Economic Impact of Bull Choices... A.I. Or Otherwise

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Profitability from bull selection and other reproductive technologies such as embryo transfer will vary from herd to herd. Much of the differences will depend on how carefully the economic consequences of the various decisions made when choosing among alternatives are evaluated. For instance, if the highest-priced bulls are used under the assumption that semen price is almost perfectly correlated with true value for commercial milk production, profitability from the selection program will be low and probably nonexistent. Using natural service just because it is perceived to always be more cost efficient will often lead to less profitability than use of A.I. Provided that replacement heifers are to be reared from calves born on the farm, a carefully planned A.I. program usually, but not always, will be the most profitable breeding strategy.

One of the few exceptions to the potentially superior profitability of A.I. would occur if replacements of equal quality can be purchased cheaper than yours can be reared. Whether A.I. should be practiced in such a situation would depend on its effect on sale price of calves a few days old compared to any extra costs of A.I. over natural service and safety considerations. The latter may be important if dairy bulls are used naturally.

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Another caveat is that common sense is used when buying and using semen. Buying semen from the currently "hot" and usually overpriced bulls to breed ordinary grade cows is not sensible. Despite the hype that usually surrounds such bulls, few if any will sire the most profitable commercial replacements. Some may, however, win the local cattle shows but how many commercial dairy producers show cows today?

Using expensive semen to inseminate cows that are likely to be culled before they calve again or those of low or questionable fertility does not fall within my definition of common sense either. Breeding heifers to bulls known to cause a high percentage of difficult births of 10% or higher is in the same category.

How should semen be chosen to maximize profitability? The best procedure is to use an index such as Net Merit published by USDA as the first screen. First, this measure includes a bull's genetic values for milk, protein, and fat minus the feed costs needed to obtain the extra outputs. If the ratio of your expected FUTURE prices for protein and fat differs from the national averages used by USDA, it is a relatively simple matter to adjust for your market. Please note that unless the ratios of prices among milk, fat and protein change there is little advantage in recomputing the index. Even if you plan to breed or buy bulls to use in natural service, you should apply the same procedure to their pedigree values to decide which ones to use.

The second part of the Net Merit index, PTA for Productive Life, also has major economic value. Longer productive life means both more months of production per cow and fewer replacements, thereby diluting the net cost of replacements per lb. of milk produced. The USDA PTA for this trait for Holstein cows also takes account of the effect of type traits on survival rates or longevity, a modification that is especially valuable for bulls with only young daughters.

The PTA for Somatic Cell Score (SCS), the third part of the Net Merit index, will almost surely be more important in the future than it is now weighted in the index. This statement is made because recent research at North Carolina State shows that daughters of bulls with desirable (low) PTAs for SCS live longer than those with higher values. Our results showed PTA-SCS to be slightly more closely related to length of life than PTA-Milk was. The value of a higher survival rate is not now included in the value assigned to PTA-SCS in the Net Merit equation. Also, quality premiums for low SCC milk and penalties for higher SCC are almost surely to increase in the future.

Admittedly, we have much to learn about the optimum use of PTA-SCS, but I am convinced that the more we learn, the higher the economic value of the trait will become. This does not mean that we will control clinical and subclinical mastitis by genetics, but simply that it will become part of the strategy for keeping them minimized.

Recent research at Virginia Tech has verified the considerable economic value of conception rate of semen. The limitation to using the currently available measure of it, Estimated Relative Conception Rate (ERCR), is that it can only be computed accurately after the bull has been in service for a year or two.

Differences of 5% in ERCR are common among active A.I. bulls. To put this in perspective, the true conception rate of Holstein cows is usually 40-50%. An ERCR of +5 means that 5 more cows per 100 serviced will become pregnant, a true advantage of at least 10%. This translates into about a 10% reduction in the cost of a conception, not an insignificant amount. Holstein heifers are more fertile, perhaps as much as 65-70%, so ERCR is not quite as important when breeding them, but a 5% difference still is not trivial. Provided calving difficulty of a bull is not too high, the most profitable place to use bulls with many desirable traits, but a below-average ERCR, is to breed them to heifers.

Breeding heifers to bulls siring calves that are born with little difficulty (7% or lower calving difficulty) is an economically desirable practice provided not too much is given up in other traits. Luckily, low calving difficulty, high milk and high survival are favorably correlated. The younger heifers are bred, the more important it is to chose for low calving difficulty among bulls high on Net Merit. However, it does not make sense to sacrifice everything else to get low calving difficulty if the resulting heifers are to be reared as replacements.

