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Stimulating private sector extension in Australian agriculture to increase returns from R&D

Research Report J: Trial 4 – The Knowledge System Trial

University of Melbourne
Dr Jana-Axinja Paschen, June 2018
Rural Innovation Research Group

Contents

About the project.....	3
Background: Australia’s evolving agricultural extension system	4
Executive summary	5
Trial 4: The opportunities and objectives.....	6
Research methods	7
Key results.....	16
Conclusions and recommendations.....	18
Project publications.....	19
References.....	19

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About the project

Stimulating private sector extension in Australian agriculture to increase returns from R&D is a three-year project to research, develop and test models to build the capacity of the commercial and private sector in delivering R&D extension services to Australian producers.

Led by Dairy Australia, the project is a collaboration involving nine partner organisations including six Research and Development Corporations (RDCs) – Dairy Australia, Meat & Livestock Australia, Cotton Research & Development Corporation, Sugar Research Australia, Australian Pork Limited, Horticulture Innovation Australia – as well as the Victorian and NSW governments, and the University of Melbourne.

The project is funded by the partners and the Australian Government's Department of Agriculture and Water Resources as part of the Australian Government's Rural Research and Development for Profit program.

The project is in response to the trend towards increasing roles for industry and private services in delivering agricultural extension. This represents a shift away from traditional, government-funded extension services over the past 20 years. Currently the extent of private sector involvement in extension varies across industries, depending on product markets, policy settings, regional issues and industry demographics.

The private sector is now a well-used information source for producers, however there is scope to enhance the capability of the private sector in delivering extension. Improving the capacity of private extension service providers will contribute to on-farm productivity gains and profitability.

Companion reports

This report describes the actions and outcomes from Trial 4: The Knowledge System Trial. It is one in a series of research reports prepared for the project *Stimulating private sector extension in Australian agriculture to increase returns from R&D*.

- Report A: Farmer demand
- Report B: Advisory services
- Report C: The advisory and extension system
- Report D: Farmer and adviser networks.
- Report E: Research results: Focus groups and surveys of farmers and advisers.
- Report G: Trial 1: The Processor Trial
- Report H: Trial 2: The Precision Agriculture Trial
- Report I: Trial 3: The Advisory Pathways Trial
- Report J: Trial 4: The Knowledge System Trial (this report)
- Report K: The four private advisory sector engagement trials: the co-innovation framework and cross-trial results

Background: Australia's evolving agricultural extension system

Over time, the means and mechanisms by which Australian farmers access and receive their information, advice and support has changed markedly. This is largely because there has been:

- Changes to the role of government and their investment in and coordination of agricultural extension services in each state of Australia.
- Variation in the way Australia's rural Research and Development Corporations have invested in and positioned extension functions.
- Variation in the extent to which a range of private providers have engaged in extension functions and the business models of agricultural service firms.
- Technological change in society, particularly, information and communication technologies.

Collaborative approaches offer the promise of more effective RD&E when applied to such complexity. The increased focus on collaboration in agricultural innovation systems is also due to a greater understanding of the failure of technology transfer models (Ayre and Nettle 2015, Hermans et al. 2015) and has been driven by policy and RD&E funding directives and the increased role of private research and extension actors.

One collaborative approach is co-innovation: Co-innovation is an engagement model that involves all stakeholders, especially end users, early on in the innovation process (Botha et al. 2017, Coutts et al. 2017, Turner et al. 2016). It implies that all stakeholders acknowledge that they are unable to achieve certain objectives on their own and need to come together with other actors who offer complementary capabilities and resources required to fully develop and implement the new idea or technology.

The private sector engagement trials were action research interventions that each explored a model of co-innovation to address one agricultural innovation challenge (see companion reports G, H, I, and K). The trials were one of five components of *Stimulating private sector extension in Australian agriculture* and were designed to:

- identify practical proposals to strengthen private advisory sector roles in driving innovation
- improve profit on farm by filling current service gaps
- generate learning about what drives and hinders co-innovation.

The synthesis of findings and implications from across the trials contributes recommendations for nuanced engagement with the private advisory sector, and guidance for practising co-innovation in the agricultural research, development and extension (RD&E) system (Report K). This report describes the actions and outcomes from Trial 4: The Knowledge Trial.

