MATCHING GENETICS TO TROPICAL PRODUCTION SYSTEMS FOR BEEF CATTLE: SOME APPROACHES APPLIED IN BRAZIL

Luiz Alberto Fries
GenSys Consultores Associados S/C Ltda and DMGA/**UNESP**/Jaboticabal-**FAPESP**

SUMMARY
To use or not to use a given breeding technology, breed or genetics? All over and almost every day producers must make decisions and to change at an increasing speed. The well being of segments of our societies rely on the adequacy of their decisions. A discussion on why people adopt new procedures is needed. Here, some experiences are presented. When new technologies don't get implemented, research workers should ask themselves: "Where did I fail?". It would be very difficult that a producer/breeder would see some new procedure; understand what it could do for him, its advantages and very little risks; and even so not be willing to use it.

INTRODUCTION
As pointed out by our Chair, the intend of this session is "to bring to focus some of the problems that are encountered by producers as they attempt to use newer technologies in animal breeding" (Jenkins, 1996). Therefore, here we should concern ourselves more with why changes happen than the pros and cons for a given implementation of breeding technology. Some comments will be made on when things don't work (*problems*) as well as when things get done (*accomplishments*), since we can learn from both kinds of events.

We should spend some words on this special kind of beef cattle producer, the one which produces the beef seeds. In the past, most breeders belonged to traditional and aristocratic families. Today, almost all have larger assets and are better educated than the average beef producer from their neighborhood. When looking at their full scale business, the amount of extra cash arriving from the breeding operation doesn't compensate the time, PR abilities and dedication it requires. But it is indescribable the kind of satisfaction they feel after a successful annual sale. Probably they realize (un- or consciously?) that genes from their proxy/surrogates will dislocate genes from animals produced by their competitors. Can anthropomorphism reach this level of abstraction? As technicians or researchers, we must be able to perceive that being a beef breeder is not just a business like any other.

PROBLEMS
Problems of communication. Two examples will be used to demonstrate the difficulties we have in understanding and listening to important concepts from producers.

Visual Scores. A good part of the differences that exist amongst beef breeds have been built by past breeders using their own good sense and visual appraisal skills. Most of us believe that using conformation scores or anything that is not measured by an instrument is not "good science". By the same token, very few breeding programs in the world really use the recommendation of 14-hour total fasting before weightings. Hence, some weights can be more "subjective" or contain more measurement errors than some scores.

How many hours were spent in bitter arguments between groups which are for truncation selection and groups which believe that we have to look at the animals also? Long (1973), Daly (1977) and Greenough et al. (1991) describe and propose visual or electronic scoring systems. Koch et al. (1982) and Pons (1988) show results that selecting for indexes also containing muscle/conformation scores produced higher responses in weight than selection for weight alone. Hammond (1992) considers the inclusion of visual scores for birthweight in breeding programs and Roso (1997) studied some possible implications when using these scores instead of the scale. Scores are important not only on their own economic, technical and biological grounds; maybe more importantly, by using the scores attributed by the breeder, we are creating a strong motive for the use of the reports latter (Kemper 1973).

What are all the show-rings and visual inspections by technicians from breed associations telling us? Why is it so difficult to listen to what they have been shouting to us for so long?

Serving Capacity Tests (SCT). In different occasions, different groups in Brazil tried to look at SCT in Zebu bulls and what have been heard the most is: "That can't be done because Zebu bulls are shy and don't respond to the test". Some top researchers have been trying to deal with it, with no success. That statement somehow blocked away the reasoning capacity from research workers on this area and it became the unquestionable and holy truth. It took a breeder, with a zero formal training/conditioning in vet science, to show some new direction (a libido test) on which it is possible to discriminate animals (Pineda & Lemos, 1994).

