

Using Co-innovation to Stimulate Innovation in the New Zealand Agricultural Sector

Neels Botha, Laurens Klerkx, Bruce Small and James A. Turner

AgResearch, New Zealand, neels.botha@agresearch.co.nz

Abstract: A recently implemented research and development program; *Co-learning and Co-innovation to Achieve Impact in New Zealand's Biological Industries (Primary Innovation for short)* aims to stimulate innovation in the New Zealand agricultural sector, which is an important contributor to the New Zealand economy, mainly through exports. The program is attempting to implement co-innovation principles, based on an Agricultural Innovation Systems (AIS) approach, in five Innovation Platforms (IPs), evaluate the processes and outcomes, and influence the national innovation system to enable implementation of co-innovation in practice. Three streams of work are used; an academic stream that translates between theory and practice, an application stream responsible for implementing co-innovation principles in five IPs and the Community of Practice, a stream responsible for “scaling up” i.e. influencing and stimulating change at the innovation system level. Reflexive monitors in the IPs and leadership team ensure that co-innovation principles are applied and that adaptive management occurs. The use of reflective practice in the program ensures that co-innovation principles are consistently used at all levels. This paper describes how the program was implemented and highlights the lessons learned during the first 14 months of the program against a backdrop of AIS theory, principles and practices.

Keywords: Agricultural Innovation System, Innovation Platform, Co-Innovation, New Zealand, Implementation

Introduction

The Agricultural Innovation Systems (AIS) approach has become increasingly accepted as a way to understand innovation and organize support for innovation (Klerkx et al., 2012). In the AIS approach, innovation is considered the result of a process of networking and interactive learning among a heterogeneous set of actors, such as farmers, input industries, processors, traders, researchers, extensionists, government officials, and civil society organizations. There are many programs which currently work with an Innovation Platform (IP) approach (Kilelu et al., 2013). The AIS approach emphasizes that agricultural innovation is not just about new technologies but also about institutional change and it is a co-evolutionary process (Kilelu et al., 2013). In such IPs, innovation is ‘co-produced’ by many stakeholders, and innovation becomes ‘co-innovation’.

Implementing a co-innovation approach does not come without challenges such as: aligning different mindsets and competencies of the people involved; creating adequate institutional incentives for linkage building and collaboration; and changing research, extension, and innovation agenda-setting and funding mechanisms to enable innovation co-production (Klerkx & Nettle, 2013). Because of the different actors’ diverging strategic and vested interests, inherent cultural differences between actors, different planning horizons, different incentives, and accountability mechanisms, interventions such as Innovation Platforms do not automatically enable co-innovation. As Nettle et al. (2013) emphasize, especially in situations in which innovation is still seen as a linear technology- transfer process, operationalizing a co-innovation approach can be quite complicated, and is often a process of experimentation. For researchers, it requires a shift

from 'Mode 1' research thinking, which is disciplinary oriented, aimed at peer scientists, to a more interactive 'Mode 2' science, which is action oriented, inter-disciplinary and transdisciplinary and accountable to a broad group of research users (Gibbons et al., 1994). This shift is required because complex problems cannot only be understood in *terms of properties of its constituent parts* (Flood, 2010: 269).

This paper outlines how a new transdisciplinary research and development program, hereafter referred to as Primary Innovation, used IPs and applied an AIS inspired co-innovation approach during its first 14 months, and the lessons learned while doing so. Primary Innovation aims to stimulate change through co-innovation in the New Zealand agricultural sector. Section 2.1 provides a brief background about New Zealand's agricultural sector and its contributions to the national economy and section 2.2 briefly describes the Primary Innovation Program. Section 3 describes how the AIS inspired co-innovation approach of Primary Innovation aims to overcome the shortcomings of the technology transfer approach (TT). It then briefly discusses the Innovation Platform and co-innovation concepts, the conceptual design and practical functioning of Primary Innovation and the role of Reflexive Monitors in integrated research. In Section 4, the paper discusses issues arising in the implementation of Primary Innovation and the resulting lessons learned. Section 5 presents discussion and conclusions.

Background

New Zealand's agricultural sector and the national economy

New Zealand's primary industries are dominated by dairy, and sheep and beef farming, but forestry, fisheries and horticulture are also important (Nana, 2012). Total primary sector export revenue for the year to 2012 was \$29.2 billion (Ministry of Primary Industries, 2012), while the size of the New Zealand economy as measured by gross domestic product (GDP) was \$206.5 billion in the year to March 2012 (Statistics New Zealand, 2012). Easton (2013) noted that the agricultural sector remains hugely important to New Zealand, both in terms of image and of export trade. He also claimed that much of agriculture remains internationally competitive, partly because animals are largely grass fed, but also because New Zealand farmers are technologically innovative and sensitive to market opportunities and changes.

