Cooperative Research Centre for Beef Genetic Technologies

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BEEF CRC SUBMISSION TO THE PRODUCTIVITY COMMISSION REVIEW OF AUSTRALIA'S RURAL RESEARCH & DEVELOPMENT MODEL (JUNE 2010)

This submission complements Beef CRC's February 2010 submission to the Rural R&D Council (RRDC), which was forwarded separately to the Productivity Commission (PC), but is also attached herewith for public record.

Beef CRC premises this submission on its belief that Australia's agricultural R&D system has served Australia well in the past. It has a strong track record of 'punching well above its weight' on the international R&D stage, in those priority areas where investment has occurred. Although it has not had the financial resources of many of its international R&D competitors, Australia's Rural R&D system has invested wisely in specific areas identified as offering greatest advantage to Australia and Australia's agricultural industries. Australia is now globally recognised as a world leader in many of those research areas.

The current system of compulsory industry levy funds, matched by Commonwealth Government funding, also serves Australia well. It ensures hundreds of thousands of Small-to-Medium Enterprises (SMEs) across the broad range of rural industries, as well as their co-dependent sectors, contribute directly to an integrated R&D program of direct benefit to their industries. The long lead times required for Rural R&D (that make R&D outcomes difficult to capture by end-users operating under short-term investment timeframes) and the high expense of much rural R&D, means that in general, individual SMEs could not undertake or commission their own research, even if they wished to do so. Hence, in the absence of such a levy system, it is unlikely many of these SMEs would invest in R&D. R&D funded through the levy system directly addresses the needs of specific industries, with a direct line of support and genuine industry consultation through the relevant RDC.

There are though, some deficiencies in the current Rural R&D system that need to be addressed if Australia is to maintain or improve its world agricultural trade position, effectively address climate change and contribute to global food security over coming decades. These deficiencies include:

1. Productivity increases across all agricultural sectors have declined over recent years, reflecting in part the decline in R&D capacity and reduced research investments over recent decades. The reduced capacity and research investments are particularly evident in longer-term strategic research areas that in earlier decades yielded very significant benefits for Australia.

2. Currently, cross-industry R&D is virtually non-existent and cross-sectoral R&D (i.e. integrated across the breeding, growing, finishing, processing and retailing sectors) within industries is largely only conducted by programs that specifically target multi-disciplinary, 'big-picture' integrated industry outcomes such as the Cooperative Research Centres.

3. International collaboration to directly benefit Australia is *ad-hoc* and under-represented in Australia's Rural R&D system. There are no significant funding mechanisms to encourage

such collaboration. The International Science Linkage program provides funds that are not sufficient to undertake genuine collaborative R&D; for example the June 2010 ISL round awarded $440,000 for 69 projects, an average of $6,377 per project - see http://minister.innovation.gov.au/Carr/Pages/440000FOR69INTERNATIONALRESEARCHPROJECTS.aspx

4. It is often extremely difficult to quantify the success of Rural R&D, a point emphasised in an evaluation of the impact of Cooperative Research Centres by Insight Economics[1], thus:

> *"Different types of CRCs face very different degrees of difficulty in quantification and verification of their impacts. For some it is as simple as asking one key industry partner to quantify a benefit they have realised, for others it involves complex sampling of end user groups or tracking of final retail outcomes. An example of the type of challenge sometimes involved in quantifying impacts can be seen in the amount of work that was required for the benefits to be calculated of the Beef CRC's contribution to the Meat Standards Australia (MSA) grading system. The benefits could only be calculated because extensive point of sale price information had been collected across Australia that allowed the producer price premium associated with the utilisation of the MSA system to be determined.*

5. The current Rural R&D system lacks consistent measures of success across the range of national, state and university research provider agencies. Such lack of consistency makes collaboration across agencies more difficult than it would otherwise be. It also means it is difficult to evaluate the effectiveness of investment across the different research provider agencies.

6. The current driver of the national innovation system (the Excellence in Research for Australia scheme now being introduced by DIISR) actually works against Rural R&D because of the very strong emphasis it places on the number of papers in prestigious but generalist scientific journals and on commercialisable Intellectual Property. R&D results with application to industry are not generally recognised as 'high quality' by organisations such as the Australian Research Council (ARC).

7. Australia's basic or fundamental science funding scheme operated by the ARC does not generally support Rural R&D as it believes industry should fund such research. However industry-funded R&D (i.e. through the R&D Corporations - RDCs) generally funds only short-term (1-3 years), close-to application development rather than more fundamental research. It also funds vital 'policy research' to position industries relative to lobby groups (e.g. research to correct mis-information about the amount of water used or methane emitted by livestock production systems). Whilst this is critical research, it must be at the expense of main-stream 'production research'. Hence, there is no general funding available for basic or exploratory R&D that might not, at this stage, have clear and direct industry outcomes. However, if Australia is to significantly increase agricultural productivity in future, it urgently needs to start re-investing in a proportion of fundamental research.

8. The recent development of National RD&E strategies for each of the agricultural industries though the PISC processes highlights a general lack of strategic vision and longer-term priority setting across many of Australia's agricultural industries. Because of the strong industry focus during development of those national strategies, the key researchable issues identified were often aimed at overcoming immediate, on-farm problems. There was an almost total lack of recognition that many vital, new, high-impact industry development opportunities may be being overlooked, particularly those opportunities based on cutting-edge new technologies.

9. With regard to these cutting-edge new technologies, there is little recognition that it may not be in Australia's best interest to simply rely on their introduction through R&D and

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[1] Insight Economics (2006) *'Economic impact of the CRC Programme'*, page 11, available online at http://www.crca.asn.au/content/economic-impact-study-crc-programme

commercialisation by other countries or multi-national companies. Reliance on such an approach generates considerable risks to Australia's rural industries, including loss of influence over how the technologies are offered, access to the technologies on sub-standard terms and the potential to disrupt production systems that currently operate effectively and efficiently in Australia.

