

CHAPTER 7

CONCLUSIONS

7.1 Temperament : the issues at commencement of these studies

“Temperament” is defined as an animal’s behavioural response to handling by humans. Poor temperament of cattle impacts on profitability of beef enterprises through increases in production costs and decreases in production, resulting from correlations between temperament and production traits (growth, fertility, and possibly carcass and meat quality). It may also affect profitability in tropical areas through correlations between temperament and resistance to environmental stressors such as gastrointestinal helminths, where favourable relationships may reduce costs of environmental manipulation (e.g. costs of chemical treatments to control worms), as well as improving production traits that are affected by environmental stressors.

Animal welfare aspects of handling animals that have a poor temperament also need to be considered, for both economic and social reasons. Currently there are few incentives for beef producers to improve temperament of their cattle solely to improve animal welfare. However animal welfare considerations are becoming increasingly important, particularly amongst consumer groups, and it is essential that producers seriously consider animal welfare aspects in their enterprises. Modification of management practices to reduce stress on farm animals is one way to improve animal welfare. Another option may be to improve the temperament of farm animals to reduce amount of stress experienced during routine handling procedures, if such improvement can be readily achieved without reducing productivity. This may be achieved genetically (e.g., through selection of breeding stock for good temperament) or non-genetically (e.g., by modification of animal behaviour through training programs).

In this study, experiments were established to investigate relationships between temperament and other productive and adaptive traits of beef cattle grazed at pasture in the tropics. In the course of the study, definitive answers to the following questions were sought:

1. What is the best way to measure “temperament” to investigate relationships between the various traits that impact on productivity?
2. Can the methods used to measure temperament be applied in practical breeding programs to improve temperament of beef cattle?
3. Will temperament respond to selection, or is it best improved by non-genetic options such as changes in management practices?
4. Is temperament correlated with other traits in beef cattle such that it impacts on profitability through losses of production?
5. Does temperament have a significant economic value in beef enterprises?
6. If temperament has a significant economic value in beef enterprises, how best can the trait be included in breeding program design?

Answers to these questions, based on experimental results derived from this study, are summarised in the following sections.

7.2 Measurement of temperament

A single measure of temperament may not identify all behaviours that beef producers aim to improve in their cattle. However, it is possible that some tests that identify particular aspects of animal behaviour also have favourable correlations with other behavioural aspects. Tests that measure temperament can be defined in a number of categories, summarised below.

Non-restrained tests: During these tests, the animal being assessed is free to move within a relatively large test area, either in the presence or absence of an observer. Behaviours assessed in these tests include an animal’s fear response to either being handled by an observer or to the presence of an observer and, in some tests, an exploratory or investigative component of behaviour.

Restrained tests: In this category, the animal’s movement is physically restricted during the conduct of the test. Most of these tests use a subjective scoring system to assess the animal’s behaviour in different testing situations, where specific behaviours are scored (e.g. the

amount of movement, vocalisation, elimination, tail swishing, kicking, audible respiration, baulking and attempts to escape.)

Ease of movement tests: These tests measure the time to move animals through a series of yards and races or other facilities such as scales and dips. It is difficult to determine exactly what these measures reflect. Fast times could indicate animals that are docile, and because of their lack of fear, they move rapidly through the test. Alternatively, animals may rush because of a high level of fear of handlers herding them from behind.

Maternal temperament tests: Behaviours that are aimed at protecting newborn animals are likely to increase the survival rate of offspring that are born under extensive conditions, and therefore need to be fostered. However, such behaviours also have potential to increase the costs of beef production, particularly in seedstock enterprises that record calf weight at birth. Maternal temperament tests aim to quantify the protective instincts of the dam to her newborn calf, using a subjective scoring system.