The Primary Innovation Program

The TT approach, that encourages the adoption of agricultural research findings, has failed to address increasingly complex problems. There are social, economic, environmental and regulatory drivers influencing innovation that must be considered (Klerkx et al., 2012), and there is also need for an exploratory process of identifying and capitalizing upon crucial opportunities and constraints, and on actors who can make a difference (Röling 2009).

Realizing that the technology transfer approach by itself does not address the contemporary challenges in modern agriculture, Primary Innovation was designed to demonstrate the use of an AIS inspired co-innovation approach in New Zealand's primary sector. Primary Innovation is a complex transdisciplinary program in which webs of participants in the NZ biological industries form Innovation Platforms to co-develop solutions to the industry's most pressing problems. Using this co-innovation approach, problems are addressed by a mix of technologies, practices, policies and market changes in a co-evolutionary fashion. Primary Innovation acknowledges that an innovation system characterized by learning and the dissemination of knowledge among platforms of organizations is critical to an AIS approach. It also recognizes that innovation policies, conflicting business and research cultures, and innovation platform and capability failures, negatively impact on the current innovation system's ability to foster an AIS approach.

Primary Innovation consists of three interlinked research streams. The first research stream is a multidisciplinary core research team comprised of eight industry and research organizations across three sectors - forestry, horticulture and pastoral (dairy and sheep and beef). This is an academic research stream focused on translation between theory and practice and follows an action research approach. Two PhD students, with their local and international academic supervisors, participate in this stream and do the academic research, with support from other stream 1 members. The second, and equally important role of this academic research team is, in collaboration with a Community of Practice (stream three), to test and evaluate the AIS approach in action and provide support to stream 2 to practically undertake the AIS approach. This is being done through the second research stream, which consists of five Innovation Platforms brought together to co-develop solutions to five key problems in New Zealand's primary industries; dairy herd reproductive performance, potato crop pest management, forestry product links to market, dairy farm nutrient management, and water management in a Canterbury irrigation scheme. Stream three is a stakeholder group of 23 industry, education, and research and policy organizations. This stakeholder group of influential individuals and organizations in New Zealand is called the 'Community of Practice' and is the mechanism through which Primary Innovation will "scale up" co-innovation in New Zealand (i.e. influence and stimulate change at the agricultural innovation system level). On-going learning from applying the agricultural innovation systems approach to the five problems through the Innovation Platforms will anchor learning in broader policies, organizations and industry structures to prevent 'islands of success'.

Integrated research is the best collective term to use for problem solving research, such as Primary Innovation, that involves the integration of multiple disciplines (Burton et al., 2008: 21). Integrated research includes interdisciplinary and transdisciplinary research projects. Harris & Lyon (2010:110) argued that participants in integrated research should *pause to reflect on the process of research collaboration* and that 'co-reflection' among team members should be an integral part of such projects. Co-reflection is an approach to user involvement that provides a means of confronting the researcher's rationale with society's motivations and values, and is aimed at societal transformation.

Reflexive Monitors in each of the Innovation Platforms and the Stream 1 play a key role in ensuring the application of agricultural innovation system principles and adaptive management. A Reflexive Monitor is a person whose role is to help the Innovation Platform reflect on process, action and progress towards the research goal. The Reflexive Monitor is the mechanism through which Primary Innovation aims to enable the challenging and change of presumptions, current practices, and underlying institutions, either in the design of a project or in its management, and whose responsibility it is to remind participants of the ambitions for system innovation (Botha, 2013), which is different to the role of a facilitator. Particular differences are that Reflexive Monitors challenge, as well as support, participants to reflect on and address how the way they work together enhances or hampers progress toward ambitions for change.

Primary Innovation uses Reflexive Monitors and reflection for two main reasons, to change practice at the program level and to stay focused on the program outcomes that require collective efforts and collaboration by all actors. The early stages of a transdisciplinary research program is "*a time during which reflection on the research process itself is most useful to establishing synergies amongst the diverse participants from science, management, government and user groups*" (Roux et al., 2010: 737). Facilitated by the Primary Innovation research team's Reflexive Monitor, reflections by the Primary Innovation team and a review of the team's meeting agendas and minutes were used to identify and describe the key lessons in implementing Primary Innovation during its first year.