To overcome these deficiencies, there is an urgent imperative to establish a coordinated approach to Rural R&D investment to achieve an appropriate mix of fundamental, strategic and close-to-application research, with measures of success that directly reflect economic, social and environmental outcomes in industry. That coordinated investment approach should aim to bring together diverse research, education and industry agencies and multi-disciplinary research teams to achieve critical mass in selected areas of R&D of highest priority to Australia. It should also encourage cross-sectoral and cross-industry RD&E efforts and promote international collaboration to the greatest extent possible, particularly on the big issues such as climate change and global food security, to generate synergies and avoid duplication of research effort.

Another urgent imperative is the need to identify incentives that would attract the brightest and best students into agriculture. This requires incentives from the university system, as well as much stronger support of early-career scientists to ensure they can envision a clear and feasible career path in Rural R&D within Australia.

Of critical importance, Australia cannot afford to continue funding Rural R&D that does not include defined adoption pathways built into its design and measures of success from the outset (an exception being the need for some 'blue-sky' research on which to build future research deliverables). A key driver of productivity growth is the development and uptake of new technologies by end users, so unless the research is focused directly on adoption from the outset, productivity gains will not be achieved.

Particular issues arising from the PC Background Paper

In addition to these broad-ranging recommendations, Beef CRC wishes to comment on several of the specific issues identified in the PC's Issues Paper.

Levels of R&D Expenditure by RDCs

If the levels of R&D expenditure by RDCs shown in Table 1 (page 7) also reflect the levels of direct industry investment in R&D, it is clear that some industries are investing more heavily than others, relative to the sizes of their industries. One explanation could be that those industries with smaller RDC investments have much greater private investment in R&D. However that is unlikely to be the case. For example, it is likely the Grains industry would, in addition to its overwhelmingly larger investment in RDC expenditure, also have considerably greater private investment than the livestock sectors due to investments from committed plant breeding companies outside the RDC structure. This suggests that those industries with a relatively smaller investment do not generally recognize the value of, or the need for, R&D, indicating a concerted education program is urgently needed to ensure those industries become cognisant of the value of R&D.

Wider benefits for the community from RDC-funded projects

In the red meat industries, Meat and Livestock Australia undertakes a critical coordination role that no other agency has either the authority or capability to perform. Three specific examples clearly demonstrate that MLA's coordination (and funding) has achieved impacts that would otherwise not have been possible:

i) **Meat Standards Australia**
A major outcome of earlier Beef CRC research was the scientific platform underpinning Meat Standards Australia (MSA), which is now the world's only meat grading scheme to guarantee meat tenderness based on consumer palatability preferences. A recent update to Insight

Economics' earlier (2006) study indicates the ***realised net value*** of MSA to the Australian economy, from a zero base in 1999 when MSA commenced to June 2009, was **$366 million, with a current annual benefit of around $65 million**. That value does not include additional benefits accruing to the sheep-meat industry through their subsequent adaptation of the scientific platform to develop an MSA scheme for lamb. Although Beef CRC undertook much of the basic research used by MSA, only MLA had the appropriate authority and development capability to initiate and implement the program on behalf of the Australian beef industry. Wider benefits have accrued to the Australian economy from MSA, with at least 1/3 of the financial benefits accruing directly to food consumers in Australia and overseas through our export markets, via greater value for money, product quality or availability of food products.[2] Other direct beneficiaries of MSA who did not invest in the R&D or implementation costs of the MSA program include the Australian meat processing and retailing sectors.

ii) **Genetic evaluation programs for the beef and sheep meat industries (BREEDPLAN and SheepGenetics).**

Research over several decades by a wide range of research-provider organisations (CSIRO, the Universities, State Departments of Agriculture and more recently by the Beef and Sheep CRCs) has clearly demonstrated the economic value of genetic improvement to Australia's red meat industries. But it has only been through the ongoing investment of industry funds by MLA and Australian Wool Innovation (and their predecessor organisations) that Australia's beef and sheep genetic evaluation schemes (BREEDPLAN and SheepGenetics) have been delivered to the Australian beef and sheep industries. As with the MSA scheme, at least 1/3 of the value of genetic improvements in these industries accrues directly to red meat consumers, with additional benefits accruing to other sectors such as meat and wool processors and retailers.

iii) **DNA Markers for Economically Important Traits**

Since 2005, Beef CRC has been undertaking research to discover and commercialise DNA markers for economically important traits (e.g. feed efficiency, carcase and beef quality, parasite resistance and reproduction). Once proven, DNA markers will provide beef producers with a simple and cost-effective method of identifying animals early in life that are best suited for breeding or to meet the exacting specifications of premium markets, thereby improving profitability and productivity of beef enterprises. In 2005, Beef CRC expected to discover 5-10 DNA markers for each commercially important trait and to commercialise those markers via a world-wide exclusive licensing arrangement with a multinational genomics company. However when the bovine genome sequence became available in 2006, it quickly became apparent that thousands or possibly tens of thousands of DNA markers influenced each trait of interest, negating a possible patentable position and the planned licensing arrangements. Beef CRC recognised the best way to achieve value for the beef industry from the use of DNA marker technologies was to integrate them into existing industry delivery mechanisms (e.g. BREEDPLAN and MSA). MLA was the only organisation in Australia with the appropriate authority and capability to work with Beef CRC to achieve the industry re-structure required to effectively deliver value to industry from DNA markers. The two organisations have been working closely and directly with beef industry agencies (as well as our counterparts in North America) since 2007 to achieve that industry re-structure and a complementary system internationally, to ensure maximum benefits accrue to industry.

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[2] Griffith GR, Parnell PF and McKiernan W (2006) The Economic, Environmental and Social Benefits to NSW from Investment in the CRC for Beef Genetic Technologies, ***Economic Research Report No.30***, NSW Department of Primary Industries, Armidale, September. Available online at http://www.dpi.nsw.gov.au/research/areas/health-science/economics-research/reports/err30

Coordination and collaboration between different components of the framework

As indicated above, the MSA scheme was developed without financial input from the processing and retailing sectors, although they are now substantial beneficiaries of the scheme. That example could be viewed as a one-off ineficiency, except that even now, there is not a strong coordinated approach across the backgrounding, feedlotting, exporting and processing sectors of beef industry R&D. It would be to industry's substantial advantage if a mechanism to achieve collaboration and coordination could be achieved. There are also substantially synergies to be achieved by stronger coordination and collaboration in some specialist areas across some industries (e.g. across the extensive livestock industries) and sometimes also across international boundaries.