Executive summary

The Knowledge Trial was a collaboration between Meat and Livestock Australia (MLA), Sugar Research Australia (SRA), the Victorian Department of Development, Jobs, Transport and Resources (Agriculture Victoria) with private sector extension professionals. The Trial Project Officer represented the consulting company Meridian Agriculture and the private sector partners represented a range of advisory types. They were approached through their participation in two networks, the Best Wool Best Lamb program in Victoria, and Project Catalyst, a network of innovative sugar cane farmers in the region of Mackay (Queensland).

The trial aimed to facilitate improved and active engagement of the private advisory sector with the agricultural knowledge system. In particular, the intervention addressed disconnections within the system, for example the direction of knowledge flows and the translation of research to practice and practice to research.

The trial objectives were to:

- Gain better understanding of what drives (and constrains) the knowledge system.
- Strengthen the role of private sector advisers in the agricultural knowledge and innovation system by collaboratively developing a shared 'vision' of what an improved model of engagement looks like.
- Improve 'ownership' of roles and functions within the system by RDCs, government and advisory professionals.
- Improve information flow and advisers' access to current R&D.
- Integrate practitioner and scientific-based knowledge towards the development of agricultural innovation solutions.
- Build collaborative capacity of those involved in the knowledge system/ the RD&E system to improve on farm productivity and profitability by:
 - generating, sharing and accessing knowledge, and translating it into practice
 - keeping up to date with and shaping/contributing to current knowledge and best practice
 - building, improving and maintaining networks for knowledge/innovation.

Over the course of two sets of workshops with members of Best Wool Best Lamb and Project Catalyst, participants collaborated to develop a rich and shared understanding of the problem context and opportunities they wanted to the trial to address. The discussions about possible actions to be taken towards an improved, collaborative agricultural knowledge system led to the following key recommendations:

- Establish/ strengthen intermediary roles to facilitate communication and drive and maintain industry specific knowledge networks, e.g. via industry-based or regional RD&E review groups comprising researchers and advisers and farmers.
- Support collaborations, strengthen advisory networks and provide financial assistance to engage in research design, development and extension (regional and inter-regional).
- 'Harvest' farmer and adviser knowledge to ensure end-user relevance.
- Improve communication around sharing, translating, contextualising research results.
- Build trust and understanding between different groups as suspicion jeopardises collaboration.

Trial 4: The opportunities and objectives

Based on the responses received from the regional forums and on the subsequent workshop discussions with the trial partners and private sector participants, the trial's goals were to achieve the following outcomes:

- Gain better understanding of what drives (and constrains) the knowledge system.
- Strengthen the role of private sector advisers in the agricultural knowledge and innovation system by collaboratively developing a shared 'vision' of what an improved model of engagement looks like.
- Improve 'ownership' of roles and functions within the system by RDCs, government and advisory professionals.
- Improve information flow and advisers' access to current R&D.
- Integrate practitioner and scientific-based knowledge towards the development of agricultural innovation solutions.
- Build collaborative capacity of those involved in the knowledge system/ the RD&E system to improve on farm productivity and profitability by:
 - generating, sharing and accessing knowledge, and translating it into practice
 - keeping up to date with and shaping/contributing to current knowledge and best practice
 - building, improving and maintaining networks for knowledge/innovation

Research methods

The trials were action research interventions designed to co-develop responses to agricultural innovation challenges and a 'route to change' as part of the collaborative interactions. Following key principles of co-innovation, each trial was a partnership between a R&D corporation or state government, a private advisory organisation, a social researcher from the University of Melbourne, and participants representing the diversity of adviser typologies in Australia, including: small to medium businesses/ sole traders, retailers/input suppliers, larger consulting firms and agribusiness firms, and producers. The engagement of the private advisory sector as key contributors to the trials was a central design element to ensure a good fit with the diversity of needs and aspirations in this sector.

