Proc. Assoc. Advmt. Anim. Breed. Genet. 20:45-48

A VERY SIMPLE MODEL FOR EXAMINING POTENTIAL IMPACTS OF VALUE CHAIN PARAMETERS ON DIRECTION OF SELECTION AND GENETIC CHANGE

R. G. Banks[1], P. R. Amer[2], and J.H.J. van der Werf[3]

[1]Animal Genetics and Breeding Unit, UNE, Armidale, NSW, 2351
[2]AbacusBio, Dunedin, New Zealand
[3] Animal Science, UNE, Armidale, NSW 2351

SUMMARY

The Australian beef (and meat sheep) industries face a significant strategic challenge around optimizing the joint improvement of qualities demanded by the consumer and production attributes affecting on- and off-farm enterprise profitability. A very simple example based on beef cattle value chains is used to show that this joint optimization may not be trivial. Possible responses to this challenge are discussed, with an emphasis on the need for coordination across the sectors involve in the value chain.

BACKGROUND

Beef (and to a lesser extent meat sheep) breeding and production in Australia is characterized by:

- diversity of production environments
- diversity of market demands, especially in relation to “quality” traits
- typically 5 links in the value chain from breeder to consumer (breeder, producer, feedlotter, processor, retailer, consumer)
- very low levels of vertical integration through ownership
- limited and/or diverse flow of price signals across the links in the chain

These circumstances generate significant challenges for development and implementation of breeding objectives and corresponding selection indexes. Given these characteristics the question is apparent should whole of chain approaches be used, and if so, how will they be accepted by breeders, and how will the breeding sector respond in terms of investment in the recording necessary to underpin selection (including genomic selection)?

To the extent that these issues are forms of market failure, they have contributed to the establishment of collective levies for a range of industry investments, including R&D. There is potential for such funds to assist with funding the recording of Hard-to-Measure traits in reference populations, but no systematic model has been developed as yet for sourcing or allocating funds for this purpose.

This paper outlines how selection index methods coupled with very simple economic models, could contribute to the development of such systematic models.

A SUPPLY CHAIN MODEL WITH A VERY SIMPLE BREEDING OBJECTIVE

A beef value chain with 5 sectors is modelled (breeder, producer, feedlotter, processor, retailer and consumer), with a breeding objective that includes 4 traits (reproduction rate, sale weight, carcase yield and eating quality). The objective is very loosely based on those developed for Angus cattle in Australia, but very much simplified here.

The economic modelling consists of 2 steps:

- estimate the expression of genetic change in each of the 4 traits in each of the 5 non-breeder sectors,
- estimate the extent to which a price signal is passed for each trait, from each sector to the one above it

Together these steps allow both the total value of genetic change in the 4 traits across the chain, and how much of that total value is passed back to the breeder to be modelled. The basic data and results are outlined in Table 1.

Table 1: Basic parameters of the economic and selection index model

		Repro'n Rate %	**Sale Weight kg**	**Carcase Yield %**	**Eating Quality Marble Score**
Whole Chain Objective Index economic weights ($)		$7.50	$1.75	$10.50	$300.00
Predicted genetic gain using Whole Chain index (trait units)		0.31	3.13	-0.13	0.36
Predicted genetic gain using Whole Chain index ($)		$2.30	$5.49	-$1.36	$106.89
Sector	**Parameter**				
Breeder	total benefit received	$0.23	$0.50	$0.00	$0.00
Producer	predicted expression of genetic gain	$2.30	$5.02	$0.00	$0.00
	% transmission to next sector up	10%	10%	1%	10%
	total benefit received	$2.30	$5.02	-$0.06	$0.03
Feedlot	predicted expression of genetic gain		$0.16	-$0.26	
	% transmission to next sector up	0%	0%	15%	10%
	total benefit received	$0.00	$0.16	-$0.39	$0.32
Processor	predicted expression of genetic gain		$0.31	-$0.91	
	% transmission to next sector up	0%	0%	15%	10%
	total benefit received	$0.00	$0.31	-$0.91	$3.21
Retailer	predicted expression of genetic gain				$10.69
	% transmission to next sector up	0%	0%	0%	10%
	total benefit received	$0.00	$0.00	$0.00	$32.07
Consumer	predicted expression of genetic gain				$71.26
	% transmission to next sector up	0%	0%	0%	30%
	total benefit received	$0.00	$0.00	$0.00	$71.26

The transmission rates used here are estimates based on observation of industry.

The 2nd row of the table shows the economic values for the whole chain. The row labeled "Breeder – total benefit received", shows the economic values that the breeding sector would apply based on price signals passed back to that sector. If these economic values are applied to index calculations using the same genetic parameters, the trait and $ value outcomes are as shown in Table 2 (over page).

Table 2: Key results – economic values, trait and $ responses.