In the past it was commonly thought that breeding to a beef bull was a surefire way to have low calving difficulty. Today, many beef bulls cause much calving difficulty and must be chosen as carefully as dairy bulls to reduce it.

Even if replacements are not to be saved, remember that losses are higher in heifers having calving difficulty from increased deaths, personnel costs, lower milk, and poorer rebreeding rates. This means it is profitable to choose bulls to minimize calving difficulty when breeding heifers. This holds regardless of what type of bull – A.I. dairy, A.I. beef, natural service dairy or beef – is used.

Bull choices that will lead to inbreeding usually will be less profitable than those giving outbreeding. Matings that will produce inbred fetuses have a reduced success rate. A fetus that is inbred has up to a 50% higher chance of dying before birth than a non- inbred one. A common misconception is that inbreeding only affects calves after they are born, but the truth is that the detrimental effect starts the day an inbred mating is made. Conception rates from inbred matings will be lower, as well as survival to implantation and any later stage of pregnancy. Bluntly, the economic effects of inbreeding in dairy cattle are often underestimated. Just ask any pig or beef producer why they usually crossbreed and you will find out why.

My rule of thumb is that for an inbred mating to be justified the predicted economic value of a resulting calf has to be at least 1% higher than the best non-inbred mating for each 1% more inbreeding that it will cause. I challenge anyone to provide data based on a complete economic analysis that refutes this. Analyses based on "inbred" cows that survive to lactate have ignored most of the true costs of inbreeding. An advantage of A.I. is that many bulls representing a wide variety of lines are available, so inbreeding can be minimized.

One of the false ideas used to support natural service is that it is practically free. This false idea arises because all direct costs of using bulls are rarely considered, let alone the indirect and opportunity costs. Research several years ago at the University of Wisconsin by Shook showed that the direct costs of natural service in a typical herd averaged $18 per service. With the larger herds typical today, this may be a few dollars too high, but natural service is still costly. Low conception rates and diseases may also be obtained from such bulls.

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Among the indirect and usually ignored costs of natural service over A.I. are more inbreeding and imprecise knowledge of expected calving dates. Unless cows can be grouped by their genetic relationships, which is impractical in most herds, some inbred matings will be made leading to the losses discussed earlier. If expected calving dates are not known, dry periods will not be of the economically best length. Also, dry cows will not get the management necessary to maximize future profitability.

For A.I. to be profitable, management adequate to detect accurately at least 40-50 percent of true heats is essential. Without this minimum level of accuracy, a high percentage of cows will be missed until their lactation is advanced. Obviously, long open periods predispose a cow to premature culling.

A common misconception is that 70-80% of heats must be detected to use A.I. successfully. Actually, only the best managed herds reach that level. Studies by Blake and colleagues at Cornell showed that increasing accurate heat detection rates beyond 50% was often unprofitable. This occurred when costs to obtain the extra accuracy amounted to more that a few dollars per additional cow detected.

Accurate identification of individual cows is also essential. Otherwise, cows may be misclassified as in heat when they are not. Inaccurate identification of the cows truly in heat usually has drastically unprofitable effects. Results will be unnecessary costs without additional pregnant cows. Breeding cows not in heat may also be harmful to the future reproductive success of a cow and provides zero return on semen and other costs.

Consequences of inadequate or inaccurate heat detection will be costly. Long calving intervals will be common. Yields of many cows will decrease to unprofitable levels before they become pregnant. Combined, these may negate some of the favorable aspects of A.I.

Limitations of facilities may affect the profitability of A.I. When it is expensive to catch and restrain cows for breeding, costs per pregnancy increase. If catching and restraint upsets cows, conception rate can be reduced. This may reduce the pregnancies resulting per A.I. service, thereby increasing their cost. New Zealand, which has one of the world's lower fixed cost per cow, breeds nearly 70% of its cows by A.I. This shows that adequate facilities for A.I. need not be expensive.

Another common misconception is that conception rate to A.I. service must be over 50% for A.I. to be profitable. At 40% conception, only 34% of cows will require three or more services. Only 10% will need more than four inseminations. The realistic upper limit of conception rate is only 65-70% with natural service to a highly fertile bull. For example, pregnancy rate is rarely more than 80% in cycling cows exposed to a fertile bull for 50-60 days. Usually higher conception rates will make A.I. more profitable, but an outstanding conception rate is not necessary to make A.I. more profitable than natural service.

