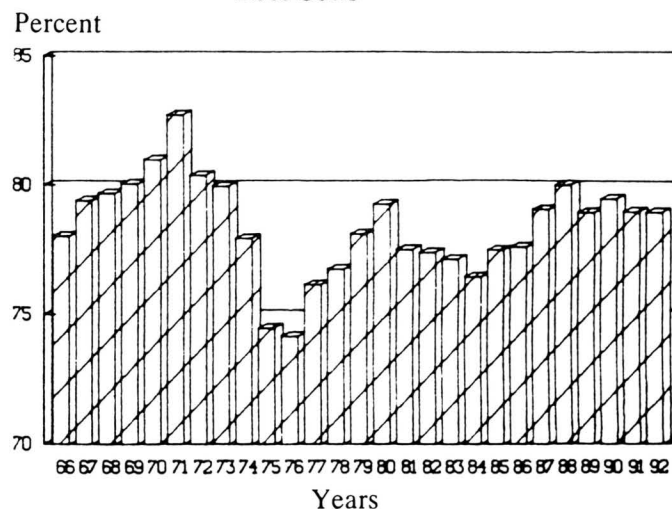
### Objective

The objective of this presentation is to suggest how a practicing veterinarian can go about integrating economic reality into his client services. I will concentrate on projecting the increased economic revenue associated with increasing your clients' beef herd's reproductive efficiencies. Other speakers at this conference will cover how reproductive efficiency can be increased and what it might cost to get the increased efficiencies. It will be left up to the con-

ference participants to compare my projected increased revenues to the other speaker's projected cost increases.

## Economic Reality

Whether the farm or ranch operation is entirely dependent on cattle or is diversified into crops, wildlife, or recreation, just being a top beef producer in the 1990's will no longer guarantee economic survival. Continued profitability during the 90's as beef prices start to decrease will require that careful economic consideration be given to the interactions of production and resource utilization. In the decade of the '90's, everything must count and everything must pay.

In light of the financial stress of the early 1980's, astute beef farmers and rancers are asking animal scientists and production economists to identify those management factors that will help ensure their economic survival in the 1990's. This necessitates that applied beef research not only focus on the biological aspects of beef production, as has frequently been done in the past, but future applied research will need to focus on the value of products produced and the costs of the resources consumed. Beef farmers and ranchers are insisting that researchers conduct an economic analysis of each and every applied production technology recommended.

An example of where technology evaluation has to go beyond the traditional biological analysis could be in comparative feeding trials. Evaluating one feeding program against another based on feed efficiency (pounds of feed-/pound of gain) does not necessarily measure profitability. Feeding efficiency is an even poorer proxy for cost of gain.

While profits may be correlated with feed efficiency, the correlation is not 1.0 as is frequently implied. In addition to the correlation between production and profit not being 1.0, the incremental gains from new technologies tend to be smaller and smaller. All of the easy research has been done. Rather than being able to make general recommendations based solely on biological response, researchers now need to determine the economic response associated with the biological response before production recommendations are made.

Economics has always played an important role in technology adoption. As calf prices go up, more technology becomes profitable and as beef prices start down in the 1990's, more technology will become economically infeasible as gross margins in the beef cow enterprise narrow.

Beef farmers and ranchers decisions to adopt new technologies and/or to adopt Recommended Best Management Practices (RBMP) have now to be based on two conditions. First, there has to be a positive biological response and, second, there has to be a favorable economic response.

Today, not all new technologies and RBMP's enhance profits. Examples are creep feeding and preconditioning calves. It is clear that these two RBMP's will generate a biological response. It is not at all clear that these practices will generate a positive economic response. This is especially true if calf prices are adjusted downward because of additional weight.

As economic conditions change during the cattle cycle, the profitability of new technologies and RBMP's will change. This implies that beef farmers have to continuously evaluate the economics of production technologies and RBMP's. Just because a given technology or RBMP's was not profitable at a given point in time does not mean that it will always remain unprofitable. Just because a technology was profitable at the time it was adopted, does not guarantee it is still profitable. Astute beef farmers need to continuously be evaluating new and old technologies and RBMP's in an attempt to increase beef farm profits. Economics will dictate which technologies and which RBMP's are and are not profitable at any point in time. This evaluation, however, takes considerable on-farm data to properly evaluate.

Herd performance records are currently being used to document the on-farm biological response of new technologies and RBMP's. Financial management records are being used to document the on-farm economic response. The problem is that many of today's beef farm managers lack one or both of these management information systems. In addition, most herd performance records and financial management record systems do not collect data on resources consumed. We simply do not know what it costs to produce beef on most of the nation's beef farms and ranches.

## Linking Your Scientific Services to Your Clients' Economic Reality

In order to demonstrate how veterinarians might go about studying the economics of reproductive efficiency on their clients' farms or ranches, I will first present a written production plan for John Rancher, a typical North Dakota beef cow farmer. I will utilize the John Rancher's written production plan to illustrate how veterinarians can "link their scientific services with a client's economic reality". I am also suggesting that astute practicing veterinarians might even want to help their leading clients prepare these written production plans for a fee.

## John Rancher's Written Production Plan

I will quickly describe some of the key input/output coefficients representing John's production technology. Dollar values are attached to each product produced and to each resource consumed. Preparing this complete written production plan forced John to write down on paper all of the important production and economic factors that affect the profitability of his beef cow herd. This written pro-

duction plan serves as John's blue print for operating his cow-calf herd.

Writing down these input/output coefficients made John think about each and every coefficient. Even more importantly, writing down the coefficients plants these coefficients firmer in John's mind.