Trait	Whole Chain			Breeder		
	Economic Value	Trait Response	$ Response	Economic Value	Trait Response	$ Response using Chain EVs
Repro'n Rate	$7.50	0.31	$2.30	$0.23	0.15	$1.14
Sale Wt	$1.75	3.13	$5.49	$0.50	13.97	$24.45
Yield	$10.50	-0.13	-$1.36	$0.00	0.08	$0.86
EQ	$300.00	0.36	$106.89	$0.00	0.00	$0.00
Total			$113.32			$26.44

Examination of Tables 1 and 2 shows very clearly that:

- on a whole chain basis, eating quality is a very important trait, contributing 94% of the total value of genetic change
- selection on the basis of price signals received by the breeding sector generates genetic change that is radically different in both direction and value from that based on whole chain value. In this case, almost all genetic change is in sale weight, there is little or no change in yield or eating quality, the value of genetic change for the whole chain is less than one quarter of that in the whole chain case, and no benefit is delivered to the consumer sector. However, benefits to the breeding and production sectors, through improved reproduction rate and sale weight, and the returns from them passed back to breeders from producers are very much greater than in the whole chain case.
- The differences in economic outcomes are substantial; $26.44 per cow joined per generation (approximately $5 per cow joined per year) compared with $113 (approximately $21 per cow joined per year). On a whole of industry basis, this difference would total $80m pa.

This very simple model case, using price signal parameters drawn from observation of industry, suggests a clear conflict of interests between the on- and off-farm sectors. How might industry respond to this situation?

POTENTIAL RESPONSES

The first response examined is developing and implementing selection indexes. To date in the Australian beef industry, the whole of chain approach has been adopted (Barwick, pers. comm.) If the genetic and price parameters modelled here are broadly relevant to the beef industry, then this approach has been good for the whole chain, at least to the extent that selection has been guided by the "whole of chain" indexes. However, the breeding and production sectors may have experienced lower direct benefits than had indexes based on on-farm returns been applied.

For this approach to be sustained for the long-term, breeders must either be altruistic, or estimate the opportunity cost to the industry, and hence to them, of ignoring improvement in quality traits. Depending on the elasticity of demand for meat of different quality, that opportunity cost would ultimately be in declining real price for meat.

This raises the question of whose interests should breeders, or industry as a whole, seek to maximize when investing in genetic improvement. The observation that a considerable portion of benefits from genetic improvement accrues to consumers is often interpreted as justifying government support for industry, usually through funding for R&D. However, it can be argued that it is the responsibility, or at least sensible aim, of an industry to maximize consumer benefits in its own interest. Under this view, breeders should aim to select to maximize benefits for each of their value chain partners. Resolving, or at least balancing these two perspectives, is an important strategic question for industry consideration.

An important aspect of this industry perspective is the importance of obtaining reliable estimates of consumers' preferences for quality levels, and of the transmission parameters between sectors. At present, the core research for estimating these is done by a very small number of individuals in the breeding sector or working with it, with very limited access to industry data. A whole of industry contribution to obtaining and sharing this data would seem sensible.

A second area of response available to industry lies in taking steps to improve the flow of price signals. The Australian beef industry through Meat and Livestock Australia is investing in infrastructure which could assist (Meat Standards Australia, National Livestock Identification Scheme, Livestock DataLink), but integration across value chains is largely an opportunity for individual chains, rather than a whole of industry imperative.

A third area of potential response lies in co-investment in reference population data. The beef and sheep industries have started down this path via the Beef and Sheep Information Nucleus programs, currently with different funding models but both drawing substantially on Commonwealth funds. The example outlined here suggests a mechanism whereby the co-investment could be balanced with interests:

- traits and trait economic values determined for a breed-production system-market combination
- sectoral expression of genetic change in each trait calculated using index methods
- transmission parameters for each trait x sector estimated
- recording costs for each trait for an appropriate reference population estimated
- sectoral contributions to those costs on a trait basis calculated according to the relative benefits captured by each sector. The actual contributions could well be adjusted according to realized genetic change in each trait, thus increasing the incentive not just for recording but for genetic improvement as well.

This draft approach would require coordinated examination of the potential for change involving all sectors, coupled with the application of selection index calculations. The latter is straightforward; the former is challenging, but failure to resolve this challenge guarantees massive opportunity costs.

It is reasonable to ask whether the problems highlighted here would disappear in the event of industry re-structuring, in broad terms involving some form of vertical integration. Were this is improve the clarity and flow of price signals, then the problems would surely be reduced, at least for those value chains so re-structured. This raises the question of whether and how widespread such restructuring might be: to date, despite some obvious economic attractions, vertical integration remains very limited in both industries.

CONCLUSIONS

In a diverse, heterogeneous and multi-sectoral industry such as the Australian beef industry, optimizing genetic improvement is a complex case of the coordination problem. Technically, the issues and how to solve the relevant calculations are straightforward, but implementation requires inputs and actions from a range of interest groups.

Currently, the approach to solving this coordination problem is a mixture of "leaving it to the market" coupled with dependence on a combination of foresight and altruism on the part of the breeding sector. The example used here, while very simple, shows that the costs of this strategy can be both significant and unevenly distributed amongst sectors. For sustained viability of the industry, a better approach to balancing the interests of sectors needs to be developed and applied.