Observations and lessons from applying a co-innovation approach in New Zealand's agricultural sector

The early stages of Primary Innovation confirm a range of observations made by researchers in the area of integrated and/or transdisciplinary research (e.g. Burton et al., 2008; EU SCAR, 2012; Harris & Lyon, 2013; Roux et al., 2010). The observations below lead to seven lessons regarding the co-innovation approach to AIS in Primary Innovation. Most of these observations and the resulting lessons are intertwined rather than being discrete, stand-a-lone issues.

Issues associated with program complexity

Implementing Primary Innovation and the five Innovation Platforms had a number of time lags and high start-up costs associated with forming teams and developing working and interpersonal relationships amongst team members because of the program's complexity created by its multi-stakeholder and multi-disciplinary nature. The initial issue identification and structuring phase was very resource intensive and time demanding. As an integrated research program Primary Innovation had to build on several knowledge bases and even different knowledge forms that reflect the individual accountabilities of its participants, who had to dedicate time for learning about each other's contexts and accountabilities, including their respective motivations and reward systems. This process of learning about each other's contexts began during the three month proposal development stage. This demanded frequent interaction among the research organisations and stakeholders in the problem the proposal was addressing. This was supported by individuals from multiple stakeholder organisations actively participating in the proposal development. Engaging stakeholders in problem definition and joint learning was especially challenging in the timeframe for preparing a proposal and given the complexity of the problem. This meant that, where stakeholders were unable to actively participate in proposal development, there was a mismatch with their own objectives and contexts.

The lesson is that there are reasonably high overheads both in time and personal contact between actors in order to develop the necessary interpersonal and inter-organizational relationships required to set up a co-innovation process in an Innovation Platform. Given that the process of set-up begins at the proposal stage it is important to be very deliberate in the design of a process for proposal development that engages all stakeholders in problem definition and joint learning. This is resource intensive and high risk given the potential that the proposal is unsuccessful.

The mechanics: contracts and intellectual property

Contracts, sub-contractual arrangements and Intellectual Property management have, in some instances, been complex and time-consuming to sort out and have created delays in getting the Innovation Platforms underway. These contract management issues created inefficiencies such as diverting researchers' time from interacting with research program participants and doing research. There have been additional costs associated with discussions and re-writing of milestones and work schedules and the uncertainty of outcomes from action research. To address the uncertainty of outcomes from action research and reduce the risk for the funding organisation, contracting was set-up on an annual basis to allow milestones to be revised in future years based on lessons from previous years.

The second lesson is that adequate time must be allowed for contractual and other formal bureaucratic processes between actors to be completed when setting up Innovation Platforms. Face-to-face time early in the contracting process enables more rapid progress in developing a common understanding and language, as well as supporting increased trust. Rapidly developing trust among programme participants is especially important at the proposal stage, as this supports sharing of knowledge and contexts to enable accurate problem definition.

Changing perceptions and paradigms

It was clear that, although Primary Innovation is a Mode 2 research program involving participatory action research, some of the research participants have primarily operated in the domain of Mode 1 research. This means they are still “linked with a linear model in the chain from basic knowledge to innovation” (EU SCAR 2012: 17). When Mode 1 and 2 researchers collaborate they can be interlinked in the sense that Mode 1, or “disciplinary research, provides essential building blocks for transdisciplinary research” (Roux et al., 2010: 739). Alternatively Mode 1 researchers can embark on a journey that traverses the landscape towards Mode 2 research. Many of the participants in Primary Innovation are on this journey, shifting from Mode 1 to Mode 2 research, which is a new paradigm in their thinking and this transition has been challenging for many of these researchers who are unfamiliar with participatory action research approaches. This has also contributed to Primary Innovation’s perceived complexity.

The lesson from this observation is that it takes time for Mode 1 researchers to make the switch to Mode 2. There may be value in attempting to help stimulate the transition from Mode 1 to Mode 2 by providing a theoretical background in participatory action research and providing information and examples from academic literature of the successful use of Mode 2 research.

Developing a shared language and interdisciplinary understanding

Scientific disciplines and organisations over time develop their own acronyms, terms and expressions that form part of their distinct cultures, which complicates cross-discipline and inter-organisational communication. A common or shared language is very important to achieving the outcomes that Primary Innovation envisioned. Although a “shared language” and interdisciplinary understanding has started to develop, it is taking considerable time and the process is not yet complete – indeed it may be an on-going process throughout the life of the program. This was particularly a challenge during proposal development, in part due to many of the stakeholders being unfamiliar with the AIS theory that underpinned the proposal. This increased the time taken to prepare the proposal as stakeholders worked toward a common language. This also hampered a common understanding of the problem and proposed solutions as language was interpreted differently.