More difficulties in communication. Very few animal breeders have had any experience in sales; but producers are under the attack of salespersons all day long. So, it's no wonder that when we don't get our message across then the producers will not accept/understand our point of view. Sometimes, we want the producer to help us on a given research project while he may be misunderstanding that we are trying to solve a given practical problem from his herd. Before going to a meeting, we should know which are the potential rewards/risks for the new vs. old technology. Producers don't have any problem asking: Will that really help me? How much does it costs? Which are the risks? Quite often we can't say for sure to a producer that he will be better off if he uses such and such practices/technologies. If we aren't unequivocally convinced ourselves, beforehand, how can we ever persuade the producer?

Who can understand what we say? We shouldn't have problems understanding breeders; their problems are clear and concrete. On the other side, they should feel like geniuses when they understand us; most of the time we can't understand each other. We go on and on building metalanguages because: (1) It is a human trick to regard as highly intellectual what is complicated and as worthless what is straightforward and simple. (2) We are not so sure on what we are doing; so, meanwhile, let's have a deafman conversation and use words, symbols and concepts which are not clear to no one (including ourselves). (3) We know that what we are doing is not 100% correct so, let's hide and disguise it in as many symbols, acronyms and explicit/implicit restrictions and assumptions as possible.

Cultural Problems. Being authentic is a scarce virtue. Most follow the EPD band wagon only because the marketing advantages. Others are afraid to think and decide by themselves.

The Super Market. Unhappily, quite some producers participate in breeding programs due only to the marketing advantages. Others, only care about EPD's (and ET's, clones and so on) to sell bulls, semen and genetic material to other breeders and possibly to other countries, like progeny tests and other gadgets have done in the recent past. On the other side, not that long ago, producers which promote their animals based on estimates of the breeding values have been discriminated against by the market. So, not that much to complain about, after all.

Don't think by yourself. During the past two years, some Brazilian beef cattle associations and independent breeding programs left direct selection for heavier weights and began using functions of the denominator of Average Daily Gain (ADG). Days to gain 160 kg preweaning (D160) and Days to gain 240 kg postweaning (D240) are example of these, as used by Albuquerque et al. (1998). This was done as part of the strategy to escape from the dead end constituted by selection for any proxy of late maturing, high milking and heavy mature weight animals, which are meaning disaster in the near future for all-forage production system (results presented by Jenkins & Williams (1994) and by McMillan et al. (1992) are revealing). Producers can understand the logic and the economic benefits behind this alternative and accept the change easily. But, after a presentation on the subject, a renown breeder asked: "why American producers don't use something like that; why they go on selecting for weight at fixed ages, if it is so bad; and why they never considered or discussed something like that? At least, I never heard or read about it". Very, very difficult to answer on the spot. You need to be somewhere between not too evasive and not too offensive. Almost the same question was formulated also by an authority and it disclose an intellectual framework on which only certain regions of the world are allowed to think and produce science and original solutions.

Making the right questions. With an opposite state of mind, another beef breeder, V.J. Potter, back in 1988, after finding himself unable to understand and accept the estimates of genetic trends for his herd for the last 14 years asked: "Are you sure that this mixed model methodology (MMM) is correct?". Even nowadays all over the world no one dares to raise this question, simply because it Henderson's. But Henderson was the first to write pages and chapters and papers of caution on when his methodology would work and when it would brake its assumptions. Outside the mainstream, Fairfull & Muir (1996) boldly lists 13 assumptions and limitations to this theory. Some Hendersonians have defended his theories and procedures more fiercely than Henderson himself. Looks like we have a religious problem here, outside the realm of science and of philosophy.