Governance of the RDC model

The PC's Issues Paper suggests several deficiencies and variable successes in the ways that different RDCs are governed and are accountable to their stakeholders, including government. Beef CRC's view is that use of a strong corporate governance model based on ASX principles (http://www.axa.com.au/axaaph/axaaph.nsf/AttachmentsByTitle/Company_GovComplianceASX.pdf/$FILE/Company_GovComplianceASX.pdf) would overcome most or all of these deficiencies. Australian research shows that businesses with strong corporate governance processes, whether for profit or not for profit, out-perform those that don't (http://www.treasury.gov.au/documents/1495/pdf/twp_2009-02.pdf).

Identification of the key performance indicators and measures of success for individual RDCs by stakeholder organisations (including government), coupled with appointment of a skills-based board to oversight company performance and appropriate monitoring and reporting mechanisms to ensure the needs of all stakeholders are addressed, is a well-tried and proven model of success.

Implementation of such a process in the RDC model would mean identification of the full range of skills required by Directors (e.g. corporate governance, financial and legal management, industry-specific experience, marketing experience if a marketing function was to remain an integral component of the RDCs, research and research management experience, commercialisation and economic evaluation expertise and expertise required to manage governments' needs) and appointment of Directors based *entirely* on the skills they could offer to the company, rather than their ability to represent a particular stakeholder sector. Beef CRC's experience is that representational Boards often result in divisiveness, whereas small, skills-based Boards that comply with ASX priniciples are far more attentive to the needs of all stakeholders and focused entirely on the measures of success established for them by the stakeholders.

Thank you for this opportunity to make this submission relating to issues that Beef CRC believes are crucial to the ongoing viability and future of Australia's agricultural industries.

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BEEF CRC SUBMISSION TO RURAL R&D COUNCIL REVIEW – FEBRUARY 2010

(Responses to be submitted on-line by 19th February 2010)

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1. What does the system do well?

In this submission, we adopt a similar definition of the National Rural R&D system to that used by Peter Core's *'Retrospective on Rural R&D in Australia'* – i.e. as including all Rural R&D undertaken by Commonwealth and State Governments, agencies such as the Universities, CSIRO and AIMS, the agricultural Cooperative Research Centres (CRCs), as well as the Rural Industry Research and Development Corporations (RIRDCs). This definition is consistent with the current efforts by industry sectors to develop National RD&E strategies to service their needs in an integrated and coordinated way through the Primary Industry Standing Committee (PISC) and Primary Industry Ministerial Council (PIMC) processes involving these agencies.

In that context, agricultural R&D has a strong track record of 'punching well above its weight' on the international R&D stage in those priority areas where investment has occurred. Although it has not had the financial resources of many of its international R&D competitors, Australia's Rural R&D system has invested wisely in selected, quite specific areas that were identified as offering greatest advantage to Australia and Australian agricultural industries. Australia is now a world leader in many of those research areas (for example animal and plant breeding genetics and genomics; (sub) tropical livestock production; tropical grasslands and forages; integrated systems development of genetic evaluation schemes like BREEDPLAN, SheepGenetics, PigBLUP, Australian Dairy Herd Improvement Scheme; and integration of multi-disciplinary research outputs to deliver Meat Standards Australia (MSA), Australia's globally-unique meat grading scheme that is the only scheme to guarantee meat eating quality based on consumer preferences).

Another positive is that the current system of compulsory industry levy funds matched by Commonwealth Government funding ensures hundreds of thousands of Small-to-Medium Enterprises (SMEs) across the range of rural industries, as well as feedlotters, live exporters and processors contribute directly to an integrated R&D program that directly benefits their industries. In the absence of such a levy system, it is unlikely that many of these businesses would invest in R&D, as significant proportions do not recognise the need for ongoing research. R&D funded through the levy system directly addresses the needs of specific industries, with a direct line of support and genuine industry consultation through the relevant RIRDC.

There needs to be greater recognition though, that the direct beneficiaries of Rural R&D are not only producers and agribusinesses associated with the food production sectors. At least 1/3 of the direct financial benefits of agricultural R&D have been shown to accrue directly to food consumers in Australia and overseas through our export markets, via greater value for money, product quality or availability of food products[1]. This is atypical of many RD&E sectors such as manufacturing, mining and IT, where the direct beneficiaries of R&D are almost entirely the commercial companies operating through those industries. That consumers of agricultural produce are financial beneficiaries of R&D underpins a legitimate expectation that some government (consumer/taxpayer) funds should continue to be available for investment in Rural R&D to directly benefit food consumers.

Other aspects that the system currently does well include:

- A well-established culture of industry benefit amongst Rural R&D researchers that does not exist in other countries;
- A geographically dispersed R&D capacity across Australia offering regional solutions to industry, with researchers very willing to collaborate more broadly to generate critical mass to directly address priority, whole-of-industry issues;
- Collaboration and multi-disciplinary research has generated high-impact, 'big-picture' outcomes for industry and Australia (e.g. development of national genetic evaluation schemes and the MSA meat grading scheme);
- Training post-graduate and under-graduate students for the Rural R&D system has directly benefited Australian rural industries and communities through enhanced regional employment and career opportunities;
- Supply chain and industry value-adding has been fostered through collaborative research;
- The flexibility of Australia's university system addresses industry's specific learning and research needs; and
- There are minimal impediments to international collaboration to achieve R&D synergies across countries.