The fourth lesson is that it is important to bear the issue of disciplinary language in mind, as well as its relevance for developing shared understanding of the research issues and potential solutions and to continually check the understanding, assumptions and different jargon associated with the range of disciplinary perspectives within an Innovation Platform.

Collaboration

Primary Innovation involves collaboration between multiple disciplines and multiple organizations (e.g. research providers, research funders, farmers, agricultural suppliers, processors, marketers, agricultural industry advocates, etc.) each of which have their own specific drivers and goals, and organizational and managerial requirements and practices. The co-innovation approach appears to be difficult for the research funders to come to grips with and place within their reporting and control structures. This indicates a problem for co-innovation with institutional rules in the current science system. Some participating research organizations are having difficulty relinquishing their historical competitive relationships and this has led to power struggles which inhibit collaboration between actors in some Innovation Platforms. A similar competitive situation exists for some of the business actors in the Innovation Platforms, where collaboration is hindered, by prior business competition and lack of appropriate levels of inter-organizational trust. For such organizations, Intellectual Property issues and/or attribution of credit for problem solution and new innovations is a concern and stumbling block for collaboration. As previously noted different actors within an Innovation Platform may have different expectations of what successful innovation looks like. This challenge is especially evident in the Primary Innovation Community of Practice group which consists of funders, providers and users in the New Zealand innovation

system. Interviews with these stakeholders in the first year of the program identified three approaches to innovation (Turner et al., in prep.) that aligned with these different actors' concepts of success as described by Roux et al. (2010) and discussed in Section 1.1.

The fifth lesson is that there appears to be a natural tendency for some actors to work in isolation from each other or more closely with those that work in similar organisational cultures. It requires deliberate persistent effort to change this part of their research or organizational cultures and structures before they can collaborate effectively.

Reflexive monitoring and changing the way we work

The role of Reflexive Monitors is new to all in Primary Innovation. Reflecting on the actions of others and oneself takes a knowledge of group and interpersonal processes and a feel for and understanding of the issue or research goal. Providing critical commentary in a manner that is acceptable to the recipient(s) requires skill and practice. The Reflexive Monitors in Primary Innovation are still in the process of developing these skills. Receiving and accepting critical reflection requires a degree of self-awareness and also trust and respect for the individual providing the critical comment. This is happening more effectively in some innovation platforms than others. There has also been a tendency for actors to shy away from having 'challenging conversations' about how they work, making change difficult. A degree of courage on the part of the Reflexive Monitor is required to initiate challenging conversations. Trust amongst the group members may also help to facilitate such conversations.

We have learned that Reflexive Monitoring is a challenging role that requires the right attitude regarding honesty, transparency, and courage and the appropriate knowledge and skills including: interpersonal communication, group process, and Mode 2 science knowledge; and observation, facilitation and mediation skills. Finding the 'right people' with the appropriate attitudes, knowledge and skills is a challenge.

Trust

Evident from a number of the observations and lessons above is the importance of trust amongst the actors in a co-innovation project. The legacy of competition underlies the struggle for power and control that has surfaced in some Innovation Platforms. The power imbalances erode trust between actors. In the first year of Primary Innovation efforts were made to support face-to-face interaction among the research teams to build trust and enable team members from different disciplines and organizations to develop an understanding of each other's disciplines and organisational obligations.

The lesson here is that trust between the actors is essential for the achievement of collaboration in co-innovation projects such as Primary Innovation. Reflexive Monitors have an important role in discovering and making power imbalances transparent and in trying to help reduce them as a mechanism of enhancing trust.

Discussion and Conclusions

As an integrated, multi-stakeholder program, Primary Innovation brings together different organisations and individuals with different values, goals and requirements and disparate bodies of knowledge with different methodological/epistemological positions. This makes the program complex, and hence challenging to implement and manage the required collaborations that have to occur. Not only does it require extra effort to build a team and to communicate and mentor participants, but it also necessitates an integration of management, planning, policy and practice in doing integrative research. In the early phase of Primary Innovation, these were resource intensive requirements that resulted in time lags and high start-up costs. Primary Innovation shares this in common with many transdisciplinary research programs.

