final report

Project code: B.STU.0267

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Date published: November 2013

PUBLISHED BY
Meat & Livestock Australia Limited
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NORTH SYDNEY NSW 2059

MLA Education Pipeline Review

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

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ACKNOWLEDGMENTS

This report builds on previous work commissioned by MLA, surveys conducted by Ian Chubb, Jim Pratley and others and many internal reports and enquiries conducted by many educational institutions.

The report would not have been possible without the assistance and cooperation of Deans, Department Heads, other academics and students, past and present from virtually every faculty and every school in every university which teaches agriculture and related sciences, including veterinary and animal science, in Australia. In addition, the team at MLA, led by Peter Vaughan and past MLA employees have provided valuable insights and information.

Thank you all.

EXECUTIVE SUMMARY

Background

The MLA Education Pipeline Review (MLAEPR) was commissioned by Meat & Livestock Australia (MLA) to ensure that adequate numbers of scientists will be available to conduct the necessary Research Development and Extension (RD&E). Without an adequate supply of scientists, MLA cannot meet the objectives of the Meat industry Strategic Plan. Currently MLA invests over one million dollars annually on the education pipeline. In addition MLA supports undergraduate students, post graduate students and developing scientists in many projects.

Sources of Information

Sources of information included MLA, key industry personnel, University Heads of Schools and other academics. Face-to-face interviews were conducted with the majority of university Heads of School and key industry participants, and some were conducted by phone. Electronic surveys were conducted for students, employees and employers.

Analysis of Present and Past Investments

This review analyses past and current investments and has developed key findings and recommendations to ensure the future RD&E needs of the redmeat industry can be met. Recommendations are also made to refine and balance the investment portfolio, and develop strategies for future investments.

MLA Concerns Justified

MLA has reason to be concerned about a looming shortage in some specific areas. Student numbers in Agricultural Science have been through a period of sharp decline and despite some recent rebuilding of student enrolments, the numbers of students graduating and available for employment in RD&E are well below the numbers of some decades ago. In addition, many of the current scientists are nearing retirement age.

Universities are re-structuring their course offerings to match student expectations and new areas of science. These changes generally mean a greater focus on general science at the expense of Agricultural Science. To add to this challenge, very few of the domestic Australian students graduating with a bachelor’s degree are contemplating further studies at

the Masters or PhD level. Most of the higher-level post graduate students are international students. For the purposes of this report, 'Domestic students' are defined as students who have grown up and received the greater part of their education in Australia

Adequate Response to Most Positions Vacant

Despite all of this, most employers surveyed commented that they receive good numbers of applicants for most positions advertised. To meet the challenges in the areas of shortage, the industry (and MLA in particular) will need to find ways to inspire students to develop their careers in the red meat industry.

The Key Findings which underpin the recommendations are as follows:

- Increase the supply of students,
- Provide inspiration for emerging scientists and encouragement to join the red meat industry,
- Target MLA investments more precisely than in the past,
- Intervention required to develop a constructive culture, and
- Nurture future leaders

Recommendations

To enable MLA to effectively respond to these challenges, we recommend that it develop a program focussed on carefully targeted development of human capacity.

The best return on this investment is on students and scientists who have already made a career commitment to the redmeat industry. This new approach will require a greater focus on people, not just projects.

Domestic students are the most likely to make a sustained contribution to the industry and to fill leadership roles in the future. One way to support these students in their post-graduate studies is with attractive stipends. Currently the level of stipend is a barrier to many prospective students.

All of the universities surveyed would welcome greater linkage and involvement with the redmeat industry. By seeking to engage with selected universities and influence them, MLA will be able to ensure an increased focus on redmeat industry outcomes, align curricula to redmeat industry needs, encourage teaching in Agricultural Systems, inspire students by supporting the appointment of inspirational professorial chairs and support the development of performance measures for universities that reflect contribution to industry outcomes as well as science excellence.

Although student numbers have suffered a serious decline, sufficient numbers of students interested in agriculture are generally available to meet the declining number of available positions. Once students graduate, they require further nurturing to develop their capacity to make a significant contribution to the industry. This "professional development" is required in all spheres of activity, but particularly in the extension arena where industry knowledge, people skills and leadership development are crucial.

The beef and sheep and Future Farming CRCs have provided a very valuable role in the development of the science pipeline. The beef CRC has concluded and the sheep CRC is

expected to conclude shortly. This will leave a significant gap. MLA should act to fill this “gap”.

These recommendations will require a change of approach in the redmeat industry (and within MLA as well). MLA should take the lead and specifically intervene to develop a constructive culture within MLA and the red meat industry.

KEY FINDINGS

These findings are based on MLA information, surveys of over 150 redmeat stakeholders (i.e. over 50 interviews and almost 100 e-surveys) and literature reviews. Stakeholders include Deans and Heads of Schools of Agriculture/Land/Food and Veterinary Science (hereafter called University Leaders), MLA-funded students (called MLA students), supervisors of MLA students (called Supervisors), representatives of RD&E agencies across Australia (RD&E staff) and key industry and R&D leaders.

Six Major Challenges For The Red Meat Industry

- Animal welfare.
- Human capacity (i.e. age, retirements, knowledge and skills).
- Land use and management (i.e. sustainability, environmental impacts of production).
- Enterprise profitability and competitiveness.
- Market demands and competition.
- Consumer perceptions and sensitivity (i.e. practices, food quality, health).

The diversity of these issues suggests a need for strategic research, applied research and experimental development. They also require the application of a wide range of disciplines in multi-disciplinary and trans-disciplinary research.

Supply of Students

The capacity for research, development and extension (RD&E) in the redmeat industry has and will be sourced from both domestic and international graduates. A number of respondents noted that **domestic students were most likely to engage closely with the redmeat industry and make a long-term career commitment to its RD&E**.

Both domestic and international graduates are trained in Australia through various agriculture, veterinary science, animal science and environmental science programs taught in 23 Schools/Departments at 14 Universities/Higher Education institutions. Over the past 10 years, MLA has directly invested in student training through funded RD&E project activities.

In MLA projects where investments total over $37million, 23 postdoctoral students have been supported along with 32 post-graduate students. In addition, seven undergraduate students have received financial support and around 145 students have been supported through investments in the Beef and Sheep CRCs. In addition, the Future Farming CRC provided the funding for post-graduate students. Well over 200 postgraduate students have been trained over the ten year period.

Based on the assertions of stakeholders, across the surveyed Research, Development, Extension, Education and Training (RDEET) institutions, the industry currently appears to have adequate research and extension strength in genetics/bioinformatics, reproduction, nutrition, animal welfare, animal production, animal health, pasture improvement, pasture and crop production, agricultural systems, soil science, and animal welfare. Research-led teaching and practical teaching strengths are apparent in the above fields,

The major emerging knowledge gaps identified are as follows:

- Impact of global changes (e.g. climate, social & financial) on profitability and sustainability.
- Pasture and feed base improvement/systems to meet product quality standards.
- Consumer concerns about animal welfare, health and red meat, and the environmental impact of production in a variable climate.
- Rangeland use and management.

Stakeholders have also identified gaps in specific specialist areas such as parasitology and higher-level farming systems.

State Government Departments of Primary Industries (DPIs) and CSIRO have reduced their investment in RD&E focussed on the red meat industry. These reductions have led to redundancies and early retirements of a number of senior RD&E specialists. These reductions in investment in red meat industry RD&E have also led to concerns by younger professionals about career prospects in the industry. The concerns about career prospects are exacerbated by the commonly used employment strategies of offering temporary positions, resulting from short-term (usually three-year) project funded positions offered.

Given this reduction in demand for scientists, a new equilibrium has become established between supply and career opportunities for new graduates. It seems likely that overall, the reduced capacity will be adequate to meet the reduced demand. However, there will be skills shortages in some specialist areas.

Overall, the number of undergraduates studying Agricultural Science and Animal Science at Australian Universities appears to have increased substantially in recent years in certain discipline areas above a low 5 to 10 years ago. Some Universities have a full complement of undergraduate students. Other universities are well below long-term previous student numbers, but are currently experiencing healthy increases. Student numbers are higher (and increasing) in the animal sciences than in agricultural production, agronomy or soil sciences.

Overall, the number of postgraduate coursework and research students is increasing, although this is largely driven by increasing numbers of international enrolments. Almost half of the institutions report flat or declining enrolments in domestic enrolments in postgraduate coursework and research. Almost half of the institutions report growth in postdoctoral numbers, although this is from a very low base, while the others report flat numbers.

Universities with a regional presence seem to have been more able to attract domestic students in the agricultural and veterinary sciences than the “capital city-based” universities. This may reflect their marketing strategies or their focus on workforce development.

Schools of Veterinary Science have a full intake, but the vast majority of these students are focussed on small animals and on clinical practice. Graduates in Veterinary Science are a

source of research scientists for the red meat industry, but some greater support and greater linkage into the red meat industry would be beneficial. These graduates, while well trained in clinical veterinary science, may need further training in production/farming systems and research methods (data collection and analysis) to be effective in RD&E.

Inspiring Students to Take Careers in Red Meat RD&E

MLA students have indicated that their inspiration to do agriculture/plant/animal science was either through a particular experience or because of a strong motivation. A farm background or experience, inspiring teachers/lecturers and school experiences were important influences. The drivers for their career choice were that they wanted to 'make a difference' by working in important areas (e.g. food security, sustainability, global warming), work with animals, or perceived (or their influencers perceived) an opportunity or growing demand in this area.

MLA Investments in the Science Pipeline

Our research shows that **MLA investments in the science pipeline deliver greater returns at later stages of the pipeline.**

MLA invests in schools, undergraduates, postgraduates, the next generation of science leadership and mid-career scientist development.

Stakeholders, surveyed for this report, were invited to prioritise investments across all stages of the science pipeline. Their responses were variable, and they gave some priority to investments in every stage of the pipeline

Generally, respondents favoured investments at the later stages of the pipeline (University undergraduate and post graduate, and professional development such as postdoctoral and mid-career grants). Travel grants were valued particularly where respondents commented that travel opportunities would not exist without MLA support. Supervisors have a clear preference for investment in postgraduate and postdoctoral scholarships and, to a lesser extent, travel grants. Employers in RD&E agencies would welcome more investment in the professional development of current employees, and would welcome a greater interest by MLA in individual staff members and their career development. University leaders appreciate investment by MLA in scholarships and curriculum development, but would also welcome an involvement by MLA in helping staff and students link with the red meat industry. They also comment that MLA should have a role in inspiring students to become part of the red meat industry. University leaders would be receptive to a greater "partnership" approach along the "pipeline".

Many of the students on scholarships (either undergraduate or postgraduate) stated that they would not have been in a position to undertake their studies without the scholarship they were offered.

Scholarships essential for students

University leaders commented that awareness of MLA scholarships and positions could be greatly improved among their student population. In some schools, University Leaders stated that there are insufficient scholarships, while in others the Leaders commented that they have insufficient high-calibre students to award all of the scholarships they already have.

Although MLA offers a considerable number of scholarships, recipients and their universities commented that they would welcome a much greater engagement with MLA in promotion of these scholarship opportunities and the opportunity to engage more effectively with the redmeat industry.

MLA has the opportunity to engage, nurture and develop these students. Closer interaction with students would enable MLA to familiarise students with MLA's priorities and other opportunities. Such a relationship could enhance the commitment students have to the greater redmeat industry.

Closer engagement with universities opens the possibility of improving the general student awareness and experience with respect to the red meat industry. Industry experiences such as field trips, visits to agricultural businesses, research institutes etc. do attract students to a career in the red meat industry. These experiences could (in part) be funded by MLA.

Investment in schools worthwhile, but not as influential on the pipeline as closer to a career

MLA has invested in two complementary bodies relevant to community perceptions of the redmeat industry and the early stages of the scientist education pipeline – the Primary Industries Education Foundation (PIEF) and the Primary Industry Centre for Science Education (PICSE).

PIEFs mission is to engage and inform primary and secondary students, teachers and the broader community about the role and importance of primary industries in the Australian economy, environment and wider community, and the breadth of career opportunities available through the food and fibre industries. PIEF's distinctive contribution has been to highlight serious mis-understandings in children's knowledge of the origins of food and fibre and mis-perceptions of agriculture. PIEF also attempts to collate and review teacher resources and industry 'education' programs, and influence the Australian Curriculum to the point that it now includes primary industry-based content in several key learning areas.

PICSEs mission is to attract students into science, and connect secondary science teachers and tertiary bound science students with the available primary industry science and career paths. PICSE's distinctive contribution has been to provide class presentations, establish activity centres, run science induction camps and provide professional development for secondary teachers.

At the time of preparation of this report, and at the invitation of TIAUTAS (PICSEs host), PIEF is investigating the possibility of assuming the coordination and management of PICSE. The intent is to revamp the PICSE model over the next 12 months to be a more sustainable and cost-effective way of enhancing learning about science related to primary industries in Australian schools. PICSE has provided a report to MLA (STU0262) which demonstrates its achievements but fails to demonstrate a return on investment and the cost-effectiveness of the program.

Investment in university leadership and curriculum development very worthwhile

Around 55% of RD&E agency representatives had no concerns about the quality, relevance or practicality of existing university programs and courses. The concerns raised related to

the limited research and extension skills in graduates and their capacity to apply learning to real-world situations. A major reason provided for the low level of uptake of postgraduate coursework was the lack of relevant programs and the personal financial costs involved.

MLA has invested in course development at Sydney, CSU, UNE, and both program/stream and course development through UQ. The Sydney and UNE courses appear to be embedded in their undergraduate and postgraduate agriculture, agribusiness and rural science programs.

MLA has an opportunity to work with universities to ensure collaboration across institutions in teaching, either in areas of research or teaching strength and to refresh and improve curricula and local offerings. Low course enrolments have been the catalyst for recent discussions on some cross-institutional collaboration in course delivery.

Leadership development and on-going professional development pays very good dividends

Many of the current RD&E leaders have undertaken post-graduate studies. Some of these were at overseas universities and mostly, these studies were funded in part by the red meat industry. These leaders comment that their post graduate studies enhanced their confidence and greatly improved their leadership capacity.

The Role of CRCs

CRC's have had a vital role in creating opportunities for students at the PhD and post doctoral level. The gap they leave at their conclusion should be filled by MLA and other RDC's.

The Sheep CRC runs until the end of 2014. The Beef CRC concluded its final term just over twelve months ago. Each CRC (Sheep 1 and 2 and Beef 1, 2 and 3) produced around 30 to 40 postgraduate students. With two Sheep CRCs and three Beef CRCs, this amounts to around 150 students/graduates. The Beef CRC and the Sheep CRC have tracked their graduate students and have found that at least 80% have remained in agriculture following graduation and that 70% have been retained more specifically within the beef and sheep industries. In addition, the Future Farming CRC provided the funding for post-graduate students and it too is scheduled to conclude in 2014. MLA has also invested in the Savanna and Desert Knowledge CRC's. There is a huge legacy from these investments.

From the point of view of students, universities and related research organisations, the CRC model has worked very well. All CRCs focussed on the students and held workshops and leadership development activities which have built a national network of young researchers and emerging research leaders.

RECOMMENDATIONS

1. That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline.

MLA should develop an education and capacity building program (or portfolio) to manage the interactions and investments in the science pipeline. MLA must develop a genuine focus and active interest in the people in the science pipeline. This will mean getting to know students and their teachers, and forming strategic partnerships with selected universities with real capacity to address the issues facing the industry. These universities must also demonstrate a commitment to further building capacity.

Currently, most of MLA's investment in the science pipeline is contained within RD&E projects and this investment is not specifically managed to ensure the supply and retention of scientists for the future.

The science needs for the red meat industry will encompass science in its broadest terms – 'pure basic', 'strategic', 'applied science' and 'experimental development'. That is, including the biological and physical sciences, social sciences, economics and marketing. The current and emerging challenges facing the industry will require this approach. As a result, MLA should support the science pipeline in its broadest definition.

MLA should appoint a senior Manager to take on these tasks, manage the relationships and take initiatives to ensure the human capacity RD&E needs of the red meat industry are met.

2. That MLA targets its investments so as to be able to focus on the major challenges facing the industry:

These are:

- Animal welfare.
- Human capacity (i.e. age, retirements, knowledge and skills).
- Land use and management (i.e. sustainability, environmental impacts of production).
- Enterprise profitability and competitiveness.
- Market demands and competition.
- Consumer perceptions and sensitivity (i.e. practices, food quality, health).

3. **That MLA changes its focus to focus on people, not just projects. This change in focus will involve knowledge of, and active networking with RD&E professionals, and investing in leadership development.**

In addition to active networking with RD&E professionals engaged in the red meat industry, this will mean developing a genuine interest in their career development and the provision of sufficient funding of operational budgets and technical assistance to enable professional creativity. Investment in suitable infrastructure will also enhance the capacity of scientists to do useful work.

4. **That MLA increases the level of support of post graduate students with attractive stipends.**

These stipends must be at a level which is competitive with other career options such as a professional position. The low level of stipends has been a barrier for domestic students to undertake postgraduate studies, and especially for those already in the workforce.

5. **That MLA moves to carefully and deliberately influence selected Universities by actively engaging in curriculum development and contributing to the appointment of inspirational professorial chairs of practical agriculture.**

MLA is unlikely to be able to allocate resources to develop partnerships with all universities which offer agriculture and veterinary science degrees. To be effective MLA will need to be selective in the development of these strategic partnerships.

- **MLA must ensure that curricula are aligned to the knowledge needs of the redmeat industry.**

To assist universities to become “outward looking” and “red meat industry relevant” in their curricula, MLA should take the opportunity to forge strategic partnerships and ensure that it has a strong influence on the curriculum. In addition, by forming close strategic relationships with selected universities, MLA will have the opportunity to co-fund strategically important scholarships and university appointments, inspire students to take up opportunities in the red meat industry and strongly influence course offerings.

- **MLA should, in collaboration with other RDC’s, contribute to the appointment of inspirational chairs of practical agriculture at selected universities.** These chairs will need to have a full understanding of the complexity of agricultural systems and each would need to have a specialisation, for example, beef, sheep or pasture/crop, and a business focus.

- The trend of agriculture and NRM schools/departments being absorbed by science faculties and the focus of these groups being driven by laboratory-based physical and biological scientists is a concern regarding capacity to address the complex issues facing the industry.

- **MLA should support teaching in an agricultural systems framework.**

  This again was a recurring theme from people involved in industry and from groups like McKinnon. Graduates need to understand the relationship between soil, soil health, water, seeds, seedlings, growing plants, maturing crops or plants growing to feed animals, the genetics of animals, the growth rates of animals, the end purpose of animals, meat, milk or fibre and the relationship of all of those things on farm. They should understand that if you change one factor everything else on the farm changes as a consequence. Until that realisation is held by the majority of students, agriculture will have an uphill battle to increase productivity.

- **MLA should support teaching the economic consequences of adopting new practices and business realities of innovation.**

  The other major recurring theme is that graduates need to understand the economic costs and benefits of the adoption of technology and the capacity of a farm production business to take on new technologies. Too often technologies are promoted without the promoter having a good understanding of the ramifications of the uptake of that technology on the individual business.

6. That MLA becomes involved in setting the future for national funding of universities.

MLA should aim to use its influence to ensure that the "value of teaching", "industry impact" are essential metrics used in the ranking of university performance. This is in the face of the ERA dilemma which rates and rewards universities which have a high publication record in "high grade" journals. As part of this, MLA should coordinate an agricultural industry push to tackle the "disconnect" between the university funding model and the benefits for industry. This would best be undertaken across all RDCs and as a result, MLA should initiate an "across industry" task force to sponsor the changes required.