In general, behaviours related to an animal's fear response to man or handling by man are the behaviours that affect ease of handling in beef herds. These behaviours are best identified by tests in the non-restrained category of tests, where the observer plays an active role in the test. Tests where the observer plays a passive role may be less useful in identifying a fear response because of difficulty of distinguishing between the animal's fear response and its investigative behaviour. Temperament tests in the restrained category have the advantage that they are generally inexpensive, quick and easy to implement on-farm, and they identify animals that are difficult to handle when restrained. However, it is not always possible to relate behaviours in a restrained situation to behaviours in a non-restrained situation, because some animals that are difficult to handle in a paddock demonstrate a "freeze" response when restrained. As well, one study herein, concluded that visual flight speed and subjective crush scores were too poorly correlated with an objective measure of temperament to justify their use. Sources of bias in the subjective scores included a) flight speed and crush scores may measure different aspects of animal behaviour, particularly in *Bos indicus* or *Bos indicus* derived animals; b) observer effects on subjective scores; c) bias due to either weight or age, where heavier or older animals were assessed as moving more in the crush test but leaving the

weighing scale more slowly in the visual flight speed test, than lighter or younger animals; and d) lack of sensitivity of the visual flight speed score in intermediate scoring ranges.

It is recommended that beef producers aiming to improve ease of handling in paddocks or yards should use a test that measures the animal's fear response to man or handling by man (i.e. one of the tests in the non-restrained category). As a result of the favourable genetic and phenotypic correlations between tests such as the flight speed score and tests in the restrained situation (e.g. the crush score), improvements in ease of handling in crushes and bails and other situations are likely to occur.

It is also recommended that a standardised scoring system for temperament of beef cattle be identified and adopted by cattle breeders and researchers in both temperate and tropical areas, to facilitate inclusion of temperament as a trait in designed beef breeding programs. In tropical breeds of cattle, the objective flight speed score is the most heritable of the tests used and is recommended as the test of choice for use in breeding programs using *Bos indicus* or *Bos indicus* derived animals.

7.3 Factors affecting temperament of beef cattle

Temperament of beef cattle is affected by a number of factors that may vary depending on the production and marketing system. The main factors are summarised briefly in the following section.

In all studies, age of animal is confounded with effects of previous handling experience. Hence, it is not possible to separate the effects. However, evidence from the literature and from studies reported herein, indicate that temperament scores vary with age, although the magnitude and direction of variation depends on the scoring system used. In general, subjective tests show that older animals react less violently to the presence of an observer than calves and younger animals. Scores derived from objective tests such as flight speed scores show that older animals have faster times than younger animals. This could be interpreted that temperaments become poorer with age. However, this is believed to reflect increasing familiarity of animals to routine procedures and facilities as they age. As animals

recognise the procedures are not threatening, they move through the facilities much more freely than when the procedures were perceived as a threat. Hence their flight speed scores decrease. Only the small minority of animals with very low flight speed scores (poor temperaments) at young ages tend to slow down (flight speed scores increase) as they mature and become experienced with routine procedures.

From literature reports, *Bos indicus* breeds and their crosses are, without exception, more difficult to handle under extensive management conditions than either the Sanga (*Bos taurus* breeds that evolved in Southern Africa) or *Bos taurus* breeds. However, from one experiment in this study, it is possible that Continental *Bos taurus* breeds either have specific, negative combining ability when crossed with Brahmans, or themselves, have temperaments that are no better than those of *Bos indicus* under extensive management conditions.

Results from these experiments and from the literature consistently indicate that short-term intensive training (i.e. use of procedures aimed at improving behaviours through intensive exposure to routine procedures and providing positive animal-handler experiences) has no short- or long-term benefits on temperament of beef cattle. However domestication procedures that accustom animals to stroking, petting and similar handling procedures may be more beneficial, though they may not be practical in large herds, particularly those where animals have little or no contact with humans prior to weaning. It is concluded that temperament of beef cattle is unlikely to be modified significantly by management practices such as intensive short-term training of young animals.

