Adoption

OVERCOMING BARRIERS TO ADOPTION OF GENETIC TECHNOLOGIES IN THE BEEF INDUSTRY

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SUMMARY
The Australian beef industry has used genetic technologies extensively for many years and economic analyses have suggested very positive economic benefits have accrued. However with the rapid expansion of tools available to the Australian beef breeder, new extension and technology transfer initiatives are necessary if maximum industry benefit is to be realized.

Meat and Livestock Australia commissioned a working group entitled the National Beef Genetics Extension Team to report on barriers to adoption of genetic technologies in the beef industry and methods for overcoming these barriers. Four major barriers were identified;

- Lack of 'PROOF of PROFIT'
- Lack of FOLLOW UP (assistance with adoption) after initial exposure to awareness programs
- Extension in a diverse and fragmented industry
- Decline of traditional extension resources

Profit is the most compelling of reasons for producers to adopt a new technology hence relevant demonstrations that profitability will be improved are essential. Due to the complex nature of the technologies available, most producers need support after the awareness phase. The fragmented structure of the beef industry is such that extension will only be effective if all sectors that influence the uptake of technologies are included in a coordinated extension effort. Political and economic pressures have resulted in changes to traditional extension resources requiring a restructuring of extension programs.

The proposed extension model for genetics in the beef industry involves identification of influencers in all important sectors of the beef industry and a coordinated continuing education program to support these influencers.

INTRODUCTION
The Australian beef industry has an impressive history of using genetic technologies from the application of contemporary comparison in the late 1960's to the introduction of the first Best Linear Unbiased Prediction (BLUP) in the form of BREEDPLAN in the mid 1980's, and with significant improvements by the inclusion of new traits through the 1990's. In the last seven years we have seen commercial DNA marker tests available for some production traits.

Evaluation of historical investment in beef cattle genetics research and development in Australia showed that investment in genetic selection and crossbreeding realised a net present value (NPV) of $861 million, a benefit cost ration of 3.6 and an internal rate of return (IRR) of 19% (Farquharson *et. al*., 2002). These results demonstrate that genetics has played an important part in the profitability of

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the beef industry but the value shown was primarily from improved growth rates with EBVs available since 1985. Subsequently evaluation techniques have become available for other economically important traits such as carcase and fertility now being supplemented by DNA tests for marbling, tenderness and feed efficiency. Whole chain selection indexes combining all EBVs into single EBV ($EBVs) describing genetic potential for profit have been introduced and are the basis for measuring genetic improvement for industry profit (Farquharson *et. al.*2002).

If the beef industry is to capitalise on these new technologies and the expanded range of traits being evaluated, new extension and technology transfer programs will be necessary. In recognising this, Meat and Livestock Australia (MLA) convened a National Beef Genetics Extension Team (NBGET) to review the extension of genetics in the beef industry.

Banks (2005) put forward the view that in recent years the rates of genetic progress in Australia's extensive livestock industries are lower than is possible and there are challenges to improve this situation in part due to a lack of coordination in the diverse interests of the industries. The NBGET was aware of similar information when it decided that a positive approach to extension of genetic technologies was warranted.

This paper reports on the barriers to adoption of genetic technologies and makes some suggestions for overcoming these barriers. The outcomes from the NBGET report are discussed in context with other published reports on agricultural extension and adoption by farmers. Some of the discussion is based on events since the NBGET report was released.

THE NATIONAL BEEF GENETICS EXTENSION TEAM

The main task of the NBGET was to ascertain from the beef industry how the use of genetic technologies could be increased. The method was to select a team of key people who represented a wide spectrum of the important sectors of the industry and its service providers. Criteria for appointment to the team was representation of an important sector in the beef supply chain or industry service sector and/or a high level of knowledge of genetic improvement technologies in the beef industry.