7. That MLA takes the initiative to Partner with other RDC's.

The education pipeline for the red meat industry has a high degree of commonality with that of the Dairy, Grain and Wool industries, and there is movement of personnel across these sectors. Many of the issues are common to all agricultural industries. MLA should actively pursue and support the establishment of a 'cross sector' approach to the investment in education.

In addition, MLA should work collaboratively with other RDCs to raise awareness of the opportunities in primary industries, enhance the student experience and interest in secondary schools, help students link and network into Australian agriculture (and the red meat industry in particular) and support undergraduate and postgraduate students financially.

8. That MLA prioritises investments to fill the gaps and meet the needs of a future redmeat industry and then actively entice students into areas of need.

The redmeat industry is one of many industries which are facing skills shortages. Other industries, particularly the mining industry have strong recruiting drives and advertising campaigns to entice future industry participants. MLA should identify future gaps, invest to fill them by creating employment opportunities and entice students to take up the roles.

9. That MLA prioritise investments in the science pipeline with greatest emphasis on the "close to career" end of the pipeline and the least investment at the primary school and secondary school end of the pipeline.

At the "close to career' end of the pipeline, students are ready to make a commitment, or in the case of PhD and Post Doctoral appointments, they have already made a commitment to work in agriculture.

10. That MLA invests in the training needed to prepare university graduates for influential extension roles for the red meat industry. This should be done with three distinct, but linked approaches:

a) Provide mentoring opportunities and professional development for new graduates to enable them to assume full consultancy or extension roles for the future. This will mean providing salary support for new graduates until they are sufficiently able to secure a consultancy income. These new graduates should be directly supervised by a recognised professional in the public or private sector.

b) Support a higher-degree program at selected universities on "Advance Extension Methodology". This course work masters should be offered as distance education with some parts of the course delivered at the selected university. The course work offered should involve advanced courses in group facilitation skills, knowledge of adult learning and the collection analysis and interpretation of socio-economic data.

c) Support and fund projects which have industry and community benefit and which utilise advanced (and novel) extension techniques. These projects could utilise modern communication media (to be accessed on smart phones) and must deliver beneficial industry practice change.

11. That MLA moves to fill the gap left by CRCs.

MLA should continue to acknowledge the contribution to the red meat science pipeline made by the Beef, Sheep and Future Farming CRCs. As a result of the termination of the beef CRC and the possible termination of the sheep CRC, MLA should act to fill the role the CRCs played in engaging and networking with students, helping them feel part of an exciting and innovative industry, and building their industry networks and leadership skills. In the absence of the CRC's the opportunities for PhD's and Post Docs will be considerably reduced.

12. That MLA specifically intervenes to develop a more constructive culture in relation to science and education within MLA and the red meat industry.

To achieve this recommendation, MLA should undertake a cultural inventory of both MLA RD&E staff and a selection of industry stakeholders. Once an inventory of

culture is “measured” then specific steps to build a more constructive and inclusive culture should be identified and undertaken. Such a culture is essential to nurture and encourage scientists engaged in the redmeat industry. A “constructive” culture will improve the focus on people and enhance innovation.

One additional step to build a constructive culture is to recruit MLA staff from a diverse background and approach. Typically, organisations employ “like” individuals. To build the necessary diversity within MLA, recruitment and selection practices which build an organisation with a diversity of view should be employed.

PROJECT BACKGROUND AND OVERVIEW

The Project

Meat & Livestock Australia (MLA) commissioned Mike Stephens and Associates to undertake a review of investments in the national scientist education pipeline for the redmeat industry. Dr John Taylor and Mr David Hamilton have assisted in the review.

The review addresses all aspects of the scientist education portfolio, and will examine the supply of scientists at all levels of service to the industry. This includes specialist consultants, extension officers and researchers, applied science researchers and strategic science researchers.

MLA aims to ensure there will be an adequate supply of scientists to meet the RD&E needs of the redmeat industry. Currently, in the Scientist Education Portfolio MLA invests over $1M annually in various stages of the education pipeline, including:

- school education.
- undergraduate scholarships and course development.
- postgraduate scholarships and course development.
- postdoctoral fellowships to develop the next generation of science leadership.
- Mid-career scientist development (i.e. travel grants and scientific conference sponsorship).

Through MLAs investments in CRCs (e.g. Beef, Sheep, Invasive Animals, Tropical Savannas and Future Farming) and other MLA programs, there has been further significant investment in 'scientist' education.

The aim of the review was to analyse past and current investments and comment on whether the needs of the redmeat industry are being met or can be met in the future, and on how the portfolio balance can be refined to meet emerging needs. The Review Team is also expected to make recommendations on strategies and priorities for future investments.

The specific objectives of the review set by MLA are as follows, and we have matched our key findings and relevant recommendations to these objectives:

1. Analysis of the effectiveness of past and current investments in each stage of the education pipeline in targeting and retaining high potential students to have careers in science contributing to the redmeat industry.

   Key Findings

   - *MLA Investments in the Science Pipeline*
   - *The Role of CRCs*

   Recommendations

   (1) **That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline.**

   (2) **That MLA targets its investments so as to be able to focus on the major challenges facing the industry**

(3) **That MLA changes its focus to focus on people, not just projects. This change in focus will involve knowledge of, and active networking with RD&E professionals, and investing in leadership development.**

2. Analysis of the effectiveness of past and current investments in each stage of the education pipeline in meeting the demand for scientists to contribute to the continued development of the redmeat industry.

Key Findings

- *Six Major Challenges for the Red meat industry*
- *Supply of students*
- *Inspiring Students to Take Careers in Red Meat RD&E*
- *MLA Investments in the Science Pipeline*
- *The Role of CRCs*

Recommendations

(1) **That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline.**

(2) **That MLA targets its investments so as to be able to focus on the major challenges facing the industry**

3. Recommendation for future requirements (deliverables) from the scientist education pipeline.

Key Findings

- *Six Major Challenges for the Red meat industry*
- *Supply of students*
- *Inspiring Students to Take Careers in Red Meat RD&E*
    - *Scholarships essential for student;*
    - *Investment in schools worthwhile, but not as influential on the pipeline as closer to a career;*
    - *Investment in university leadership and curriculum development very worthwhile;*
    - *Leadership development and on-going professional development pays very good dividends.*
- *MLA Investments in the Science Pipeline*
- *The Role of CRCs*

Recommendations

(1) **That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline.**

(2) **That MLA targets its investments so as to be able to focus on the major challenges facing the industry.**

(3) **That MLA changes its focus to focus on people, not just projects. This change in focus will involve knowledge of, and**

active networking with RD&E professionals, and investing in leadership development.

(4) That MLA increases the level of support of post graduate students with attractive stipends.

(5) That MLA moves to carefully and deliberately influence selected Universities by actively engaging in curriculum development and contributing to the appointment of inspirational professorial chairs of practical agriculture.

4. An analysis of the investments required to achieve the deliverables and recommendations on future investment priorities.

Key Findings

- *Six Major Challenges for the Red meat industry*
- *Supply of students*
- *Inspiring Students to Take Careers in Red Meat RD&E*
    - *Scholarships essential for students*
    - *Investment in schools worthwhile, but not as influential on the pipeline as closer to a career.*
    - *Investment in university leadership and curriculum development very worthwhile.*
    - *Leadership development and on-going professional development pays very good dividends.*
- *MLA Investments in the Science Pipeline*
- *The Role of CRCs*

Recommendations

(1) That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline;

(2) That MLA targets its investments so as to be able to focus on the major challenges facing the industry;

(3) That MLA changes its focus to focus on people, not just projects. This change in focus will involve knowledge of, and active networking with RD&E professionals, and investing in leadership development;

(4) That MLA increases the level of support of post graduate students with attractive stipends;

(5) That MLA moves to carefully and deliberately influence selected Universities by actively engaging in curriculum development and contributing to the appointment of inspirational professorial chairs of practical agriculture;

(6) That MLA becomes involved in setting the future for national funding of universities;

(7) That MLA takes the initiative to Partner with other RDC's;

(8) That MLA prioritises investments to fill the gaps and meet the needs of a future redmeat industry and then actively entice students into areas of need;

(9) That MLA prioritise investments in the science pipeline with greatest emphasis on the "close to career" end of the pipeline and the least investment at the primary school and secondary school end of the pipeline;

(10) That MLA invests in the training needed to prepare university graduates for influential extension roles for the red meat industry. This should be done with three distinct, but linked approaches;

(11) That MLA moves to fill the gap left by CRCs;

(12) That MLA specifically intervenes to develop a more constructive culture in relation to science and education within MLA and the red meat industry.

The Project Review Team

The Review Team comprised Mr Mike Stephens, Dr John Taylor & Mr David Hamilton. This team brings together long experience across Research, Development, Extension (RD&E) and Higher Education. Brief biographies of the members of the Review Team are provided in Appendix 1.

How the review was undertaken

The Review Team has considered:

i) Reports and information supplied by MLA

ii) The results of face-to-face interviews with Deans/Heads of Schools of Agriculture/Land/Food and Veterinary Science (hereafter called University Leaders) and key Industry stakeholders

iii) The results of e-surveys of MLA-funded 'students' (called MLA students), Supervisors of MLA-funded students (called Supervisors) and representatives of Research, Development and Extension (RD&E) agencies from across Australia (RD&E staff)

iv) Literature on career influences and decision making, Australian enrolments in agriculture, trends in education in the US, etc.

A full list of interviewees will be provided to MLA. The interview format and survey instruments are provided in Appendix 2.

Preliminary key findings and recommendations were reviewed in a meeting with key MLA staff in June 2013.

'University Leaders' were interviewed to provide insight into institutional aspirations and any planned changes in RD&E focus that could influence the training and output of professionals

including scientists. The list of University Leaders was compiled from the Australian Council of Deans of Agriculture (ACDA) list of members (i.e. Deans and Heads of Schools/Departments), and supplemented with the names of the Deans/Heads of Australian Schools of Veterinary Science. The vast majority made themselves available for face-to-face or telephone interviews while senior staff filled in for those unavailable due to overseas travel or other commitments.

The surveys sought perceptions of current and emerging industry challenges, knowledge and science needs, institutional strengths, and undergraduate and postgraduate student enrolment trends. Information was also sought on awareness of the MLA Scientist Education portfolio, inspiration and motivations for research and rural RD&E in particular, pathways into RD&E, career horizons and factors that would drive them from a leadership role at their university/institution. Actual data on enrolment trends, especially in the postgraduate area was also collected.

'Students' surveyed included the recipients of MLA Undergraduate scholarships, Postgraduate Scholarships and Post Doctoral Scholarships for the period 2001-2012. A list of MLA-funded 'students' and their Supervisors was provided by MLA staff. Unfortunately, the contact details of the 2001-06 postgraduate students were not available and required considerable research. Up to date contact details are not available for many from the original list of students. Students were surveyed electronically, with 39 of 57 students responding (58%).

The e- surveys sought insights into current and emerging industry challenges, knowledge and science needs, institutional strengths, institutional changes, undergraduate and postgraduate enrolment trends, the benefits of their scholarships to themselves and their supervisors, inspiration and motivations for a career in RD&E, pathways into RD&E, anticipated horizon for a career in R&D in the red-meat industry and factors that would drive them away from this field.

Among the student respondents:

- 41% saw themselves as a 'young researcher/extension officer';
- 18% as an 'emerging R&D or extension leader';
- 10% as a 'junior academic or educator', and 5% as an 'R&D leader'; and
- Around 10% (2001-12) are now supervising Postgraduate student or Postdoctoral positions.

'Supervisors' were also surveyed electronically, with 21 of 43 responding (49%). These surveys sought insights into current and emerging industry challenges, knowledge and science needs, institutional strengths, institutional changes, university enrolment trends, the benefits of scholarships to students and supervisors, inspiration and motivations for a career in RD&E, impediments to entering into and RD&E career, pathways into RD&E, anticipated horizon for a career in R&D in the red-meat industry and factors that would drive them away from this field.

Among the supervisor respondents:

- 67% classified themselves as senior academics; and
- 19% as research leaders.

Representatives of RD&E Organizations (i.e. Employers) were identified by MLA and the Review Teams' networks, and were also surveyed electronically (33 of 93, 35% response rate). These surveys sought insight into current and emerging industry challenges,

knowledge and science needs, anticipated changes to organizational direction, recruitment and retention trends, the MLA Scientist Education portfolio, university training and education, inspiration and motivations for a career in RD&E, impediments to entering into and RD&E career, pathways into RD&E, the anticipated horizon for their career in the red-meat industry and factors that would drive them away from this field.

Among the RD&E organisation respondents:

- 52% classified themselves as an R&D or Extension leader;
- 15% as Emerging RD&E leaders; and
- 15% as a Young RD&E officer and 10% as Consultants.

Further key industry and other stakeholders were identified by MLA and through the Review Team's networks, and were interviewed face-to-face. These surveys sought perceptions of the current and emerging challenges, knowledge and science needs and planned changes in the direction of research.

The long-standing Human Capacity Problem Issue defined

From McColl (1991) through to the recent Senate inquiry and the Southey report commissioned by the Victorian Government and concluded in 2012, successive studies and reports have identified a problem of increasing intensity with regard to Human Capacity in Australian agriculture.

The response to date has been to do more with less. Severe shortages are evident in specific areas, although the adoption of technology by the industry has averted the looming 'crisis'.

The current situation, of making do, combined with a general slowdown in Australia's RD&E capacity, particularly in comparison to overseas competitors and the ever declining terms of trade, combine to demand a new approach.

Declines in undergraduate enrolments in agriculture were apparent by 2000, and the Australian Council of Deans of Agriculture (ACDA) was established in 2007, largely to address this problem. The ACDA has identified external factors such as negative perceptions of agriculture, a lack of awareness of where food and fibre come from and career opportunities as the main reasons for the decline in enrolments.

However, the 2012 University Experience Survey (ACER 2013) **reveals that the performance of Australian universities is 'below national average' in terms of First Year Agriculture** and Forestry student support, learner engagement, teaching quality and skills development. By contrast, Later Year Veterinary Science is 'above national average' in learner engagement and student support. Also, only one subject area - 'First Year Agriculture and Forestry' - (1 of 45 subject areas) was rated 'below national average' for more than one university performance area, and it comprised four of the ten areas where Australian universities are performing below national average.

Recent reports (Pratley 2012) suggest that the current supply of agriculture graduates (~700) will only meet around 20% of the current demand (4000), and this gap is expected to grow with retirements of current scientists and extension professionals over the next 5-10 years. **However, these reports do not distinguish the occupations that are the focus of this review.**

Across the food-related fields of education (i.e. agriculture, food science, agribusiness, etc) the five-year trend in the number of commencements in undergraduate and postgraduate studies has been -19% and -8%, respectively.

Data for 2011 shows 850 domestic undergraduates and 200 domestic postgraduates commencing agriculture and agribusiness studies. While undergraduate enrolments in these two fields have declined over the past five years, (-2 and -50% respectively), postgraduate enrolments have increased 3% and 340% over the same period (AWPA, 2013). In 2011, 180 postgraduates in agriculture (169) and agribusiness (11) completed their studies. This represents a 5-year change of 42% and 38% for the fields of agriculture and agribusiness respectively. This means that in general terms there should be an adequate supply of participants with higher degrees.

In early 2013, reports in the rural press suggested a widespread surge in undergraduate enrolments in agriculture of 10-20% (Atkins 2013, Austin 2013). No insights into the reasons for this sudden increase were provided, and at this stage it is not possible to determine if this is just a one-off ‘spike’ or the beginning of a longer-term trend.

THE SCIENCE PIPELINE--STAKEHOLDER VIEWS

MLA students, Supervisors and University leaders were asked to comment on the trend(s) over the past 5 years in undergraduate, postgraduate coursework, postgraduate research and postdoctoral student numbers. University leaders were also asked to supply actual data on the numbers of students in these categories in the years 2008 and 2012. The responses from Veterinary Science schools were comprehensive, but the responses from Agriculture and related schools have been very patchy and are incomplete.

University Leaders

Over 60% of University Leaders report a growing trend in undergraduate numbers over the past 5 years while the remainder report steady or flat enrolments. Growth in domestic postgraduate coursework enrolments are reported for around half the institutions with the remainder reporting flat or declining enrolments. Seventy percent of the University Leaders reported growth in international enrolments in postgraduate coursework and eighty percent in postgraduate research. Just over half reported growth in numbers of postdoctoral appointments, although from a very low base, while the remainder reported a flat pattern of enrolments.

Supervisors

Thirty-six percent of the Supervisors report declining domestic postgraduate coursework enrolments, and a further 21% declared that these enrolments have been flat or steady over the past 5 years. Reasons provided for these trends include the lack of interest and employer support, the relevance of the programs and poor marketing.

Thirty-six percent of Supervisors report a decline in international postgraduate coursework enrolments, while 29% report growth in this area over the past 5 years.

Fifty-seven percent of Supervisors report flat or declining numbers of domestic postgraduate research students, while 21% report growth in this area over the past 5 years. Reasons given for steady or declining enrolments include the value of scholarships and the lack of research funding, and better opportunities in the biomedical area or other industries.

The trends in international postgraduate research enrolments reported are equally divided across the three options presented – declining, flat or growing.

The Supervisors forecast that the outcome of these trends in postgraduate enrolments will be a smaller pool of capacity for high-level analysis, problem solving and application of science, a lack of research expertise, and an increasing need to recruit from overseas. However, those who have experienced growth in postgraduate enrolments report that they are able to attract very good students. This augers well for industry and for solving its emerging challenges.

Students

Over 72% of MLA students do not perceive any growth or decline in domestic student enrolments in postgraduate coursework or postgraduate research programs over the past 5 years, while 18% and 67% of MLA students believe that international student enrolments in postgraduate coursework and postgraduate research programs respectively have been growing steadily over the past 5 years. MLA students who believe that domestic enrolments have been steady or in decline (18% respondents) have suggested that there is limited or no relevant postgraduate coursework available, fees and costs are too high, and that the incentives for postgraduate research (especially funding) are inadequate and jobs scarce or hard to find**. Students perceive that Poultry and Pork scholarships are better funded (i.e. $5000-$10,000 more) and have better student support than MLA scholarships**.

Students acknowledge that the outcome of these trends will be a shortage of people to work with and reposition the Australian red meat industry to meet the emerging challenges.

Conclusions

Clearly, student numbers in agricultural science have declined in the last decade, compared with the 1990s and earlier. However, two universities report very strong enrolments and Veterinary Science faculties are at capacity. Other universities report a recent surge in interest in Agricultural Science. In addition, animal science is favoured among students of Agricultural Science.

This leads us to conclude that sufficient numbers of students are available for the red meat industry pipeline, provided they are nurtured and attracted into redmeat industry RD&E careers.

We also conclude that some institutions are more effective in their marketing to domestic students, and especially potential postgraduate students.

Recommendations

That MLA actively engages with universities to attract students into the redmeat industry RD&E pipeline. This will require a focus on people, not just projects, and an increase to the stipends available for post graduate students. This should also involve a program to carefully influence selected universities. By contributing to the appointment of inspirational professorial chairs for the red meat industry, MLA will be able to entice students to areas of need.

The relevant recommendations are as follows:

(1) That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline.