2. What does it not do well?

Productivity increases across all agricultural sectors have declined over recent years, reflecting in part the decline in R&D capacity and reduced research investments over recent decades. The reduced capacity and research investments are particularly evident in longer-term strategic research areas that in earlier decades (e.g. 1940s through the 1980s) yielded very significant R&D impacts for Australia. Since the 1990s, Cooperative Research Centres (CRCs) have picked up on some of those declining longer-term investments, but under current CRC guidelines, it appears successful CRCs may have a maximum term of 10 years, meaning most existing successful agricultural CRCs will complete their terms within the next 0-4 years. Their potential closure is

[1] Griffith GR, Parnell PF and McKiernan W (2006) The Economic, Environmental and Social Benefits to NSW from Investment in the CRC for Beef Genetic Technologies, ***Economic Research Report No.30***, NSW Department of Primary Industries, Armidale, September. Available online at http://www.dpi.nsw.gov.au/research/areas/health-science/economics-research/reports/err30

likely to impact very significantly on future research potential and collaboration across the Rural R&D landscape. Although new agricultural CRCs could in principle develop, current CRC guidelines make this unlikely because they require substantially new participants and new research areas. Since the most important industry researchable issues are covered by existing CRCs and they involve the most capable research organisations, it is hard to see how new agricultural CRCs would be funded.

Currently, cross-industry R&D is virtually non-existent and cross-sectoral R&D (i.e. integrated across the breeding, growing, finishing, processing and retailing sectors) within industries is largely only conducted by programs that specifically target multi-disciplinary, 'big-picture' integrated industry outcomes such as through the CRCs.

Formal international collaboration to directly benefit Australia (as well as the international partners) is *ad-hoc* and under-represented in Australia's Rural R&D system, as there are no significant funding mechanisms to encourage such collaboration. The International Science Linkage program provides relatively small amounts of funding that are sufficient to scope the international linkages, but insufficient to actually undertake serious collaborative R&D.

Except through the CRC program since inception in 1991, and over recent years through the RIRDCs, there have been virtually no attempts made to measure the economic, social and environmental impacts of R&D in industry businesses, again reflecting the different measures of R&D success that are applied by the various agencies.

Beef CRC believes the current driver of the national innovation system (the Excellence in Research for Australia - the ERA scheme now being introduced by DIISR) actually works against Rural R&D because of the very strong emphasis it places on the number of papers in prestigious but generalist scientific journals (e.g. *Nature* or *Science* with very high citation indexes) and commercialisable Intellectual Property. R&D results with application to industry are generally published in specialist scientific journals (e.g. *Animal Science* that have lower citation indexes and are not recognised as 'high quality' by organisations such as the Australian Research Council (ARC)).

Australia's basic or fundamental science funding scheme operated by the ARC does not have a track record of supporting Rural R&D because it believes industry should fund such research. However industry-funded R&D (i.e. through the RIRDCs) generally funds only short-term (1-3 years), close-to application development rather than the more fundamental research. Hence, there is currently no generalised funding available for basic or exploratory R&D that might not, at this stage, have clear and direct industry outcomes. However, if Australia is to significantly increase agricultural productivity in future, it urgently needs to start re-investing in a proportion of fundamental research through agencies like the CRC Program or ARC. Close-to-application research is only likely to lead to incremental improvements at best, as reflected in current declining productivity increases across the agricultural sectors.

As outlined above, in the more recent past, investment in longer-term more strategic Rural R&D investments were derived mainly through the CRC's program. However it appears such funds are rapidly declining and may no longer be available within the next few years.

3. What does it need to do better?

An urgent imperative is for the Rural R&D system to establish a coordinated approach to Rural R&D investment to achieve an appropriate mix of fundamental, strategic and close-to-application research, with measures of success that directly reflect economic, social and environmental outcomes in industry. That coordinated investment approach should aim to bring together diverse

research, education and industry agencies and multi-disciplinary research teams to achieve critical mass in selected areas of R&D of highest priority to Australia. It should also encourage cross-sectoral and cross-industry RD&E efforts and promote international collaboration to the greatest extent possible, particularly on the big issues such as climate change and global food security, to generate synergies and avoid duplication of research effort.

An additional priority area could be collaboration to develop 'technology platforms' such as genomics and bio-informatics across a range of plant and livestock sectors aimed at improving productivity and profitability of those industries.

Another urgent imperative is the need to identify incentives that would attract the brightest and best students into agriculture. This requires incentives from the university system, as well as much stronger support of early-career scientists to ensure they can envision a clear and feasible career path in Rural R&D within Australia. Currently other industries are far more appealing than agriculture to young people trying to make career choices.

4. Is the system adapting to current challenges at a rate that is likely to address them?

Declining productivity growth implies that the agricultural sectors are not adapting to current challenges rapidly enough. It is therefore critical that, in future, the Rural R&D system focuses very strongly on improving productivity across all industry sectors, with measurable R&D deliverables required in line with that focus. Beef CRC believes productivity can be enhanced through multi-disciplinary, cross-sectoral R&D as well as through international research collaborations, with the proviso that industry identifies the key researchable issues and oversights the R&D process to ensure delivery of industry-relevant outputs and outcomes. The benefits of a fully integrated, multi-disciplinary, multi-organisational R&D program designed with industry deliverables and a path to market and industry uptake in mind from the outset of the program accrue through a reduction in time to delivery, increased levels of adoption, strong synergies generated through development of critical mass at RD&E levels and substantially increased flexibility within the research program that ensures maximum benefits to industry.

There is a great opportunity and need for Rural R&D in Australia over coming decades. Food security is a global concern and the demand for livestock products is especially expected to increase. However, the expectations of greater food production, especially meat and milk, will be difficult to fulfill given environmental concerns, water shortages, climate change and competition for grain for biofuels, without substantial new knowledge and technology. Unfortunately our capacity to deliver this new knowledge and technology is declining. The investment in Rural R&D by state governments is declining and the investment in agricultural CRCs seems likely to decrease given the current CRC guidelines. In addition, universities have declining enrolments in agricultural courses and research assessment procedures are weighted against agricultural research, causing staff to shift to other areas of research. The collective effect of these changes could impact very negatively on Australia's future capacity to deliver research, just when significant new opportunities are becoming available and agricultural innovation is needed.

A point of concern to Beef CRC is that some State Departments of Agriculture appear to have lost their focus with regards to R&D and are unclear about their role in the national R&D system. Increasingly their R&D efforts are becoming integrated with other agencies (the university sector for example), and it is possible that in future, much close-to-application research may disappear completely because their formerly clearly-defined and valuable role has disappeared.