The team operated as a facilitated focus group for beef industry. As described by the Harvard Family Research Project (2004), focus groups are conducted with 'targeted samples of stakeholders' and one of the advantages is that the group 'may highlight issues not previously considered' with other data collection techniques. The group was directed to use previous reports of preferred extension techniques such as 'Technology Transfer in the Seedstock Sector' (ABT 1991)

Each member of the team was asked to use their network of contacts to canvass ideas and discussion for this task. Priorities and major barriers were developed from group discussion, reporting back and applying rankings. The NBGET was operational for twelve months and included two meetings that included all team members as well as numerous email discussions and small working party meetings.

Individuals were allocated to specific working parties to focus their attention on aspects in which they had specific expertise. For example there was a working party that focused on the needs of commercial breeders and one that addressed the issues and requirements of the service sector. The working parties then reported to the whole extension team at the final team meeting.

With their broad experience within the industry, the team was very competent to review and plan extension activities. In planning for future activities, the team also reviewed relevant survey reports e.g. Animal Breeding Technology (1991).

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Terms of Reference for the NBGET were negotiated with MLA and are summarised as follows:

1. Define the constraints to adoption of beef breeding technology
2. Develop an extension strategy to achieve MLA Genetic Business Plan goals, namely to double the rate of genetic gain and profitability of Australian beef herds. This strategy is to address the key messages involved and the most effective methods of delivery.

In response to these objectives the team adopted the following strategies:

1. To review beef genetics extension and communication activities in terms of key messages,
2. To recommend most effective communication methods for new and existing MLA beef genetics products and services.

The diffusion model (Rogers 1983) was the base model, suggested by the NBGET for extension of genetic technologies due to the complex scientific nature of the developments and the need to make producers aware of the potential benefits. However, the underlying assumption that knowledge will diffuse through the system after the progressive farmers have adopted is justifiably questioned (Black 2000) because of the fragmented nature of the industry.

Two modifications to the conventional model of diffusion were suggested to handle the complex nature of extension in the beef industry. Firstly, education activities must target influencers in all important sectors of the beef supply chain such that the benefits of genetic improvement (eg. $EBVs for different market/production systems) are recognized by all sectors and some reward for the superior genetics may flow. This modification does not rely only on diffusion via farmer to farmer. Secondly, follow-up and on-going support must be available to all sectors to assist adoption.

A market-segmentation analysis identified more than 20 groups or networks (sectors) that can positively influence the uptake, utilisation and increase in genetic improvement in the beef industry. Ensuring that each segment recognizes the potential of genetic improvement is essential to ensuring that the full potential of genetic improvement within the industry is achieved.

Outcomes and deliberations of the NBGET were reported to MLA (Freer *et. al*. 2003).

DISCUSSION

The Genetics Message The genetics message for the beef industry has some unique features that deserve consideration when designing an extension program. The simple message is that genetics can make permanent, cumulative and low cost improvements to production but improvement in any generation or year will tend to be small by comparison to changes to management or treatments e.g. the application of fertiliser.

But the reality is that this simple message must then be complicated by a more complex message of how to use genetic information and genetic tools to manipulate the required phenotypic outcome. The general lack of understanding within the industry of the difference between genetic merit as distinct from phenotypic merit is a major constraint to adoption. That lack of understanding combined with what must appear as a never-ending delivery of new, refined and enhanced genetic tools, quite often for new traits and recently magnified by the commercialisation of gene marker technologies is going to be confusing for many people in the beef supply chain (Nicol & Upton. 2007). Rapid change in any technology will force the extension model to adopt elements of the linear 'top-down' model as described by Black (2000) or 'science push' as described by Marsh and Pannell (2000), which involves seeding of information from science. However since farmers prefer non-organised, non-institutional learning such as one-on-one consultation with experts or peers and observation (Fulton *et al.*2003), the top down approach is not conducive to farmer learning and

adoption. A compromise is obviously required and the NBGET modified diffusion model is one proposal worthy of consideration.

A 'management change before genetics' attitude resulting from perceived limits of environmental constraints on herd genetic improvement further complicates the genetic message. It was of concern to the NBGET that a leading beef consultancy group, Resource Consulting Services P/L, who deliver the highly successful "Grazing for Profit" schools, give little support to the importance of genetics in farm business profitability. The 125-page workbook used at the Grazing for Profit™ schools (Parsons 1993) does not mention genetics, and this in a paradigm that purports to be holistic. This attitude needs to be addressed at all levels of the beef industry by acknowledging that genetic selection is largely independent from and complementary to other management decisions.