(3) That MLA changes its focus to focus on people, not just projects.

(4) That MLA increases the level of support of post graduate students with attractive stipends.

(5) That MLA moves to carefully and deliberately influence selected Universities

RECRUITMENT AND RETENTION TRENDS

University Leaders

Today's University leaders (i.e. Deans, Heads of Schools or Departments) have been in a leadership role for 7.5 years on average (range 2-13 years). These are usually term appointments, and the incumbents anticipate remaining in these roles for only 2.2 years on average (range 1-5 years). They are confident that they can be replaced but have expressed concerns about the industry knowledge and managerial skills of the new appointments because their employers increasingly focus on ascending the international university ranking scales rather that addressing domestic issues

Supervisors

The supervisors anticipate continuing to work in the redmeat industry for an average of 15 years (range 3-30 years) and to continue supervising postgraduate/ or postdocs for almost 14 years (range 3-30 years). The main drivers for them to leave the field will be retirement, lack of funding, redundancy and a requirement to do more teaching.

Students

MLA students envisage that they will continue working in the red meat industry for an average of 13.1 years (range 0-35 years), although this masks the bi-modal response. Thirty-two percent of MLA students anticipate remaining in the industry for 1-5 years, and 27% for 21+ years, while 18% do not see themselves working in the red-meat industry. Given the investment in students, it is rather disconcerting that 50% of student respondents see either no career opportunities, or at most a 5-year career in the red meat industry.

The Beef and Sheep CRCs have made a major contribution to the pool of highly trained and industry focussed RD&E professionals**. The significantly higher rate of retention of CRC students compared to MLA students, in either the redmeat industry or in agriculture generally, warrants further investigation.**

The major drivers for students to move away from the red meat industry are jobs/career opportunities/job security, with research funding and support and pay and conditions also important decision factors. This is expressed in their words as:

"Lack of job opportunities and no job security"
"Careers in science, research and agriculture do not pay near enough to make them attractive at this stage of life"
"Generally more money to be made in the industry or private sector"
"Need better incentives to attract and retain good people"

As previously mentioned, those who commented on better opportunities in other industries cited the dairy and poultry industry as examples.

RD&E Agencies

Seventy percent of the representatives of RD&E agencies believe that recruitment has been declining and a further 20% believe that at best it has been flat over the past 5 years.

State Government Departments of Primary industries (DPIs) and CSIRO have reduced their investment in RD&E focussed on the red meat industry. These reductions have led to redundancies and early retirements of a number of senior scientists, including extension specialists. **These reductions in investment in red meat industry RD&E have also led to concerns by younger professionals about career prospects in the industry, and in R&D in particular**. This reduction of investment by DPIs has also led to a reduction in the opportunities for new graduates to gain experience and capability which would enable them to readily move to the extension or consultancy arena.

Agency responses suggest that RD&E staff have worked in the industry for an average of 25 years (range 5-50 years) and anticipate continuing to work in the industry for a further 20 years (range 5-40 years).

The redmeat industry is losing skills in several areas through reduced Government (State and Commonwealth) funding, and these skills are not being replaced. Apart from the loss of invaluable experience and key skills, the loss of corporate knowledge and scientific rigour are two other important consequences identified. **Experience and skills have been lost in pasture and range management, animal health, extension, and genomics/bioinformatics over the past 5 years,** and further losses are predicted in pasture and range management and extension skills through retirements and redundancies over the next 5 years.

The impacts of reductions in recruitment in Government agencies (State Departments and CSIRO) and the temporary reduction in numbers of graduating students point to a possible "gap" in numbers of scientists available for the red meat industry in the 30 to 50 year-old age group. With significant losses of senior scientists, extension officers and academics in some universities, through retirements and redundancies anticipated over the next 5 years, this "gap" might flow on to a major "gap" in leadership and experience in research, extension and teaching in the next few years. **The major challenge is to predict the outcome of the interaction of a shrinking market for employees (reductions in numbers in CSIRO and State agencies), the trend towards "mega farming businesses' and the supply and quality of graduates.** It seems likely that supply of 'fresh' graduates may meet the demand in the near future if those graduates can be enticed into and remain in careers in research. The availability of clear career options and the level of mentoring and financial support for Masters, PhD and Postdoc candidates will be important influences on this outcome.

Conclusions:

MLA investments in undergraduate students, post graduate students and post-doctoral and mid career scientists have been effective and in certain cases, highly effective. However, with the reductions in employment opportunities in State Departments of Agriculture and CSIRO, and a feeling among students that their career options are limited, a far more active approach is required.

Students have reacted very favourably to opportunities to engage more closely with the red meat industry, as have the university academics.

In addition, a "new equilibrium" is being established between the numbers of graduating students and the available RD&E career.

Sufficient students are interested in careers in the red meat industry, but they will only be will be available for the red meat industry if they are attracted to it and can see genuine career opportunities.

Recommendations:

To ensure an effective pipeline of RD&E professionals for the red meat industry, MLA must actively influence selected universities and entice students to areas of need. Because the opportunities to develop their skills in the red meat industry with State Departments of Agriculture have diminished, MLA should actively enable the training of fresh graduates to ensure their usefulness to the industry.

The relevant recommendations are as follows:

(1) That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline.

(3) That MLA change focus to focus on people, not just projects.

(5) That MLA moves to carefully and deliberately influence selected Universities.

(9) That MLA prioritises investments in the science pipeline with greatest emphasis on the "close to career" end of the pipeline and the least investment at the primary school and secondary school end of the pipeline.

STUDENT NUMBERS

Overall, the number of undergraduates studying Agricultural Science and Animal Science at Australian Universities appears to have increased substantially in some areas above the low of 10 years ago. This trend is contrary to recently published data on enrolments (Pratley, 2012). Some Universities have a full complement of undergraduate students, other universities are well below long-term previous student numbers, but are currently experiencing healthy increases. Student numbers are higher in the veterinary sciences and animal sciences than in agricultural production or soil sciences.

Overall, the number of postgraduate coursework and research students is growing, although this is largely driven by growing international enrolments. Almost half of the institutions report flat or declining enrolments in domestic enrolments in postgraduate coursework and research. Almost half of the institutions report growth in postdoctoral numbers, although this is from a very low base, while the others report flat numbers.

Universities with a regional presence seem to have been more able to attract domestic students in the agricultural and veterinary sciences than a number of the "capital city-based" universities. This may reflect their marketing strategies and its' focus on workforce development.

Schools of Veterinary Science have a full intake, but the vast majority of these students are focused on small animals and on clinical practice. Graduates in Veterinary Science are a source of research scientists for the red meat industry, but some support and greater linkage into the red meat industry would be beneficial. These graduates, while well trained in clinical veterinary science, may need further training in production/farming systems and research methods (data collection and analysis) to be effective in R&D.

Schools of Agriculture/Food/Land/Environment are generally below capacity and focused on some of the current and emerging issues along the supply chain. **The most significant issue in the food market according to the universities is that customers are becoming more discerning and are demanding full transparency of the provenance of their food (and fiber).** Australia will not be feeding the world, and the people we do feed are moving up the scale in standard of living and are more sensitive and demanding of our food production systems. From a production viewpoint the issue is ensuring that Australia has Agriculture and Veterinary Science leaders who understand the whole farming system and have unbounded enthusiasm for inspiring inquiry and passing their knowledge on to the next generation.

Domestic postgraduate students undertaking studies which would lead to a career in R&D for the red meat industries are heavily reliant on MLA scholarship support.

Many of the post-graduate students studying in fields of importance to the red meat industry are from overseas. Some Universities have found it very difficult to recruit postgraduate students from Australian origins, particularly those with significant work experience. These students are highly regarded for the quality and relevance of their work, but find it difficult to return to living on a stipend after a period of time in the workforce.

Conclusions:

The numbers of students undertaking degrees in Agricultural Science (including Animal Science and related degrees) has been a concern. Overall student numbers suffered a decline, and commentary suggested that far more jobs would be available than qualified applicants to fill available jobs.

This concern is only partly founded. A number of universities have continued to experience strong student enrolments over the last five years, and a number of institutions report a resurgence of interest in Agricultural Science. All of the Veterinary Science schools nationally report full student numbers, although many of these students are interested in small animals and in clinical work rather than RD&E.

Many of the RD&E roles for the red meat industry have a common science base to human health sciences or environmental sciences.

While the numbers of students undertaking Agricultural Science may have suffered a decline (and then somewhat of a resurgence of interest) on average, nationally, this decline does not necessarily mean insufficient applicants for the number of the positions required for the future of the RD&E in the red meat industry. This is because fewer jobs are available, and students from related fields can readily adapt to roles for the red meat industry. What is lacking is the clear focus on animal science and red meat animals in particular. What is also lacking is close industry connection with the red meat industry and engagement of students in the practical aspects of animal husbandry and production practices.

Recommendations:

The red meat industry is part of agriculture and the scientists who will form the core of red meat R&D capacity will come from a variety of sources. For this reason, MLA should work in harmony with other RDCs to enhance the student experience, help students link and network into Australian agriculture (and the red meat industry in particular) and support students financially.

That MLA **contributes to the appointment of inspirational chairs of practical agriculture** at universities. The role of these appointments should be to inspire students, to engage with industry, to provide practical industry experiences for students (such as study tours) and to influence the development of curricula suited to the needs of the red meat industry.

That MLA acknowledges that scientists of the future will come from a range of backgrounds and have been inspired into “agricultural science” at various stages of their education. Given this acknowledgement**, MLA should actively seek to entice students into areas of need by specifying the field of interest for undergraduate scholarships.** Parasitology is one such area and pasture and production systems research is another.

The relevant recommendations are as follows:

(1) That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline.

(2) That MLA targets its investments so as to be able to focus on the major challenges facing the industry.

(3) That MLA changes its focus to focus on people, not just projects.

(5) That MLA moves to carefully and deliberately influence selected Universities

(8) That MLA prioritises investments to fill the gaps and meet the needs of a future redmeat industry and then actively entice students into areas of need

CURRENT AND EMERGING CHALLENGES AND SCIENCE NEEDS

Across the four stakeholder groups surveyed, the top six challenges facing the red meat industry over the next 5-10 years have been identified as follows:

- Animal welfare
- Human capacity (i.e. age, retirements, knowledge and skills)
- Land use and management (i.e. sustainability, environmental impacts of production)
- Enterprise profitability and competitiveness
- Market demands and competition
- Consumer perceptions and sensitivity (i.e. practices, food quality, health).

This list is consistent with the priorities identified in Red Meat Industry Plan, NABRC & SAMRC RD&E priorities and MLAs 2010-15 Strategic Plan.

It should be noted that there is some variation in perceptions of the relative importance of the challenges identified by the four stakeholder groups (above). For example, the University Leaders and RD&E representatives rated consumer perceptions higher than either the Supervisors or Students. RD&E reps rated human capacity higher than the University Leaders or Supervisors. Students rated environmental impact and maintenance or improving productivity higher than any of the other stakeholder groups. Students and RD&E agencies rated land use and management higher than the University leaders or Supervisors. These differences probably reflect differences in understanding of practitioner's needs and proximity to the application of R&D.

RD&E agency perspective

The science/disciplines needed to fill the emerging knowledge gaps over the next 5-10 years have been identified by the representatives of RD&E agencies as grazing/farming systems, pasture science and feedbase management, animal behaviour, simulation and economic modelling, IT (remote technologies), rangeland ecology, economics and social science. Fifty-five percent of the respondents believe that their organizations can access the skills and knowledge they need, and forty-five do not.

The knowledge and skill areas where agencies have been struggling to find suitable applicants have been identified as pasture and range management, modelling, reproduction, animal behaviour, parasitology and disease management. It is noted that attracting senior scientists/research managers and researchers to remote localities has been an ongoing and significant problem.

Fifty-seven percent of the representatives of RD&E agencies believe there will be changes in their agencies' research focus, and thirty–six believe there will be changes in extension activity. Likely changes in research focus include both reductions and increases in research effort. Increased research activity is planned in sheepmeat, genetics, pasture and rangeland management, sustainability and resource use efficiency.

Apart from a general decline in extension activity, changes anticipated include less 'one-on-one' and more group extension and greater evaluation of extension. Some universities have recognized an emerging need to track the impact of their research, and are now considering extension appointments in an adaptation of the US Land Grant University model.

University Leaders

Current challenges for the red meat industry, identified by University Leaders, included the following issues (in declining order of frequency):

- Consumer perceptions and concerns re production systems, human health
- Animal welfare
- Profitability and competitiveness
- Sustainable land use
- Markets and market share
- Climate change and greenhouse gas
- Productivity
- Water use efficiency
- Supply chains
- Labour shortages and attracting youth
- Adoption of R&D
- Biosecurity

Emerging challenges for the red meat industry over the next 5-10 years, identified by University Leaders, included the following issues (in declining order of frequency)

- Ethics and animal welfare.
- Consumer understanding of production systems and sensitivity to health and environmental impacts of production
- Environmental impact of production
- People and human capacity (labour shortages, disconnection between the city and the bush)
- Food quality, safety and health
- Extension and adoption
- Climate change re new pests and disease vectors, irrigated and intensive agriculture
- Biosecurity
- Technology
- Sustainability (NRM, resource use efficiency, increasing production within the constraints of sustainability, B/C of intensive and extensive production systems, Greenhouse gas)
- Product quality and assurance
- Enterprise profitability and competitiveness
- Segregation of the supply chain

Knowledge needs/gaps identified by University Leaders, included the following (in declining order of frequency):

- Rangeland use and management
- Animal behaviour and nutrition
- Sustainable production systems that integrate animal and environmental factors, Environmental footprint of production
- Farming systems that integrate crop and animal production, Organic production systems
- Production systems with increasing resource use efficiency in a variable climate, Adapting to a more arid climate
- Improved pastures
- Extension training
- Consumer influences and decision making
- Public attitudes and concerns
- Systems understanding
- Livestock reproduction

Supervisors

Current challenges for the red meat industry, identified by the Supervisors, included the following issues (in declining order of frequency):

- Animal welfare
- Profitability and competitiveness.
- Consumer perceptions and expectations re sustainability.
- Maintaining or improving production.
- Market demands, competition and supply chains.
- Human capacity (ageing profession, succession, attracting the best).
- Extension and adoption of R&D.
- Land use and management, sustainability.
- Disease and animal health.
- Climate change and variability.
- Biosecurity.
- Reproduction.

Emerging challenges for the red meat industry over the next 5-10 years, identified by Supervisors, included the following issues (in declining order of frequency):

- Consumer perceptions and expectations (health and dietary issues, ecosystem and animal management).
- Sustainable resource use and production; pasture and weed management.
- Animal welfare.
- Markets and competition.
- Productivity improvement and profitability.
- Human capacity (workforce skills and education, ageing, succession, technical support).
- Climate change and extreme weather events.
- Support for R&D and innovation.
- Livestock diseases, drench resistance.
- Declining government investment in education (low enrolments and high cost units untenable).
- Supply chain integration and optimisation.
- Food security.
- Adoption and extension
- Reproduction.
- Greenhouse gas.
- Willingness of industry to support anything that doesn't deliver an outcome in 2 years.

Knowledge needs/gaps emerging over the next 5-10 years, identified by Supervisors, and included the following (in no particular order):

- Meeting consumer and other stakeholder expectations meat production
- Effective and rapid mechanisms for communication with a diversity of stakeholders about industry issues
- Education and training strategies for wider and more rapid adoption of research outputs
- Applications of technology to enhance productivity and efficiency
- Balancing production efficiency and environmental impact
- Understanding the boundaries of sustainable management of different land types and landscapes
- Greenhouse gas emission management and measurement

- Unforseen physiological or product quality problems associated with continued genetic selection for production traits

In addition, some Supervisors have identified opportunities for innovation in areas such as application of technology to improve public perception of animal management and welfare, refinement of management of inputs, surveillance of animal diseases and more efficient meat processing.

MLA students – the next generation of RD&E specialists

Current challenges for the red meat industry, identified by MLA students, included the following issues (in declining order of frequency):

- Consumer perceptions (re environmental impact, human health, etc)
- Animal welfare
- Sustainable land use and management
- Market demand and competition
- Profitability and competitiveness
- Capacity of producers and agribusiness
- Improving production
- Animal health/disease
- Disease
- Adoption/extension
- Others included declining investment in research, job/work conditions.

Emerging challenges for the red meat industry over the next 5-10 years, identified by MLA students, included the following issues (in declining order of frequency):

- Market demands and competition
- Animal welfare
- Sustainable land use and management
- Environmental impact
- Maintaining and improving production
- Capacity, attraction and retention of producers and agribusiness
- Consumer perceptions
- Profitability and competitiveness
- Adoption and extension
- Animal health/disease/biosecurity
- Declining investment in research
- Others included meat quality, food safety and integration.

Knowledge needs and gaps identified by MLA students, included the following (in no particular order):

- Linking sustainable land management to economic outcomes
- Bridging cultural differences for better animal welfare
- Impacts of agriculture on the environment
- Effects of global changes (i.e. climatic, social and financial) on the profitability and sustainability of beef production

- Enterprise level ROI of commercial animal health and nutrition products
- Impact of the lack of information flow along the supply chain.

Conclusions:

The diversity of these current and emerging challenges and science needs suggests that a mix of strategic research, applied research and experimental development is required. The application of a wide range of disciplines in multi-disciplinary and trans-disciplinary research will also be required. **Not one of these big issues will be solved through a single discipline or technological approach and all have a strong social dimension.**

In order to address these major gaps and the emerging challenges the following disciplines will be required:

Agronomy; animal health; animal nutrition; animal welfare; biochemistry; biodiversity conservation; climatology; ecology; economics; food technology; genetics; landscape ecology; marketing; meat science; meteorology; microbiology; modelling; pest management; plant nutrition; sociology; soil science; systems science and veterinary science.

In order to meet many of the challenges for the red meat industry in future, particularly the socio-economic issues which have been highlighted, MLA will need a "constructive" organisational culture. This culture will enable MLA to take a broad approach to problem solving and will engage a number of disciplines not traditionally part of red meat RD&E. This "constructive" culture will value diversity of view and will value a breadth of disciplinary approaches.

Measurement of organisational culture and the implementation of changes to culture are beyond the scope of this consultancy, but most of the recommendations outlined above require a different approach to RD&E. They involve a focus on "people" rather than "projects" and, and this requires innovation in approach and a "constructive" culture.

A shift in culture is also required for the industry as a whole, if it is to have a vibrant future. The development of a "constructive" culture will enhance industry prospects. MLA can lead!

Recommendations:

That MLA undertake a cultural inventory of both MLA RD&E staff and a selection of industry stakeholders. Once an inventory of culture is "measured" then specific steps to build a constructive and inclusive culture should be identified and undertaken.

One additional step to build a constructive culture is to recruit MLA staff from a diverse background and approach. Typically, organisations employ "like" individuals. To build the necessary diversity within MLA, recruitment and selection practices which build an organisation with a diversity of view should be employed.

The relevant recommendations are as follows:

(1) That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline.

(3) That MLA change focus to focus on people, not just projects.

(5) That MLA moves to carefully and deliberately influence selected Universities.

(6) That MLA takes the initiative to Partner with other RDC's.

(11) That MLA moves to fill the gap left by CRCs.

(12) That MLA specifically intervene to develop a more constructive culture in relation to science and education within MLA and the redmeat industry.