Over the past two decades, agricultural CRCs have had a mandate to ensure the collaboration and innovation required by rural industries to adapt to challenges was a strong focus of the CRCs'

RD&E efforts. However with changed CRC guidelines this source of funding may disappear, to the detriment of the agricultural sectors, leading to reduced innovation and adaptation at industry levels.

5. If not, what policy adjustments could accelerate change without increasing risk?

Australia needs a geographically diverse university and agriculture department system to provide R&D, education and services to its rural and regional constituents. However because of the sparse populations in such rural and remote regions, that system does not warrant independent regional development of critical mass by any one agency. Hence, the Rural R&D system requires a policy that encourages collaboration and co-location across agencies and in conjunction with industry to provide the necessary critical mass, as well as to avoid duplication of effort.

Beef CRC recommends a policy change in the CRC program, in line with the recommendations of the 2008 O'Kane Review of the CRC program, whereby a mechanism would be developed for successful long-term CRCs to transition to a 'CRC Institute' model that retains some level of government funding. To date, DIISR has not outlined a process whereby that recommendation could be implemented. However it has clearly flagged those successful CRCs can expect to be funded for a maximum of 10 years. This policy change is required particularly for successful long-term agricultural CRCs, to ensure rural industries are able to maintain current levels of longer-term strategic science and the successful collaborations and industry partnerships that have been developed.

Alternately, because of the reduction in longer-term agricultural R&D investments through CRCs, there is a need to review and re-direct agricultural R&D investment to ensure the critical longer-term strategic R&D needs are directly addressed using new funding sources.

The Rural R&D system also requires a policy shift to create an environment where researchers, particularly those in the University sector, are rewarded for an involvement in Rural R&D. The current ERA system, with its focus on prestigious journal papers and commercialisable Intellectual Property, means that high-achieving university researchers have little incentive to undertake agricultural research.

University funding is currently based on student numbers. Because there are so few agricultural students, due to more appealing and numerous opportunities in other industries and sectors, agriculture is now suffering from declining student numbers in the university system. Policy adjustments that create an incentive for regional universities to offer agricultural courses would greatly assist in increasing the numbers of agricultural students.

It should be noted that considerable risks may accrue to the rural industries whilst these various policy changes are being reviewed and recommendations formulated, because it will be very easy in this process to allow current R&D efforts to stagnate or even disappear completely. By way of example, in the last major policy change encountered by the beef industry (i.e. the industry re-structure that resulted in the formation of Meat and Livestock Australia in the mid 1990s), beef industry R&D was virtually put on hold for several years, beef industry R&D funds were not generally directed to research agencies and this in turn meant the research agencies either divested themselves of staff or diverted their scientific efforts to focus on issues of importance to other industries, where funding was more readily available.

It is essential that, during the current review process, Rural R&D momentum, existing national and international RD&E partnerships and critical expertise are not lost while the system is reviewed and recommendations developed and implemented.

There is a tendency in government to regard funding of Rural R&D as the responsibility of the agricultural industries. If that situation continues, this would be a grave mistake because it would lead to significant under-investment in an area of critical importance to Australia's future.

No industry in Australia funds all its basic research needs. It is instructive to compare Rural R&D with medical research. Medical research is well funded from government sources such as the ARC and National Health and Medical Research Council schemes, despite the fact there are large pharmaceutical companies with enormous research budgets of their own, many or most of which are not Australian, but who nevertheless benefit from co-investment of Australian government R&D funds. Just as medical research in Australia would wither without government investment, so will Rural R&D.

6. As investors, what principles do you use to balance short-term claims with long-term requirements?

Beef CRC recommends use of a portfolio approach to balance short and longer-term R&D investments based on a detailed industry needs analysis and predicted economic, social and environmental benefits and impacts across the different R&D disciplines, with cross-sector and cross-industry 'subsidisation' or efficiencies recommended where feasible.

Clear criteria should be established to evaluate all Rural R&D proposals, based on industry benefits and impact, with regular peer and external reviews of the portfolio recommended.

Because there is no ability under the current Rural R&D investment model to justify longer-term strategic R&D, the agricultural sector is currently losing significant future opportunities and large potential economic, environmental and social impacts.

7. Do these differ from the principles that balance commercial interests with public good objectives?

If by commercial interests this means the interests of companies such as pharmaceutical companies that service the agricultural sector, they do. They differ significantly in that such commercial interests do not design their objectives with industry needs first and foremost on their agenda. There is a need to consider the balance between commercial sector and consumer benefits relative to direct industry benefits, as the decision-making points differ substantially. A case in point is the example of DNA markers associated with livestock production traits. Beef CRC's and MLA's recent analyses suggest that greatest industry benefits from DNA markers will accrue by encouraging competition amongst the genomics service providers rather than taking a protected IP position; on the other hand, the large pharmaceutical companies are focused on developing a protected IP position, with exclusive world-wide licenses of DNA markers that reduce points of competition and maximise returns to the company. These positions are not mutually compatible and efforts are currently underway to try to identify issues in common that will promote collaboration between the private and public sector researchers, to add greater value to industry.

8. Where do 'big break throughs' come from in your area of interest?

In Beef CRC's view, there are no one-off, big scientific 'break-throughs'. Rather, big break-throughs are achieved through industry application of long-term strategic and shorter-term incremental research based on multi-disciplinary, collaborative research programs, followed by a deliberate attempt to integrate technologies and systems during the delivery stages. Examples of such break-throughs and the processes that led to them are described below.

Meat Standards Australia – A major outcome of earlier Beef CRC research was the scientific

platform underpinning Meat Standards Australia, which is now the world's only meat grading scheme that guarantees beef tenderness based on consumer palatability preferences. An independent study by Insight Economics[2] in 2006 indicated the *realised net value* of MSA to the Australian economy, from a zero base in 1999 when MSA commenced to June 2006, was $244 million or a benefit: cost ratio of 8:1 relative to the total estimated Commonwealth Government funds contributed to Beef CRC between 1993 and 2012. That estimated value does not account for the considerable additional benefits that have accrued to the beef industry and the Australian economy since July 2006 or for the benefits that have accrued to the sheep-meat industry, through their subsequent use of the scientific platform to develop an MSA scheme for lamb.