With these difficulties in mind the NBGET in their final deliberations considered the major constraints to adoption of the genetic message in the current and future industry. The constraints listed below need to be addressed and a more innovative and inclusive approach found to extending the genetic message, while still recognising the essential role of the scientist in ongoing research and development.

The NBGET (Freer *et al.* 2003) found that the four primary constraints to adoption of genetic technologies within the beef industry were:

- Lack of PROOF of PROFIT
- Lack of FOLLOW UP (assistance with adoption) after initial exposure to awareness programs
- Extension in a diverse and fragmented industry
- Decline of traditional extension resources

Proof of Profit Proof of Profit is considered the key to adoption of new genetic technology. It is also a prerequisite for overcoming the other constraints listed. The term has been coined and adapted in the beef industry to mean proof that changes in traits associated with beef industry profit, can be achieved by selecting the right genetics. If we accept that most of the traits for which EBVs are published are related to beef industry profit, or cost saving at varying levels, then in its simplest form, Proof of Profit can simply involve demonstrations that 'EBVs work' or more recently that 'gene markers work'.

If producers are given a clear reason to adopt technology, they are more likely to act. The most compelling reason is an impact on their profitability. Profit for the cow calf operator depends among other things, on the number and value of the calves they sell. Extra returns from more calves to sell is a given thus there is rarely a problem convincing breeders that fertility is a profit driver. However the returns the breeder receives for each calf also depends on the weight and the cents/kg value of the calves. The genetic potential of calves influences the profit of the buyers of the calves and will be a key driver in the value they place on the calves.

Buyers (lot feeders, backgrounders, processors etc.) will only value the genetic potential of the calves if they themselves understand the flow-on effect of good genetics on their profit line. Once they recognize the effect of genetics they will in turn provide the correct (monetary) signals to their suppliers. Convincing those involved further down the beef supply chain that improved genetics can help their 'bottom line' will help to create a 'demand pull' rather than just the 'science push' as defined by Marsh and Pannell (2000). Proof of Profit demonstration must include the whole beef supply chain if it is to make an important impact and gain whole- chain credibility. This is especially important given the lack of vertical integration in the beef industry (Banks 2005).

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If shown a profit incentive and that it fits in with their management program, producers are likely to seek the information they need. Kilpatrick (1996) states that farmers' main motivation for learning is to improve a specific aspect of farm efficiency. It is suggested that if it is demonstrated that genetics can be used to increase profit farmers will be motivated to learn. And if the increased profit message can be reinforced with 'demand pull' via clearer market signals and premiums (and discounts) from those buying the breeders' products the genetics message will be more quickly adopted. A number of the larger feedlots are already rewarding suppliers on the past performance of their genetics, so the feedback mechanism is in place in the industry. Stronger proof of profit messages will strengthen this mechanism.

Proof of profit demonstrations, if they are to be well accepted, need to have a degree of inclusiveness. Participatory or 'farmer first' approaches to extension (Black 2000) have the advantages of drawing on the accumulated knowledge and experience of the farming community and are consistent with the principle that stakeholder involvement is likely to enhance impacts on the farming community. Progeny test programs conducted by the Angus and Shorthorn breed societies are good sources of information for 'Proof of Profit' stories and are inclusive as they are testing industry bulls.

Follow-up Follow-up after the awareness phase is critical to implementation of breeding technology. The principle for follow-up is that it must be readily available and participants must be encouraged within all extension activities to seek the follow-up. Follow-up needs to be;

- specialised, and customised to individual enterprise situations (the target audience)
- ongoing, with time frame of two to five years
- provided by agencies with high level technical competence

Over 80% of farmers regularly attend field days and meetings, but only 3% attend accredited training courses (Kilpatrick 1996). Kilpatrick went on to recommend that, "Follow-up mechanisms including establishing support networks, should be built into all training activities". The NBGET noted that awareness is created by breed society publications, meetings and field days, MLA Meat Profit Days and CRC producer meetings. The awareness message is generally clear in that the new technologies offer potential benefits, but the adoption process often stops at that point because of lack of follow-up and customisation of technology to the needs of individual enterprises.