I want to demonstrate how John's practicing veterinarian can utilize this written production plan for linking his "scientific services to John's economic reality". But first, I need to be sure that each of you understands what I mean by a written production plan. Let's look in detail at John's production plan.

**Opportunity Costs**

The Appendix Tables present John Rancher's 1990 complete written production plan. The business summary is presented in Table 1 and the cash flow summary is presented in Table 2 . A business summary values all resources consumed at their opportunity costs. If the local elevator will pay $1.80 for a bushel of barley, then John's beef cow herd has to pay this $1.80 for each bushel of barley consumed. Costs of all resources consumed by the cow herd are based on this opportunity cost concept. Market prices detemine the opportunity costs for most of the re-

Table 1.  John Rancher's Beef Cow Budget

| | | OPPORTUNITY COST | YOUR FARM |
|---|---|---|---|
| BEEF COW BUDGET SUMMARY | | | |
| 100 COWS | | 0% IN DEBT | |
| GROSS INCOME PER COW: | | $411 | _____ |
| FEED COSTS: | | | |
| SUMMER | $88 | | _____ |
| AFTERMATH | $3 | | _____ |
| WINTER | $123 | $215 | _____    _____ |
| LIVESTOCK EXPENSE: | | | |
| VET & MED | $8 | | _____ |
| FLY TAGS | $4 | | _____ |
| WORMER | $7 | | _____ |
| UTILITIES & GEN FARM | $9 | | _____ |
| POWER & FUEL | $9 | | _____ |
| MISC | $7 | | _____ |
| MARKETING | $8 | | _____ |
| BREEDING | $9 | | _____ |
| BEDDING | $2 | $63 | _____    _____ |
| INTEREST ON FEED & L.S. EXP | | $0 | _____ |
| FIXED EXPENSE: | | | |
| BLD, FAC, COWS & HEIFERS | | $26 | _____ |
| INTEREST ON BORROWED CAP | | $0 | _____ |
| TOTAL COSTS | | $304 | _____ |
| RETURNS TO OPERATOR AND UNPAID FAMILY LABOR, MANAGEMENT AND EQUITY CAPITAL | | $107 | _____ |

# Help me stop crying over spilled milk.

## Supporting The Veterinarian

### Use Amoxi-Mast® (amoxicillin) to treat mastitis.

**M**astitis steals milk and profits. It can be a stubborn infection that often strikes your top producers, causing even more frustration and "spilled milk."

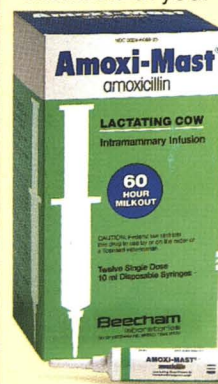### Amoxi-Mast works fast to end the misery of mastitis.

As soon as it's infused into the udder, Amoxi-Mast® starts killing Staph[1] and Strep[1], the organisms that cause 95% of all mastitis. Antibiotics such as novobiocin and erythromycin inhibit bacterial growth and depend on the cow's natural defenses to kill the bacteria.

### A 60-hour milkout means less spilled milk.

With just a 60-hour milkout, Amoxi-Mast saves you from one to three milkings. Which makes it more economical than drugs with 72 or 96 hour milkouts.

### Reach for the box with the blue top.

Ask your veterinarian about Amoxi-Mast. It's the box with the blue top available at your veterinary clinic. The sooner you start using Amoxi-Mast, the sooner your top producers will be putting milk in the tank—where it belongs.

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**SB** SmithKline Beecham Animal Health

[1] Amoxicillin sensitive Staphylococcus aureus and Streptococcus agalactiae bacteria.

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**Amoxi-Mast® amoxicillin**
**BRIEF SUMMARY**

Before prescribing AMOXI-MAST® (amoxicillin), please consult Complete Product Information, a summary of which follows:

AMOXI-MAST (amoxicillin) is specially prepared for the treatment of bovine mastitis during the lactating period.

**INDICATIONS**-AMOXI-MAST (amoxicillin) is indicated in the treatment of subclinical infectious bovine mastitis in lactating cows due to Streptococcus agalactiae and Staphylococcus aureus (penicillin sensitive). Early detection and treatment of mastitis are advised.

**WARNING-** Milk that has been taken from animals during treatment and for 60 hours (five milkings)

after the last treatment should not be used for food. Animals treated should not be slaughtered for food purposes within 12 days after the last treatment.

**PRECAUTION-**Because it is a derivative of 6-amino-penicillanic acid, AMOXI-MAST (amoxicillin) has the potential for producing allergic reactions. Such reactions are rare; however, should they occur, the subject should be treated with the usual agents (antihistamines, pressor amines).

**CAUTION-**Federal law restricts this drug to use by or on the order of a licensed veterinarian.

**HOW SUPPLIED-**AMOXI-MAST (amoxicillin) is supplied in cartons of twelve 10 mL single-dose disposable plastic syringes with twelve alcohol swabs. Each disposable syringe contains amoxicillin trihydrate equivalent to 62.5 mg of amoxicillin activity.

**amoxi-mast®** is a registered trademark of SmithKline Beecham Animal Health.
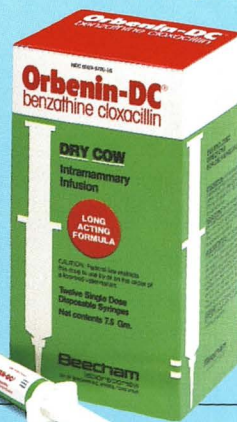
# ORBENIN-DC®
(benzathine cloxacillin)
# GIVES DRY-COW MASTITIS NO QUARTER!