Problems with people and their technology: the other side of the story. The ready availability of genetic evaluation programs on the hands of some undereducated animal breeders are producing an excess of questionable numbers, summaries, trends and reports. No doubts about the jump made in the quality of the predictors when we went from deviation records to MMM. But there are quite some half-truths being told to the producers about their real capabilities. For example, we can read, in a recent book on Animal Breeding, the following paragraph (amongst a sequence of miracles):

> ***Removes genetic biases.*** *Account is taken of effects such as preferential mating, unequal competition between contemporary groups, prior culling and the genetic differences between age groups resulting from selection itself.*

We should explain to producers that when we separate the best and the worst animals and put them in different contemporary groups (CG) after weaning, something will be lost. EPD's will be on a smaller range than if only one CG was formed. These ranges will also be different if we collect postweaning data on the top (at weaning) 80%, 50% or 25% animals. We shouldn't be afraid to tell them the truth. Producers can deal with compromises; their survival rely on it. Too much is being promised to the producer; he is being indoctrinated that modern, powerful and perfect technology and instruments are at work on his farm.

Almost everybody, up to a certain level, believe that the relationship matrix can solve all selection problems. Quite some people believe that the Individual Animal Model (IAM) produces better or different results from the Reduced AM; others are unable to see the relationships among calves in a sire and dam model. Schaeffer (1993) discusses the conditions for equality of different versions of animal models and Schaeffer (1996) states "*the basic assumption for the various kinds of animal models has been that selection has not taken place*" and continues: "*The animal model, if heritability in the base population is known, accounts for the reduction in genetic variation through the complete additive genetic relationship matrix, but does not account for the bias to β unless Henderson's (1975a) modified MME are used, or unless L'X=0*". Schaeffer shows how the estimates of CG and other β's are used to calculate EPD's of young animals. Even so, quite some people translate 'no problems in estimating variance components' into 'no problems in estimating EPD's'.

Importing technology and its adaptation. Adjusting weaning weight records according to Beef Improvement Federation (BIF) recommendations has been a very helpful first step. A recent study conducted by the Brazilian Association of Zebu Breeders (ABCZ), with close to two million weight records taken repeatedly (every 90 days) on more than 600,000 zebu calves, were used to estimate, after absorbing animal, the effect of age on ADG. ADG is not linear on age within 160 to 250 days (Figure 1). Correction factors for age of calf were generated based on a quadratic spline function with 2 knots. Using ADG to adjust weights leads to severe biases (Figure 2), also on animal EPD's and on their sires EPD's.

Data since 1975 was used and, across years, some 1500 to 3000 calves were born every single day of the year. Very large (more than 20 kg between extremes) Julian date of birth effects

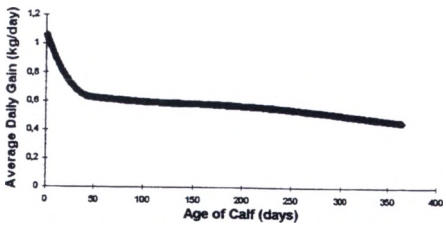

Figure 1. Age of calf effects on pre-weaning Average Daily Gain (ADG) of Zebu calves

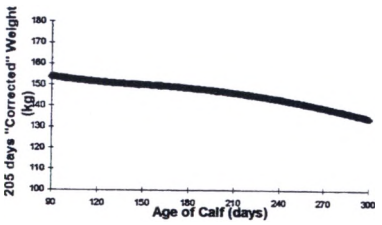

Figure 2. Correcting weaning weights only for the linear effect of age (ADG) produces large biases.

were found and are displayed at Figure 3. For the average region and year, within season correction factors for day of birth were developed, after adjusting a quadratic segmented polynomial regression. In temperate zones these effects may be less pronounced.

The longevity of the zebu cow is an old paradigm. But that is not saying much about production longevity. Figure 4 shows that 12-year cows are at the same level of production as 3-year-old ones and that there is possibly an interaction between the date of birth of dam and that of calf. An interaction between sex of calf and age of dam was found.

These results are in line with BIF recommendations but they also show that there is a lot to be gained from the detailed study of records which may be subjected to different environmental effects. These forces are more complex and powerful in the tropics than in the temperate zones. The results showed that proper correction factors for the important factors on a given system of production should be developed, whenever possible. Unhappily and wrongly, working on correction factors don't carry all that prestige. Quite some changes in production levels can be made if management decisions are taken upon such results. Sometimes we forget that continuously examining and adjusting the operational/environmental model (own correction factors; adequate CG definitions and a realistic **R** -Var(**e**)- matrix) is where we should be focusing our attention if we want to improve our breeding programs.