INTERVENTION IN SCHOOLS TO ENHANCE THE SCIENTIST EDUCATION PIPELINE

Approximately 9400 schools in Australia annually feed students into a number of Vocational Education and Training (VET) and 14 Higher Education institutions offering a range of programs and courses relevant to the redmeat industry - agriculture, animal, plant and veterinary science, environmental science or natural resource management, economics and social science.

Career motivation and decision-making

Schools and education reinforce values and attitudes about national issues and emerging challenges, and induct the young into society (Halsey, 2013), and early school experiences have long-lasting outcomes (Shonkoff et.al, 2000, Bowman et.al 2001). Middle childhood (8 to 12 years) is when children learn the values of their society and is important for developing interests, motivation and enthusiasm for learning and work (NAEYC 2002). Motivation is an important consideration because it contributes more to the prediction of achievement than the effects of ability (Lai 2011). Adolescence (12 to 18-20ish) is when children/youth search for identity and face the challenge of matching who they want to be and what is socially acceptable. This is a period where students benefit more from direct experience than from abstract ideas and principles (Lai 2011), and motivation can be manipulated through certain instructional practices (e.g. experiential or action and collaborative learning).

Other industries (e.g. engineering and nursing) are now focusing their awareness and career intervention strategies on schools (Myers 2011, Rhodes et al 2011), as are animal activists.

Funneling students into the Pipeline

MLA-funded students have emphasized that there were three key phases when their career motivations were aroused, nurtured and developed – primary school, late secondary school and at university.

At primary school any intervention should focus on raising awareness and interest in primary industries through learning environments. The values and views of teachers and parents will be important influences at this stage.

Intervention in secondary school should focus on developing awareness of professions and careers through direct experiences. In this phase, the values and views of teachers, parents (especially mothers) and student's peers will be important influences on career motivation and decisions.

At university, interest in the redmeat industry and/or research is often motivated by the experiences provided by inspirational teachers/lecturers and a clearer understanding of the diversity of opportunities along the food and fibre supply chain.

Conclusions:

Interventions along the science pipeline are necessary to eventually end up with adequate numbers of graduates for the red meat science pipeline. However, we conclude that investments close to the end of the pipeline, (university undergraduate and post-graduate students), are the most effective investments.

Recommendations

MLA prioritise investments in the science pipeline with greatest emphasis on the “close to career” end of the pipeline and the least investment at the primary school and secondary school end of the pipeline.

The relevant recommendation is as follows:

(9) That MLA prioritise investments in the science pipeline with greatest emphasis on the “close to career” end of the pipeline and the least investment at the primary school and secondary school end of the pipeline.

PATHWAYS TO QUALIFICATIONS FOR RD&E

According to the 2011 census, 60% of the occupation 'Agriculture and Forestry Scientists' have a Bachelor degree or above, and 16% have an Advanced Diploma/Diploma.

Pathways and criteria for entry and qualifications are defined by the Australian Qualifications Framework (AQF). Among other things, the AQF '*supports the development and maintenance of pathways which provide access to qualifications and assist people to move easily and readily between different education and training sectors and between those sectors and the labour market'* (AQF Council, 2013). The historical distinctions between VET and Higher education are blurring.

Recent changes to the AQF released in January 2013 have some implications for the scientist education pipeline:

- Diplomas, Advanced Diplomas, Graduate Certificates and Graduate Diplomas can now be issued by both the higher education and vocational education sectors.

- Masters by Coursework rules now specify a requirement to plan and execute a significant research-based project.

Importantly, recognition of prior learning or advanced standing for relevant and current learning will continue for entry or credit towards a qualification.

Conclusions:

There is no "one size fits all pathway" and whilst the traditional pathway from school to university to higher education works well for some, there are many potential students who will embark on higher education later in their careers if the opportunities are available.

The relevant recommendations are as follows:

(1) That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline.

(3) That MLA changes its focus to focus on people, not just projects.

(9) That MLA prioritise investments in the science pipeline with greatest emphasis on the "close to career" end of the pipeline and the least investment at the primary school and secondary school end of the pipeline.

(12) That MLA specifically intervene to develop a more constructive culture in relation to science and education within MLA and the red meat industry.

INSPIRING AND MOTIVATING THE NEXT GENERATION OF SCIENTISTS AND ADVISORS

University Leaders, Supervisors, RD&E agency reps and Students were asked 'when do people start thinking about a career in agriculture/science', 'what inspires young people to take a career in agriculture, and to undertake rural R&D in particular'.

There is no consensus on when students start thinking about a career in agriculture/science (Table 1). The perceptions reported were mostly based on personal experience or observations, although the response of several University leaders was informed by the body of research on career influences and decision-making.

This finding suggests that investments are required in both schools and universities to funnel students into RD&E and to capture the diversity of interests and backgrounds required for innovation, knowledge and skills to address the redmeat industry's biggest challenges.

School-based experiences are clearly highly influential, while work experience after school years is the least influential experience.

Table 1. Percentage response by stakeholder group when asked the question "at which stage do students start thinking about agricultural careers".

Stage at which students start thinking about agricultural careers	University Leader perceptions	Supervisor perceptions	RD&E staff perceptions	MLA students - actual
Primary school	26%	14%	5%	27%
Early secondary school	21%	21%	26%	0%
Late secondary school	18%	29%	57%	41%
After leaving school / work experience	6%	0%	5%	18%
At university	29%	29%	5%	23%

University leader perspective

University leaders highlighted the importance of a rural experience and inspirational teachers and lecturers in motivating students to take agricultural subjects. Once awareness of the importance and relevance of the industry is aroused, other motivators like the lifestyle and opportunities for travel become important. Once enrolled in agriculture or a related program, the undergraduate experience and support, especially during final years/honours are particularly important motivators of interest in R&D.

However, several University leaders noted that increasingly, rural R&D is done in a laboratory, and that this is not attractive to the traditional age student. Furthermore, it was also noted that many postgraduates can't find jobs and that a PhD was less of a passport to academics and may in fact limit career opportunities

Supervisor perspective

Supervisors reinforce the importance of a rural background or exposure to, or some other connection with agriculture from an early age. Inspirational lecturers and scientists relating agriculture to global issues (e.g. food supply and security) are also important. However, it is noted that reliance on scientists with farming experience may not enable industry to address some of the big emerging issues. People who see rural R&D as an academic and intellectual challenge can provide a different and valuable perspective on these issues.

Student perspective

MLA students have indicated that their inspiration to do agriculture/plant/animal science was either an experience or a strong motivation. For example, 46% of students cited a farm background or experience and a further 9% a school-related experience. Fourteen percent cited inspiring teachers/lecturers, while 18% had always wanted to work with animals and a further 14% wanted to make a difference.

Forty-one percent of students chose rural R&D specifically because they wanted to make a difference by working in important areas (e.g. food security, sustainability, global warming), while 14% cited previous knowledge/experience, 14% cited a rural lifestyle and a further 9% perceived (or their influences perceived) an opportunity or growing demand in this area.

RD&E agency perspective

This group also identified a range of rural experiences and inspirational individuals as major influences, and highlighted the lifestyle aspect (i.e. outdoors, working with animals) as a very important influence.

Conclusions:

Although each student makes career decisions uniquely, most individuals make career decisions in late secondary school and while at university. Many students change their career choice when they see opportunities that interest them. From MLA's perspective, redmeat RD&E careers must be made attractive for students to choose this career.

The relevant recommendations are as follows:

(3) That MLA change focus to focus on people, not just projects.

(12) That MLA specifically intervene to develop a more constructive culture in relation to science and education within MLA and the red meat industry.

IMPEDIMENTS TO ENTERING INTO AN R&D CAREER TODAY

Among the stakeholder groups there is widespread agreement that lack of jobs/career opportunities and better remuneration and employment conditions elsewhere are the major impediments to entering into a career in rural RD&E and the redmeat industry in particular. In stark contrast to various reports from the Deans of Agriculture very few of our respondents identified the image of agriculture as an impediment. Some observed that agricultural R&D was not a highly regarded or prestigious career (cf. biomedical research).

The other important impediments identified include:

- Job insecurity (i.e. looking for a new job every 2-3 years)
- Lack of clear career paths and progression
- Negative perceptions of R&D (i.e. ridiculous hours, loneliness)
- Funding for R&D (i.e. press reports of dis-investment by State agencies)
- Lack of access to professional development and isolation of RD&E professionals in remote areas.

Differences in the culture of various RD&E employers (i.e. workloads, support, mentoring) were noted, and this may impact on the capacity of some institutions/agencies to attract appropriate skills and the 'best' people. The veterinary and biomedical sciences do not appear to have problems in attracting and retaining high quality students and graduates, and a comparative analysis of agricultural and the veterinary/biomedical sciences might be a worthwhile investment.

Finally, it was noted by University leaders that the income differential between graduate and postgraduate qualifications in agriculture has been declining steadily over the past 5 years, and was now a dis-incentive for undertaking a PhD. For example, the comment was made that "*there are plenty of well-paid jobs without doing a PhD*".

Conclusions:

To be competitive with other careers, RD&E careers for the red meat industry will need to be more attractive. This will require improvements to job security, remuneration, work conditions and professional development.

Recommendations

The appointment, in collaboration with other RDC's of 'Inspirational Chairs' (as discussed in recommendation 3) at selected universities. The development of 'Human Capacity' and a greater focus on people will address these issues.

The relevant recommendations are:

(1) That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline.

(2) That MLA targets its investments so as to be able to focus on the major challenges facing the industry.

(3) That MLA changes its focus to focus on people, not just projects.

(12) That MLA specifically intervenes to develop a more constructive culture in relation to science and education within MLA and the red meat industry.

Addressing the Impediments

Solutions offered by survey respondents ranged from greater investment in school education, through greater engagement with the universities and investment in professionals (career scientists and mentors), to a total revamp of the funding model.

At the secondary schools level, the suggestions included developing more positive messages about the lifestyle and sophistication of today's agribusinesses, using younger 'role models' to promote the value of agriculture and the impact of R&D, sponsoring secondary students to MLA events (e.g. MLA Meat profit Days), and even targeting 'passionate students' in regional high schools for undergraduate scholarships. Industry has a role in providing opportunities for both urban and regional students to experience the lifestyle and hear of the opportunities and career paths.

Enrolments in Vet Science suggest that there is no difficulty in attracting people to work with animals, the challenge is attracting people in general, and city-based children in particular, into related areas of agriculture and especially R&D.

Given the high turnover of leadership at university school/department levels it is apparent that MLA needs to engage more with selected universities at a higher (e.g. DVC Research) and more strategic level. This may include co-investment in facilities and people at universities where there is real research and teaching strength and a commitment to 'extension', and facilitating partnerships with other RDCs and R&D agencies.

There is a clear need to better manage and support early and mid-career scientists. This should include mentoring, assisting them in finding worthwhile and engaging roles, enabling their first research grant, tackling the isolation issue by facilitating 'communities of practice' and other support networks and funding for networking activities, especially for people in rural and regional areas.

Greater continuity of employment (i.e. min 5-10 year contracts) is essential to attract high potential RD&E professionals and retain the critical mass in high performing RD&E teams. A UK scheme for attracting and retaining staff called 'New Blood' warrants further investigation.

There is clearly a need for greater investment in research. Suggestions for a revamp of the funding model include identifying key research areas or needs and its location(s), sourcing the best skills to address the issue(s), and providing pay, benefits and a work culture that retains key staff. The Beef Industry R&D Plan provides a framework for this approach.
It has been suggested that the way GRDC operates in this area has merit.

Finally, it would appear **that MLA and the industry may need to lobby governments to improve the pay and conditions of scientists and other professionals if they are to attract and retain the skills needed to ensure a bright future for the redmeat industry**. In 1980, Ag Science graduates earned the fifth highest salary after graduation (out of 20 fields of education). By 2011, this had fallen to 18th out of 23 fields (AWPS, 2013).

However, in the current economic climate it seems inevitable that there will be staff cuts rather than pay increases at both state and Commonwealth levels. In any case, history suggests that the former is usually a consequence of the latter.

Conclusions:

A multi-pronged strategy and a diversity of investments are required to address the impediments.

MLA is seen as (and sees itself as) a funder of RD&E, not a provider. However, MLA has a critical interest in the "people" undertaking the RD&E work in the red meat industry. It is the "people" who will be able to respond to emerging critical issues for the industry, and it is the "people" who provide the insights to take advantage of new knowledge and new technologies. These new and emerging technologies, and their adoption, provide the best prospect of a vibrant and prosperous red meat industry for the future.

The "people" reside in RD&E agencies, universities and private companies (consultancy firms), so MLA has no direct responsibility for them, but MLA has a critical interest in them. While the rights and responsibilities of employers is to be carefully respected, all of the employers we met and surveyed would welcome genuine engagement from MLA and active involvement in supporting RD&E staff, their professional development and their career development.

MLA has been accustomed to "managing projects" and is regarded as being able to do this well. However, a "project focus" has led to an "avoidance" of involvement in managing the science pipeline. Likewise, the "project" focus, has led to a diminution in the career prospects (as seen by RD&E entrants) and a lack of career development, particularly when RD&E agencies have been forced to reduce their investment in the RD&E pipeline for the red meat industries.

Recommendations:

That MLA **develops a "program"** to consolidate its investment in the human capacity to deliver RD&E outcomes for the future of the red meat industry. This "program" requires strong leadership and ongoing analysis to ensure strong performance. The "program" also requires performance indicators that make the program outcomes clear to all internal and external stakeholders. This program must not be separate from other programs, because some of the investments should be embedded on projects securing particular industry outcomes.

That MLA develops a genuine focus and active interest in the people and in the science education and employment pipeline. This will mean getting to know students and their teachers, and forming strategic partnerships with selected (but all relevant) universities.

To enable both of these objectives, MLA must appoint a senior manager to oversight this human capacity program. This senior manager should interact at board level, and be empowered to negotiate with senior executives of RD&E provider organisations, and universities (at the Deputy Vice Chancellor level).

The relevant recommendations are as follows:

(1) That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline.

IDENTIFICATION OF FUTURE SCIENTISTS

Pathways into RD&E

Diversity of Pathways

The source and pool of RD&E professionals includes domestic students trained in Australia and/or overseas, and international students who receive their basic training in country and come to Australia for research or extension training.

Domestic-trained RD&E professionals

All stakeholder groups agree that, for domestic students, the most common pathway into a position in R&D is:

Primary School – Secondary School – Undergraduate (UG) – Honours (H) – Doctor of Philosophy (PhD) – Post Doctoral appointment, sometimes a second Post Doctoral and then employment as a scientist, but usually only a term appointment.

Estimates provided suggest that this pathway could be delivering from 40 to 90% of the postgraduate output.

However, there is great diversity in the pathways within a university to a career into agricultural RD&E. Other pathways identified by stakeholders include:

UG – Work in industry/agency – PhD (Full-time) – Employment

UG – Work in industry/agency – PhD (Part-time whilst raising a family) – Employment

UG – Work in industry/agency – Masters (M) – PhD (Fulltime or Part-time) – Employment

Introduction of the 'Melbourne Model' has seen a new pathway emerge:

UG – M – PhD

More recently, the introduction of 'dual' institutions has seen greater integration of vocational and higher education, and more pathways for university students to gain practical experience and for VET students to strengthen their understanding of the theory behind management practices.

The most common pathway (above) is believed to attract the 'best and easiest students', but it is a widely held view by academics/university leaders that these students often lack industry context/understanding and real world experience, and may require close supervision and will need mentoring.

Students who take the pathway that involves 3-10 years work experience before undertaking a PhD are perceived to retain their industry links and undertake the most successful projects. The reports of University Leaders suggest continuing growth in numbers in this area.

However, changes to the AQF in 2012 (the requirement to undertake a Masters before a PhD) and recently announced changes to Education Expense Deductions (i.e. limiting these to $2000 when annual fees are much more) may curtail this trend or even kill off this pathway.

Sadly, it was noted by a representative of the RD&E agencies that today *"the most common pathway is out of research, either into management or out altogether"*.

International

Typically, the pathway for International students is:

School – UG – M - Work experience in research or extension in country – PhD (overseas)

The quality of these graduates is perceived to be highly variable, and the vast majority (60-70%) of them are on a country or Aid scholarship and will return home after completing their PhD. However, international recruitment of researchers has been growing over the past 10 years as suitably qualified Australian students could not be found.

The Australian education system has research-only Masters and PhDs, and coursework Masters, and is widely perceived to be weaker than the US system which includes advanced coursework at both Masters and PhD levels.

Best pathway for various occupations

The specific industry issue, to be addressed, will largely determine the most appropriate mix of skills and personnel to deliver tangible outcomes and benefits to industry. At various stages of an investigation, an issue may require pure basic, strategic or applied research and extension to adapt the research outputs to regional or specific farming systems.

In response to the question - 'What is the best pathway for a (RD&E position?') - The following insights were provided by RD&E agency representatives:

i) Extension officer

A Bachelor's degree from a 'practical' institution, several years of industry experience and mentoring by an experienced operative, then postgraduate study (e.g. Masters by coursework including a 1-2 semester research project). The industry experience may involve a technical role in research and/or a secondment to a private sector consultant to build business skills. However, for this role personal qualities are probably more important than qualification(s).

ii) Applied researcher

Applied research and experimental development are usually the provenance of extension officers today, and the extension officer pathway is the most appropriate. Again, many years of practical or commercial experience, along with exposure to a wide range of research, are seen to be critical for effectiveness in this occupation.

iii) Strategic researcher

A strategic researcher will often be part of a larger team, including applied researchers and extension officers, addressing a major multi-disciplinary or trans-disciplinary problem. Industry experience is widely valued in this occupation, either before an undergraduate degree or before undertaking a PhD. A strong basic science and applied science background, and training in research skills and methodology (data collection and analysis) are essential.

iv) Pure basic researcher

A typical pathway would be Bachelors degree, Honours degree, PhD and 1-2 postdoctoral in a research-intensive university. They are unlikely to have any training in agriculture and will have difficulty relating to the problems of industry. Most will be employed in the medical bio-

science field, and their research focus will typically be a research problem identified in the course of investigating the last research problem.

Conclusions:

The pathways for “Pure basic”, Applied” and “Strategic” science have traditionally been found in CSIRO, State Departments of Agriculture and at University. Occasionally, pathways exist in some commercial organizations. The pressure for a “quick answer” to meet stakeholder expectations has meant that the areas of applied and pure basic research are under considerable funding pressure. Few Australian institutions are involved in these areas, particularly in agricultural fields.

In order for Australia to maintain (or aspire to) “world class” science, overseas experience and linkages are essential. This applies to “Pure basic”, “Applied” and Strategic science, but also to the Extension profession.

Many commercial organizations (including seed, fertilizer, chemicals, animal health, genetics and genomics) work in the areas of applied research and, generally, adequate opportunities exist in these areas.

The Extension profession is currently undergoing considerable change. State Governments are withdrawing from active extension activates. Consultants are taking up much of the role of “day-to-day” advice and are undertaking extension projects aimed at industry and community benefit. Large Agribusiness companies claim that they intend to move closer to the ‘Consultant’ model. Universities are interested in extension but are not attracted to deliver much of it. Other research agencies are likewise interested in extension but have not made inroads into practice change in industry.

Part of the reason for this is that livestock producers, despite having many different learning styles, generally require a relationship of trust with their “extension agent”. Such relationships only develop over time, when both parties (the extension agent and the producer) make beneficial gains from the relationship.

In the transition from “university to useful” new graduates need to learn about the industry they serve, understand the technology, and understand how to inspire beneficial change. These are skills best learned “on the job” but these skills also require directed development.