Mastitis is a tough disease that requires an even tougher dry cow treatment—Orbenin-DC® (benzathine cloxacillin). Orbenin-DC (pronounced OR-BEN´IN) contains one of the longest acting dry cow antibiotics available. This extended activity is crucial, since 40-50% of all mastitis cases originate during the dry period.

Because Orbenin-DC is longer lasting, it continues to kill Staph and Strep bacteria[1] (the major causes of mastitis) long after the antibiotic has been infused. This makes Orbenin-DC an excellent dry cow treatment.

But the proof is in the performance in your herd. You'll never know how well Orbenin-DC works until you try it. Ask your veterinarian for Orbenin-DC. You'll save a lot of quarters.

**SB SmithKline Beecham** Animal Health

[1]Due to susceptible organisms.

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sources consumed by the beef cow herd. Opportunity costs are projected on the right hand side of John's written production plan. Table 1 summarizes John's business plan.

A cow herd has five potential sources of income. They are steer calves, heifer calves, cull cows, cull heifers, and cull bulls (see Appendix Table 2). John's cow herd is projected to gross $411 per cow from all five income sources in 1990. The total feed costs per cow are projected to be $215 per cow spread over summer costs at $88, aftermath at $3, and wintering costs of $123 per cow. Livestock costs are projected at $63 per cow. Fixed costs for buildings and equipment are projected at $26 per cow. Total costs are projected at $304 per cow for the year. The bottom line projection is $107 per cow returns to operator and unpaid family labor, management, and equity capital. This is a record high projected return for John Rancher's beef cows.

## Cash Costs

Table 2 presents the projected beef cow cash flow summary for John Rancher's cow herd. In a cash flow summary, resources are not valued at market value but are valued at the actual out-of-pocket cash costs. Farm raised feeds are valued at their cash costs of production. Cash

Table 2. John Rancher's Projected Beef Cow Cash Flow Summary

| BEEF COW CASH FLOW SUMMARY 1990 100 COWS 0% IN DEBT | OPPORTUNITY COST | | YOUR FARM |
|---|---|---|---|
| GROSS INCOME PER COW: | $411 | | _____ |
| FEED COSTS: | | | |
| SUMMER | $8 | | _____ |
| AFTERMATH | $.30 | | _____ |
| WINTER | $44 | $52 | _____ |
| LIVESTOCK EXPENSE: | | | |
| VET & MED | $8 | | _____ |
| FLY TAGS | $4 | | _____ |
| WORMER | $7 | | _____ |
| UTILITIES & GEN FARM | $9 | | _____ |
| POWER & FUEL | $9 | | _____ |
| MISC | $7 | | _____ |
| MARKETING | $8 | | _____ |
| BREEDING | $18 | | _____ |
| BEDDING | $0 | $69 | _____ |
| INTEREST ON FEED & L.S. EXP | | $0 | _____ |
| FIXED EXPENSE: | | | |
| BLD,FAC, COWS & HEIFERS | | $14 | _____ |
| DEBT REPAYMENT | | $0 | _____ |
| TOTAL COSTS | | $135 | _____ |
| FAMILY LIVING DRAW | | $100 | |
| RETURNS TO OPERATOR AND UNPAID FAMILY LABOR, MANAGEMENT AND EQUITY CAPITAL | | $176 | _____ |

COWBUD90.CAL4 ON #87

costs reflect the rancher's actual cash outlay and are totally independent of market prices. Individual rancher's cash costs of production of feeds consumed by the beef cow herd can be either above or below market prices.

If hay is produced on owned land with owned equipment, then the only cash costs in producing hay are for twine, preservatives, fuel, repairs, and land taxes. In my example, $15 per ton cash costs were used. If hay is produced on land financed and/or machinery financed by the bank, principle and interest payments are added to the $15 per ton hay costs. Debt can quickly cause cash costs to be greater than market price. Since every producer's debt structure is different, every producer's cash costs are different.

Cash costs of all resources consumed are tracked on the left-hand side of John's written production plan. John Rancher has his land, cows, and machinery paid for; therefore, his cash costs do not include principle or interest charges. John's cash costs of feeding his beef cow herd is $52 per cow (see Table 2).

As indicated in the cash flow summary presented in Table 2, John's projected cash income to the beef cow herd is $411 per cow. Cash feed costs total $52 per cow made up of mostly wintering feed costs. Summer costs for owned pasture covers the cash costs of fence repair, pasture land taxes, and providing water. Livestock cash costs total $69 and fixed costs are projected at $14 per cow. Since John owns all of the resources, there is no bank interest charge in the plan. Note that return to equity capital is included in the bottom line. Total cash costs are projected at $135 per

Table 3. Beef Cow Summary for 90% Calf Crop

| BEEF COW BUDGET SUMMARY | | |
|---|---|---|
| 100 COWS          0% IN DEBT | | |
| | OPPORTUNITY COST | YOUR FARM |
| GROSS INCOME PER COW: | $434 | _____ |
| FEED COSTS: | | |
| SUMMER | $88 | _____ |
| AFTERMATH | $3 | _____ |
| WINTER | $123          $215 | _____          _____ |
| LIVESTOCK EXPENSE: | | |
| VET & MED | $8 | _____ |
| FLY TAGS | $4 | _____ |
| WORMER | $7 | _____ |
| UTILITIES & GEN FARM | $9 | _____ |
| POWER & FUEL | $9 | _____ |
| MISC | $7 | _____ |
| MARKETING | $8 | _____ |
| BREEDING | $9 | _____ |
| BEDDING | $2          $63 | _____          _____ |
| INTEREST ON FEED & L.S. EXP | $0 | _____ |
| FIXED EXPENSE: | | |
| BLD, FAC, COWS & HEIFERS | $26 | _____ |
| INTEREST ON BORROWED CAP | $0 | _____ |
| TOTAL COSTS | $304 | _____ |
| RETURNS TO OPERATOR AND UNPAID FAMILY LABOR, MANAGEMENT AND EQUITY CAPITAL | $131 | _____ |

cow.