This example can also illustrate the idea that being a bit cautious and/or conservative before adopting something new and unproved in a given environment should not be labeled as being backward and that it is not always meaning bad management.

Problems of cost, structure and organization. Maybe for the first time in Brazilian history, land purchasing costs are decreasing and land speculation is becoming less important. More producers will need to use technologies which would allow them to remain in operation. Some breeding technologies have potential to be used in large scale if their price is slashed.

Some private producers and large ranch owners can use the excuse of being too big to care to increase productivity in their operations. Revenue per hectare is low but the scale of the operation allows for inefficiencies. Other producers are too small to support a breeding operation and only through cooperation a viable structure can be designed.

There are four different ways that producers are using to organize themselves or to participate in pure- or crossbreeding programs:

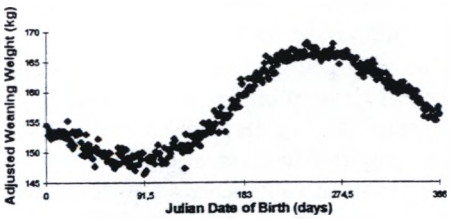

Figure 3. Julian date of birth effects on weaning weights.

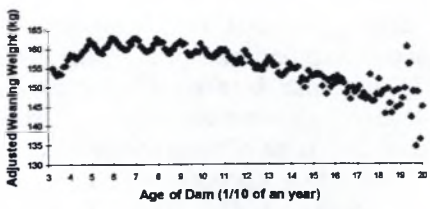

Figure 4. Age of dam effects on weaning weights of zebu calves.

1) The time-proved "Breeders Association", some of them very receptive, modern and flexible.
2) Signing a contract with a breeding company and receiving from them genetic supplies and/or services (like the case of Natura Genética Sul Americana S/A).
3) Running a breeding program (buying genetics, contracting all needed services, promoting and selling) on a co-operative fashion (like the case of Braford EPD Connection).
4) Becoming the franchisee of another one.

PRIVATE OR PUBLIC?

Concepts like "smaller government" and "globalization" are also affecting the way animal breeding is being experienced. Official job places are shrinking in all agencies and there is a pressure from the civilian society to justify every job opening or replacement.

What is research or a public duty and what is plain service? Should a public institution create knowledge or offer new methodologies to improve genetic programs or offer services? Should the university provide to the society what it should be teaching how to do?

What is more effective to tax-payers: to pay directly for the needed services or to fund official institutions which let their personnel offer their services at their own will? We can imagine that we would have a complete mature "animal breeding" sector when services are fully private. When "government" wants to abandon some of its responsibilities and stimulates universities and institutes to look for (themselves) self-sustaining practices this can't be done on a way to prevent the formation of new private groups. But the real and long lasting damage will occur in the opposite direction (where these institutions should be working full-time and full- charged): "trying to solve the scientific problems of tomorrow" (Silva, 1997).

How to solve this social, economical and ethical dilemma? We shouldn't let government run way from its responsibilities; besides restraining development, it will become more costly to the society, after all. We need both public and private sectors strong and working in harmony, each one playing a clear part. To arrive at this point, an open debate should be installed; and we should look for an equilibrium between competition and cooperation.

EVEN SO, THERE ARE SOME ACCOMPLISHMENTS

Strong market forces as regional and international competition, and the competition with other species and with other uses for land are forcing Brazilian beef breeders to change.

Advantages from the competition. In order to survive, the organizations which serve the breeders also need to change in their efficiency, form and modes of operation. Some are adapting very fast, as it is the case of ABCZ, by far the largest in Brazil (more than 4.000 active members and files on some 4 million animals with pedigree records and more than 700.000 animals with performance records). Some recent changes implemented were:
1) Using all repeated weightings from an animal, instead of an interpolation method which used only some of these weightings to arrive at weights adjusted to given ages.
2) Beginning a program to certify (with an official Production Certificate - CP) only 20% of the superior (on a breed base) young animals, after going through the pedigree phase.