So, clearly, the growing need for professional extension, aimed at practice change, and focussed on innovation for industry and community benefit must be satisfied. MLA has not taken a substantial role in this historically, but now has a growing interest in extension, because this is the professional role which will enable the uptake of technology and foster innovation in the industry.

Recommendations:

That MLA invests in the training needed to prepare university graduates for influential extension roles for the red meat industry. This should be done with three distinct, but linked approaches:

1. Provide mentoring opportunities and professional development for new graduates to enable them to assume full consultancy or extension roles for the future. This will mean providing salary support for new graduates until they are sufficiently able to secure a consultancy income. These new graduates should be directly supervised by a recognised professional in the public or private sector. (University to useful).

2. Support a higher-degree program at selected universities on “Advanced Extension Methodology”. This course work Masters should be offered as distance education

with some parts of the course delivered at the selected university. The sorts of course work offered should involve advanced courses in group facilitation skills, knowledge of adult learning and the collection, analysis and interpretation of socio-economic data.

3. Support and fund projects which have industry and community benefit and which utilise advanced (and novel) extension techniques. These projects could utilise modern communication media (to be accessed on smart phones) and must deliver beneficial industry practice change.

The relevant recommendations are as follows:

(10) That MLA invests in the training needed to prepare university graduates for influential extension roles for the red meat industry.

(11) That MLA moves to fill the gap left by CRCs.

EDUCATION PROVIDERS

In this section the capability, focus and strengths of the providers of RD&E training are explored. Insights into the changes underway in the higher education sector in general, and specifically in the areas of research, teaching and extension are examined.

Capability, Focus and Strengths

University leaders, supervisors and students were asked to identify the research, teaching and extension strengths of their institution, and to provide examples of external recognition of their areas of strength.

University leaders provided 35 measures of research strength, 15 measures of teaching strength but no examples of external recognition of any strength in extension. Supervisors provided 13 measures of external recognition of research strength, 6 of teaching strength and 2 of extensions strength. The sum of these provides an interesting measure of the focus of our higher education institutions today - #1 is research, #2 is teaching with extension and adoption of research the lowest priority.

As the funding from Government depends in part on the number of publications the academics produce, this focus is not surprising.

University Leaders Perspective

Institutional research strengths, identified by University Leaders, included the following disciplines (in declining order of frequency):

- Genetics/genomics
- Animal welfare
- Animal nutrition
- Farming systems/systems agriculture
- Pasture improvement and management
- Soil science
- Resource and environmental economics
- Parasitology
- Microbiology
- Plant science
- Modelling
- Food science
- Food demand
- Pasture and crop production
- Product quality and post-harvest
- Hydrology and spatial science

Institutional teaching strengths, identified by University Leaders, included the following disciplines (in declining order of frequency):

- Systems thinking
- Research-led teaching
- Excursions/field work/practical teaching, connections to research centres
- Facilities
- Industry based programs
- Genetics
- Animal science, agribusiness and agronomy
- Agro-environmental science

- Livestock management
- Disease pathology
- Teaching in a business context
- Spatial statistics and biometry

Supervisor Perspective

Over 93% of the Supervisors indicated that research was 'very important' at their institution, and the remainder indicated that it was 'important'. Over 90% of them were also able to provide examples of evidence of their research strength. Examples included ERA and World University rankings, external funding, and publications in high-impact international journals, citation indices and invitations to speak at international conferences.

Institutional research strengths, identified by Supervisors, included the following disciplines (in declining order of frequency):

- Genetics
- Animal production
- Crop, pasture and weed science
- Welfare
- Reproduction
- Environmental science

Among the Supervisors 93% acknowledged that teaching was 'very important' or 'important' at their institution, but only 35% were able to provide examples of external recognition of teaching strength (e.g. teaching awards, accreditation, scholarships, student numbers, etc).

Institutional teaching strengths, identified by Supervisors, included the following disciplines (in declining order of frequency):

- Genetics
- Animal science
- Agriculture, crop and pasture science/agronomy
- Postgrad supervision and training
- Veterinary science.

Less than 30% indicated that extension was 'very important' or 'important'. Most rated it as 'moderately important' or of 'no importance'. Examples of external recognition included tools in use by industry, awards and involvement in CRC extension activities.

Student Perspective

MLA students were asked what level of importance was placed on research, teaching and extension/outreach at their institution/university. Surprisingly, 8-12% did not know. The modal response (% student respondents) was:

- Very important – Research (75%)
- Important – Teaching (38%, with 25% rating it Very Important)
- Moderately important – Extension (38%, with 12% rating it Important)

Despite its importance, from 68 to 83% of MLA students could not give an example of external evidence of their institutions research or teaching strength, respectively. This begs the question:

'How important are Global University Rankings and Excellence in Research for Australia (ERA) rankings, and marketing based on these data, in attracting domestic research students?'

It also raises the question

'What really inspires or motivates students?'

Institutional research strengths, identified by MLA students, included the following disciplines (in declining order of frequency):

- Animal Health
- Environmental Studies/Ecology
- Meat Science
- Pasture Agronomy & Management
- Livestock Production
- Animal Welfare
- Agricultural Development
- Animal Science/Nutrition
- Food Science/Safety
- Climate Science
- Modelling/Systems
- Precision Agriculture
- Crop Science/Agronomy
- Microbiology
- Parasitology
- Plant Nutrition
- Resource Economics
- Soil Science.

Other strengths of institutional research identified by a small proportion of students included: Experienced research and technical staff, and collaborative, multi-disciplinary and inter-disciplinary research.

Twenty-five percent of MLA student respondents indicated that teaching was not a strength of their university, while others indicated that the quality of teaching at their institution was declining. Institutional teaching strengths, identified by MLA students, included the following disciplines (in declining order of frequency):

- Animal Health
- Animal Science/Nutrition
- Environmental Science/Ecology/Biodiversity Conservation
- Resource Economics
- Agricultural Systems
- Agriculture
- Animal Production
- Business management
- Crop Science
- Microbiology
- Plant Nutrition
- Physiology
- Soil Science.

Research-led teaching is part of the marketing rhetoric among the research-intensive universities, yet less than 4% of student responses cited that as a strength of their institution.

Almost all of the MLA students could not identify an example of where their institution/university had been externally acknowledged for its extension activities.

Quality, relevance and practicality of research training and teaching

Around 55% of RD&E agency representatives had no concerns about the quality, relevance or practicality of existing programs and courses. The concerns raised related to the limited research and extension skills in graduates and their capacity to apply learning to real-world situations.

However, the 2012 University Experience Survey (ACER 2013) suggests that there are major problems in teaching quality and skill development across all Australian universities delivering agriculture programs. While evidence of high performance in these areas was presented by University leaders, the fact that the student experience of agriculture is 'below national average' suggests that there is room for rationalizing the providers.

Repositioning and Change

Universities have been established to teach and produce research, and the latest registration standards require engagement with local and regional communities and a commitment to social responsibility in their activities (DIISRTE, 2012).

Significant changes in the Higher Education sector over the past 5-10 years include restructuring of Faculties and Schools, and a greater focus on research than teaching.

Major sources of university income are student fees and completion of higher degrees. Research funding rarely covers the full cost of research and does not follow student numbers, and it is recognized that our universities cannot sustain a workforce to both teach and research. This has resulted in a growing workforce of casual and 'teaching only' academics. Over the past 20 years, research-only academic staff in Australian universities has grown from 21 to 34%. Enrolments in research degrees have grown 20% over the past 5 years.

Research-led teaching is cited as a distinguishing feature of many of our universities, yet a range of Australian studies show a negative or at best a small positive relationship between research performance and student satisfaction (Ramsden & Moses 1992, Barrett & Milbourne 2012, Norton 2013).

Structural

University leaders anticipate further significant changes over the next decade as international competition in higher education and on-line education challenges the traditional role of a Professor (i.e. 'the sage on the stage') and the Australian university business model.

Leadership

As previously mentioned, today's University leaders (i.e. Deans, Heads of Schools or Departments) have been in a leadership role for 7.5 years on average (range 2-13 years), and anticipate remaining in these roles for only 2.2 years on average (range 1-5 years).

Many of the current leaders anticipate that the next generation of university leaders will have a greater external stakeholder management and fund-raising focus, and that they will typically be replaced by reductionist scientists with strong disciplinary skills in biology and a high publication record that will enhance the institution's ERA &/or World Universities ranking. It is also anticipated that their replacements will not be from an agricultural background or industry focused, and will probably lack management and leadership skills. For example, a senior academic observed that ***"there is a lack of leaders with a passion for the application of science to industry problems; rather the new leaders are***

***motivated by a passion for leading a science discipline which may not connect with industry"*.**

Research

Most of our universities are planning changes in their research direction/focus and some are planning curriculum reforms over the next 3-5 years. Depending on industry support, these changes will see universities concentrate on their current research strengths.

Almost all of the universities plan to increase research activity over the next 3-5 years, and around a third to decrease research in that time. Increased research activity is planned in the following areas by at least two institutions: Food security and production, Food science and nutrition, Crop and Pasture science, Animal production and Soil science. Individual institutions are planning to increase research activity in Economic development, Environmental Science and management, Production systems, Sustainable production Welfare, Meat science, Dairy science, Rangeland science and Rural communities.

Several institutions foreshadowed a move from livestock/animal research into Medical/Human research. Other areas of planned decreases in research activity were identified as: Wool, Genetics, Pasture agronomy, and Agricultural economics.

With the decline of extension capacity in state agencies, and academics rewarded for research outputs not impact, this raises the question of how will this research progress from a simple output (i.e. a publication) to having an application and outcome/impact in our production systems?

Over 90% of Supervisors indicated that research was 'very important' at their institution, with the remainder indicating it was 'important'. Over 90% were also able to provide examples of external recognition of their research strengths. Examples provided include the following:

- ERA scores of 4 or 5 in fields such as Veterinary science, Economics and applied economics, Animal production, Crop and pasture science, Soil and plant science, Environmental science and management.
- Institutional global ranking (e.g. World Universities Ranking).
- Publication citations and rate of publications.
- Eureka prize, CRCs based at the institution &/or Program leaders roles.
- Research and consultancy income.

Teaching

Several of the universities indicated that there would be major curricula reforms or 'reinvigoration of programs' over the next 3-5 years. Almost all institutions indicated plans to increase teaching in some areas, while a few flagged plans to decrease teaching. These changes appear to be driven by financial considerations, restructuring and strategic positioning.

Areas of increasing undergraduate teaching activity revealed include a greater focus on food, food security and sustainability, agrifood systems, supply chains, environmental aspects of animal production, soils and social dimensions. Increasing activity in postgraduate coursework is planned at a few institutions.

Decreasing effort in teaching animal and crop production is being driven by costs, and in basic sciences by the lack of relevance of the courses to agriculture. Cross-institutional collaboration in course delivery is planned by a few institutions to facilitate efficiencies without detracting from the quality of the local program.

Among the supervisors, 93% acknowledged that teaching was 'very important' or 'important'. However only 35% were able to provide an example of external recognition of teaching strength. Examples provided include:

- Course evaluations and student satisfaction ratings
- Institutional and national awards for teaching (e.g. AVA, ALTC).
- Demand for students.

Around 17% of MLA students believe that their institution is planning changes to its teaching focus over the next 3-5 years, but, apart from modifications to undergraduate programs and introducing a postgraduate Veterinary Science Degree (DVM), are generally unaware of any specific changes. Budget cuts and financial considerations are widely perceived to be the main driver for the changes.

Extension

Among the Supervisors, only 26% saw extension as 'important', and only 14% could provide an example of external recognition of their institution's extension activities. Examples provided include:

Conclusions:

Australian (and overseas) universities provide the science training and deliver much of the R&D required by the red meat industry. Currently, their performance is measured by their ERA[1] score. The perverse outcome of this metric is that universities focus on the publication of research rather than making a contribution to industry or to student education.

[1] The ARC is responsible for administering *Excellence in Research for Australia* (ERA), which aims to identify and promote excellence across the full spectrum of research activity in Australia's higher education institutions.

ERA evaluates the quality of the research undertaken in Australian universities against national and international benchmarks. The ratings are determined and moderated by committees of distinguished researchers, drawn from Australia and overseas. The unit of evaluation is broadly defined as the Field of Research (FoR) within an institution based on the Australia and New Zealand Standard Classification (ANZSRC).

As a review panel, we do not wish to diminish the value of the ERA approach, but rather we would seek to have it augmented by metrics which value the contribution RD&E makes to industry innovation and industry development, and the important work of teaching and developing students so that they can fulfil a valuable RD&E role for the industry in future.

Extension is the mechanism (regardless of who delivers it) for building knowledge, fostering innovation and driving practice change in the industry.

With the decline of extension capacity in state agencies, and academics rewarded for research outputs not impact, this highlights a looming problem in adoption and adaptation of a growing body of research in an industry with a generally low rate of research uptake. It follows that any analysis of the impact of the investments in university-based R&D could reflect poorly on the funding body, which in turn could lead to a reduction in the matching funds offered by Government.

RDEET Strategies to meet future needs (ERA implications, Land Grant University Model, TIA)

Although it is outside the terms of reference of this project, it is appropriate to draw attention to significant problems with the current model and the consequential relationships between the universities, the state departments and the private extension providers.

Universities, whilst they are funded to teach, get kudos from staff members who publish, and from ‘Star Performers’. Even those faculties and schools within universities which see agriculture as core business have difficulty in adequately funding agriculture and veterinary science activities.

Both the universities and the state departments carry out research, but it would be more effective if there were stronger linkages.

When it comes to extension, both the universities and the state departments and the universities claim to be effective but in reality there is little done. The MacKinnon Project at Melbourne University and the Graham Centre at CSU are notable exceptions. However, the model in Australia with the greatest potential to combine best research with best teaching and best extension in the Tasmanian Institute of Agricultural Research (TIAR).

In 1997, the University of Tasmania (UTAS) and the State government joined forces in order to deliver agricultural research, development and extension to Tasmania. The joint venture underpinned the formation of the Tasmanian Institute of Agricultural Research (TIAR). The Institute is advised by a board comprising industry, State Government and UTAS staff.

The success of this model has led to Queensland establishing the Queensland Alliance for Agriculture and Food innovation (QAAFI) , and more recently South Australia adopted similar arrangements.

In another national first, responsibility for dairy and vegetable (2007) and extensive agriculture and perennial horticulture (late 2009) industry development and extension was transferred to TIAR. The recent re-structure and re-branding, to the Tasmanian Institute of Agriculture, reflects the scope, foci and bi-line of TIAR: Research, Development, Extension, Education and Training.

Metrics for University Performance

That MLA becomes involved in setting the future for national funding of universities. MLA should aim to influence the “value of teaching” and “industry contribution” in the ranking of university performance. For a “Land Grant University” model to operate effectively in Australia, performance incentives must be aligned to desired outcomes. In particular for universities to engage in professional extension, the organisation and its professional staff

must be rewarded for “Impact” on industry. For this reason, we recommend that **MLA should coordinate an agricultural industry push** to tackle the "disconnect" between the university funding model and the benefits for industry. This would best be undertaken across all RDCs and as a result, MLA should initiate an “across industry” task force to sponsor the changes required.

The relevant recommendations are as follows:

(3) That MLA changes its focus to focus on people, not just projects.

(5) That MLA moves to carefully and deliberately influence selected Universities.

(6) That MLA becomes involved in setting the future for national funding of universities.

(7) That MLA takes the initiative to Partner with other RDC’s.

(8) That MLA prioritises investments to fill the gaps and meet the needs of a future redmeat industry and then actively entice students into areas of need.

(10) That MLA moves to fill the gap left by CRCs.

MLA'S SCIENTIST EDUCATION PORTFOLIO

MLA invests in schools (PIEF and PICSE) in undergraduate and post graduate scholarships and MLA also funds mid-career scientists. Following a request from the project team, MLA went to considerable lengths to interrogate the MLA project management system and to get MLA-funded project leaders to provide up to date information relating to the support of higher degree students. In addition MLA sent an email survey to a list of research project leaders

Most of the project leaders responded and as a result we can be confident that at a minimum:

23.5 postdoctoral students were supported including 6 Mentor for Postdoctoral Fellow Projects;

32 PhD students were supported within projects and from scholarships (full or partial or TAG only);

7.3 undergraduate students were supported.

A wide range of subjects is covered including the following:

- Options for addressing protein under-nutrition in northern Australian cattle
- Northern Australian Beef Fertility Project: CashCow
- Strategies to increase the adoption of artificial insemination in tropical beef genotype herds
- Heat load nutrition program
- Australian Nuffield Farming program scholarship
- Assessing cattle motivation for access to pasture or feedlot environments
- Development of a self medication methodology for pain relief in sheep and cattle
- Beef supply chain post doctoral fellow
- Epidemiology and management of bovine respiratory disease in feedlot cattle.

Whilst all of the projects listed appear to be worthwhile no strategic direction in the choice of students or the subject they study is apparent. Because the details of these investments were only recently made available to the review team, we conclude that until now, MLA has not had a clear understanding of its investments in the science pipeline. Similarly, a large proportion of the University Leaders declared little or no understanding of the breadth of MLAs Scientist Education Portfolio or the scale of MLA investments.

Conclusions

MLA makes considerable investments in the science pipeline but has not managed these investments as a Program.

The relevant recommendation is as follows:

(1) That MLA develops a Program specifically focussed on development of human capacity and including the enhancement of the science education pipeline.

Investments in Schools

MLA has invested in two complementary bodies relevant to community perceptions of the redmeat industry and the early stages of the scientist education pipeline – the Primary Industries Education Foundation (PIEF) and the Primary Industries Centre for Science Education (PICSE).

PIEF

PIEF (The Primary Industries Education Foundation) is a not-for-profit company limited by guarantee, formed through the collaboration of the Australian Government, primary industries organisations and the education sector. Its mission is to engage and inform primary and secondary students, teachers and the broader community about i) the role and importance of primary industries in the Australian economy, environment and wider community, and ii) the breadth of career opportunities available through the food and fibre industries. PIEF's distinctive contribution has been to highlight serious mis-understandings in children's knowledge of the origins of food and fibre and mis-perceptions of agriculture, collate and review teacher resources and industry 'education' programs, and influence the Australian Curriculum to the point that it now includes primary industry-based content in several key learning areas.

PICSE

PICSE, the Primary Industry Centre for Science Education, "engages students and teachers at key school intervention points in order to focus them on university science courses that will lead to professional, primary industry focussed careers". The objective of the PICSE program, supported by funding from MLA, is to encourage increased numbers of high quality students to study and work in science-based careers in the agri-food and fibre industries, which will result in flow-on to the meat and livestock industries".

PICSE's mission is to attract students into science, and connect secondary science teachers and tertiary bound science students with primary industry science and career paths. PICSE's distinctive contribution has been to provide class presentations, establish activity centres, run science induction camps and provide professional development for secondary teachers.

At the time of preparation of this report, and at the invitation of TIA-UTAS (PICSEs host), discussions are in progress about PIEF assuming the coordination and management of PICSE. The intent is to revamp the PICSE model over the next 6-12 months to be a more sustainable and cost-effective way of enhancing learning about science related to primary industries in Australian schools.

Over 30% of University leaders and RD&E staff rated investment in primary and secondary school education as a priority for MLA investment.

Conclusions:

Whilst investments in primary and secondary schools is seen as important, the returns on investment for the redmeat industry pipeline are small when the number of students influenced is compared with the total cost of these programs.