While family living draw is a family cost and not a business cost, a full time beef farmer or rancher normally needs to generate his family's living from the farm business. John Rancher needs to pull a family living draw of $100 per cow out of his herds cash flow. This, then, leaves a projected $176 per cow left over as the net cash flow returns to operator and unpaid family labor, management, and equity capital.

This $176 net cash flow can be used for what ever purpose John and his family so desires. It could be used for savings, retirement, capital investment in more cows or machinery, off-farm investment or etc. This also is record net cash flow from beef cows for John Rancher.

## Asking "What if" Questions

The availability of portable micro computers now offer veterinarians a unique opportunity to demonstrate economic reality for their leading clients. Please envision what I am about to describe as happening at one of your client's kitchen table.

Let's now change the percent calf crop, holding everything else constant, and see what happens to John's projected bottom line by making this one and only one change. Let's change the percent calf crop from 85 percent to 90 percent. Table 3 present the new projected bottom line.

The five percent change in percent calf crop lead to a $24 projected increase in the bottom line. This suggests that each one percent increase in calf crop that John's veterinarian can accomplish for John Rancher leads to a $4.80 increase per cow in his bottom line. John Rancher's economic reality is that he can increase his net returns by $4.80/per point per cow by improving his calving percentage. In John Rancher's 100 cow herd, each one-percent improvement in reproductive efficiency is projected to net him $480 per year. A five percent improvement is projected to generate $2400 increase in bottom line returns per year. Note that any additional costs associated with the increased calf crop have not been taken into account.

This $4.80 per cow returns to improved reproductive efficiency per percentage point assumes that the increased calving percentage is accomplished by improved management and does not require any additional resources. This further suggests that John Rancher could pay up to $4.80 per cow per year per percentage point for improved reproductive efficiency. This includes herd health, nutrition, labor and management advice from his veterinarian that would result in improved reproductive efficiency.

Can John's herd be improved 5 percent in reproductive efficiency? I suggest that his veterinarian is in the best position to answer this question. Can his veterinarian do it at a profit to John? I do not know, but John and his local veterinarian now have a projection of the "economic reality of selling his scientific services" to John Rancher.

## Simulation Study of Reproductive Efficiency

Let's now expand the "what if" section and make 40 different runs with John Rancher's written production plan varying the percent calf crop, weaning weight, calf prices, culling rates, amount of hay fed in the winter feeding program, the price of hay, pasture costs, and price of bulls purchased in a scientific designed manner. Selected input/output coefficients from each simulated run were extracted and summarized in a working table. This table of numbers were then subjected to statistical analysis relating economic reality back to the value of the physical production and the value of the resources consumed. The purpose of this formal statistical analysis is to mathematically relate herd performance variables with John's profitability projections. One of these variables is reproductive efficiency measured by percent calf crop.

The beef cow projected profit or loss (P&L) is projected as a function of: (1) steer price, (2) % calf crop, (3) steer weaning weight, (4) % cows culled, (5) tons of hay fed in the wintering program, (6) cost of hay fed, (7) cost of pasture, and (7) price paid for bulls.

The regression equation estimated is:

Table 4. Regression Results

```
Intercept        -69249.90
Steer Price      435.97604
% Calf Crop      45795.208
Steer Weight     41.220586
% Cows Culled    -4119.098
Qnt Hay Fed      0.0771246  (not significant)
$/ Ton of Hay    -1.001714
Pasture Cost     -1.155867
Price Of Bulls   -0.3480417
-----------------------------
Adjusted R squared 0.9998
F Value          32.56
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Percent calf crop was expressed in decimal form so the 45795 coefficient can be divided by 100 to express the coefficient in percent terms (457.95). Since total profits (P&L) was used for the 100 cows, the coefficient has to again be divided by 100 to express the increase in P&L per cow; therefore, the coefficient per cow is $4.58. This suggests that over the 40 different simulation runs, that each percentage point increase in calf crop increased P&L by $4.58 per cow. A five percent increase in percent calf crop is projected to increase the P&L $22.85 per cow. If the total 100 cow herd is taken into account, a five percent increase in percent calf crop is projected to have a $2285 impact on P&L.

Table 5. Summary of Selected Regression Coefficients

