WHERE TO FROM BRAHMANS IN THE NORTHERN AUSTRALIAN HERD? MAINTAINING THE ECONOMIC BENEFIT OF EARLIER INFUSIONS OF *Bos indicus*

H.M. Burrow[1], G.R. Griffith[2], S.A. Barwick[3] and W.E. Holmes[4]
Cooperative Research Centre for Cattle and Beef Quality
[1]CSIRO Livestock Industries, Box 5545, Rockhampton Mail Centre, Qld 4702
[2]NSW Agriculture, Beef Industry Centre, University of New England, Armidale, NSW 2351
[3]Animal Genetics and Breeding Unit, University of New England, Armidale, NSW 2351
[4]Queensland Department of Primary Industries, P.O. Box 1085, Qld 4810

SUMMARY
Economic values derived from a terminal crossbreeding system based on Brahman cows and a tropically adapted composite herd targeted to meet specifications of the grass-finished Japanese market were compared to a straightbred Brahman herd. The model represented a typical individual central Queensland integrated breeding/finishing enterprise or a northern Australian vertically integrated enterprise with separate breeding and finishing properties. Due mainly to a reduced age of turnoff of Crossbred and Composite sale animals and an improved weaning rate in the Composite herd, Crossbred and Composite herds returned a gross margin of $7 and $24 per Adult Equivalent (AE) respectively above that of the Brahman herd. The benefits of changing 25% of the existing 85% of Brahmans in the northern Australian herd to either Crossbreds or Composites over a 10-year period were also examined, using either no premium or a 5c per kg premium for carcass quality in Crossbred and Composite sale animals. With no premium, annual benefits were $16m and $61m for Crossbreds and Composites in 2013. The cumulative Present Value (PV) of this shift over the 10-year period was $88m and $342m respectively, discounted at 7%. When a 5c per kg premium for carcass quality was included, differences in annual benefits rose to $30m and $75m and cumulative PVs to $168m and $421m for Crossbreds and Composites respectively.
Keywords: beef cattle, *Bos indicus*, economic benefit, crossbreeding, tropically adapted composite

INTRODUCTION
A recent study (Farquharson *et al*., 2003) conservatively estimated the cumulative PV of increasing the proportion of *Bos indicus* genes in the northern Australian herd from 5% in 1970 to 85% in the 1990s to be $8.1 billion. The value was estimated in terms of improved profit from replacing British breed cows with *Bos indicus* cows and reflects the superior adaptation of *Bos indicus* to the harsh production environments in northern Australia. It does not include cost savings achieved by reduction of treatments for parasites and supplements to ensure survival of British breeds. It is likely the returns from infusion of *Bos indicus* into the northern herd are now slowing as herd composition stabilises on high *Bos indicus* content breed types. Sustained returns on investment in genetics in northern Australia in the future are more likely to accrue from use of crossbreeding or development of tropically adapted composites designed to improve product quantity and quality relative to the Brahman, without compromising adaptation to the environmental stressors. This paper models the economic benefits at herd and northern Australian industry level from changing from a high *Bos indicus* herd finished at pasture for the Japanese

[3] AGBU is a joint venture of NSW Agriculture and the University of New England

steer market to either a terminal crossbred or a 3-breed-type tropically adapted composite herd finished to the same grass-fed market as the Brahman herd.

MATERIALS AND METHODS

A beef production system based on a 1,000 AE herd generating 320 kg carcasses targeted for the Japanese grass-fed market was simulated using the Breedcow and Dynama software package (Holmes, 2002) to represent the dominant production/marketing system in northern Australia. The simulation compared 3 breeding systems:

1. A straight-bred Brahman herd (Brahman), representing the current dominant breeding system throughout most of northern Australia;
2. A terminal crossbreeding system (Crossbred), where a proportion of Brahman dams was joined to Brahman sires to produce heifer replacements but the majority of the breeding herd was joined to British breed bulls to produce terminal crossbred progeny that were all slaughtered;
3. A 3-breed tropically adapted composite (Composite) comprising an admixture of approximately equal breed types (not breeds) including *Bos indicus* (e.g. Brahman, Boran), tropically adapted *Bos taurus* (e.g. Afrikaner, Tuli, Belmont Red, Bonsmara, Senepol) and other *Bos taurus* (British breeds). Such a composite is now being generated by some of the major pastoral companies in northern Australia to optimise heterosis, productivity and resistance to environmental stressors with the ease of management of a straightbreeding herd.

Differences in animal performance for each of the breeding systems were used as input into simulations of representative grass-fed Brahman, Crossbred and Composite herds calibrated for a typical central Queensland integrated breeding/finishing enterprise or a vertically integrated enterprise where calves are bred in harsher climates (e.g. Barkly Tablelands, NW Queensland) and sale animals are finished at pasture in more benign areas (e.g. central or southern Queensland). Conservative performance values for growth and fertility traits were based on previously published comparisons from Belmont Research Station and industry herds in central and northern Queensland. The only differences in performance between the simulated herds related to weaning percentage (Composites were assumed to have a 17% higher weaning rate than Brahmans based on reports in the literature of differences of 21-25%; see for example Frisch, 1993; Mackinnon *et al.*, 1989) and in growth rate (Crossbreds and Composites were turned off at 320 kg carcass weights at 36 months of age, 6 months earlier than Brahmans at comparable weights; see for example Prayaga, 2003; Frisch, 1997, 1993). Allowance was made for additional feed consumption of the heavier Crossbred and Composite cows when calculating AE.