Developing a shared language through communication is necessary as it is helping to bridge cultural differences between Primary Innovation participants. A shared language is an ongoing requirement for program success because it helps participants to co-operate across disciplinary and institutional boundaries. Apart from a shared language, these interdisciplinary and inter-institutional communications also build trust. However, as is evident from the observations and lessons above, these processes take time and resources. It is also evident that Reflexive Monitors may play a key role in facilitating processes that assist Primary Innovation participants to develop trust in one another and avoid exploitation. Harris & Lyon (2013: 115) concluded that “*trust was built through working together, openness and putting themselves at risk from others, discussing issues democratically, gaining understanding about others’ disciplines, having clear and complementary roles and socializing*”.

This paper has found a range of issues facing the development of co-innovation in the Primary Innovation Program, many of which are common to transdisciplinary research programs. The lessons learned above need to be taken into consideration when developing co-innovation projects, some of which will need to be further considered and addressed in the remaining three and a half years of Primary Innovation.

Acknowledgements

We acknowledge the Ministry of Business, Innovation and Employment which is funding the Primary Innovation project (CONT-30071-BITR-AGR) through a Biological Industries Targeted Research grant.

References

- Botha, N (ed.). (2013). Co-Innovation and Innovation Systems Glossary of Terms. AgResearch, Hamilton, New Zealand.
- Burton, R., Rønningen, K. & Wedderburn, L. (2008). Conducting integrated research: A critical literature review of interdisciplinary and transdisciplinary research. Centre for Rural Research, Norwegian University of Science and Technology, Trondheim. Report 12/08. ISSN 1503-2035.
- Easton, B. (2013). Economy - Agricultural production, Te Ara - the Encyclopedia of New Zealand. Available at: <http://www.TeAra.govt.nz/en/economy/page-2>
- EU SCAR. (2012). Agricultural knowledge and innovation systems in transition – a reflection paper, Brussels. Available at: http://ec.europa.eu/research/bioeconomy/pdf/ki3211999enc_002.pdf
- Flood, R.L. (2010) The relationship of ‘Systems Thinking’ to Action Research. *Systems Practice and Action Research*, 23, 269-284.
- Gibbons, M., Limoges, C., Nowotny, H., 1994. *new production of knowledge : the dynamics of science and research in contemporary societies*. Sage, London.
- Harris, F. & Lyon, F. (2013). Transdisciplinary environmental research: Building trust across professional cultures. *Environmental Science and Policy* 31: 109-119.

Kilelu, C.W.L., Klerkx, L. & Leeuwis, C. (2013). Unraveling the role of innovation platforms in supporting co-evolution of innovation: Contributions and tensions in a smallholder dairy development programme. *Agricultural Systems* 118(0): 65-77.

Klerkx, L., Van Mierlo, B. & Leeuwis, C. (2012). Evolution of Systems Approaches to Agricultural Innovation: Concepts, Analysis and Interventions. In I. Darnhofer, D. Gibbon & B. Dedieu. *Farming Systems Research into the 21st Century: The New Dynamic*, Dordrecht : Springer: 457-83.

Klerkx, L. & Nettle, R. (2013). Achievements and challenges of innovation co-production support initiatives in the Australian and Dutch dairy sectors: A comparative study. *Food Policy* 40: 74-89.

Ministry of Primary Industries. (2012). Tough going for primary products. Media release 12 December 2012. Available at <http://www.mpi.govt.nz/news-resources/news/tough-going-for-primary-products>

Nana, G. (2012). Industrial sectors, Te Ara - the Encyclopedia of New Zealand, updated 9-Nov-12. Available at <http://www.TeAra.govt.nz/en/industrial-sectors>

Nettle, R., Brightling, P., & Hope, A. (2013). How Programme Teams Progress Agricultural Innovation in the Australian Dairy Industry. *Journal of Agricultural Education and Extension*, 19(3), 271-290.

Röling, N. (2009). Pathways for impact: scientists' different perspectives on agricultural innovation. *International Journal of Agricultural Sustainability* 7: 83-94.

Roux, D.J., Stirzaker, R.J., Breen, C.M., Lefroy, E.C. & Cresswell, H.P. (2010). Framework for participative reflection on the accomplishment of transdisciplinary research programs. *Environmental Science & Policy* 13(8): 733-741.

Statistics New Zealand. (2012). Size of New Zealand economy reaches \$207 billion. Media release published 21 November 2012. Available at http://www.stats.govt.nz/browse_for_stats/economic_indicators/NationalAccounts/NationalAccountsIncomeExpenditure_MRYeMar12.aspx

Turner, J.A., Rijswijk, K., Williams, T., Klerkx, L. and Barnard, T. (in prep.). Systemic problems hampering innovation in the New Zealand Agricultural Innovation System. Paper submitted to the International Farm Systems Association Symposium, Berlin, April 1-4, 2014.