```
--------------------------------------------------
% Calf Crop       $4.58/point/cow
Steer Price       $4.36/cow/$ price change
Weaning Weight    $0.41/cow/pound additional weight
% Culling Rate    -$41.12/point/herd
Hay Fed (tons)    not significantly different from zero
$ Total Hay Cost  -$1.00/cow herd
$ Total Pasture Cost  -$1.16/cow herd
$ Cost Of Bulls   -$0.35/cow herd
==================================================
```

## Economic Reality of Marketing Heavier Feeder Calves

One of the most surprising regression coefficients in the above list is the $0.41 value for steer weight. This coefficient suggests that the economic value of adding one additional pound to weaning weight adds only 41 cents to P&L. Why would an additional pound of weight marketed only add $0.41 per pound? Why is there so much slippage from the 96 cents average market price for each pound of steer calf marketed?

The answer, while not immediately obvious, is that slippage comes from at least four sources. First, heifer calves were priced at a $6 per hundred weight discount to steer calves. Second, replacement heifers for 17 percent of the cows were held back and not marketed. It is projected that these two factors are projected to account for approximately 38 percent of the slippage.

The third source of slippage comes from the 85 percent calf crop. The 85 percent calf crop suggests that "economic reality" of an average 96 cent price averaged over all cows is only 81.6 cents (.85 times 96) per additional pound marketed. It is projected that twenty-five percent of the slippage came from the percent calf crop.

The remaining 37 percent of the slippage is projected to come from the marketing side. Marketing slippage stems from the fact that the "value of additional weight" sold is considerably less than market price. An example should help clarify marketing slippage.

Let's look at October 1989 feeder calf prices for Fargo, North Dakota. Four hundred pound calves sold for $99.22 per hundred weight and totaled to $396.88 per head. Five hundred pound steers sold for $94.50 per hundred weight and totaled to $472.50 per head. On a per head basis, the value of the extra 100 pounds of weight was $75.62 ($472.50-$396.88). While the average market price was well over $95 per hundred weight, the value of additional weight was only 76 cents per pound ($75.62/100); therefore, considerable slippage comes on the marketing side.

The "value of additional weight" is equivalent to the economist's "marginal price" or "marginal revenue" taught in Agricultural Economics 101 classes. Since the market price versus increasing market weights is normally downward sloping, marginal price is normally less than average price. Many scientists forget to include this marketing slippage in their recommendations and they end up making some recommendations that are not profitable.

This marketing slippage can be graphed against calf weight (see Figure 2). As weaning weights are increased, the marginal price per pound (MP) of the additional weight is normally less than average price (AP) (see Figure 2). Whenever the average price-weight relationship for feeder cattle is downward sloping, marginal price is always below the average price. This proven geometric theorem and its related economic price theorem is generally ig-

nored in technology Recommended Best Management Practice (RBMP's) evaluations. This can lead to over estimation of the economic rewards from adoption of new technology and RBMP's (Wholgemuth).

Figure 2. Average (AP) & Marginal (MP) Market Prices for Feeder Cattle (Oct. 1989). PA



West Fargo Large Framed Steer Prices
Oct. Monthly Average

Feeder Weights in CWTS
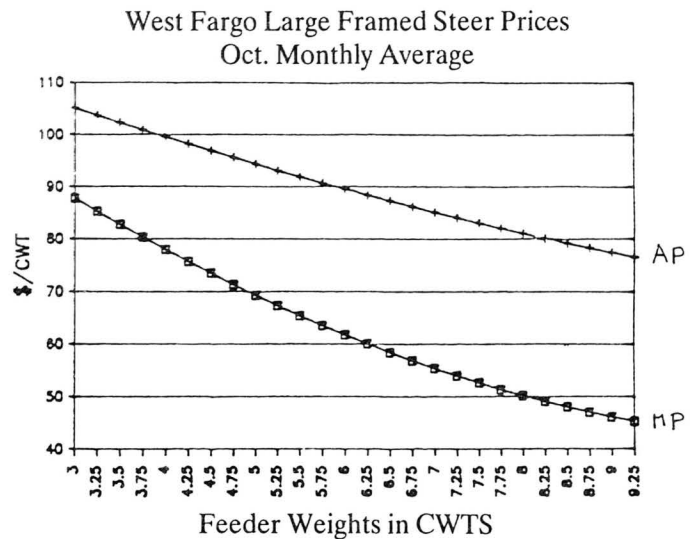
Conclusion -- costs of weight increasing technologies have to be evaluated against the value of additional weight and not against average market price. It is extemely important that veterinarians take into account this marketing slippage in their production recommendations. Your clients' bottom lines depend on your putting a proper marginal value on weight increasing technologies and Recommended Best Management Practices.

## Economics of Changing Calving Distribution

Another frequently used indicator of reproductive efficiency is the percent of calves born in cycle 1. One researcher (Fitzgerald, 1989) suggests that a reproductive efficiency goal should be to have 60 percent of the calves born in the first 21 days of the calving season. He suggests that the second cycle goal should be 50 percent of the remaining calves, the third cycle goal should be 50 percent of the remaining, etc. I will first look at North Dakota's average calving distribution and then compare it, economically, to the above recommended calving distribution.

Based on 66,000 cow records currently in North Dakota's Cow Herd Appraisal Program (CHAPS) database, the average calving distribution in North Dakota is 4.3% early, 43.0% in cycle 1, 35.1% in cycle 2, 11.7% in cycle 3, 4.3% in cycle 4 and 1.6% late (Ringwall & Berg). The average calving season starts on March 9 and calves are weaned on the average on October 25 at 203 day average age. The average birth weight is 84 pounds for those herds that collect birth weight. The average actual weaning

weight is 498 pounds. weight per day of age is 2.47 pounds and the 205 day sex adjusted weaning weight is 532 pounds (Ringwall & Berg).

North Dakota's average calving distribution and average weaning weights were built into a simulation model along with fall 1989 market prices to calculate the gross income per cow from a typical 100 cow herd (see Table 6). The purpose of the simulation model is to study the economics of calving a higher percent of the calf crop in earlier cycles compared to the market price drops associated with heavier weaned calves. Steer market prices are for Fall 1989 adjusted for average weaning weight of each calving cycle. These adjustments come from a regression equation of USDA actual market price quotes for different weights of feeder steer calves reported by USDA Marketing Service, Fargo, North Dakota. Market price is expressed as a function of the weight of the feeder steer.

The values in the top of Table 6 describe the herd. The weaning weights for each cycle are based on North Dakota's Herd Performance Averages (Ringwall & Berg). The percentages for the calving intervals are also based on North Dakota averages. The simulation model calculates the gross income for each cycle group in the herd and uses these numbers to generate an average gross income per cow. The gross income for this average North Dakota herd is $408 per cow (see bottom right hand corner of Table 6).

The simulation model was again run with a recommended new calving distribution (see Table 7). The 17 percent more calves born in cycle 1 and the 1.8 percent reduction in the early group resulted in a biological response of weaning weight averaging 2 pounds per calf higher but producing 317.7 less total pounds of calf. The net result was both a negative biological response and a negative economic response. The projected gross income per cow is projected at $404 per cow. The current North Dakota average, coupled with 1989 North Dakota calf prices, appears to be more optimum than the recommended 60 percent calf crop in cycle 1 coupled with North Dakota's 1989 calf prices. Our current research plans are to re-confirm these simulation results with actual herd data. This does suggest, however, once again that maximum is not optimum.