Infestation with gastrointestinal nematodes or treatment to control these parasites also affects temperament scores. Animals that are drenched to control worms have poorer temperament scores than untreated controls. The effect may result from the unpleasant treatment received by drenched animals or from a favourable relationship between resistance to worms and temperament in untreated animals. Appropriately designed experiments are needed to determine the relative effects on temperament of treatment to control worms and worm resistance in untreated animals.

7.4 Temperament as a selection criterion for improving productive and adaptive traits of beef cattle

Estimates of heritability of temperament are generally moderate to high, even though great differences exist between the various temperament tests, scoring systems, species of livestock, previous experience of experimental animals and experimental settings. Even a single flight speed score is moderately heritable, but use of the average of two or three flight speed scores substantially increases heritability. Direct responses to a single generation of divergent selection for a single flight speed score demonstrated that selection for flight speed is effective in modifying flight speed scores of progeny.

Results from these studies indicate the best option for beef producers aiming to improve temperament is through selection of breeding stock for improved temperament, using one of the non-restrained temperament tests as a selection criterion.

7.5 Economic importance of temperament to beef production in the tropics

In these studies, relationships between temperament and most productive and adaptive traits measured under extensive management systems were close to zero, indicating the traits were largely independent. Hence, under extensive management systems, the economic value of temperament mainly reflects increased production costs and possibly losses in production through decreases in meat quality, although the latter effect remains to be unequivocally demonstrated. Under intensive management systems, the economic value of temperament reflects increased production costs, as well as losses of production through reduced growth rates, conception rates in artificial insemination programs and possibly increased carcass bruising and poor meat quality.

7.6 Inclusion of temperament as a trait in beef breeding objectives

Ideally, beef producers aiming to improve temperament should include the trait in a formalised breeding objective or seedstock purchase objective. However, some difficulties

currently exist with inclusion of temperament as a trait in beef breeding objectives, as discussed below.

In conventional selection indices, most objective traits are based on increases in profitability resulting from increases in production. Hence, relative economic values are calculated as the change in profit associated with a change of one unit in that trait, assuming the values for all other traits are held constant. However, use of this method to quantify variation in traits such as temperament tends to be arbitrary. As well, these methods do not account for the value of improving temperament to reduce labour and other production costs or to improve animal welfare, as these considerations are independent of improvements in productive traits. A conventional selection index approach to include temperament as a trait in beef breeding objectives is also difficult because knowledge of relationships between temperament and production traits are not known for most cattle breeds, or, where correlations have been estimated, they are not consistent across intensive and extensive production systems.

In addition, there are problems with the temperament scoring systems currently being used in beef herds. The majority of these scores are subjective and non-linear, and the differences in temperament between the scores on each of the scales are not necessarily equal. Even where objective assessments of temperament have been used, it is difficult to equate the different measurements of temperament in order to interpret the reported relationships between temperament and production traits. Use of a standardised scoring system for temperament in beef cattle would assist inclusion of temperament in formalised breeding objectives.

One way to include temperament in formal beef breeding objectives may be to use a desired gains approach. This allows inclusion in the selection index of traits that are economically important, but for which it is difficult to derive economic weights. To use the desired gains approach, relative changes in all traits under selection are prespecified. Hence relative economic weights are not required in the derivation of the desired gains index.

However before temperament can reliably be included in formal beef breeding objectives, a standardised scoring system for temperament of beef cattle needs to be identified and adopted. Also, the nature and magnitude of relationships between temperament (based on a

standardised scoring system) and other productive and adaptive traits must be better quantified in order to predict the likely consequences for herd profitability and productivity of changes in temperament through traditional selection procedures.

7.7 New research areas

The studies reported herein provided answers to the questions originally asked of them. However, they also identified new areas of research that are beyond the scope of this thesis. These are listed below, in no particular order of importance, in the hope that other researchers will strive to find answers for some of these new questions.