Taking a co-innovation design approach

The four private sector engagement trials contributed to the overall project aims of: increasing private sector engagement in driving innovation; making research more accessible to farmers through a more integrated and co-operative extension system; identifying barriers to private sector involvement in delivering R&D; stimulating further growth of a capable private sector through training and retention of professionals; and building a stronger connection between end-users and researchers by trialling different approaches to increase engagement. The trials took a co-innovation design approach, involving diverse groups of actors from agricultural industry bodies, public and private advisory sectors, and primary producers (Botha et al. 2017, Turner et al. 2016, Vereijssen et al. 2017) in all stages of developing the intervention to:

- facilitate collaborative identification of shared interests and desired change
- identify opportunities for the advisory service sector to expand its role in the system by:
- identifying the need for and developing new capacities at different levels of the system
- creating networks and initiate partnering with other orgs/ levels and sectors
- developing roles/ functions capable of addressing specific technical issues
- sharing information and learning, in order to enable ongoing adaptation, and hence
- building capacity to collaborate.

Coutts et al. (2017) identified that academics are yet to agree on specific characteristics of co-innovation (as a form of collaboration) and use of innovation platforms. The design of the action research engagement trials in this project was informed by a set of core collaborative principles, adapted from the literature on co-innovation (Botha et al. 2014, Coutts et al. 2017, Nederlof et al. 2011), cooperative inquiry (Blackmore 2010, De Jaegher et al. 2016, Heron and Reason 2001, Ison 2008, Kemmis et al. 2013), and the research team's prior experience with designing co-productive research for policy and the agricultural RD&E system (Ayre et al. 2018, Klerkx and Nettle 2013, Nettle et al. 2013, Paine and Nettle 2008, Paschen and Ison 2014). These principles (Text Box) shaped the design each of the trials' action components, from the initial conception of the trial contexts through to the various phases of their operationalisation.

Text Box 1 - Core principles of the collaborative action research trial intervention

1. **Inclusivity** – emphasises experiential learning from social interaction and supports multiple sources and ‘forms’ of knowledge.
2. **Diversity** – diversity and inclusion are important values in co-production.
all stakeholders are involved in and able to contribute to the definition of the problem
differences between stakeholders are accepted
all are involved in joint processes of defining the problem and a solution.
3. **Equality** – co-production starts from a partnership approach in which everyone is equal and everyone has assets to bring to the process
recognition of skills complementarity
mutual decision making
all participants are fully involved in research decisions as co-researchers.
4. **Accessibility** – access is a fundamental principle of co-production if everyone is going to take part on an equal basis.
5. **Reciprocity** – ‘reciprocity’ is a key concept in co-production. It ensures that people receive something back for putting something in; it builds on people’s desire to feel needed and valued; and it means sharing responsibility for shared outcomes.

Additionally, the collaborative action pursued by this project drew on the complementary principles of co-innovation as described by Coutts et al. (2017) (Text Box 2).

Text Box 2 - Nine principles of co-innovation (Coutts et al. 2017)

1. **Take time to understand the problem from many different views:** By taking the time to understand the complex nature of a problem, and building a shared vision (or ambition for change), solutions will be more likely to succeed. Be prepared to consider a variety of solutions.
2. **Be inclusive** – ensure everybody is present who needs to be there in order to understand the problem, its causes and to develop workable solutions.
3. **Engage with and value all sources of knowledge** – seek new insights and take the time to listen to all the different perspectives – everyone brings something to the table.
4. **Strive to learn from each other by actively listening and understanding** – be open to new ideas by being willing to let your own understanding and perspectives evolve.
5. **Keep sight of the shared vision** or ‘ambition for change’: Agree on the nature of the problem, its causes and the desired outcome of the project.
6. **Be honest, open and constructive** in your interactions with other participants.
7. **Be aware of the wider context** of the problem and any changes that may occur.
8. **Be flexible and adaptable:** How we work together and the roles we have may change over time.
9. **Stick with the co-innovation process** despite its frustrations: Setbacks occur; working through historical or current tensions, and negotiating shared and workable solutions, are part of the process and will pay off.

It was critical to the development of the collaborative trial partnerships that partners and participants were involved early on in the process of developing the trials, from the trial concepts to the design of specific actions, analysis of findings and the presentation of recommendations for future actions at a final symposium. The trial governance structure and regular meetings, with updates and feedback, ensured all partners had access to ideas and material produced as part of the trial interactions (see the process of engagement of the private sector in action research trials Figure 3).