A third simulation was run with only 20 percent of the calves being born in the first cycle. Fifty percent of the remaining calves were born in cycle 2, fifty percent of those still remaining born in cycle 3, same for cycle 4, and the remaining split between the early and late cycles. This worse case scenario resulted in 1,677 less pounds (4.3% less) of calf produced and a gross income of $393 per cow or 2.7 percent less than the recommended distribution (see Table 8).

A comparison of the worse case scenario and the recommended 60 percent of calves born in cycle 1, projects a $11 difference per cow in favor of the 60 percent calves in cycle 1. The moving from a 20 percent calving rate in cycle 1 with a 511 pound average weaning weight to a 60 percent calving rate with a 530 pound average weaning weight in cycle 1 generated an additional 19 pounds of weaning weight resulting in a $11 per cow increase in gross income. In economic terms, this calculates out to $0.58 per cow per additional pound average weaning weight associated with the early cycle calving.

In terms of the economic benefit of changing the percent calves born in cycle 1, this also suggests that each ad-

## Table 6. Distribution of Calving Interval & Impact on Average Weaning Weight

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| NUMBER OF | 100 | | | CALVING PERCENT = | 85.00% | | |
| % HFRS = | 50.00% | | | HFR MKT DISCOUNT= | $6.00 /CWT | | |

| BREEDING CYCLE | ACTUAL WEANING WEIGHT | WDA_a/ | %AGE OF TOTAL | NUMBER OF CALVES | POUNDS OF CALF PRODUCED | STEER MARKET PRICE | GROSS REVENUE |
|---|---|---|---|---|---|---|---|
| EARLY | 562 | 2.35 | 4.30% | 4 | 2247 | $91.26 | $1,984 |
| CYCLE 1 | 550 | 2.48 | 43.00% | 37 | 20358 | $91.82 | $18,081 |
| CYCLE 2 | 525 | 2.53 | 35.10% | 30 | 15745 | $93.05 | $14,178 |
| CYCLE 3 | 485 | 2.53 | 11.70% | 10 | 4846 | $95.06 | $4,461 |
| CYCLE 4 | 449 | 2.53 | 4.30% | 4 | 1795 | $96.91 | $1,685 |
| LATE | 418 | 2.56 | 1.60% | 1 | 418 | $98.52 | $399 |
| AVERAGE | 534 | 2.50 | | | | $94.44 | |
| TOTAL | | | 100.00% | 85 | 45409.06 | | $40,789 |
| | | | | | GROSS INCOME/ COW= | | $408 |

DISTCALF/CAL4 ON 88

Table 7. Distribution of Calving Interval & Impact on Average Weaning Weight

| NUMBER OF | 100 | | CALVING PERCENT = | | 85.00% | | |
| % HFRS = | 50.00% | | HFR MKT DISCOUNT= | | $6.00 | /CWT | |

| BREEDING CYCLE | ACTUAL WEANING WEIGHT | WDA_a/ | %AGE OF TOTAL | NUMBER OF CALVES | POUNDS OF CALF PRODUCED | STEER MARKET PRICE | GROSS REVENUE |
|---|---|---|---|---|---|---|---|
| EARLY | 562 | 2.35 | 2.50% | 2 | 1194 | $91.26 | $1,054 |
| CYCLE 1 | 550 | 2.48 | 60.00% | 51 | 28061 | $91.82 | $24,923 |
| CYCLE 2 | 525 | 2.53 | 20.00% | 17 | 8922 | $93.05 | $8,034 |
| CYCLE 3 | 485 | 2.53 | 10.00% | 9 | 4119 | $95.06 | $3,792 |
| CYCLE 4 | 449 | 2.53 | 5.00% | 4 | 1907 | $96.91 | $1,791 |
| LATE | 418 | 2.56 | 2.50% | 2 | 888 | $98.52 | $848 |
| AVERAGE | | 2.50 | | | | $94.44 | |
| TOTAL | | | 100.00% | 85 | 45091.36 | | $40,442 |
| AVERAGE | 530 | | | | GROSS INCOME/ COW= | | $404 |

DISTCAL3/CAL4 ON 88

Table 8. Distribution of Calving Interval & Impact on Average Weaning Weight

| NUMBER OF | 100 | | CALVING PERCENT = | | 85.00% | | |
| % HFRS = | 50.00% | | HFR MKT DISCOUNT= | | $6.00 | /CWT | |

| BREEDING CYCLE | ACTUAL WEANING WEIGHT | WDA_a/ | %AGE OF TOTAL | NUMBER OF CALVES | POUNDS OF CALF PRODUCED | STEER MARKET PRICE | GROSS REVENUE |
|---|---|---|---|---|---|---|---|
| EARLY | 562 | 2.35 | 5.00% | 4 | 2388 | $91.26 | $2,108 |
| CYCLE 1 | 550 | 2.48 | 20.00% | 17 | 9354 | $91.82 | $8,308 |
| CYCLE 2 | 525 | 2.53 | 40.00% | 34 | 17844 | $93.05 | $16,069 |
| CYCLE 3 | 485 | 2.53 | 20.00% | 17 | 8238 | $95.06 | $7,584 |
| CYCLE 4 | 449 | 2.53 | 10.00% | 9 | 3813 | $96.91 | $3,581 |
| LATE | 418 | 2.56 | 5.00% | 4 | 1776 | $98.52 | $1,697 |
| AVERAGE | | 2.51 | | | | $94.44 | |
| TOTAL | | | 100.00% | 85 | 43413.98 | | $39,346 |
| AVERAGE | 511 | | | | GROSS INCOME/ COW= | | $393 |

DISTCAL3/CAL4 ON 88

ditional percent of calves born in cycle 1 adds $0.28 per percentage point per cow. Adding a 40 percent increase in calves born in cycle 1 is projected to add $11.20 per cow.

## Summary

USDA data suggests that the nation's 1990 beef and dairy cow herd will produce a 79-80 percent calf crop. Based on current market prices this suggests a potential loss of over $4 billion dollars to reproductive inefficiency.

Is this low national calving percentage a health problem, nutrition problem, a management problem, or an economic problem?

This same national data suggests that cattlemen do adjust their calving percentages to cattle prices. When prices are high, they seem to produce more calves. When prices are low, they back off on some production practices. I sure don't need to remind veterinarians about how beef cow farmers and ranchers backed off on veterinarian services during the low prices of the mid '80's.

A written production plan for a typical North Dakota rancher was used to conduct a case study of the economics of increasing reproductive efficiency. It was projected that John Rancher could increase his herd's profits by $4.57 per cow for each percentage point increase in calving percentage.

Reproductive efficiency expressed in calving distribution was also simulated for the average North Dakota herd. Herd performance records for 66,000 cows were used to generate the typical herd calving distribution. Based on this typical calving distribution, the projected gross income from calf sales per cow was $408.

A second simulation was done by changing the calving distribution to 60 percent of the calves born in the first cycle as recommended by a specific researcher. Projected gross income from the recommended calving distribution decreased the gross income projections of the herd. Both the biological response and the economic response were negative; however, some of the negative biological response was reduced by the economic reponse. The net results is that the current North Dakota average, coupled with 1989 North Dakota calf prices, appears to be more optimum than the recommended 60 percent calf crop in cycle 1 coupled with North Dakota's 1989 calf prices. It appears under the 1989 price relationships, North Dakota producers may be close to the optimum calving distribution.
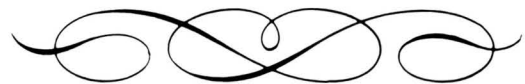
Additional simulation work looked at the economics of extreme calving distributions suggest that the economic returns from changing the percentage of calves born in cycle 1 is $0.28 per percentage point per cow. Adding a 40 percent increase in calves born in cycle 1 is projected to add $11.20 gross income per cow.

Due to considerable slippage from the percent calf crop and the lower market value of additional weaning weight per animal, the projected economic value of increasing weaning weight was $0.41 per pound. Costs of weight increasing technologies and RBMP's have to be evaluated against the value of additional weight and not against average market price.

**Clearly, before a Recommended Best Management Practice (RBMP) is promoted, it has to have both a positive biological response and a positive economic response. Not all technologies and RBMP enchance profits.**

Economics will dictate which technologies and which RBMP's are profitable at any point in time. As this decade's beef prices move down from the current 1990 record high price peak, the profitability of various technologies and RBMP's will change. This suggests that production recommendations will have to also change during this decade. Astute veterinarians will constantly be aware of the changing economic reality of their clients and will offer services to their clients for a fee that help determine the "economic reality of their scientific services".

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Appendix Tables

## John Rancher's Written Production Plan

### Table 1. Production Technology Assumed