In all herds it was assumed that heifers and bulls were initially joined at 2 years, at a rate of 4 bulls per 100 cows. Bulls were purchased each year at the same price of $2,000 for all systems and were replaced after 4 joinings. Calves were weaned at 6 months of age. Final joining of cows occurred at 8 years to calve at about 9 years in Brahman and Composite herds but was increased to 11 years in the Crossbred herd, to accommodate breeding of Brahman replacement heifers. Other assumptions relating to culling and disposal policies for cows, annual mortality rates and prices were the same for all herds. Premiums for improved carcass quality that would favour Crossbreds and Composites were not included in the base model, even though clear evidence for such premiums exists (Newman *et al.*, 1999a,b).

To examine potential benefits from changing the predominantly Brahman herd to a Crossbred or

Composite herd at the level of the northern beef industry, 2 scenarios were modelled. In the first, it was assumed 25% of the existing 85% of Brahman cattle in northern Australia became Crossbreds by 2013. Differences in gross margins derived from the base simulation were applied to cattle numbers in northern Australia (ABARE data) and adjusted to an AE basis using the ratios for the simulated Brahman herd. An essentially linear curve tracing the increase in Crossbred proportion from 0 to 25% was applied over the 10-year period to 2013. In the second scenario, it was assumed that 25% of the existing Brahman cattle became Composites by 2013 and the same procedures were followed. In both scenarios, a comparison was also made using either no price premium or a conservative 5c per kg premium for improved carcass quality in Crossbred and Composite sale progeny.

RESULTS

The effect of changing from Brahmans to Crossbreds or Composites over a 10-year period on herd structure and gross margin of an individual 1,000 AE herd is shown in Table 1. In this base analysis, Crossbreds returned an average gross margin of $7 per AE above that of the Brahmans, whilst the Composites returned a gross margin of $17 per AE above that of the Crossbreds.

Table 1. Herd structure and income from simulated straightbred Brahman, terminal crossbred and tropically adapted composite herds producing grass-finished Japanese market steers

	Straightbred	Terminal Crossbred		Straightbred
Annual herd values	Brahman	Brahman	Crossbred	Composite
Individual herd level				
Adult Equivalents	1000	425	575	1000
Total cattle	1082	438	670	1107
Cows and heifers sold	118	57	63	132
Steers and bullocks sold	131	61	73	144
Gross margin for herd	$170,000	$ 72,000	$104,000	$194,000
Gross margin per Adult Equivalent	$170	$170	$181 (+6.5%)	$194 (+14.1%)
Northern beef industry level				
Annual industry benefit[a] (no premium)	-	-	$ 16 m	$ 61 m
Present Value[b] (no premium)	-	-	$ 88 m	$342 m
Annual industry benefit[a] (with premium)	-	-	$ 30 m	$ 75 m
Present Value[b] (with premium)	-	-	$168 m	$421 m

[a] in year 10, of 25% Brahman herds changing to terminal crossbreds or tropically adapted composites
[b] of 25% Brahman herds changing to terminal crossbreds or composites over a 10-year period

Improved profits from replacing 25% of Brahmans with Crossbreds or Composites over a 10-year period are also shown in Table 1. Annual industry benefits from a change from Brahmans to Crossbreds were $16m. The cumulative PV of this shift over the full 10-year period was $88m when discounted at 7%. Annual benefits from a change from Brahmans to Composites were $61m in 2013 and the cumulative PV was $342m over the 10-year period. The benefits for a change to Composites are much larger than for a change to Crossbreds because the breeding herds are more than twice as profitable due to the significantly increased weaning rates and this difference is magnified over time. The base model does not include price premiums. If a price premium of just 5c per kg is assumed for Crossbred and Composite slaughter cattle, the benefits of change increased further. Differences in annual benefits rose to $30m and $75m and cumulative PVs to $168m and $421m for Crossbreds and Composites respectively, providing clear evidence that it pays to develop markets that reward quality.

COMMERCIAL IMPLICATIONS

These results clearly demonstrate significant economic benefits will accrue by changing the composition of a proportion of the northern herd from Brahmans to Crossbreds or Composites. It is possible that further changes to the breeding system (e.g. use of rotational crossbreeding or different composites, combined with selection of breeding animals for economically important traits) or the production / marketing system (e.g. grain-finishing to capture beef quality differences) will yield even greater economic benefits. To date, northern beef producers have been reluctant to change from Brahmans, primarily due to a perceived need for increased management inputs to control environmental stressors in Crossbred and Composite herds. However, the changes modelled herein can be readily achieved without compromising adaptation to environmental stressors and without the need for sophisticated genetic tools such as multi-breed EBVs, providing appropriately designed breeding programs are implemented. There are for example, many difficulties in implementing the terminal crossbreeding system simulated here, because British and Continental breed bulls are unable to survive in many northern environments without significant additional care due to their lack of adaptation to environmental stressors. This highlights the need for, and importance of, the tropically adapted *Bos taurus* breeds in structured crossbreeding or composite development programs targeting the tropics and sub-tropics. Use of these breeds allows producers to manipulate heterosis between breed types and levels of adaptation to environmental stressors (up to 100% of “adapted genes” if required) without incurring significant reductions in production that may occur from inappropriate use of British or Continental breeds in these environments.

While these annual and cumulative benefits accrue initially to cattle producers, eventually they are distributed throughout the beef marketing chain, thereby benefiting all sectors of the beef industry (producers, feedlots, processors, marketers and consumers) from these potential genetic improvements implemented at the individual farm level. Previous analyses (Zhao *et al*., 2001) show that producers receive one third of the total benefits from RD&E in the Australian beef industry and domestic consumers receive about half, due to their access to greater quantities of beef at lower prices.

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