1991

Impacts of Types on Feed and Market Requirements

Donald L. Boggs
South Dakota State University

Impacts of Type on Feed and Market Requirements

Donald L. Boggs, Extension Beef Specialist
Department of Animal and Range Sciences, South Dakota State University

So you want to make them bigger! Or, do you want to add some milk to your cow herd? Improvements in these and other traits offer opportunities to increase production through higher weaning weights. However, the increased outputs are accompanied by increased feed and management inputs. Available research indicates that the increased production may or may not outweigh the increased inputs.

Mature cow size and level of milk production are typically the factors considered when changes in cattle type are discussed. Numerous research studies have been conducted to evaluate the effects of these factors on biological and economic efficiency. In these studies, biological efficiency varied widely as conditions changed from study to study. The bottom line was that no one type, breed or kind worked best under all conditions. In fact, when biological efficiency was measured as the total energy required by a cow and calf to produce a pound of edible beef, there were virtually no significant differences noted among the breeds or types.

Economic efficiency has varied according to the resources available. When an abundant supply of high quality feed is available, the larger, heavier milking cow has generally been more profitable. However, when the feed supply is restricted below the level needed to maintain high reproductive rates in these larger, high producing cattle, the smaller cow with somewhat lower milking ability generally becomes the more economically efficient.

Thus, commercial cattlemen must face the question, "How do I design a breeding and selection program that produces cattle that are adapted to my resources?"

Effects of Type Changes on Nutritional Requirements and Reproduction

Let's first look at how various type changes affect the energy requirement (pounds of total digestible nutrients (TDN) per day) of the cow. Cornell University researchers define (Table 1) the relationship of frame score (FS) and hip height to mature cow weight and to TDN requirements postweaning and at two different levels of milk production during peak lactation. Increasing cow size from FS 3 to a FS 5 results in an additional 145 lb of cow weight to maintain. This additional size requires an 11% increase in TDN during gestation and a 7 to 8% increase during lactation. If the feed is available, the larger intake capacity of the bigger cow will generally allow her to consume enough feed to meet these higher requirements.

Table 1. Relationship of Frame Score and Hip Height to Mature Cow Weight and Energy Requirements Following Weaning and During Peak Lactation[a]

			TDN, lb per day		
				Lactation	
Frame score	Cow hip height, in.	Mature cow weight	Postweaning	12 lb per day	18 lb per day
1	44	880	7.4	11.6	13.2
2	46	955	7.9	12.0	13.7
3	48	1030	8.3	12.6	14.2
4	50	1100	8.7	13.1	14.7
5	52	1175	9.2	13.6	15.2
6	54	1250	9.6	14.1	15.7
7	56	1320	10.1	14.6	16.1
8	58	1395	10.5	15.0	16.6
9	60	1470	10.9	15.5	17.0

[a]Adapted from Fox et al., 1988.

Stocking rates must therefore be adjusted to meet the demands of the bigger cows. The land necessary to carry 100 of the 1030 lb cows will carry approximately 92 of the 1175 lb cows and only 86 of the 1320 lb cows. These additional feed costs have to be made up through additional calf growth or increased selling price per pound.

The actual weight increase for each frame score increase in size will vary among different breeds and cattle types. Therefore, the mature weights of larger framed cows could easily exceed the predictions of Fox and coworkers. Researchers at Colorado State University projected cow weights for different frame scores (FS) to be: FS 2-3 = 850 lb, FS 3-4 = 1000 lb, FS 4-5 = 1150 lb, FS 5-6 = 1300 lb, FS 6-7 = 1450 lb. Check the weights on your own cows. Most producers are usually surprised by the mature weight of their current cow herd; consequently, they have often failed to make the necessary adjustments in stocking rates and winter feeding programs.