The relevant recommendation is as follows:

(9) That MLA prioritise investments in the science pipeline with greatest emphasis on the "close to career" end of the pipeline and the least investment at the primary school and secondary school end of the pipeline.

Investments in Universities

Scholarships/Fellowships

Many of the students on scholarships (either undergraduate or postgraduate) state that they would not be in a position to undertake their studies without the scholarship they have been offered. University leaders comment that awareness of MLA scholarships and positions could be greatly improved among their student population.

In some schools, University Leaders state that there are insufficient scholarships, while in others the Leaders comment that they have insufficient high-calibre students to award all of the scholarships they already have.

Although MLA offers a considerable number of scholarships, recipients and their universities comment that they would welcome a much greater engagement with MLA in promotion of these scholarship opportunities and the opportunity to engage more effectively with the redmeat industry.

MLA has the opportunity to engage, nurture and develop these students. Closer interaction with students would enable MLA to familiarise students with MLA's priorities and other opportunities. Such a relationship could enhance the commitment students have with the greater redmeat industry.

Conclusions:

Whilst university leaders rate investment in secondary schools as very important, students with higher degrees rate influences while at university as much more important. Scholarships to students while at university and beyond will provide a better return.

The relevant recommendation is as follows:

(8) That MLA prioritise investments in the science pipeline with greatest emphasis on the "close to career" end of the pipeline and the least investment at the primary school and secondary school end of the pipeline.

Closer engagement with universities opens the possibility of improving the general student awareness and experience with respect to the red meat industry. There is widespread recognition that industry experiences such as field trips, visits to agricultural businesses, research institutes etc. do attract students to a career in the red meat industry. These experiences could (in part) be funded by MLA.

Course development – Undergraduate and Postgraduate

Around 55% of RD&E agency representatives had no concerns about the quality, relevance or practicality of existing programs and courses. The concerns raised related to the limited research and extension skills in graduates, and their capacity to apply learning to real-world situations. A reason provided for the low level of uptake of postgraduate coursework was the lack of relevant programs.

MLA has invested in course development at Sydney University, Charles Sturt University (CSU) and the University of New England (UNE) and both program/stream and course development through the University of Queensland (UQ).The Sydney and UNE courses appear to be embedded in their undergraduate and postgraduate agriculture, agribusiness and rural science programs. Although the Rangeland Management coursework program at UQ has been acknowledged for industry engagement and relevance (AgriFood Skills Australia 2011, Allen Consulting Group 2012) and has won several national and international education awards, this program has been discontinued and almost all of the courses are no longer available to students.

Conclusions:

MLA has an opportunity to work with universities to ensure collaboration across institutions in teaching, either in areas of research or teaching strength and to refresh and improve curricula and local offerings. Low course enrolments have been the catalyst for recent discussions on some cross-institutional collaboration in course delivery.

The relevant recommendation is as follows:

(6) That MLA moves to carefully and deliberately influence selected Universities

Other relevant investments - CRCs

The Sheep CRC runs until the end of 2014. The Beef CRC concluded its final term just over twelve months ago. Each CRC (Sheep and Beef) produced around 30 to 40 postgraduate students. With two Sheep CRCs and three Beef CRCs, this amounts to around 150 Students. The Beef CRC and the Sheep CRC have tracked their graduate students and found that at least 80% have remained in agriculture following graduation and that 70% have been retained more specifically within the beef and sheep industries. This is a huge legacy of these investments. The role and importance of the CRC's is a recurring subject in this report.

Conclusions:

From the point of view of students, universities and related research organisations, this CRC model has worked very well. Both of these CRCs gave strong support to post graduate students, enabling them to develop a national network, and supporting their professional development beyond their academic studies. This feeling of being part of the red meat industry and the national linkage with other scientists is seen as very important.

The relevant recommendation is as follows:

(10) That MLA moves to fill the gap left by CRCs

CRC's have been crucial in creating opportunities for research and further education. As they will disappear, the formation of a combined RDC Student Alumni should be considered.

Return on MLA investments

The return on MLA investments can be considered in terms of outputs and outcomes. While this is reasonably well documented for research projects and investments in people (e.g. scholarships), it is more difficult to capture for the investments in Not-For-Profits (NFPs) managing school-based awareness and motivational activities and course development.

Over 60% of University leaders declared little or no awareness of MLAs investments in various stages of the scientist pipeline, and were unable to answer questions about the outputs and outcomes of MLA investments. Of those who were aware, half considered that the investments had been 'very effective' and the remainder rated their impact as 'neutral'. There is clearly a need to raise awareness of these opportunities and their outcomes in terms of jobs, careers, etc as the first step to attracting more and better applicants for MLA scholarships and fellowships.

The impact of MLA-funded students has generally been rated as high, although a small proportion (14%) of the Supervisors indicated that the students had had little or no impact. However, the vast majority of students have described their MLA scholarship as 'very significant' or 'essential' to their career.

Outputs

Supervisor Perspective

The main outputs identified have been publications and reports, graduations and project milestones being met.

Student Perspective

The contribution towards fees and the living allowance has provided financial stability to students, which in turn has enabled them to focus on their research and complete their qualifications in a shorter time. Students also acknowledge that their MLA scholarship has enabled more comprehensive studies, greater networking in industry and among peers, and legitimized their research which in turn has facilitated greater interaction with top scientists and other specialists, and collaboration on cross-institutional projects, nationally and internationally.

Students' perceptions of the benefits of the scholarship to their Supervisors include additional measurements that have enhanced a project, completion of research and theses on schedule, further scientific and conference papers which enhance the Supervisors' standing, and identification of new research opportunities.

Outcomes

Supervisor Perspective

The major outcome of MLAs investments is seen to be a larger pool of highly trained, early career researchers and academics, with a strong loyalty to the industry. Other outcomes were new knowledge on industry issues or tools delivered to industry, and/or influencing current and new research activities.

Student Perspective

Students believe that the main outcomes of the scholarships are a pool of skilled researchers, new knowledge and a host of scientific and conference papers. Some identified that it has led to Post Doctoral appointments and employment.

While the majority of students described their MLA scholarship as ‘very significant’ or ‘essential’ to their career, it is disappointing that 50% of them see their career in the red meat industry lasting only 5-years! This is a poor outcome.

Conclusions:

Universities are not universally aware of the opportunities offered by MLA, particularly with respect to scholarships.

Awareness of MLA scholarship opportunities is not universally high among university students.

Those university students who are the beneficiaries of scholarships have welcomed the support, and some students state that they would not be in a position to continue their studies without such support.

The relevant recommendation is as follows:

(5) That MLA moves to carefully and deliberately influence selected Universities

PRIORITIES FOR INVESTMENT ALONG PIPELINE

The average or most frequent responses regarding the priorities for investment along the pipeline are shown in Table 2.

Stakeholders were invited to prioritise investments across all stages of the science pipeline. Their responses were variable, and they gave some priority to investments in every stage of the pipeline. The justifications of the rankings provided, across all stakeholder groups, reveal little awareness of the extensive literature on career motivation and decision-making.

There is no consensus among University Leaders or RD&E agency representatives on the priorities for investment along the pipeline. Generally, respondents favoured investments at the later stages of the pipeline (University undergraduate and post graduate and professional development such as postdoc and mid-career grants). Travel grants were valued particularly where respondents commented that travel opportunities would not exist without MLA support. The justifications of the rankings provided, across all stakeholder groups, reveal little awareness of the extensive literature on career motivation and decision-making.

Supervisors have a clear preference for investment in postgrad and postdoc scholarships and, to a lesser extent, travel grants, but there might just be an element of self-interest behind this. Employers in RD&E agencies would welcome more investment in the professional development of current employees, and would welcome a greater interest by MLA in individual staff members and their career development.

University leaders welcome investment by MLA in scholarships and curriculum development, but would also welcome greater involvement by MLA in helping staff and students link with the red meat industry. They also comment that MLA should have a role in inspiring students to become part of the red meat industry, and would be receptive to a greater "partnership" approach along the "pipeline". A number of university leaders commented that they thought the awareness of the availability of MLA scholarships could be improved.

Table 2: The priority for investment, as defined by the % frequency of stages in the pipeline rated by stakeholders as 'most important' and 'second most important' (combined).

Priorities for investment	University Leaders	Supervisors	RD&E staff
Primary school children	16%	4%	11%
Senior school children	16%	11%	21%
Undergraduate scholarships	29%	3%	13%
Postgraduate scholarships	21%	35%	29%
Postdoctoral fellowships	6%	43%	19%
Mid-career development (i.e. travel grants)	6%	3%	8%

Conclusions:

While investments along the science pipeline are beneficial, the investments close to the "career" end are providing the greatest return.

The relevant recommendations are as follows:

(9) **That MLA prioritise investments in the science pipeline with greatest emphasis on the "close to career" end of the pipeline and the least investment at the primary school and secondary school end of the pipeline.**

(10) **That MLA invests in the training needed to prepare university graduates for influential extension roles for the red meat industry. This should be done with three distinct, but linked approaches**

OPPORTUNITIES AND CHANGE IN AUSTRALIAN AGRICULTURE

The rise of the middle class in Asia presents a huge opportunity for Australian food exports (AWPA, 2013), but greater investment in research, greater adoption of research and technology and up-skilling of the workforce are required to realize these opportunities.

These opportunities, and the need for a strategic approach to capture it, are the major drivers behind the recently released National Food Plan.

Over the past 5 years beef exports have remained stable, while poultry meat exports have increased by almost 6% per annum and sheep meat exports have declined 5% per annum. ABAREs projections for export commodity volumes suggest increases over the medium term to 2016-18 in lamb and mutton, and a fall in value of exports of beef, lamb and mutton. However, the food commodities projected to be most sought after in Asia by 2050 will be beef and sheep meat (AWPA, 2013).

SCENARIOS FOR AGRICULTURE (AND THE REDMEAT INDUSTRY)

Significant trends influencing the redmeat industry are well described in MLAs 2010-15 Strategic Plan.

In 2013 the Australian Workforce and Productivity Agency (AWPA, formerly Skills Australia) modelled employment changes in the Australia and New Zealand Standard Classification of Occupations out to 2025 under four global scenarios – Long Boom, Smart Recovery, Terms of Trade Shock and Ring of Fire (AWPA, 2013).

Projected average annual employment changes in the 'agricultural and forestry scientist' occupation category across the four scenarios ranged from 2.4% (Ring of Fire, i.e. risky situation with multiple economic and environmental shocks) to 4.3% (Long Boom, i.e. continuing high demand for products from China and other countries).

The Australian Workforce and Productivity Agency has estimated that around 8700 Agriculture and Forestry Scientists are employed in Australia, and that while total employment has grown to this level at around 5% per annum for the past 5 years, it will continue to grow but only by 0.5% p.a. (or a total of around 175 scientists) over the 5 years to 016-17. (AWPA, 2013).

In 2011-12, forty '457 visas' were granted for the occupation 'Agriculture & Forestry scientists', which is a clear indication that we can't source the necessary skills from domestic students (AWPA, 2013).

The 'Agricultural consultant Scientist' occupation has not been identified by DEEWR as an area of skills shortage (DEEWR 2013, AWPA, 2013). Eighty-seven percent of vacancies were filled in 2012, with 13.9 applications and 2.5 suitable applicants.

Conclusion:

The current situation, of "making do", combined with a general slowdown in Australia's RD&E capacity, particularly in comparison to overseas competitors, and ever declining terms of trade, combine to demand a new approach.

While the demand for scientists is forecast to decline marginally and while it is likely that supply and demand will reach a new equilibrium, a new approach will demand a significant in increase operational budgets, technical assistance, and investment in infrastructure so that scientists can do useful work.

The relevant recommendations are as follows:

(2) That MLA targets its investments so as to be able to focus on the major challenges facing the industry.

(5) That MLA moves to carefully and deliberately influence selected Universities.

(8) That MLA prioritise investments to fill the gaps and meet the needs of a future redmeat industry and then actively entice students into areas of need.

(9) That MLA prioritise investments in the science pipeline with greatest emphasis on the "close to career" end of the pipeline and the least investment at the primary school and secondary school end of the pipeline.

APPENDIX 1: REVIEW TEAM

The Review Team comprised Mr Mike Stephens, Mr David Hamilton & Dr John Taylor. This team brings together long experience of Research and Development, Extension and Higher Education as outlined below.

Mike Stephens currently holds the following positions

- Consulting partner, MS&A, Agricultural Consultants.
- National President, Ag Institute of Australia.
- Chairman, Churchill Fellowship Victorian Rural and Business Selection Panel
- Board member, Country Education Project (Victoria)

His qualifications include:

- Diploma Farm Management, Marcus Oldham
- Master of Science, Swinburne University
- Diploma, Company Directors Course, Australian Institute of Company Directors.
- AgCredited
- Certificate IV in Workplace Training and Assessment

His current affiliations/ memberships include:

- Australian Institute of Company Directors (Fellow).
- Australian Association of Agricultural Consultants (Member)
- Recruitment and Consulting Services Association (Accredited Professional)
- Australian Institute of Agricultural Science and Technology (Certified Practicing Agriculturalist.

Mike has received the following awards:

- 1993 – Churchill Fellowship Farming UK/France and New Zealand
- 1997 – Marcus Oldham inaugural winner in excellence agricultural award.

William David Hamilton

David Hamilton is Managing Director Hamilton Agriculture (Qld) Pty Ltd and in that capacity acts both as a Consultant and farmer.

He is:

- Chairman of the Basin Sustainability Alliance
- Chairman of the Springsure Creek Agricultural Co-existence Research Committee
- Deputy-chairman of the Board of Ag Institute Australia.
- Member Strategic Cropping - Science and Technical Implementation Committee – a Queensland Government Ministerial Advisory Committee

Previously he was:

- General Manager Plant Science Futures (November 2008 – December 2009)
- General Manager Plant Science and previously, Director Department of Primary Industries, Farming Systems (1997 – October 2008)
- Extension Agronomist and subsequent leadership roles (1974 to 1997)

David's other roles include or have included:

- Vice President, Queensland Division, Agricultural Institute Australia (Current)
- Director Cotton Catchments Communities Cooperative Research Centre
- Director Cotton R&D Corporation
- Member Northern Panel GRDC
- Dalby and Emerald Agricultural College Boards
- Justice of the Peace (Qualified).

His qualifications include:

- Fellow of Australian Institute of Company Directors.
- Master of Science in Agronomy, Texas A & M University, 1982.
- Bachelor of Agricultural Science, Queensland University, 1973.

Dr John A Taylor currently holds the following positions

- President and Director, Australian Rangeland Society
- Non-executive Director, Primary Industries Education Foundation
- Non-executive Director, Southern Gulf Catchments (NRM Group)
- Independent Chair, Agriculture, Fisheries & Forestry Industry Skills Advisory Group (Qld).

His qualifications include:

- Bachelor of Applied Science (Rur.Tech.) Hons 1 (Qld), 1972
- Doctor of Philosophy (NE), 1980
- Certificate IV (Workplace Assessment & Training), 2006
- Graduate, Australian Institute of Company Directors, 2007.

In previous life's he was:

- Research Scientist, CSIRO Division of Wildlife and Rangelands Research (1980-85)
- Senior Research Scientist, Program Manager and Chief, CSIRO Tropical Crops and Pastures (1985-1999)
- Deputy Chief, CSIRO Tropical Agriculture (1999 -2001)
- Director, Rangelands Australia and Professor of Rangeland Management at The University of Queensland, Gatton (2001-2011)

His current affiliations/ memberships include

- Ag Institute, Australia
- Australian Institute of Company Directors
- Australian Rangeland Society
- Range Science Education Council (USA)
- Society for the Provision of Education in Rural Australia
- Society for Range Management (USA)

John has received the following AWARDS:

- 1990 – Churchill Fellowship

- 2009 – Australian Rural Education Award
- 2010 – UQ Award for Programs that Enhance Learning
- 2011 – Australian Learning and Teaching Council Award for Programs that Enhance Learning (Postgraduate Education)
- 2013 – Society for Range Management (USA) Outstanding Achievement in Research / Academia Award.

APPENDIX 2: CATEGORIES STAKEHOLDERS INTERVIEWED OR SURVEYED

2.1 University Heads of Schools/Departments and Deans – Agriculture and Veterinary Science

2.2 Supervisors of MLA-Funded students

2.3 MLA-Funded students 2001 to 2012

2.4 Representatives of RD&E Organisations and Employer(s)

2.5 Industry Stakeholders

APPENDIX 3 SURVEY INSTRUMENTS

SURVEY 1: UNIVERSITY HEADS

Name: .....

Email: ..... Phone: .....

MLA Structured Questionnaire #1 - V4 30/09/2013 1:22 PM

Heads of University Schools/Departments & Deans – Agric/Vet Sci/Land&Food

(Face-to-face Interviews, N= 21)

Background

Meat and Livestock Australia (MLA) has commissioned Mike Stephens and Associates to undertake a review of investments in the national scientist education pipeline for the red meat industry. Dr John Taylor and David Hamilton are assisting in this review. MLA is keen to ensure that there is an adequate supply of scientists to meet the Research, Development and Extension (RD&E) needs of the red meat industry. Currently MLA invests in various stages of the education pipeline including:

- Senior school children
- Undergraduate scholarships and course development
- Postgraduate scholarships and course development
- Developing the next generation of science leadership via postdoctoral fellowships and mentors program, and
- Mid-career scientist development via travel grants and scientific conference sponsorships.

Pls respond re your School/Dept or Faculty as appropriate.
Your name will not be connected to any of your responses, and your answers will be strictly confidential.
Please review my notes and correct as necessary using Track Changes.
Pls return your edited version to ... *email* ... **within seven days.**
Thank you.

Industry Challenges

What do you see as the current challenges for the red meat industry? Pls be specific.

-

What do you see as the emerging challenges for the red meat industry over the next five to ten years? Pls be specific.

-

Knowledge Needs

What do you see as the knowledge needs for the future success of the red meat industry over the next five to ten years? Pls be specific.

-

Science Needs

What science(s) will be needed to provide this knowledge and ensure the future success of the red meat industry over the next five to ten years? Pls be specific.

•

Institutional Strengths

What do you believe are your School/Dept/institutions' Research strengths? Pls specify fields of research.

•

What do you believe are your institutions' Teaching strengths? Pls specify programs.

•

What evidence do you have that your School/Departments' research and teaching are externally-recognized strengths? Pls be specific.

•

Is your School/Department/Faculty planning any changes in:

i) Research focus or direction in the next three to five years? Y N
ii) Teaching focus or direction in the next three to five years? Y N

If changes are proposed, please specify in what knowledge & skill areas your School/Department is planning to:

i) Increase research?
•

ii) Decrease research?
•

iii) Increase teaching?
•

iv) Decrease teaching?
•

Enrolments

In revising this document, can you pls supply real data on the five-year trend(s) in enrolments in: a) your undergraduate and postgraduate coursework programs, and b) postgraduate research?

What has been the trend in **undergraduate** enrolments in your School/Dept over the last five years?
Declining Flat Growing ie. 2008: 2012:

What has been the trend in **postgraduate coursework** enrolments over the last five years?

i) Domestic coursework enrolments? Declining Flat Growing ie. 2008: 2012:
ii) International coursework enrolments? Declining Flat Growing ie. 2008: 2012:

What has your School/Dept done to address any decline in domestic enrolments? Pls be specific.