The MSA scientific platform was based on at least two decades of fundamental research, in Australia and elsewhere, in disciplines such as meat science, animal nutrition, animal production, animal breeding and genetics, statistics, computer modelling and industry economics. Results derived from all of those disciplines were subsequently integrated and tested by Beef CRC, before an MLA-funded initiative was undertaken to deliver the 'break-through' MSA scheme to industry.

Introduction of Brahmans to Northern Australia – a 2003 study[3] conservatively estimated the cumulative present value of infusing *Bos indicus* cattle into the northern Australian herd over 30 years from 1970 was $8.1 billion. The value was estimated in terms of improved profit from replacing British breed cows with *Bos indicus* cows and reflected the superior adaptation of *Bos indicus* to the harsh production environments in northern Australia. It did not include cost savings achieved by the reduction of treatments for parasites and nutritional supplements to ensure survival of British breeds. This break-through is described as the single greatest livestock revolution in the world. Yet a history of the Brahman breed in Australia shows it took close to 50 years to achieve widespread acceptance, based on decades of research into the genetic and non-genetic factors that impacted on improved productivity of adapted breeds in the tropics. It required multi-disciplinary, multi-organisational research undertaken by animal breeders, nutritionists, physiologists, endocrinologists, thermo-regulatory experts, statisticians and economists to assure industry of the significant benefits from the use of the Brahman.

9. What potential do you see for 'step ups' in system performance and what are necessary pre-conditions?

To achieve 'step ups' in system performance that lead to major break-through applications in industry, Beef CRC believes the necessary pre-conditions include:

- Tightly integrated and coordinated, multi-disciplinary, multi-organisational approaches to research that is focused directly on 'big-picture' high priority needs identified by industry;
- Clearly defined measures of R&D success established from the outset of the research, that relate to direct economic, social and environmental impacts in agricultural enterprises;
- A proven process(es) that achieves industry uptake and adoption based on best-practice business principles, including improvements to gross margin and cost of production measures at individual enterprise level;
- Evaluation and demonstration of R&D outputs and benefits provided to industry using the same best-practice business principles and language, to better convince industry of the R&D benefits from research that accrue to their own enterprises.

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[2] Insight Economics (2006) *'Economic impact of the CRC Programme'* available online at http://www.crca.asn.au/content/economic-impact-study-crc-programme

[3] Farquharson *et al* (2003) *'Estimating the returns from past investment into beef cattle genetic technologies in Australia'* available online at http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/146592/err-15-Estimating-returns-from-past-investment-into-beef-cattle-genetic-technologies-in-Australia.pdf

10. What are the implications of these papers for your industry or area of rural R&D interest?

These papers strongly promote collaboration between research agencies and industry across sectors to ensure critical mass and efficiencies and to limit duplication. Institutional consolidation may assist this process. The ongoing work of the Primary Industry Standing Committee and the Primary Industry Ministerial Council aimed at developing national-level strategies for each of the agricultural industries is a critical undertaking. There is recognition that entrenched interests are likely to slow these processes. However greater collaboration and specialisation, larger critical mass and less fragmentation are regarded as inevitable.

Of critical importance, Australia cannot afford to continue funding Rural R&D that does not include defined adoption pathways built into its design and measures of success from the outset. A key driver of productivity growth is the development and uptake of new technologies by end users, so unless the research is focused directly on adoption from the outset, productivity gains will not be maximised.

Key international drivers for Rural R&D include the need to significantly increase productivity in developed and developing countries; global food security; climate change; and development of an appropriate mix of public and private investments in R&D.

11. Are there any models in your industry that have been particularly effective and are suited to broader application?

Three models in particular have achieved very significant impacts in industry and on the Australian economy from beef industry R&D. They are:

i) ***The Cooperative Research Centre (CRC) model,*** which has been described in detail in many forums and national and international reviews. It is based on integrated multi-disciplinary, multi-organisational research focused on high priority researchable industry issues and over-sighted by industry. Independent economic assessments[4] of the CRC program outline the conservative, but very significant realised benefits of the model.

ii) ***International research collaborations in bovine genomics*** through the current CRC for Beef Genetic Technologies have allowed Beef CRC to, in effect, treble the size of its genomics experiments at no additional cost to Beef CRC, by sharing animal and financial resources with US and Canadian research groups, at least halving the time taken to deliver industry outcomes (relative to Beef CRC operating independently) and very significantly increasing industry confidence in the research results.

iii) ***An industry adoption and uptake model*** which Beef CRC knows as 'Sustainable Improvement and Innovation' that is based on best-practice business principles, participative research, action-learning and team-based processes ('Beef Profit Partnerships' – BPP) that are specifically designed to offer an innovative and stimulating way of achieving rapid, measurable and sustainable improvement in the profitability and productivity of individual beef businesses. The process was developed in Beef CRC's second term as part of an ACIAR-funded project with smallholder farmers in South Africa. That project achieved outstanding success and widespread recognition, as summarised in the Final Report of the project (available online at http://www.aciar.gov.au/publication/FR2008-44).

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[4] Insight Economics (2006) *'Economic impact of the CRC Programme'* available online at http://www.crca.asn.au/content/economic-impact-study-crc-programme

The CRC for Beef Genetic Technologies thereafter adapted the BPP process for use by the Australian beef industry and implemented it in a pilot trial across Australia and New Zealand, as described in a collection of 13 papers published in a Special Edition of the Australian Farm Business Management Journal (available online at http://www.csu.edu.au/faculty/science/saws/afbmnetwork/afbmjournal/Vol5/).

The use of these processes is now delivering significant improvements in innovation, profitability and productivity to Australian and New Zealand beef businesses as recorded by end-users in the latest edition of Beef CRC's stakeholder newsletter (available online at http://www.beefcrc.com.au/Assets/633/1/Beef_Bulletin_spring09_web.pdf). As indicated in the RRDC-commissioned background papers, achieving uptake of research outputs is critical to increasing levels of productivity in Australia's rural industries. In Beef CRC's experience, this 'Sustainable Improvement and Innovation' model is the only approach that it is aware of that demonstrably achieves, measures and evaluates the impact of uptake and innovation at individual SME level. Through networking and multiplier effects, it also achieves more widespread industry uptake.