Collecting data from the trials

Trial data were collected using a mixed methods approach. Before the trials were established, the project team reviewed the international literature (and current engagement dynamics in the Australian RD&E system (Milestone 1, Reichelt et al. 2015), and ran four regional forums with advisers and

farmers in South Australia, Victoria, Queensland and New South Wales (2016). Two national surveys of advisers and farmers were also conducted in 2016/ 2017 and informed aspects of the trials (Nettle et al 2017). The data collection from the operationalisation of the trials consisted of interviews, survey questionnaires and the researchers' participant observations.

Interviews: A first round of interviews with project partners from participating RDCs and state governments (n=12) was conducted by the research team in December 2016 to produce a snapshot of the partners' experiences and expectations of the trial process to date. This was followed up by a second round of interviews at different times of the individual trial processes as well as towards their completion.

Survey questionnaires: Over the course of two years, each trial conducted a number of workshops (4-8 per trial) to work through the stages of the trial process. The research team evaluated these workshops using a short questionnaire at the end of each session, asking participants about the perceived value of the particular workshop session and the collaborative approach more generally.

Participant observation: The researchers' participant observations of meetings and other trial-related interactions, in conjunction with the team's collective reflection on these observations and emerging insights and notes of these conversations, presented a third data source.

Research phases: Developing the four trial contexts

The four trial intervention contexts were developed according to a set of criteria that ensured that all:

- had cross-sectoral significance (i.e. make progress on areas that one industry could achieve or address on its own)
- sought to be of public, industry and private interest/good
- included a professional development/training component not used/available currently
- were able to demonstrate a link between RD&E investments reaching more farms/improving on-farm productivity.

The interventions shared a common structure for their establishment, implementation and analysis phases that ensured that all teams adhered to the core principles of collaborative inquiry and action research. Each trial team adapted the methodological framework to its individual trial contexts and timelines as they emerged from each of the trials' actions (see individual trial reports G, H, I, J and K).

Phase A – Establishment – Co-defining the opportunity

- Identifying and refining the trial concept
- RDC leads, participating RDCs and RIRG researchers – nominate project officer
- Identifying and engaging with trial partners
- Defining the opportunities for collaboration through the trial
- Identify shared interests, problems and core participants.

Phase B – Intervention Action – co-innovation/ co-designing action

- Developing a co-design process for intervention in the identified area
- Identifying and implementing engagement, development and learning activities
- This is an action-oriented approach that follows a 'plan, do, review' cycle.

Phase C – Analysis

- Analyse the activities with regards to how they have addressed the gap/opportunity identified and what they contribute to answering the overall research questions.

Establishment – Co-defining the opportunity – step 1

Identifying and refining the trial concept

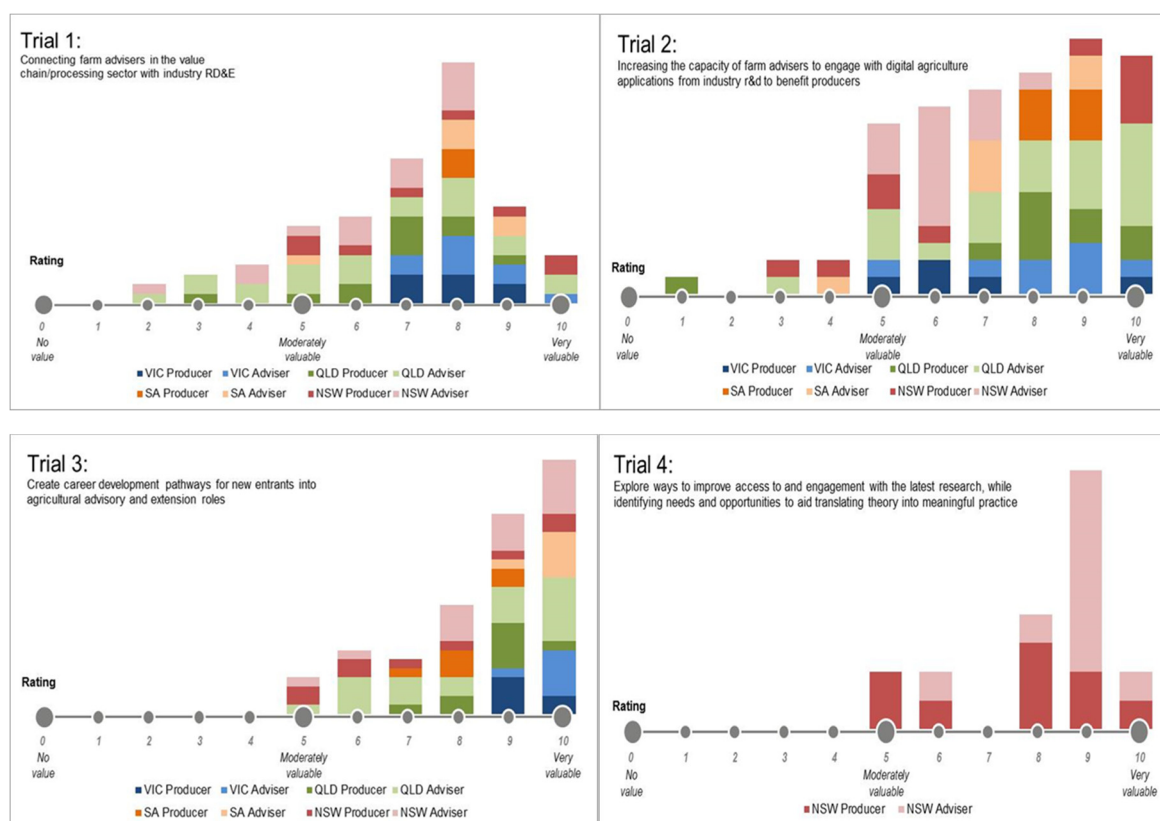
Three draft trial concepts were developed based on project assumptions around gaps, needs, and opportunities for advisers derived from the international literature and in consultation with participating RDCs and representatives of the Victorian and New South Wales departments of primary industries. These concepts were based on broadly recognised gaps or opportunities within the current Australian RD&E system and a set of selection criteria designed to ascertain that the trials addressed:

- opportunities around engaging with the processing sector/ the supply chain
- gaps and opportunities in precision/ digital agriculture
- gaps in professional development and career pathways for new entrants into the advisory sector.

These three draft concepts were tested at four regional forums the project team conducted with advisers and producers in South Australia, Victoria, Queensland and New South Wales in early to mid-2016. The forum participants were invited to rank the suggested concepts by order of their perceived importance to the private sector and to provide detailed feedback on the drafts.

A fourth trial concept, addressing the gaps in the agricultural knowledge system, was developed from additional forum responses and was test-run with participants at the last forum in New South Wales (Figure 2).

Figure 2: Regional practitioner ranking of three suggested trial concepts. A fourth was developed on the basis of additional feedback received and was ranked at a forum in NSW



Establishing the teams

The trials were purposefully designed according to the key principles of co-innovation (text box 1). To ensure that the values of diversity, inclusion and equality were met, each core team consisted of an RDC or government lead, participating RDC representatives, a researcher from the University of Melbourne, and a Project Officer from the private advisory sector. The selection of trial participants further aimed to ensure representation of the diversity of adviser typologies in Australia by including small to medium businesses/sole traders, retailers/input suppliers, larger consulting firms and agribusiness firms as well as, wherever possible, other types of advisers not captured by this typology.

Engaging the private advisory sector as key contributors to the trial development was a central purposeful design element as they were the project's link to wider advisory networks and ensured that the trials were engaging an adequate range of individuals and types of advisers. The Project Officers were invited into a broker role that drew on their professional networks as well as their understanding and perspective of the problem the trial was addressing. They held a key role in ensuring that the private sector perspective guided the further definition of the trial concepts and trial actions.

Trial roles

Each core trial team consisted of one Industry Lead (RDC lead), one Project Officer (PO) and one Research lead from the UoM research team (RIRG lead).

The RDCs/ state governments:

Following the establishment of the trial concepts, the RDCs nominated the concepts of interest to them. A trial Industry Lead and participating roles were decided. Their role included:

- leading the establishment and progress of the trials
- identifying partners and actively support engagement
- engaging in the co-design process
- supporting responses to needs identified through the process.

The Project Officers:

Following an expression of interest process, four Project Officers and one trial consultant were appointed through a contractual agreement with the University of Melbourne. The Project Officers were professionals from the private advisory sector, with industry specific networks and experience in project design/development and workshop facilitation. Their role included:

- contributing a private advisory sector perspective to the definition of the trial opportunity
- identifying suitable trial partners and networks private advisory sector
- working with RDCs, trial partners and project researchers to enact the trial methodology
- facilitating all interactions between trial partners (broker role).