•

What has been the trend in **postgraduate research** enrolments over the last five years?

i) Domestic research enrolments in your School/Dept? Declining Flat Growing
ie. 2008: 2012:
What are the drivers of this trend? Pls be specific.

•

ii) International research enrolments? Declining Flat Growing ie. 2008: 2012:
•

What has your School/Dept or Faculty done to address any decline in domestic enrolments? Pls be specific.

•

What has been the trend on **post doc appointments** over the last five years? Declining Flat Growing
ie. 2008: 2012:
What are the drivers of this trend? Pls be specific.

•

What are the implications of these enrolment trends for the Australian red meat industry and its science needs? Pls be specific.

•

MLA scientist education portfolio

Are you aware of the MLA investments in the scientist pipeline (i.e. undergraduate scholarships and course development, postgraduate scholarships and course development, postdoc scholarships and mentoring, travel grants and conference sponsorships): Y N

If NO, jump to 'What inspires people…'

If YES/aware:

- Have you had an MLA-funded Undergrad, PostGrad or PostDoc position in your School/Dept? Y N
- If NO, skip to the next section 'What inspires people …'.
- If YES,
    - Can you pls specify the outputs of this position(s)?
    - Can you pls specify the outcomes of this position(s)?
    - How effective do you think this investment has been?
        - Very effective
        - Neutral
        - Not effective.
    - What is your evidence for this assertion? Pls be specific.
    - Are MLA and industry doing enough in this area? Y N
    - If not, how could these investments be improved for:
        - Greater uptake of the scholarships/positions? Pls be specific.
        - Greater impact/outcomes? Pls be specific.
    - What should be the priorities for investments in the stages of the pipeline over the next 5-10 years? (Pls prioritise ALL by ranking 1 least important to 6 most important)
        - Primary school children
        - Senior school children
        - Undergraduate scholarships and course development
        - Postgraduate scholarships and course development
        - Developing the next generation of science leadership via postdoctoral fellowships and mentors program
        - Mid-career scientist development via travel grants and scientific conference sponsorship) over the next five to ten years.

What inspires people to do research?

When do people start thinking about a career in agriculture/ animal/ plant science:

- Primary school? Y N
- Early secondary school? Y N
- Late secondary school? Y N
- After leaving school/work experience? Y N
- At university? Y N

What evidence is this perception based on? Pls be specific.

-

What do you think inspires and motivates young people to choose a career in R&D? Pls be specific.

-

What do you think inspires and motivates young people to choose a career in extension? Pls be specific.

-

What inspires people about rural R&D in particular? Pls be specific.

-

What do you see as the major impediments to people entering into an R&D or Extension career today? Pls be specific.

-

How could MLA address these impediments? Pls be specific.

-

Pathways

Among the researchers and research students in your School/Dept, what have been the:

i) Range of pathways into R&D? Pls describe.
-

ii) Most common pathway? Pls specify one.

-

Finally, a little about you, the survey respondent

How long have you been in the role of Head of a University School/Dept? ..... Years

How long do you anticipate remaining in this role? ..... Years

What will be the main drivers for you to leave this role? Pls be specific.

-

When this happens, what skills will be sought for this role? Pls be specific.

-

Thank you or your time. Your input has provided valuable insights to help improve the scientist education pipeline for the red meat industry in Australia. In due course, I will forward my interview notes for you to review and correct as necessary.

Again, thank you for your time and valuable insights.

SURVEY 2: SUPERVISORS

1. Introduction

Meat and Livestock Australia (MLA) has commissioned Mike Stephens and Associates to undertake a review of investments in the national scientist education pipeline for the red meat industry. Dr John Taylor and David Hamilton are assisting in this review. MLA is keen to ensure that there is an adequate supply of scientists to meet the Research, Development and Extension (RD&E) needs of the red meat industry. Currently MLA invests in various stages of the education pipeline including:

- Senior school children
- Undergraduate scholarships and course development
- Postgraduate scholarships and course development
- Developing the next generation of science leadership via postdoctoral fellowships and mentors program, and
- Mid-career scientist development via travel grants and scientific conference sponsorships.

This survey is a combination of approximately 50 'tick the box' type questions and short written answers, and will take around 30-45 minutes of your time. Please endeavor to answer ALL questions. You will need to respond to each question to progress through this survey.

Your name will not be connected to any of your responses, and your answers will be strictly confidential. Your participation is voluntary, and we would really appreciate your valuable insights in tackling this important issue. We hope you will seize this opportunity to influence investments in the scientist education pipeline.

Thank you in anticipation.

2. Role, Location and Contact Information

***1. How would you describe your current role? (Please select one)**

- ◯ Young researcher/extension officer
- ◯ Emerging R&D or extension leader
- ◯ R&D leader
- ◯ Junior Academic or Educator
- ◯ Senior Academic or Educator
- ◯ Other

(please specify)

***2. Have you been a supervisor of a MLA post-grad student?**

- ◯ Yes
- ◯ No

***3. Have you been a mentor to a MLA post-doc?**

- ◯ Yes
- ◯ No

4. Optional. Please provide further information on your location and your position (This will enable us to contact you to clarify any comments). All information will be treated as strictly confidential and your name will not be connected to any of your responses.

Name:	
Organisation/Institution:	
Position:	
City/Town:	
State/Province:	
Postal Code:	
Email Address:	
Phone Number:	

3. Industry Challenges

In order to prioritise investment in the red meat industry it is important they we understand what current and emerging challenges exist.

***1. What do you perceive to be the top 5 CURRENT challenges for the red meat industy. Please be specific.**

Current Challenge 1	
Current Challenge 2	
Current Challenge 3	
Current Challenge 4	
Current Challenge 5	

***2. What do you perceive to be the top 5 EMERGING challenges for the red meat industry over the next 5-10 years. Please be specific.**

Emerging Challenge 1	
Emerging Challenge 2	
Emerging Challenge 3	
Emerging Challenge 4	
Emerging Challenge 5	

4. Knowledge Gaps

We'd like to know what you see as current and emerging knowledge gaps in the red meat industry and what is needed to fill these gaps.

*1. What do you see as specific CURRENT knowledge gaps in the red meat industry?

*2. What do you see as specific EMERGING knowledge gaps in the red meat industry over the next 5 to 10 years?

5. Knowledge Gaps cont....

*1. What science(s)/disciplines will be needed to fill the CURRENT knowledge gaps identified in the above question. Please be specific.

*2. What science(s)/disciplines will be needed to fill the EMERGING knowledge gaps over the next 5 to 10 years identified in the above question. Please be specific.

***3. Are there other comments you'd like to make about knowledge and science gaps in the red meat industry?**

6. Organisation/Institution Strengths

We'd like to hear what you think the strengths of your organisation/institution are.

***1. At your Institution what level of importance is placed on research?**

Very Important	Important	Moderately important	No importance	Dont Know / Not Relevant
◯	◯	◯	◯	◯

***2. At your Institution what level of importance is placed on teaching?**

Very Important	Important	Moderately important	No Importance	Dont Know / Not Relevant
◯	◯	◯	◯	◯

***3. At your Institution what level of importance is placed on extension?**

Very Important	Important	Moderately Important	No Importance	Dont know / Not Relevant
◯	◯	◯	◯	◯

***4. What do you believe are your institution's research strengths? Please specify fields of research.**

1.
2.
3.
4.
5.

***5. What do you believe are your institution's teaching strengths? Please specify programs or fields of study or insert N/A if not appropriate.**

1.
2.
3.
4.
5.

***6. What do you believe are your institution's extension strengths? Please specify fields of study or insert N/A if not appropriate.**

1.
2.
3.
4.
5.

7. Organisation/Institution Strengths - Section 2

The next three questions relate to your Organisation/Institutions Research, Teaching and Extension.

***1. Do you have examples of where your institution's research is an externally recognised strength? e.g. Citation classic, Rankings, ERA assessment, Awards, etc.**

- ◯ Yes
- ◯ No

8. Organisation/Institution Strengths - Section 2

***1. Please provide examples of where your institution's research has been externally recognised. Please be specific.**

9. Organisation/Institution Information Research, Teaching and Extension - Sec...

***1. Do you have examples of where your institution's teaching is an externally recognised strength? e.g. Awards, etc.**

- ◯ Yes
- ◯ No

10. Organisation/Institution Strengths - Section 2

*1. Please provide examples of where your institution's teaching has been externally recognised. Please be specific.

11. Organisation/Institution Information Research, Teaching and Extension - Sec...

*1. Do you have examples of where your institution's extension is an externally recognised strength? e.g. Awards, etc.

- ◯ Yes
- ◯ No

12. Organisation/Institution Strengths - Section 2

*1. Please provide examples of where your institution's extension has been externally recognised. Please be specific.

13. Organisation/Institution Strengths - Section cont....

*1. In the next 3 to 5 years is your institution planning any changes in it's RESEARCH focus?

- ◯ Yes
- ◯ No

14. Organisation/Institution Strengths - Section cont....

*1. Please describe any expected changes in it's RESEARCH focus

***2. Please describe any expected changes in it's DISCIPLINE focus.**

15. Organisation/Institution Strengths - Section 2 cont....

***1. In in the next 3 to 5 years is your institution planning any changes in it's TEACHING focus?**

- ◯ Yes
- ◯ No

16. Organisation/Institution Strengths - Section 2 cont....

***1. Please describe the expected changes in the TEACHING focus**

17. Organisation/Institution Strengths - Section 2 cont....

The following questions relate to post graduate student enrolments at your institution.

***1. What has been the trend in DOMESTIC postgraduate COURSEWORK enrolments over the last 5 years? (i.e. Australian students)**

- ◯ Declining
- ◯ Steady
- ◯ Growing
- ◯ Don't Know/Not Applicable

***2. What has been the trend in INTERNATIONAL postgraduate COURSEWORK enrolments over the last 5 years? (i.e. Overseas students)**

- ◯ Declining
- ◯ Steady
- ◯ Growing
- ◯ Don't Know/Not Applicable

18. Organisation/Institution Strengths - Section 2 cont....

***1. Based on your previous answer can you comment on why you think DOMESTIC postgraduate COURSEWORK enrolments are Declining/Steady/Growing [Q17.1]?**

19. Organisation/Institution Strengths - Section 2 cont....

***1. What has been the trend in DOMESTIC postgraduate RESEARCH enrolments over the last five years?**

- ◯ Declining
- ◯ Flat
- ◯ Growing
- ◯ Dont Know

20. Organisation/Institution Strengths - Section 2 cont....

***1. What has been the trend in INTERNATIONAL postgraduate RESEARCH enrolments over the last five years?**

- ◯ Declining
- ◯ Flat
- ◯ Growing
- ◯ Dont Know

21. Organisation/Institution Strengths - Section 2 cont....

***1. Based on your previous answer can you comment on why you think DOMESTIC postgraduate RESEARCH enrolments are Declining/Steady/Growing [Q19.1]?**

22. Organisation/Institution Strengths - Section 2 cont....

***1. What are the implications of these enrolment trends for the Australian red meat industry? Please be specific**

23. MLA Scientist Education Portfolio

Having supervised MLA-funded, Undergraduates, PostGrads, or PostDocs, you will be aware of the MLA investments in the scientist pipeline (i.e. undergraduate scholarships and course development, postgraduate scholarships and course development, PostDoc scholarships and mentoring, travel grants and conference sponsorships).

***1. In relation to the MLA funded positions, please describe the OUTPUTS. Please be specific.**

***2. In relation to the MLA funded positions, please describe the OUTCOMES. Please be specific.**

***3. In relation to the MLA funded positions, please rate the impact on the red meat industry.**

High impact	Low impact	Neutral or Nil impact
◯	◯	◯

***4. How could these investments be improved to ensure a greater uptake of scholarships or travel grants? Please be specific.**

***5. How could these investments be improved to ensure a greater impact or outcomes? Please be specific.**

***6. What should be the priorities for investments in the stages of the pipeline over the next 5 to 10 years?**
(Prioritise 1 most important to 6 least important)

	1	2	3	4	5	6
Primary school children	◯	◯	◯	◯	◯	◯
Senior school children	◯	◯	◯	◯	◯	◯
Undergraduate scholarships	◯	◯	◯	◯	◯	◯
Postgraduate scholarships	◯	◯	◯	◯	◯	◯
Postdoctoral fellowships	◯	◯	◯	◯	◯	◯
Mid-career development (travel grants and scientific conference sponsorship)	◯	◯	◯	◯	◯	◯

24. Research Careers

We are interested to know what inspires people to do research and rural research in particular.

***1. When do people first start thinking about a career in agriculture/animal science/plant science? (choose one).**

- ◯ Primary school?
- ◯ Early secondary school?
- ◯ Late secondary school?
- ◯ After leaving school/work experience?
- ◯ At university?
- ◯ Other

(please specify)

2. What evidence is this perception based on? Please be specific.

*3. What do you think inspires young people to take a career in the agricultural sciences? Please be specific.

*4. What do you think inspires young people to undertake rural R&D in particular? Please be specific.

*5. What do you see as the key impediments to entering into an R&D career today? Please be specific.

*6. How could MLA address these impediments? Please be specific.

25. Career Pathways

***1. Among the young researchers and research students around you, what have been the range of career pathways into RD&E? Please describe.**

***2. Among the young researchers and research students around you, what has been the most common career pathway? Please specify one pathway.**

26. Your Future Contribution

***1. How long do you anticipate continuing to supervise post-grads/post docs in the red meat industry?**

Years

***2. How long do you anticipate continuing to work in the red meat industry? Please be specific.**

Years

***3. What will be the main drivers for you moving away from this field? Please be specific.**

27. Conclusion

Thank you for your assistance. You have finished the survey and your input will provide valuable insights to help improve the scientist eduction pipeline for the red meat industry in Australia.

SURVEY 3: STUDENTS

1. Introduction

Meat and Livestock Australia (MLA) has commissioned Mike Stephens and Associates to undertake a review of investments in the national scientist education pipeline for the red meat industry. Dr John Taylor and David Hamilton are assisting in this review. MLA is keen to ensure that there is an adequate supply of scientists to meet the Research, Development and Extension (RD&E) needs of the red meat industry. Currently MLA invests in various stages of the education pipeline including:

- Senior school children
- Undergraduate scholarships and course development
- Postgraduate scholarships and course development
- Developing the next generation of science leadership via postdoctoral fellowships and mentors program, and
- Mid-career scientist development via travel grants and scientific conference sponsorships.

This survey is a combination of approximately 50 'tick the box' type questions and short written answers, and will take around 30-45 minutes of your time. Please endeavor to answer ALL questions. You will need to respond to each question to progress through this survey.

Your name will not be connected to any of your responses, and your answers will be strictly confidential. Your participation is voluntary, and we would really appreciate your valuable insights in tackling this important issue. We hope you will seize this opportunity to influence investments in the scientist education pipeline.

Thank you in anticipation.

2. Role, Location and Contact Information

***1. How would you describe your current role? (Please select one)**

- ◯ Young researcher/extension officer
- ◯ Emerging R&D or extension leader
- ◯ R&D leader
- ◯ Junior Academic or Educator
- ◯ Senior Academic or Educator
- ◯ Other

(please specify)

***2. Have you been a supervisor of a MLA post-grad student?**

- ◯ Yes
- ◯ No

***3. Have you been a mentor to a MLA post-doc?**

- ◯ Yes
- ◯ No

4. Optional. Please provide further information on your location and your position (This will enable us to contact you to clarify any comments). All information will be treated as strictly confidential and your name will not be connected to any of your responses.

Name:	
Organisation/Institution:	
Position:	
City/Town:	
State/Province:	
Postal Code:	
Email Address:	
Phone Number:	

3. Industry Challenges

In order to prioritise investment in the red meat industry it is important they we understand what current and emerging challenges exist.

***1. What do you perceive to be the top 5 CURRENT challenges for the red meat industy. Please be specific.**

Current Challenge 1	
Current Challenge 2	
Current Challenge 3	
Current Challenge 4	
Current Challenge 5	

***2. What do you perceive to be the top 5 EMERGING challenges for the red meat industry over the next 5-10 years. Please be specific.**

Emerging Challenge 1	
Emerging Challenge 2	
Emerging Challenge 3	
Emerging Challenge 4	
Emerging Challenge 5	

4. Knowledge Gaps

We'd like to know what you see as current and emerging knowledge gaps in the red meat industry and what is needed to fill these gaps.

*1. What do you see as specific CURRENT knowledge gaps in the red meat industry?

*2. What do you see as specific EMERGING knowledge gaps in the red meat industry over the next 5 to 10 years?

5. Knowledge Gaps cont....

*1. What science(s)/disciplines will be needed to fill the CURRENT knowledge gaps identified in the above question. Please be specific.

*2. What science(s)/disciplines will be needed to fill the EMERGING knowledge gaps over the next 5 to 10 years identified in the above question. Please be specific.

***3. Are there other comments you'd like to make about knowledge and science gaps in the red meat industry?**

6. Organisation/Institution Strengths

We'd like to hear what you think the strengths of your organisation/institution are.

***1. At your Institution what level of importance is placed on research?**

Very Important	Important	Moderately important	No importance	Dont Know / Not Relevant
◯	◯	◯	◯	◯

***2. At your Institution what level of importance is placed on teaching?**

Very Important	Important	Moderately important	No Importance	Dont Know / Not Relevant
◯	◯	◯	◯	◯

***3. At your Institution what level of importance is placed on extension?**

Very Important	Important	Moderately Important	No Importance	Dont know / Not Relevant
◯	◯	◯	◯	◯

***4. What do you believe are your institution's research strengths? Please specify fields of research**

1.
2.
3.
4.
5.

***5. What do you believe are your institution's teaching strengths? Please specify programs or fields of study or insert N/A if not appropriate.**

1.
2.
3.
4.
5.

***6. What do you believe are your institution's extension strengths? Please specify fields of study or insert N/A if not appropriate.**

1.
2.
3.
4.
5.

7. Organisation/Institution Strengths - Section 2

The next three questions relate to your organisation/Institutions Research, Teaching and Extension.

***1. Do you have examples of where your institution's research is an externally recognised strength? e.g. Citation classic, Rakings, ERA assessment, Awards, etc.**

◯ Yes
◯ No

8. Organisation/Institution Strengths - Section 2

***1. Please provide examples of where your institution's research has been externally recognised. Please be specific.**

9. Organisation/Institution Information Research, Teaching and Extension - Sec...

***1. Do you have examples of where your institution's teaching is an externally recognised strength? e.g. Awards, etc..**

◯ Yes
◯ No

10. Organisation/Institution Strengths - Section 2

*1. Please provide examples of where your institution's teaching has been externally recognised. Please be specific.

11. Organisation/Institution Information Research, Teaching and Extension - Sec...

*1. Do you have examples of where your institution's extension is an externally recognised strength? e.g. Awards, etc.

- ◯ Yes
- ◯ No

12. Organisation/Institution Strengths - Section 2

*1. Please provide examples of where your institution's extension has been externally recognised. Please be specific.

13. Organisation/Institution Strengths - Section cont....

*1. In the next 3 to 5 years is your institution planning any changes in its RESEARCH focus?

- ◯ Yes
- ◯ No

14. Organisation/Institution Strengths - Section cont....

*1. Please describe any expected changes in its RESEARCH focus

***2. Please describe any expected changes in it's DISCIPLINE focus.**

15. Organisation/Institution Strengths - Section 2 cont....

***1. In in the next 3 to 5 years is your institution planning any changes in its TEACHING focus?**

- ◯ Yes
- ◯ No

16. Organisation/Institution Strengths - Section 2 cont....

***1. Please describe the expected changes in the TEACHING focus**

17. Organisation/Institution Strengths - Section 2 cont....

The following relate to enrolments at your institution.