- ◆ The nature and magnitude of relationships between temperament and feed efficiency, both in the feedlot and at pasture, and between temperament and carcass and meat quality attributes, must be quantified to optimise breeding program design for breeders of beef cattle in both temperate and tropical areas.
- ◆ To date, very little work has been done on temperament of *Bos taurus* breeds, largely because temperament is perceived as less of a problem in these breeds. However, studies published in North America indicate significant relationships exist between temperament and performance of British breeds of cattle finished in feedlots. As well, results from an experiment reported herein, indicate that Continental breeds may have temperament scores that are, at best, no worse than temperament scores of purebred *Bos indicus* cattle. In temperate areas, even pasture-based beef enterprises are likely to be managed more intensively than beef enterprises in tropical areas. Results from these studies show that effects of temperament are more pronounced under intensive, rather than extensive, management systems. Hence, further studies are required on relationships between temperament and productive traits in *Bos taurus* breeds of cattle reared in temperate environments, to determine the economic value of temperament in those cattle, and better design breeding programs for those areas.
- ◆ Methods of measuring temperament in *Bos taurus* breeds require further investigation. Subjective measures of temperament, scored when animals are restrained, are poor indicators of “trouble-maker” *Bos indicus* and *Bos indicus* derived animals, because of the tendency of some of these animals to demonstrate a “freeze” response when restrained.

Similar studies are required in *Bos taurus* animals to determine most appropriate methods of measuring temperament in those cattle.

- ◆ Before temperament can reliably be included in formal beef breeding objectives, a standardised scoring system for temperament of beef cattle needs to be identified and adopted. Ideally, this standardised scoring system should apply to both temperate and tropical breeds of cattle, to ensure portability and ease of interpretation of results.
- ◆ To date, there are no published studies that have examined effects of crossbreeding on measures of temperament. Estimates of effects of heterosis on temperament scores are needed to determine whether temperament can be improved through crossbreeding.
- ◆ Maternal behaviour (as opposed to maternal effects that impact primarily through milk production, and that were investigated herein) may have important effects on behaviours and performance of offspring. However further studies are required to quantify the effects.
- ◆ Estimates of heritability of dominance scores (as measures of temperament) and maternal temperament score are moderate to high, but are based on single studies with small numbers of animals. Further studies are required to determine the value of selecting animals to change these traits.
- ◆ Although changes in temperament scores resulting from increases in inbreeding reported herein were small, they were favourable, indicating more highly inbred animals were more docile. If this result is confirmed by further studies, it contradicts meat tenderness results from this study, that indicate meat from inbred animals is likely to be tougher. In general, more docile animals, that do not suffer preslaughter stress, have more tender meat than their less docile contemporaries. At higher levels of inbreeding, temperament scores may reflect generally depressed activity due to other factors such as levels of immune competence, and these may be independent of effects on meat tenderness. Further studies are required to separate the effects.
- ◆ Results from studies of inbreeding and crossbreeding indicate the amount of inbreeding depression and heterosis for most economically important traits may vary with environment. However, these effects need to be better quantified before the significance and magnitude of such interactions can be accurately assessed, and adjustments made to breeding program design to accommodate the interactions.
- ◆ Traits such as temperament and worm resistance change over time, due to increased experience and acquisition of resistance to worms respectively. In those instances,

methods of analysis may need to change to improve predictions of breeding values for these traits. Hence, analyses that utilise relationships between measures recorded at different times (covariance functions or random regression models) may be more appropriate for these traits. Similarly, alternative models for female fertility traits may yield higher heritabilities and better definition of relationships with other traits than the models used herein.

- ◆ It is possible that relationships between worm resistance and growth in this study reflect compensatory growth as animals acquire resistance to worms. The nature of this relationship requires further investigation, possibly through use of alternative methods of analysis, such as use of covariance functions that consider relationships between worm counts over time.
- ◆ Further studies are needed to identify indicator traits in young growing animals that are reliable predictors of pregnancy rate and calving outcome in mature cows.
- ◆ The physiological basis for changes in marbling due to selection for low EBV for rectal temperature needs to be defined, as this may lead to a very simple method of improving marbling, which is a difficult-to-measure trait with a very high economic value.