Heavier milking cows also require more feed. As shown in Table 1, increasing peak milk production from 12 lb per day to 18 lb per day requires approximately 1 1/2 lb more TDN per day. This translates into a 10 to 14% increase in energy requirement, depending on the cow's size. The 1984 NRC indicates that increasing the peak milk production potential of an 1100-lb cow from 10 lb per day (average) to 20 lb per day (superior) will raise her daily requirement for energy by 25%, protein by 30%, phosphorus by 25% and calcium by 40%. Whereas increases in requirements due to size were partially offset by increases in intake, increased intake due to increases in milk production do not usually offset the increased requirements. Therefore, increased diet quality (i.e., higher percentage TDN), whether in the form of grain or higher quality forage, may be needed to meet these higher nutritional demands (Table 2).

Table 2. Impact of Cow Size and Milk Production Level on Feed Intake (DMI) and Feed Quality (% TDN)

Cow weight	Avg milk		High milk	
	DMI	% TDN	DMI	% TDN
1000	20.2	57	20.6	67
1200	23.0	56	23.8	64
1400	25.6	55	26.7	62

Impact of Frame Size on Reproduction

When feed resources are restricted, the larger framed cattle are more susceptible to decreases in reproductive performance. The results of an Iowa study (Buttran and Willham, 1987) demonstrate the interaction that occurs between frame size and management conditions (Table 3). Under favorable management conditions, there were no significant differences among small, medium and large framed first calf heifers in the percentage cycling during a 42-day breeding season or in the percentage calving the following year. However, when management conditions were marginal, the large framed heifers reacted more adversely. Even though reproductive performance of both groups was depressed, the small framed heifers had both a higher percentage cycling and a higher percentage calving than the large framed heifers.

Table 3. Effects of Size and Management on Reproductive Traits of First Calf Heifers[a]

Trait	Favorable management			Marginal management		
	Small	Medium	Large	Small	Medium	Large
Cycling rate, %	98.5	98.3	97.9	83.8	81.5	63.1
Calving rate, %	84.9	84.5	81.6	73.8	67.5	53.0

[a] Adapted from Buttran and Willham, 1987.

In addition to the effects on mature size, changes in size also impact the weight at puberty of replacement heifers. Weight at puberty is a function of mature size. As mature size potential increases, the weight needed for a heifer to begin cycling also increases. For example, if a FS 3 heifer reached puberty at 575 lb, a FS 6 heifer may need to weigh 750 lb before she starts cycling. Thus, if the selection program creates an increase in mature size potential, the replacement heifer development program will have to be adjusted accordingly to get the heifers to their heavier target weights. Perhaps more importantly, larger framed cattle are generally later maturing cattle. This means that they reach stages of physiological development, such as puberty or maturity, at older ages. Therefore, it becomes difficult for extremely large framed cattle to reach puberty in time to be bred at 13 to 15 months of age in order to calve at 22 to 24 months.

This is not to say increases in growth cannot be accomplished without increasing age at puberty. However, to improve both of these traits at once will require a strict heifer culling program and a strong selection emphasis on earlier maturing breeds and scrotal circumference when selecting sires.

Another potential type change that deserves consideration is the emphasis to improve carcass cutability. Increasing the thickness and muscularity of an animal is another way to increase its mature weight. If frame and body condition are held constant, differences in muscling can create as much as a 150- to 200-lb variation in the mature weight of the beef cow. These changes in size and weight will cause increases in nutritional requirements similar to those caused by increased frame size.

Also, be aware that carcass traits and reproductive traits are antagonistic. Increased selection pressure in one of these areas generally results in a decrease in performance in the other area. Pruitt and coworkers at South Dakota State University reported that thin cows at calving (condition scores 2 and 3) had only a 15 to 25% probability of cycling by the beginning of the breeding season and an 87 to 93% change of becoming pregnant in a 60-day breeding season. This compared to a 60 to 75% probability of cycling and a 98 to 99% probability of pregnancy for moderately conditioned cows at calving (condition scores 5 and 6). This research indicates that we do run the risk of reproductive problems if we breed all of the fat and fleshing ability out of replacement females.