12. On what basis do you assess adequacy of investment?

Adequate investment is based on the outcomes that are required or desired to increase productivity of Australia's rural industries. The need is to attract sufficient investment to achieve the desired or planned impacts at industry level. This will require economic analyses to determine the desired or planned impacts (i.e. the value proposition) and hence, the level of investment necessary to achieve those outcomes.

13. How do you think a 'national investment plan' should be measured and monitored?

A national R&D investment plan should require direct targeting of industry outcomes by each individual R&D program or project. Success should be measured in terms of productivity, profitability and social and environmental outcomes for industry, without overlooking the need for high quality science that delivers reliable recommendations to industry.

Beef CRC recommends that a national R&D investment plan builds in periodic Productivity Commission reviews to ensure the plan remains on track and resource allocation is appropriate.

It also recommends routine economic modeling of all R&D projects using internationally credible (e.g. DREAM-type) software to examine top-down impacts by sector and industry. Each research agency should be required to use the same model of economic impact assessment to ensure genuine comparisons of possible outcomes (for example, all CRCs are now required to use a single economic impact assessment tool based on the DREAM model, available online at https://www.crc.gov.au/Information/ShowInformation.aspx?Doc=ApplicationMaterials&key=bulletin-board-selection-rounds&Heading=Selection%20Round%20Application%20Materials).

14. How do we ensure that major cross-sectoral and cross-portfolio issues are addressed?

This issue has been partially addressed through the National RD&E co-investment models that are now being developed on an industry-by-industry basis through the PISC and PIMC processes. Whilst the various agencies have worked through this process together in a collaborative manner to date, the operational level issues associated with implementation of the national strategies are likely to be far more difficult, as flagged by Frontier Economics in their RRDC-commissioned background paper.

To help overcome those difficulties, it will be essential that all R&D included in the national investment plan be focused on desired industry outcomes rather than 'interesting science' and commissioned on the basis of predicted impact at a whole-of-industry level rather than addressing issues of regional political importance, for example.

Through effective integration of R&D, it should be possible to build common outcomes across industries that will generate efficiencies of investment and R&D synergies. By way of example, Beef CRC is currently working with national and international genomics researchers to develop and implement common platforms for the commercial delivery of DNA markers to the benefit of each of the beef, sheep and dairy industries. Not only will joint development of these platforms generate cost-savings and shared knowledge, their use across the different livestock industries both nationally and internationally will make technology transfer and industry uptake easier through the use of common 'language' and approaches.

Beef CRC recommends that some specific funding be made available through the national investment plan to encourage and promote cross-sector and cross-country R&D. Currently the only industry-based funding is derived from within a specific industry, which makes it difficult to develop and implement cross-industry or cross-country research.

15. What opportunities and threats do you see for Australia as a result of international drivers?

The current 'brain-drain' of key experts from Australia is a symptom of the lack of opportunities for agricultural sector careers within Australia. With the imperatives of global food security and climate change that place great importance on Rural R&D, there is now a good opportunity to provide incentives and career paths for outstanding agricultural researchers in Australia, to address these issues of international importance and imperative.

The need for global food security is generating a very strong emphasis on the increased and growing demand for livestock and livestock products through the so-called *'Livestock Revolution*[5]. This is an enormous opportunity, particularly for researchers in the livestock industries.

Trade protection by some countries is a threat to agricultural sector productivity that needs to be addressed directly through international trade negotiations. As well, high exchange rates impact negatively on Australia's agricultural production that is so dependent on export markets. International monetary policies may assist in stabilising exchange rates to secure Australia's global markets.

Competition for grain which is required for global food security, as feedstuff for livestock and for bio-fuels is likely to drive grain prices up markedly in future, particularly under climate change scenarios that limit grain production. This is a threat to intensive livestock production systems globally, but also provides Australia with a very strong R&D opportunity, because Australia is currently the world leader in research on adaptation of livestock to harsh environments.

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[5] Delgado Christopher, Rosegrant Mark, Steinfeld Henning, Ehui Simeon and Courbois Claude (1999) Livestock to 2020 – the Next Food Revolution. *Food, Agriculture and the Environment Discussion Paper 28*, International Food Policy Research Institute, Food and Agriculture Organization of the United Nations and International Livestock Research Institute.

Delgado CL, Rosegrant MW and Meijer Siet (2002) Livestock to 2020 – The Revolution Continues. *Proceedings World Brahman Congress,* Rockhampton, Australia, 16 April 2002.

Based on Australia's national research priorities[6], which were reviewed and left unchanged by the 2008 Cutler Review of Australia's Innovation System, there are two broad strategies whereby Rural R&D can impact to increase productivity of agricultural enterprises. Those strategies are:

i) ***'An Environmentally Sustainable Australia*** - *Transforming the way we utilise our land, water, mineral and energy resources through a better understanding of human and environmental systems and the use of new technologies'; and*

ii) ***'Frontier Technologies for Building and Transforming Australian Industries*** - *Stimulating the growth of world-class Australian industries using innovative technologies developed from cutting-edge research'.*

When considering livestock (and possibly also pasture, forage, grain and forestry production), Beef CRC equates those two strategies to R&D that respectively impacts on improving:

i) ***The production environment***, to improve livestock performance - i.e. it has a focus to improve all aspects of production associated with the environment *for livestock production*, whilst enhancing, or at least without compromising, the natural resource base; and

ii) ***The animal***, to ensure it is best suited to the production and marketing system for which it is being targeted.

Beef CRC therefore recognises a very significant, new opportunity to establish two new CRC-type collaborative research 'institutes' (where 'institutes' are regarded as RD&E networks rather than bricks-and-mortar) to directly address the needs of Australia's livestock sectors and continue the cutting-edge, high-impact research commenced by several agricultural CRCs, all of which are likely to terminate (or have already terminated) in the period 2009 – 2014, unless the CRC institutes model recommended by the 2008 O'Kane review is formally established in the very near future.