3) Allowing the use of multiple sires and the registration of their products without any discrimination, instead of inducing educated guessing due to the inadequacy of those imported rules and by-laws which were fit for the bucolic England of the early 1800.
4) Using traits like D160 and D240, instead of weights adjusted for age to compound the indexes used for the ranking of the animals and certifying them (CP).

There is no single cause for these changes. ABCZ should be chosen as a case study to explain why so much has been achieved in such a short period after a decade preparing for it.

Good directions. During the late 80's, the government offices, working pioneeringly with the private sector, had the understanding to create , regulate and enforce the Production Certificates to accelerate genetic processes and changes. Perhaps, in the near future and with the proper retrospective distance, this instrument will be seen as the most important decision taken and implemented in this century, simply because it forced selection to be applied. Private companies, associations and other entities from the breeders answered to this directive and new market demands. Pedigree records go on being issued to all animals belonging to a given category, while CP's are issued only to those animals which are controlled, connected and superior. Working with EPD's in large populations, only the top 20% males receive CP's.

Animals with CP's, when sold privately or on public auction, receive price recognition. A strong determination and a positive correlation is occurring between EPD's and price. Some groups are selling their genetic products using a function of the EPD's to determine prices and these are, generally, well understood by the market. Agropecuária Jacarézinho Ltda. sold some 2.000 young Nelore bulls during 1996/1997 based on such a rule. Following what is happening everywhere else with the economy, genetic quality of animals being offered are increasing while prices (per EPD's unit) are slightly decreasing. Beef cattle genetics is being very close to be understood as just any other component of the beef production cycle.

Good responses. At the same time and synergetic to this developments, private companies began to produce beef cattle genetics (the surplus going to market) and this fact brought up:
1. Somehow forced the different associations and other entities to rethink their role in the industry and restructure the services being offered.
2. Beef genetics being commercially offered at different points of the country and on significant numbers, with throughout specs (based on EPD's) on reproduction and production traits.
3. Optimization of use of heterotic, complementarity and additive effects on commercial herds with the organization of comprehensive but simple synthetic programs.
4. Some private groups are making investments in applied research, like the effort to produce an Elisa Test for calpastatine activity (aimed to be used massively, on the farms), going on at UFRGS/ UNICAMP and funded by Condomínio Delta G.
5. Putting strong selection forces to operate on sexual precocity in large Nelore herds. Results show that there is no genetic impediment for a Nelore heifer to be mated at 13-15 months and that good pregnancies are achieved. Fine tuning is needed to establish proper supplements-forage management which can produce good biological and economical results for each niche.

The fundamentals. Besides the competitive advantages for the production of beef and synergetic to these, Brazil possesses the following conditions to keep up constant advances in genetics:

1. The size and structure of the production and breeding farms allows the execution of breeding programs based on large populations, working with very strong selection pressures.
2. Even large producers (with more than 10.000 breeding cows controlled) are forming alliances and co-operative work to reassure technical and economical results and to optimize investments in animal breeding.
3. The existence of some very large beef cattle populations, selected for long enough periods for adaptation and production, like the Nelore (some 40 million breeding cows), Angus, Polled Hereford and their synthetics.

CONCLUDING REMARKS

1. If production costs can be used as a measure of overall efficiency, than Brazilian beef cattle industry is worth mentioning; at US $300 per steer (well finished), it shows some competitive edge also to the poultry industry.
2. In a nutshell, the advances in beef cattle breeding arose from the organization and coordination of activities which induced the full utilization of the preconditions, structures and vocations which existed beforehand and the positive interaction amongst the several segments.
3. Why this happened? Breeders saw clear economic and strategic advantages for doing so. Technical and academic personnel had some effectual proposals which proved to be worthy.

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