The project team researchers:

The role of the Research Lead included:

- development of the action research plan, structuring the trial communication documents, and overseeing the trial methodology
- working with the Project Officers to design facilitate trial engagement workshops
- gathering research data and providing feedback on insights gained to inform the co-design process.

Trial participants/ partners:

Trial partners and participants were identified from the private advisory sector utilising both the RDCs' and Project Officers' networks. The RDC Leads, POs and Research Leads started engaging with prospective trial partners using a refined trial concept-briefing document.

Figure 1: Trial set up: participants and roles



Co-defining the trial opportunity – step 2

Following the initial engagement, the private sector trial partners were invited co-define the opportunities for collaboration through the trial and identify the shared interests or shared problems the trial was going to address, as well as who might be additional core participants that needed to be engaged. Inviting further diversity into the refined definition of the problem and opportunities was central to the collaborative process for a number of reasons:

1. It ensured inclusivity and diversity of adviser perspectives and resulted in a richer, more complex understanding of the problem/opportunity at hand.
2. The approach produced a break in habitual, linear approaches by recognising the diversity and complementarity of professional skills as a clear asset to the process.
3. The recognition of all trial participants as equal in the process contributed to improved mutual understanding of people's different professional contexts and needs.
4. Empowering participants as co-innovators and co-designers encouraged them to take ownership of the process and collective decision-making.
5. Mutual decision-making and commitment to collective action was intended to help create trust between different stakeholders.

Intervention Action – co-designing action

While each of the four trials operated at its own pace and according to the specific trial's contextual design, their implementation phase generally focused on developing a co-design process for the intervention action in the identified area. Once all participants had arrived at a shared understanding of the problem and the opportunity they were going to address, several rounds of workshops and meetings identified and designed engagement, development and learning activities to be implemented as part of the trial and beyond the project's duration. This action-oriented approach in the implementation phases followed a classic action research cycle of 'plan, do, observe, review'.

Figure 3: the process of engagement of the private sector in action research trials:



To complement the overall co-innovation framework guiding the trials (Report K), the Knowledge Trial drew on insights from a Development-led (D-led) approach to innovation (Nettle et al. 2013). In this approach, co-development works like a collaborative 'filter' that opens up the 'D-phase' of RD&E (program development activities) to a wider range of key system actors, importantly including private advisory service providers. Program development is 'the people-focused dimension of innovation' (Brightling et al. 2010) in that it is part of setting the scene for the uptake and use of new technologies (including products, knowledge and services), by designing 'a route to change' that is oriented at the needs and values of the target audience (the farmers). This has the benefit that the development teams are guided early on by their understanding of how technology or services align with particular farming systems, existing technology and practices, and the commercial environment, and therefore can ensure end-user relevance of the new technology.

Participants in Trial 4

The core trial team consisted of the Industry Lead (Agriculture Victoria); a Project Officer (PO) from the private advisory sector (Meridian Agriculture); and a Research Lead from the University of Melbourne. The PO's engagement was a contractual agreement with the University of Melbourne paid for at Meridian Agriculture's standard hourly rate. The role included contributing a private sector perspective in the initial stages of refining the trial concept and engaging with potential trial partners from the private advisory sector. The PO worked with the industry and research leads to ensure that the trial interactions complied with the cross-industry and collaborative criteria stipulated by the project design. They also approached possible partners with an advanced version of the trial concept to gauge their interest in participating in the trial and engaged them in further modifying the problem context to ensure its relevance to the private sector.

Two program-based industry groups were selected by the trial team, based on their existing networks and with the aim of reaching a representative range of adviser types, including sole traders, small-to medium enterprises, larger consulting firms and supply chain professionals. In recognition of the time and travel these partners committed to participating in the trial, private advisers were offered a sitting fee of \$500 per workshop as well as reimbursements for travel expenses.

The case studies

The Best Wool Best Lamb network (Victoria)

The Best Wool Best Lamb program (BWBL) facilitates information exchange and learning activities via a network of extension providers who function as group coordinators within a large network of lamb and wool producers. It is supported by Agriculture Victoria (the Victorian Department of Development, Jobs, Transport and Resources), Meat and Livestock Australia (MLA), and the Australian Wool Industry (AWI). Regular meetings of local discussion groups are central to the program, making use of the diverse skills and similar interests of group members. Facilitated by the coordinators, members identify key issues for their businesses and learning approaches best suited to their needs, and have the opportunity to participate in yearly planning sessions on the topics that are to be addressed. Group coordinators organise learning activities, communicate new research and development information, and challenge producers to trial new technologies.