```
------------------------------------------------------------------------
     BEEF COW HERD SELLING WEANED CALVES IN FALL        1990
                    DATE:    8/28/90                  0% IN DEBT
========================================================================
                            DESCRIPTION
------------------------------------------------------------------------
  A spring calving       100-cow herd weaning        85% calf crop.
Hfr calves weigh         498 lbs. & steer calves weigh        528 lbs.
Cow death loss of          1% rate and       15% cow culling rate.
Suggested heifer conception     87%.Actual conception       85%
Feed requirements include        100 cows and       19 replacement hfrs.
        3 bulls.  Calves sold in the fall at 5-8 months old  with a
        4% transit shrink.  Cows on pasture         180 days with
        30 days addition on aftermath.
        1 Code 1 for raised or 2 for purchased replacement heifers.
========================================================================
```

### Table 2. Projected Receipts

```
------------------------------------------------------------------------
Steers          43 head        522 pounds     $.96 /lb =      $21,293
Heifers         24 head        493 pounds     $.90 /lb =      $10,500
Cull cows       14 head        900 pounds     $.47 /lb =       $5,922
Cull Hfrs        4 head        875 pounds     $.74 /lb =       $2,476
Cull Bull        1 head       1700 pounds     $.53 /lb =         $893
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                        Total Income Per Herd            $41,083
                        Total Income Per Cow                $411
========================================================================
```

### Table 3. Projected Feed Expense

```
------------------------------------------------------------------------
CASH FLOW                                          OPPORTUNITY COST
---------           180 Summer Pasture Program     ---------------