***1. What has been the trend in DOMESTIC postgraduate COURSEWORK enrolments over the last 5 years? (i.e. Australian students)**

- ◯ Declining
- ◯ Steady
- ◯ Growing
- ◯ Don't Know/Not Applicable

***2. What has been the trend in INTERNATIONAL postgraduate COURSEWORK enrolments over the last 5 years? (i.e. Overseas students)**

- ◯ Declining
- ◯ Steady
- ◯ Growing
- ◯ Don't Know/Not Applicable

18. Organisation/Institution Strengths - Section 2 cont....

***1. Based on your previous answer can you comment on why you think DOMESTIC postgraduate COURSEWORK enrolments are Declining/Steady/Growing [Q17.1]?**

19. Organisation/Institution Strengths - Section 2 cont....

***1. What has been the trend in DOMESTIC postgraduate RESEARCH enrolments over the last five years?**

- ◯ Declining
- ◯ Flat
- ◯ Growing
- ◯ Dont Know/Not Applicable

20. Organisation/Institution Strengths - Section 2 cont....

***1. What has been the trend in INTERNATIONAL postgraduate RESEARCH enrolments over the last five years?**

- ◯ Declining
- ◯ Flat
- ◯ Growing
- ◯ Dont Know/Not Applicable

21. Organisation/Institution Strengths - Section 2 cont....

***1. Based on your previous answer can you comment on why you think DOMESTIC postgraduate RESEARCH enrolments are Decling/Steady/Growing [Q19.1]?**

22. Organisation/Institution Strengths - Section 2 cont....

***1. What are the implications of these enrolment trends for the Australian red meat industry? Please be specific**

23. MLA Scientist Education Portfolio

Being a beneficiary of an MLA grant or scholarship, you will be aware of the MLA investments in the science pipeline (i.e. undergraduate scholarships and course development, postgraduate scholarships and course development, postdoc scholarships and mentoring, travel grants and conference sponsorships).

***1. List the benefits to you in order of importance? Please be specific in terms of OUTPUTS and OUTCOMES.**

***2. What would your supervisor see as the major OUTPUTS and OUTCOMES of your scholarship? Please be specific.**

***3. How significant has this investment been in developing your career? Please be specific.**

24. What inspires people to do research?

***1. When did you first start thinking about a career in agriculture/animal science/plant science? (choose one).**

- ◯ Primary school?
- ◯ Early secondary school?
- ◯ Late secondary school?
- ◯ After leaving school/work experience?
- ◯ At university?
- ◯ Other

(please specify)

***2. What inspired you to take a career in science/ animal/ pasture science? Please be specific.**

***3. What inspired you about rural R&D in particular? Please be specific.**

***4. What could increase interest in MLA scholarships and travel grants? Please be specific.**

25. Career Pathways

***1. Among the young researchers and research students around you, what have been the range of career pathways into RD&E? Please describe.**

***2. Among the young researchers and research students around you, what has been the most common career pathway? Please specify one path.**

26. Your Future Contribution

***1. Are you now supervising postgrads or postdocs?**

- ◯ Yes
- ◯ No

27. Your Future Contribution

***1. How long do you anticipate continuing to supervise post-grads/post docs in the red meat industry?**

Years

***2. How long do you anticipate continuing to work in the red meat industry? Please be specific.**

Years

***3. What will be the main drivers for you moving away from this field? Please be specific.**

28. Conclusion

Thank you for your assistance. You have finished the survey and your input will provide valuable insights to help improve the scientist eduction pipeline for the red meat industry in Australia.

SURVEY 4: EMPLOYERS

1. Introduction

Meat and Livestock Australia (MLA) has commissioned Mike Stephens and Associates to undertake a review of investments in the national scientist education pipeline for the red meat industry. Dr John Taylor and David Hamilton are assisting in this review. MLA is keen to ensure that there is an adequate supply of scientists to meet the Research, Development and Extension (RD&E) needs of the red meat industry. Currently MLA invests in various stages of the education pipeline including:

- Senior school children
- Undergraduate scholarships and course development
- Postgraduate scholarships and course development
- Developing the next generation of science leadership via postdoctoral fellowships and mentors program, and
- Mid-career scientist development via travel grants and scientific conference sponsorships.

This survey is a combination of approximately 50 'tick the box' type questions and short written answers, and will take around 30-45 minutes of your time. Please endeavor to answer ALL questions. You will need to respond to each question to progress through this survey.

Your name will not be connected to any of your responses, and your answers will be strictly confidential. Your participation is voluntary, and we would really appreciate your valuable insights in tackling this important issue. We hope you will seize this opportunity to influence investments in the scientist education pipeline.

Thank you in anticipation.

2. Role, Location and Contact Information

***1. How would you describe your current role? (Please select one)**

- ◯ Young researcher/extension officer
- ◯ Emerging R&D or extension leader
- ◯ R&D leader or extension leader
- ◯ Junior Academic or Educator
- ◯ Senior Academic or Educator
- ◯ Consultant
- ◯ Other

(please specify)

***2. Have you been a supervisor of a MLA post-grad student?**

- ◯ Yes
- ◯ No

***3. Have you been a mentor to a MLA post-doc?**

- ◯ Yes
- ◯ No

4. Optional. Please provide further information on your location and your position (This will enable us to contact you to clarify any comments). All information will be treated as strictly confidential and your name will not be connected to any of your responses.

Name:	
Company/Organisation:	
Position:	
City/Town:	
State/Province:	
Postal Code	
Email Address:	
Phone Number:	

3. Industry Challenges

In order to prioritise investment in the red meat industry it is important that we understand what current and emerging challenges exist.

***1. What do you perceive to be the top 5 CURRENT challenges for the red meat industy. Please be specific.**

Current Challenge 1	
Current Challenge 2	
Current Challenge 3	
Current Challenge 4	
Current Challenge 5	

***2. What do you perceive to be the top 5 EMERGING challenges for the red meat industry over the next 5-10 years. Please be specific.**

Emerging Challenge 1	
Emerging Challenge 2	
Emerging Challenge 3	
Emerging Challenge 4	
Emerging Challenge 5	

4. Knowledge Gaps

We'd like to know what you see as current and emerging knowledge gaps in the red meat industry and what is needed to fill these gaps.

***1. What do you see as specific CURRENT knowledge gaps in the red meat industry?**

***2. What do you see as specific EMERGING knowledge gaps in the red meat industry over the next 5 to 10 years?**

5. Knowledge Gaps cont....

***1. What science(s)/disciplines will be needed to fill the CURRENT knowledge gaps you identified in the above question. Please be specific.**

***2. What science(s)/disciplines will be needed to fill the EMERGING knowledge gaps over the next 5 to 10 years that you identified in the above question. Please be specific.**

3. Can your organisation access the skills and knowledge you need?

- ◯ Yes
- ◯ No

6. Knowledge Gaps cont....

*1. If No, please describe the problem. Please be specific.

7. Knowledge Gaps cont....

*1. Are there other comments you'd like to make about knowledge and science gaps in the red meat industry?

8. Organisation/Company Strengths

We'd like to hear what you think the strengths of your organisation/company are.

*1. At your organisation what level of importance is placed on research?

Very Important	Important	Moderately important	No importance	Dont Know / Not Relevant
○	○	○	○	○

*2. At your Organisation what level of importance is placed on teaching?

Very Important	Important	Moderately important	No Importance	Dont Know / Not Relevant
○	○	○	○	○

*3. At your Organisation what level of importance is placed on extension?

Very Important	Important	Moderately Important	No Importance	Dont know / Not Relevant
○	○	○	○	○

*4. What do you believe are your organisation's research strengths? Please specify fields of research

1.
2.
3.
4.
5.

***5. What do you believe are your organisation's teaching strengths? Please specify programs/courses or fields of study or insert N/A if not appropriate.**

1.
2.
3.
4.
5.

***6. What do you believe are your organisation's extension strengths? Please specify fields of study or insert N/A if not appropriate.**

1.
2.
3.
4.
5.

9. Organisation/Company Strengths

The next three questions relate to your Organisation/Company Research, Teaching and Extension.

***1.**

- ◯ Yes
- ◯ No/Not Applicable

10. Organisation/Company Strengths

***1. Please provide examples of where your organisation's research has been externally recognised. Please be specific.**

11. Organisation/Company Strengths

***1. Do you have examples of where your organisation's teaching is an externally recognised strength? e.g. Awards, etc..**

- ◯ Yes
- ◯ No/Not Applicable

12. Organisation/Company Strengths

*1. Please provide examples of where your organisation's teaching has been externally recognised. Please be specific.

13. Organisation/Company Strengths

*1. Do you have examples of where your organisation's extension is an externally recognised strength? e.g. Awards, etc.

- ◯ Yes
- ◯ No/Not Applicable

14. Organisation/Company Strengths

*1. Please provide examples of where your oganisation's extension has been externally recognised. Please be specific.

15. Organisation/Company Strengths

*1. In the next 3 to 5 years is your organisation planning any changes in its RESEARCH focus?

- ◯ Yes
- ◯ No
- ◯ Not Applicable

16. Organisation/Company Strengths

*1. Please describe any expected changes in its RESEARCH focus

*2. Please describe any expected changes in it's DISCIPLINE focus.

17. Organisation/Company Strengths

*1. In the next 3 to 5 years is your organisation planning any changes in its TEACHING focus?

- ◯ Yes
- ◯ No
- ◯ Not Applicable

18. Organisation/Company Strengths

*1. Please describe the expected changes in the TEACHING focus

19. Organisation/Company Strengths

1. In the next three to five years is your organisation planning any changes in it's extension activity?

- ◯ Yes
- ◯ No
- ◯ Not Applicable

20. Organisation/Company Strengths

1. Please describe the expected changes in extension activity. Please be specific.

21. Recruitment and Retirements

***1. What has been the trend in recruitment of scientists/researchers in your organisation over the last five years? (Please select one)**

- ◯ Declining
- ◯ Flat
- ◯ Growing
- ◯ Don't Know/Not Applicable

***2. In what knowledge and skill areas relevant to the future success of the red meat industry have you been seeking applicants over the past 2 years? Please be specific.**

***3. In what knowledge and skill areas have you struggled to find suitable applicants? Please be specific.**

***4. What are the implications of the scarcity of these skills for the Australian red meat industry and its science needs? Please be specific.**

***5. Regarding young graduates recruited from Australian Universities, have you had any concerns about the quality, relevance or practicality of their training/education?**

- ◯ Yes
- ◯ No

22. Recruitment and Retirements

***1. Please specify your concerns about the quality &/or relevance &/or practicality of current Australian agriculture/animal science/plant science programs or courses?**

***2. What capacity has been lost in your organisation over the past five years through retirements and redundancies? Please specify in terms of FTEs and knowledge/skill areas.**

***3. Looking ahead, over the next five years what further capacity will be lost through retirements? Please specify in terms of FTEs and knowledge/skill areas.**

***4. What are the implications of these losses for Australia's red meat industry? Please be specific?**

23. Pathways

***1. Among the researchers and extension officers you know, what has been the range of pathways into RD&E? Please describe.**

***2. What has been the most common pathway over the past few years? Please specify one.**

***3. What is the best pathway for an Extension officer/advisor? Please specify and describe one.**

Four types of R&D are recognized by the ABS - Pure basic, strategic, applied and experimental development. We are interested to know if you think different educational pathways are required to build capacity for the different types of R&D in a balanced portfolio.

***4. What is the best pathway for an applied researcher? Please specify and describe one.**

***5. What is the best pathway for a strategic researcher? Please specify and describe one.**

***6. What is the best pathway for a 'pure basic' researcher? Please specify and describe one.**

24. MLA Scientist Education Portfolio

Are you aware of some of the MLA investments in the scientist pipeline (i.e. undergraduate scholarships and course development, postgraduate scholarships and course development, PostDoc scholarships and mentoring, travel grants and conference sponsorships).

1. Have you supervised MLA-funded post graduates?

- ◯ Yes
- ◯ No

25. MLA Scientist Education Portfolio

***1. In relation to the MLA funded student(s), please describe the OUTPUTS. Please be specific.**

***2. In relation to the MLA funded student(s), please describe the OUTCOMES. Please be specific.**

***3. In relation to the MLA funded student(s), please rate the impact on the red meat industry.**

High impact	Low impact	Neutral or Nil impact
◯	◯	◯

***4. How could these investments be improved to ensure a greater uptake of scholarships or travel grants? Please be specific.**

***5. How could these investments be improved to ensure a greater impact or outcomes? Please be specific.**

***6. What should be the priorities for investments in the stages of the pipeline over the next 5 to 10 years?(Prioritise 1 most important to 6 least important)**

	1	2	3	4	5	6
Primary school children	◯	◯	◯	◯	◯	◯
Senior school children	◯	◯	◯	◯	◯	◯
Undergraduate scholarships	◯	◯	◯	◯	◯	◯
Postgraduate scholarships	◯	◯	◯	◯	◯	◯
Postdoctoral fellowships	◯	◯	◯	◯	◯	◯
Mid-career development (travel grants and scientific conference sponsorship)	◯	◯	◯	◯	◯	◯

7. What evidence are these priorities based on? Please be specific?

26. Research Careers

We are interested to know what inspires people to do research and rural research in particular.

***1. When do people first start thinking about a career in agriculture/animal science/plant science? (Choose one or two only).**

- ◯ Primary school?
- ◯ Early secondary school?
- ◯ Late secondary school?
- ◯ After leaving school/work experience?
- ◯ At university?
- ◯ Other

(please specify)

***2. What evidence is this perception based on? Please be specific.**

***3. What do you think inspires young people to take a career in the agricultural sciences? Please be specific.**

***4. What do you think inspires young people to undertake rural RD&E in particular? Please be specific.**

*5. What do you see as the key impediments to entering into an RD&E career today? Please be specific.

*6. How could MLA address these impediments? Please be specific.

27. Career Pathways

*1. Among the young researchers and research students you know, what have been the range of career pathways into RD&E? Please describe.

*2. Among the young researchers and research students you know, what has been the most common career pathway? Please specify one pathway.

28. Your Future Contribution

***1. How long have you been working in the red meat industry?**

Years

***2. How long do you anticipate continuing to work in the red meat industry?**

Years

***3. What will be the main drivers for you moving away from this field? Please be specific.**

29. Conclusion

Thank you for your assistance. You have finished the survey and your input will provide valuable insights to help improve the scientist education pipeline for the red meat industry in Australia.

SURVEY 5: VIPs

MLA Structured Questionnaire #5 – V4: 30/09/2013 12:49 PM

VIPs Identified by MLA & Review Team

(Face-to-face Interviews, N= …)

Meat and Livestock Australia (MLA) has commissioned Mike Stephens and Associates to undertake a review of investments in the national scientist education pipeline for the red meat industry. Dr John Taylor and David Hamilton are assisting in this review. MLA is keen to ensure that there is an adequate supply of scientists to meet the Research, Development and Extension (RD&E) needs of the red meat industry. Currently MLA invests in various stages of the education pipeline including:

- Senior school children
- Undergraduate scholarships and course development
- Postgraduate scholarships and course development
- Developing the next generation of science leadership via postdoctoral fellowships and mentors program
- Mid-career scientist development via travel grants and scientific conference sponsorships.

Your name will not be connected to any of your responses and your answers will be strictly confidential.

Industry Challenges

What do you see as the current challenges for the red meat industry? Pls be specific.

What do you see as the emerging challenges for the red meat industry over the next five to ten years? Pls be specific.

Knowledge Needs

What do you see as the knowledge needs for the future success of the red meat industry over the next five to ten years? Pls be specific.

What capability does your organization have to address these needs? (Pls specify skill areas/fields and FTEs)

Science Needs

What science(s) will be needed to provide this knowledge and ensure the future success of the red meat industry over the next five to ten years? Pls be specific.

Can your organization access these sciences?

Directional Changes

Is your Organization planning any changes in:

i) Research & development focus and direction in the next three to five years? Y N

ii) Extension focus and direction in the next three to five years? Y N

If changes are proposed, what are they likely to be?

i) Fields of Research? Pls be specific.

ii) Extension? Pls be specific.

Recruitment of Scientists and Extension Officers

What has been the trend in recruitment of animal and plant scientists/extension officers in your organization over the last five years?

In what knowledge and skill areas relevant to the future success of the red meat industry have you been seeking applicants over the past 2 years?

In what knowledge and skill areas have you struggled to find suitable Australian applicants?

Looking ahead, say three to five years, what critical knowledge and skills will you be seeking in recruits?

What are the implications of the scarcity of these skills for the Australian red meat industry and its science needs?

MLA scientist education portfolio

Are you aware of the range of MLA investments in the scientist pipeline (i.e. undergraduate scholarships and course development, postgraduate scholarships and course development, postdoc scholarships and mentoring, travel grants and conference sponsorships): Y N

If so,

- Has this funding provided skills in an area of need? Y N
- What have been the most important: i) outputs and ii) outcomes of these investments?
- Overall, how effective do you think this investment has been? Pls be specific.
- What is your evidence for this assertion?
- How could these investments be improved for greater impact/outcomes? Pls be specific.
- What should be the priorities for the range of investments (see Background / above) over the next five to ten years? Pls be specific.

If not aware, go to the next question.

What inspires people to do research?

When do you think people start thinking about a career in agriculture/animal/pasture science:

- Primary school? Y N
- Early secondary school? Y N
- Late secondary school? Y N
- After leaving school/work experience? Y N
- At university? Y N

What evidence is this perception based on? Pls be specific.

What do you think motivates and inspires young people to choose a career in science/animal/pasture science? Pls be specific.

What inspires people about rural RD&E in particular? Pls be specific.

What do you see as the major impediments to people entering into an RD&E career today? Pls be specific.

How could MLA address these impediments? Pls be specific.

Pathways

Among the researchers and extension officers you've encountered, what has been the range of pathways into RD&E? Pls be specific.

What has been the most common pathway over the past few years?

What is the best pathway for an Extension officer/Advisor? Pls be specific.

What is the best pathway for a:

I. Applied researcher? Pls be specific.
II. Strategic researcher? Pls be specific.
III. 'Blue sky' researcher? Pls be specific.

Finally, a little about you, the survey respondent

Pls describe your current role.

How long have you been in this role? (Years)

How much longer do you anticipate remaining in this role/field? (Years)

What will be the main drivers for you to leave this role/field?

When this happens, what skills will be sought for this role?

Thank you for your time in completing this survey. We really appreciate your insights in tackling this important issue.

NOTE: Possible variant of #5 for MLA staff **–** rework questions around 'MLA scientist...'

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GLOSSARY

ABARE – Australian Bureau of Agricultural and Resource Economics

ACDA – Australian Council of Deans of Agriculture

ACER – Australian Council for Educational Research

AQF – Australian Qualifications Framework

AWPA – Australian Workforce and Productivity Agency

CRC's – Cooperative Research Centres

CSU – Charles Sturt University

DPI's – State Department of Primary Industries

ERA – Excellence in Research for Australia (ERA)

Post Doc – Post Doctoral Study

RD&E – Research, Development & Extension

RDC's – Research and Development Corporations

ROI – Return on investment

Sydney – refers to the Sydney University

UNE – New England University

UQ – University of Queensland