Project Catalyst (Queensland)

Project Catalyst (PC) brings together 70+ sugar cane growers, Natural Resource Management (NRM) groups, the Australian Government (Queensland Department of Agriculture and Fisheries (DAF), the World Wildlife Fund (WWF) and The Coca-Cola Foundation. Sugar Research Australia (SRA), the principal Research and Development Corporation for the sugar cane industry, engages with PC as an

interested partner. The project aims to harness diverse interests and expertise to improve water quality by reducing fertiliser run-off from sugarcane farms affecting the Great Barrier Reef. Coordinated by PC, participating growers from across Queensland's sugar cane growing regions run trials and case studies on their farms. These grower-led trials aim to verify existing research and capitalise on the growers' applied knowledge, observation or innovations to add to existing knowledge. The processes of integration are multi-directional (adoption/trialling of new research on farm; on-farm knowledge informing research) and there is an expectation that knowledge generated in this way may be authorised by SRA and taken up into the industry's Best Management Practice (BMP). PC dissemination activities include: the annual PC forum; shed meetings on technical topics (soil health, nutrients); local networks; and innovative growers communicating their findings to other growers, private advisers, the industry's productivity services and to researchers.

Research process and data collection in Trial 4

Over 15 months, the trial team and partners worked together to, first, establish a comprehensive problem and opportunity context and, second, develop approaches to addressing the gaps and barriers partners experienced to their effective participation in the agricultural knowledge system. The trial ran two focus group workshops in each case study area, a number of meetings between the trial team and each of the case study program leaders, and one final symposium, each spaced apart by a few months. In the first meetings, participants were invited to define what they saw as the 'problem' to be addressed through the intervention and who were the stakeholders and actors they saw as important to its success. Following the discussions, the trial team summarised the findings from both workshops and distributed these back to the participants asking for their feedback. Based on the results from the discussions, the trial team (including the Sugar Research Australia representative) held a series of meetings with representatives from the two trial partner networks, Best Wool Best Lamb and Project Catalyst, to develop a process able to address the gaps in the knowledge system as they had been diagnosed by the participants. The second round of workshops in late 2017 revisited the findings from previous workshop discussions. The trial team presented the process designed around the workshop results and actions/opportunities suggested by the participants to improve connections, coordination and communication in the knowledge systems specific to the red meat and wool and sugar cane farming sectors. In this second workshop, participants were invited to provide their feedback on and refine the co-innovation process and to nominate tangible actions they or their organisations could undertake to progress the opportunities identified.

All project interactions were regarded as sources of data and therefore a mixed methods approach to data collection was appropriate. The lead researcher kept notes of team meetings and telephone conferences to document the emergence of the collaboration. The team-led design of workshops and learning activities provided opportunity to reflect on how the understanding of the complexity of the topic evolved with the action research. The focus group meetings/workshops in each of the case study areas provided participants with the opportunity to collaborate, network and learn from each other in the pursuit of a shared goal (improving the knowledge system). Further data collection occurred on the basis of discussion notes as well as interviews and questionnaires that were used to evaluate the experience of research interactions.

Key results

Weak links between research organisations, advisers and farmers disconnect R&D from extension practice and on-farm relevance and can potentially affect adoption

Trial participants highlighted a disconnection between R&D and its 'path to market', the packaging of extension messages, and the translation and integration of R&D into on-farm practice. Participating private advisers observed that R&D knowledge continues to be delivered 'top-down'. They described a lack of opportunity for contextualised 'sense-making' in discussion with peers to ensure practice relevance and build confidence in the research and validity of results. For example, PC participants observed that:

The mode of sharing, translating, contextualising research results is important and often inadequate. (Workshop notes Mackay, December 2017)

All you get at the end of a project is the final report– all you get is data – we don't get taken along on the journey of a project, don't get any stories about the project, its context and [what happens on] farms. (PC workshop participant, Mackay, December 2017)

Participants suggested that greater involvement of advisers in research priority setting, research design and evaluation would add value to research and path to market development and assist in ensuring end-user relevance by 'harvesting' producer and adviser knowledge. Participants strongly suggested a need for research forums that allow the time for exploration of research, application and critical feedback. The importance of 'ground truthing' research questions and findings in on-farm settings was also emphasised. In this context, participants suggested that using producers' social connections as knowledge/ adoption conduits would help create positive peer pressure.