    $372      $.50   Pasture      743 AUMs      $10.00/AUM =      $7,434
      $8      $.50 Rpl Hfrs        .9 AUM/HD    $10.00/AUM =      $1,016
    $395   $400.00  Min&salt      .99 ton       $400.00/ton =       $395
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                    155 Day Winter Feeding Program

    $218     $1.00      Oats     218.0 bushels   $1.20/bu  =       $262
    $400   $160.00   Protein       2.5 ton      $160.00/ton =       $400
  $3,375    $15.00      Hay       225.0 ton       $50.00/ton =    $11,250
      $0    $10.00  Corn Sil        .0 ton       $14.00/ton =         $0
      $0     $5.00Oat Straw         .0 ton       $20.00/ton =         $0
    $406       400 Min&salt       1.01 ton      $400.00/ton =       $406
     $30     $.01Aftermath         30 days       $.10/day  =        $300
  Heifer     Feed   included     14.25 Lbs DMI   $3.65$/Cwt Dry     xxxx
---------                     (BEEF GROWER DATA)                ---------
  $5,203                   Total Feed Cost Per Herd           $21,462
     $52                   Feed Cost Per Cow                     $215
========================================================================
```

## Table 4. Projected Livestock Expenses

| CASH FLOW | | | OPPORTUNITY COST |
|---|---|---|---|
| $808 | Vet and Medicine | $8.08 / cow | $808 |
| $350 | Fly Tags | $3.50 / cow | $350 |
| $60 | Bull Semen Check | $20.00 / bull | $60 |
| $713 | Worm Cows & Heifers | $6.00 / head | $713 |
| $868 | Utilities & Gen farm | $8.68 / cow | $868 |
| $906 | Power and Fuel | $9.06 / cow | $906 |
| $701 | Miscellaneous | $7.01 / cow | $701 |
| $800 | Marketing | $8.00 / cow | $800 |
| $5,206 | | | $5,206 |

Bull Depreciation

| | Loan | | | | |
|---|---|---|---|---|---|
| | $0 total | a: purchase price | $1,750 / bull | | |
| Loan Pmt | 13% APR | b: salvage value | $893 | | |
| $0 | 1 yrs | c: years of use | 3.00 | | $857 |
| $53 | | d: insurance | 1% | | $53 |
| $1,750 | xxxx xxxxxx | e: cash pmt for new bulls | | | xxxxx |
| $0 | $.00 | Bedding | $2.00 / cow | | $200 |
| $0 | 0% | Interest Feed & Lvsk | .00% @ 6 Mo | | $0 |
| $7,009 | | Total Livestock Costs | | | $6,315 |
| $70 | | Livestock Costs Per Cow | | | $63 |

## Table 5. Projected Fixed Expenses

| CASH FLOW | | | | OPPORTUNITY COST |
|---|---|---|---|---|
| | Depreciation, Repairs, Taxes & Insurance | | | |
| $100 | 2% Total Bldg Invest | $5,000 | 7% | $350 |
| $300 | 3% Total Eqpt Invest | $10,000 | 13% | $1,300 |
| $800 | 1% Investment /cow | $800 | 1% | $800 |
| $113 | 1% Heifer investment | $750 | 1% | $141 |
| $53 | 1% Bull Investment | $5,251 | 1% | $53 |
| xxxxx | Total Inv/Cow | $1,144 | xxxx | xxxxx |

| Loan Pmt | Interest on Investment Capital At | | Int Rate | Years | Dollars |
|---|---|---|---|---|---|
| $0 | $0 Total Bldg Invest | $5,000 | 12% | 15 | xxxx |
| $0 | $0 Total Eqpt Invest | $10,000 | 12% | 10 | xxxx |
| $0 | $0 Investment/Cow  $ | $800 | 12% | 7 | xxxx |
| $0 | $0 Investment/Heifer | $750 | 12% | 1 | xxxx |
| xxxxx | xxxx Average Bull Valu | $1,322 | 12% | xxxx | xxxx |
| $1,365 | Total Fixed Cost Per Herd | | | $2,644 |
| $14 | Total Fixed Costs Per Cow | | | $26 |

## Table 6. Cost/Return Summary

| CASH FLOW | | OPPORTUNITY COST |
|---|---|---|
| $41,083 | Receipts | $41,083 |
| $12,212 | Less Feed and Livestock Expenses | $27,777 |
| $28,871 | Returns Above Variable Costs | $13,306 |
| $1,365 | Less Fixed Expenses | $2,644 |
| $27,506 | Returns to Labor & Mgt, & Equity Capital Per Herd | $10,662 |
| $410.83 | Total Receipts Per Cow | $410.83 |
| $135.77 | Total Expenses Per Cow | $304.21 |
| $275.06 | Returns to Labor & Mgt, & Equity Capital Per Cow | $106.62 |

## Table 7. Adjustments For Multiple Products

| CASH FLOW | | OPPORTUNITY COST |
|---|---|---|
| 427.95 | Cwts of steer equivalents sold | 427.95 |
| $96.00 | Receipts Per Steer Equivalent | $96.00 |
| $31.73 | Cost Per Hundred Weight Sold (All Costs) | $71.09 |
| xxxxx | Returns To Labor, Mgt, & Eq. Cap/Steer Eq. | $24.91 |
| $10,000 | Family Living To Be Supported From Cow Herd | xxxxxx |
| $17,506 | Cash Available To Pay Debt From Herd | xxxxxx |
| $175.06 | Cash Available To Pay Debt Per Cow | xxxxxx |

SOURCE: COWBUD90.CAL ON DISK #87.