The opportunity costs of using natural service are well known. The USDA summaries released after every sire summary show that the net value of the extra milk of an A.I.-sired cow is worth at least $25 over feed costs in each of her three or more lactations. This occurs because feed costs for maintenance and fixed costs are nearly the same for every cow of the same age and body size. The total additional net of $75 per cow over her life should be mostly profit because costs of A.I. can be kept near that of natural service by good planning and management.

How much one can profitably pay per unit of semen over the cost of natural service has been the subject of much research and discussion without an answer that satisfies everyone. General agreement *has been reached that the expected net financial return from the resulting heifers is the best method of computing how much can be paid. Disagreement still remains on details of some of the minor costs and returns that should be included.*

The main factors affecting expected or predicted income are:

1. Expected additional lactation yield of a cow resulting from the semen of a particular bull.

2. Future values of milk and its components.

3. Expected length of a resulting cow's productive life.

4. Conception rate of semen as it affects the probability of a heifer calf.

5. Values of any traits such mastitis resistance, ease, labor or speed of milking, calving difficulty, etc., that reduce costs over that of an average cow.

The main factors affecting variable and A.I. costs are:

1. Expected future feed costs per unit of milk and components.

2. Minimum cost of getting a cow pregnant by A.I. minus cost of a pregnancy from natural service.

3. Extra cost of semen from a particular bull necessary to obta.n a milking heifer, discounted for the time value of money.

4. Opportunity costs from any milk lost due to calving intervals longer than those from natural service.

You may note that only the additional cost of semen is affected by conception rate. Whether the cow will be kept to calve, calf liveability, and all other costs affect A.I. and natural service equally

Comparing Profitability of A.I. and Natural Service for a Herd:

A simple but reasonably accurate comparison of the relative profitability of A.I. and natural service breeding may be obtained by the following steps. Estimate or compute the following:

- **Expected value of milk and its components in your future milk market for a lactation from an average daughter of the A.I. bulls available, minus the values for an average natural service daughter. Multiply by 3.0 for lifetime value.**
- **Add in the value of superiority for additional traits of the A.I. bulls, including udders, feet, SCS, and longevity. Multiply by 3.**
- **Compute value for feed costs of the extra milk, which usually varies from 35-40 % of the milk value.**
- **Compute the costs of getting an A.I.-sired heifer minus the cost of a naturally sired one.**

The approximate profitability of A.I. for your herd is simply:

Number of replacements per year times [(1 above)+(2)-(3)-(4)]

or:

Number of replacements x (milk $+ $value of other traits minus feed costs for extra milk minus extra cost of an A.I. daughter).

For example, suppose the following costs and returns are appropriate for your herd:

a. Many studies have demonstrated the genetic superiority of A.I. bulls over those used in natural service. Daughters of first-proof A.I. young bulls average about 400 lbs. more milk than those of first-proof natural service bulls from USDA summaries based on differences in USDA PTAs. This is worth about $40. For a lifetime multiply by 3.0 to equal $120.

b. Suppose superiority in other traits adds $15 per cow over her life.

c. Suppose extra feed costs are 40% of milk, or $48 over the cow's life.

d. Suppose the extra cost of obtaining an A.I. daughter is $50. This would include the extra labor and supplies over natural service costs.

The net value of A.I. is now $120+$15-$48-$50, for an advantage of $37 per cow. For 100 replacements the total would be $3,700. This does not include any additional value the A.I. daughter might have for other traits or if sold as a replacement. It also assumes that there is not any value in knowing when a cow is due to calve, a bit of information I believe most producers would agree has some usefulness.

Let us now see if the $50 extra cost of getting an A.I. daughter is reasonable. Assuming the cost of the natural service bull is $12 per service, and 5.0 services are required to get a milking heifer by natural service, base breeding costs are $ 60.

Now let us look at A.I. costs. Because our example is based on only using young A.I. bulls, the semen cost per service would not be more than $5 and probably less. Assuming other A.I. costs are $9 per service, and 8.0 services are needed because of lower conception rate, we have an overall cost of $110. This totals $50 more for the A.I. heifer. The costs used are probably too low for natural service and too high for A.I., but it still appeared to be more profitable. I believe A.I. to be a profitable investment.

In my opinion this simple example justifies my opening statement that A.I. will practically always be more profitable than natural service if replacements are to be saved.

The same general procedure can be used to compare any groups of bulls, or even two individual bulls.

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