The commercialisation of knowledge creates challenges for knowledge sharing and access to research

Participants in both case studies identified issues around accessing new and current agricultural research and development. Scientific journal subscriptions often come at a significant financial cost and this means that sole trading extension providers are often unable to access scientific publications. Participants in PC additionally emphasised the issues that come with operating in a commercial environment where the sharing of knowledge, and particularly applied contextual knowledge, is seen as giving up individual (or organisational) competitive advantage (workshop notes, Mackay 2017). This commercialisation of knowledge further inhibits the communication of practice relevant knowledge or needs for new research between advisers and the industry body. As one SRA representative observed:

There are too many players competing for reduced funding – if I sit down with [private sector] advisers, why would they share their info with me? (Mackay December 2017)

Participants identified the need for research networks and a database for ongoing field research to avoid research duplication. The development of a database, it was suggested, would also help to create and foster networks and ongoing interaction between researchers and extension providers.

Lack of communication and transparency jeopardises collaboration

Both case studies highlighted the need to improve communication and foster collaborations via the development of multi-disciplinary and cross-sectoral networks. Participants in the sugar industry case considered that the suspicion that vested interests, hidden agendas and other 'agri politics' might influence RD&E messaging was the main barrier to collaboration and innovation in this sector (workshop comment, Mackay 2017). One cane grower observed that such suspicion, especially in the context of potentially conflicting economic and environmental interests led to an 'us and them' mentality that is in conflict with collaborative efforts:

*There's certain things you work on together and others you won't – often it's just a perception thing [but there is a] suspicion of agendas that puts up the barriers.
(Workshop notes Mackay December 2017).*

There is a clear need for an industry specific broker role to address the issues and opportunities identified

Participants in both case studies identified the need for an industry-specific intermediary or innovation broker to assist in addressing the issues identified around weak links between research and practice, knowledge sharing and access, and lack of communication. The brokering function would be directed at fostering topic-specific collaborations and coordinating actions needed to address current and future gaps and opportunities, including improving communication channels and access to data bases, publications and RD&E process; and supporting issues of access and opportunity within the RD&E system among key groups to influence processes. The creation of an industry panel and/or regional review group comprising researchers and advisers and producers was suggested as an example of how such intermediary roles could work at different scales as required.

Conclusions and recommendations

The co-innovation interactions in Trial 4 have revealed the value and importance of a more explicit partnership approach of R&D with private sector advisers and farmers to access a broader knowledge base for co-innovation. For example, enabling advisers and farmers to engage in research design, development & extension will ensure a more 'fit-for-purpose' agricultural knowledge system equipped to meet end-user R&D needs, including the provision of contextualised knowledge and systems that support farm decision-making and advisory capacity. Moreover, and beyond highlighting the value and market signals of collaborative, interdisciplinary and integrative approaches to knowledge production, the co-innovation approach has contributed to initiating a 'route to change' in this context by raising awareness for both the complexity of the knowledge system and of the realities faced by the range of different players within this system. It has also revealed possibilities of addressing this complexity by drawing on the diverse expertise available.

Recommendations for action

The trial team arrived at the following recommendations for action beyond the project to address knowledge flow gaps and improve the interaction between research, development and extension functions in the RD&E system. These recommendations are explicitly transferrable across industries as they relate to implementing a co-innovation approach to improving knowledge flows.

1. RDC funding could help establish/ strengthen intermediary roles to facilitate communication and drive and maintain industry specific knowledge networks, e.g. via industry-based or regional RD&E review groups comprising researchers and advisers and farmers. Such broker roles could include but are not limited to:
2. Supporting collaborations, strengthen advisory networks and provide financial assistance to engage in research design, development and extension (regional and inter-regional).
3. 'Harvesting' farmer and adviser knowledge to ensure end-user relevance.
4. Improving communication around sharing, translating, contextualising research results.
5. Building trust and understanding between different groups as suspicion jeopardises collaboration.

Project publications

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