Impact of Frame Size on Market Potential

Frame scores are useful in determining the appropriate market weight. Table 4 lists the approximate live and carcass weights at which steers and heifers of varying frame scores will reach a market endpoint of Low Choice (approximately 30% carcass fat). It is obvious that both live and carcass weights increase dramatically as frame scores increase. It is also important to realize that, just as with mature cow weights, heavy muscled Limousin steers and heifers will likely weigh more than is predicted in Table 4 for a given frame size.

Table 4. Relationship of Frame Size to Live Weight and Carcass and Weight at Choice Grade (30% Carcass Fat)

Frame score	Approximate weight at Choice grade, lb			
	Steers		Heifers	
	Live	Carcass[a]	Live	Carcass[a]
1	750	472	600	378
2	850	536	700	441
3	950	598	800	504
4	1050	662	900	567
5	1150	724	1000	630
6	1250	788	1100	693
7	1350	850	1200	756
8	1450	914	1300	819
9	1550	976	1400	882

[a] Assuming a dressing percent of 63% (hot carcass basis).

If the acceptable carcass weight range is 550 to 850 lb, we need to produce feeder cattle (steers and heifers) in the 4 to 7 frame score range. For a herd of small framed cows (frame scores 2 and 3), bulls with frame scores of 6 to 8 would be needed to generate the desired frame score in the offspring. However, calving difficulty could definitely be a problem in this instance of using larger mature size bulls on the small cows. For moderate framed (4 to 5 frame) cows, bulls in the 4 to 7 frame score range would be desirable. For large framed cows (6 to 7 frame score), bulls of the same frame score or smaller would be needed to produce the specified feeder cattle. If packer pressure narrows the acceptable carcass weight range, the acceptable range in frame scores for feeder cattle will also narrow and breeding programs will need to be adjusted accordingly.

The predicted impacts on market steers and replacement heifers from using various frame score bulls on 1050 lb and 1150 lb cows are shown in Table 5. Even though the changes in weight are not as dramatic as one might think, one must be aware that these predictions are averages and that the extremes of the calf crop can quickly move outside of acceptable weight ranges. Also, it is important to realize that "frame creep"--where frame size increases as a correlated response to selection for increased growth rate--usually occurs gradually through a series of selection decisions.

Table 5. Predicted Average Steer Market Weights and Replacement Heifer Breeding Weights Sired by Bulls of Various Frame Scores

Cow size	FS 3-4 Wt 1050	FS 4-5 Wt 1150	FS 4-5 Wt 1150
Bull FS	Steer wt	Steer wt	Heifer breeding wt
4	1065	1135	735
5	1095	1165	755
6	1125	1195	775
7	1155	1225	795
8	1185	1255	815
9	1215	1285	835

Matching Type to Resources

There is no one right type or kind for all situations. Under different production environments, the different cattle types will re-rank themselves in terms of production efficiency and profitability. Therefore, each producer must evaluate the type of cattle that adapt and perform most economically in their own production system.

Selection for extremes, whether it be extreme frame, extreme weight, extreme muscling or extreme milk production, is fairly easy, and rapid progress in the selected traits can be made. Remember, however, that nature selects against extremes and, unless rapid change is needed, extremes in type really aren't needed, either.

Many factors must be considered in a multiple trait, balanced selection program designed to produce cattle that perform efficiently within their given resources and environment. It has often been said that we should "match the cow to the environment and the bull to the marketplace" to truly capture economic efficiency while meeting the needs of the consumer. For commercial cattle producers, this is best accomplished through a planned crossbreeding that properly utilizes the variety of genetics that are available to the beef industry. As seedstock producers, it is imperative that you establish the role that you want your breed and your herds to play in the commercial cattle production scheme. Once that role is firmly established, you must then design your breeding programs to produce cattle that meet the goals and objectives of your customers!