Follow-up options that need to be explored include support networks, easy access to advisers and consultants post course including telephone help services or web information. Kilpatrick (1996) suggests that follow-up mechanisms should be built into all training activities. Field days and meetings create awareness but adoption is fostered by one on one follow-up.

The changing delivery of government extension services to group or community-based activities has reduced the options for one on one follow-up advice to producers or the customisation of breeding programs to individual needs. By default, private sector extension is gaining the high ground of extension entry-point and credibility, but the availability of experienced specialists is very limited and generally available only to producers who can and are willing to pay. Any discussion about public versus private sector extension has many angles but the pertinent point in this context is that if follow-up is to be handled by private sector operators it will only be accessed by the more progressive and there will be large dependence on the 'trickle-down' effect. While farmers like to learn from peers (Animal BreedingTechnology 1991) that method does not offer customisation for individual breeding programs.

Follow-up strategies are likely to include specialist workshops that involve activity-based learning exercises and that use information directly relevant to the individual's enterprise. Inclusion of the whole management team in such a learning activity is more effective in bringing about change (Kilpatrick 1996) and the NBGET endorsed this as it encourages discussion post -workshop and will encourage management to seek follow-up.

Extension in a Diverse and Fragmented Industry The Australian beef industry has a fragmented supply chain, poor feedback upstream and down stream, a vast array of market specifications and large differences in production environments and scale of enterprise. The fragmented nature of the industry, with the product passing through a number of proprietarily unrelated sectors has largely arisen from this diversity of markets and production environments. In a market economy the fact that a more integrated system has not developed undoubtedly has logical economic reasons but clearly this creates problems for extension and technology transfer. No single extension method will fit comfortably across all sectors and the structure does not support highly trained technology transfer agents for the majority of businesses. This fragmented nature of the industry was primarily responsible for the NBGET recommendation for extension to target all sectors of the beef supply chain that will positively influence the uptake of genetic technologies.

By contrast, intensive industries such as pig and poultry have used specialist genetics advisers successfully in their vertically integrated systems to make large gains from genetics. Genetics technology transfer within the intensive industries is almost exclusively in- house or on contract, using highly trained specialists.

Adding to the fragmentation of the industry is the growth of private sector extension and research agencies. Agency competition for funding and producer attention can cause confusion to producers through uncoordinated extension effort. Private agencies are unlikely to deliver 'public good' information (Fulton *et al.* 2003) that is independent and there is suspicion regarding the potential bias in extension from private agencies.

Coordination of extension activities is seen as essential to overcome some of the difficulties caused by fragmentation. Kilpatrick (1996) recommends that providers of all forms of training need to work together. Political differences, state boundaries and differences between public and private providers are likely to maintain problems for some time. Coordination will need to be under control of a public, national entity and MLA is the most likely candidate to be able to provide such a role. Despite being highlighted as a priority by the NBGET and others, there is no initiative in place for coordination of extension activities in breeding and genetics.

Declining Extension Resources Change agents in beef cattle genetics extension have generally come from public sector extension agencies. In more recent times the role of breed society technical officers (usually former Dept of Ag extension officers), managers with tertiary agricultural training and consultants from service agencies has become more important. In addition cooperative projects between breed societies, the Agricultural Business Research Institute (ABRI) and MLA have been formed to extend BREEDPLAN. Named, Southern Beef Technology Services (SBTS) or Northern Beef Technology Services (NBTS) these projects have a very specific goal to support genetic evaluation systems and while providing a very important role they do not take the broader view of genetic improvement strategies.