The first of those 'institutes' (i.e. the one that aims to improve the production environment) could be based on scoping work now being undertaken by Meat and Livestock Australia on behalf of the Cattle Council of Australia.

The second of those 'institutes' (i.e. the one that aims to improve the animal to best suit its production and marketing environment) could be developed along the lines of an internationally-focused 'Livestock Genomics Institute' which Beef CRC has been developing in conjunction with national and international partners across the beef, sheep and dairy industries. Beef CRC would be happy to share its latest thinking about this initiative with the RRDC if appropriate.

Beef CRC envisions that if these 'institutes' were to be developed as outlined in this submission, there would be significant opportunities for collaboration between them, particularly with regards to the essential livestock research populations required by both types of research, industry delivery of research outputs and uptake of research outcomes and education at vocational, under-graduate and post-graduate levels.

16. How can the flow of foreign knowledge be encouraged and enhanced for the benefit of Australian industry and the community?

Beef CRC has a well-established track record of capturing the benefits of foreign knowledge for the benefit of the Australian beef industry and rural and regional communities throughout Australia.

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[6] Australia's national research priorities are available online at http://www.innovation.gov.au/Section/AboutDIISR/FactSheets/Pages/NationalResearchPrioritiesFactSheet.aspx

This has been achieved through more than a decade of collaborative research funded by the Australian Centre for International Agricultural Research and more recently through legally-binding collaborative agreements with US and Canadian research organisations in the area of bovine genomics. These international collaborations have all yielded win-win outcomes for all countries participating in the research.

Knowledge exchange and capture has occurred via a range of different processes including project planning meetings and specifically-designed workshops to progress the collaborations; conduct of joint conferences; regular teleconferences, videoconferences and email discussions; student and scientific exchanges and visits; sabbatical visits; invitations for Beef CRC scientists to present at international conferences etc.

17. What are the implications for the structure and composition of Australia's 'receptive' capacity?

Australia's rural industries are generally regarded as traditional and risk-averse, an essential characteristic to overcome the vagaries of climates and markets over which they have no control. However to greatly increase levels of productivity across those industries, there is a need for greater innovation and entrepreneurship to improve receptive capacity, whilst appropriately managing the known risks. The Beef CRC's 'Sustainable Improvement and Innovation' process described above is directly addressing this very significant need at a range of levels including grass-roots producers, extension and technology transfer agents, industry consultants, agribusinesses, educators and R&D participants.

A similar process or approach is required across all of Australia's agricultural sectors to promote collaboration and sharing of ideas, trialling of new technologies and measurement of economic, social and environmental impacts of these technologies at enterprise and industry levels.

18. In developed countries, there is a trend towards greater private investment in rural R&D. To what extent is this likely to be a trend in Australia?

Under the current industry environment, where many grass-roots producers do not appreciate the role and value of R&D to their industry, it is hard to see greatly increased private investment in R&D from hundreds of thousands of SMEs in the near future.

There may be increased levels of investment in development of technologies targeting the agricultural sectors, for example by the major pharmaceutical companies, but the main driver of that research would be company profits rather than productivity of the Australian agricultural sector, though those two drivers are not necessarily antagonistic.

Amongst Beef CRC's international genomics collaborators, the trend towards increased private investment in their research has actually slowed considerably over the past 2-3 years.

19. To what extent is there a shortage of skilled researchers and other professionals to support the agriculture, fisheries and forestry sector?

To achieve productivity increases of the order required by Australia over coming years, there will need to be a significant increase in the number of skilled researchers and other professionals to support the agricultural sector. It is not clear where the funding to provide the incentive for such growth would come from. Assuming the funding and the incentives are available, Australia should be able to grow the research base or attract international scientists and other professionals to

contribute to the necessary growth, except perhaps in very specialised, high-demand, low-availability disciplines.

20. How is this impacting on the sector's productivity?

Beef CRC's view is that the greatest impact on the sector's diminishing productivity derives from declining investments in basic, strategic and fundamental R&D rather than a shortage of skilled researchers and other professionals. This is a 'chicken-and-egg' type scenario: if increased investments were available in Rural R&D, the interest and availability of skilled researchers to contribute to R&D would also improve.

21. What should be done to address this?

Unless it is possible to attract additional investment into Rural R&D, and particularly into fundamental and strategic research, it is unlikely this issue can be addressed.

22. What best practice models for extension and knowledge transfer exist?

As described above, in Beef CRC's experience, the most effective model to achieve demonstrable uptake and impact of complex knowledge-based and integrated technologies and know-how is its 'Sustainable Improvement and Innovation' model. Beef CRC is not aware of any other model in the agricultural sector with the ability to generate innovation, entrepreneurship and continuous improvement, whilst simultaneously measuring, monitoring and evaluating impacts of complex knowledge-based systems and technologies at individual enterprise and industry levels.

More traditional models of extension and knowledge transfer, including communication activities, are appropriate to generate 'awareness' of technologies. But if Australia is serious about increasing productivity levels in its agricultural sectors, the only way this will be achieved is through demonstrable uptake of technologies and know-how and increased levels of innovation and entrepreneurship.

23. How are they evaluated?

Beef CRC recommends that evaluation of uptake and adoption of know-how and technologies be based on clearly defined measures of success that relate to direct economic, social and environmental impacts in agricultural enterprises, such as gross margin and cost of production values, measures of productivity and documented changes in agricultural practice, at individual enterprise, regional, state and national levels.

24. Is diversity, including community (indigenous and cultural) and industry diversity adequately provided for in the current model?

The agricultural sector is no different to other sectors in Australia, in that there remains clear under-representation of women and indigenous people in leadership roles. Greater attention should be given to these issues when developing the new national R&D investment plan.

In this context though, it is worthwhile noting Beef CRC's 'Sustainable Improvement and Innovation' process has a track record of defying this general trend of under-representation by encouraging cultural diversity and cross-cultural and cross-gender leadership roles throughout its 'Beef Profit Partnership' teams.