In Western Australia the State agricultural portfolio was restructured to provide a more accountable, participatory and business approach focused on the market and customers (Nabben *et al.* 2006). Similar changes appear to be happening in other states and around the world (Marsh and

Pannell 2000) and while it may be inevitable due to political and economic trends towards user-pay principles, the challenge is to manage this change and ensure outcomes are achieved. Historically and importantly during the period evaluated by Farquharson *et. al.* (2002), State Departments of Agriculture (or equivalents) accounted for about 50% of the investment in genetic technologies.

The NBGET proposed that this decline of resources be met with targeted education in a broad range of sectors within the beef industry (Freer *et al.* 2003). This education must be aimed at the 'influencers' within each sector and there must be continuing support of these influencers so their knowledge is current.

Traditionally, extension services have been state based and with the restriction of and changes to the activities of these services, there is greater need for coordination of extension efforts to avoid duplication and to ensure consistency and equality across all states and agencies (Freer *et al.* 2003). Other reports have called for greater cooperation between public and private extension agencies (Marsh and Pannell 2000) to overcome some voids and this cooperation would be facilitated by better coordination. The changing mix of extension priorities across states, the different levels of services and resources across states, the constraints of state boundaries and the competition of extension agencies for funding can be counterproductive to a national extension effort.

The changing composition and growing complexity of the message also requires a system of follow-up and assistance with adoption that is different to those of the past. The level of genetics training and skills of deliverers of the genetic improvement message has not generally kept pace with research and development in the genetics field. New generations of beef genetics change agents and 'technology champions' needs to be developed from the wider groups and networks of people that influence or service the parts of the beef supply and marketing chain.

The NBGET suggests equal opportunity should apply and that high quality genetics advice should be available for all. Currently an Angus breeder in NSW will have much greater access to quality genetics advice than a composite breeder in South Australia, for example. For the industry to take advantage of the potential gains from genetics this inequality needs to be addressed. Employment opportunities for extension agents need to be reviewed, as the traditional support for these agents, from the structure described above, may not be sufficient in the future.

A PROPOSED EXTENSION MODEL FOR GENETICS IN THE BEEF INDUSTRY

It is proposed to take different approaches in the diffusion of the key technologies and messages by sector and according to the target audience. The beef seedstock producer will be targeted differently to the commercial producer, the rest of the beef supply chain and the processor. Essentially the technology diffusion model (Black 2000) will be the base model, because the technologies to be promoted are new and complex and to solely rely on producers thirst for knowledge to adopt these advanced tools to promote higher genetic gains is not realistic.

In formulating this model the NBGET considered different strategies including a 'do nothing' approach that would reply on more technically aware breeders adopting the technologies when they become available then a trickle down effect to others using diffusion principles (Black 2000) but as Kilpatick (1996) found there is a large group of farmers who are unaware that they could benefit from further learning. The diverse and fragmented industry structure described by Freer (2003) and Banks (2005) plus the rapid rate of development in the genetic technologies field, mean that adoption would be slow and the industry would not see an appropriate return to the substantial investment into genetic technologies.

In the face of the constraints identified above, how then to increase the knowledge, credibility and ultimately adoption of advanced breeding technologies in a way that leads to much greater genetic gains nationally?

The number of groups that can influence the target audience is wider than before and more complex than other livestock industries.

One proposed model is an acceleration of the diffusion of advanced breeding technologies and genetic tools by high level coaching and widening the process across opinion leader groups not normally included in the genetics extension processes.

If coaching can target opinion leaders from the wider beef industry they will be key players in diffusing good messages on beef genetics to their followers and thus through industry.

The key target audience categories are:

- Seedstock breeders
- Beef supply chain and processors – operators who have direct investment in product. This comprises three sectors:
    - Commercial breeders
    - Grow-out or backgrounders
    - Supply chain end-users
- Supply chain service providers – these operators don't have direct investment in product

These groups have not all been included in previous extension campaigns nor have they been identified as being a source of opinion leaders for breeding technologies and the use of beef genetics for profit.

The key extension technique suggested is identification of influencers within each of the nominated groups and technical updating education of these influencers. Education of these key influencers must be ongoing and have support and follow-up options available.

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