Triggering system innovation in agricultural innovation systems: Initial insights from a Community for Change in New Zealand

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Abstract

The ability of actors to co-innovate is influenced by how Agricultural Innovation Systems (AIS) are structured, with systemic problems related to the absence or weakness of structural elements. To create structural change, the causes of interconnected systemic problems need to be dealt with by addressing underpinning institutional logics; so called system innovation. This requires active engagement with potential change agents, with potentially conflicting perspectives about the underpinning institutional logics. This paper describes a process for stimulating this engagement to develop a shared understanding of systemic problems, challenge prevalent institutional logics, and identify individual and collective actions that change agents might undertake to stimulate system innovation. To achieve this the process included (i) multiple actors from the AIS, (ii) steps to prompt reflexivity to challenge underlying institutional logics, (iii) an iterative process of practical experimentation to challenge current practices, and (iv) actions to encourage generative collaboration. Problem structuring was used to support potential change agents to develop a shared understanding of three systemic problems and understand the role that inter-relationships, perspectives and boundaries play in reinforcing or destabilising current practices and institutional logics. There is early evidence that involving multiple actors from the AIS in challenging underlying institutional logics and encouraging generative collaboration is stimulating project-level actions and recognition of wider AIS barriers and opportunities. This confirms the benefits of collective system analyses for identifying and addressing structural changes, and extends this to potential for system innovation of the AIS. A challenge still to be addressed is how to simultaneously resolve innovation project-level actions with AIS-level actions.

1. Introduction

In response to earlier identified shortcomings of a science-driven, linear, technology transfer approach to innovation in New Zealand (Davenport et al., 2003; Leitch & Davenport, 2005; Morriss et al., 2006; Ministry for Primary Industries 2013; Turner et al., 2014, 2016), there is interest in bringing together relevant actors from the primary sector to increase innovation in a coordinated and interactive fashion through co-innovation (Dogliotti et al., 2014; Hall et al., 2001; Klerkx et al., 2012). However, the ability of actors to co-innovate is influenced by the structural composition of the Agricultural Innovation System (AIS); the presence of actors, their interactions, the institutions that influence their behaviour, and supportive physical, financial and knowledge infrastructure and incentives (Klein-Woolthuis et al., 2005; Nettle et al., 2013; Wieczorek & Hekkert, 2012).

Often systemic problems are related to the absence or weakness of these structures (Wieczorek & Hekkert, 2012). To address this, policies that pro-actively stimulate and support co-innovation at the systems level are needed (Wieczorek & Hekkert, 2012). Many countries, including New Zealand, have yet to fully embed such policies (Friederichsen et al., 2013; Minh et al., 2014; Nettle et al., 2013; Schut et al., 2015; Turner et al., 2016) by addressing the institutional logics underpinning systemic

problems (Kivimaa & Kern, 2016; Fuenfschilling & Truffer, 2013; Turner et al., 2016). Institutional logics are "the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality" (Thornton & Ocasio, 1999:804). For example, in the New Zealand AIS science-centred innovation focused on revenue generation from science-driven knowledge development is a prevalent blending of science and commercial institutional logics. This is attributed to public sector reforms in the 1990s when the Government invested in science to support policies pursuing economic goals, to increase the relevance of knowledge development for innovation (Turner et al., 2016).

Some authors (e.g. Borrás, 2011; Leitch et al., 2014) argue that innovation policy learning therefore needs make visible these underpinning institutional logics in order to generate new analyses and potential solutions for systemic problems that have proven difficult to resolve. Research on system innovation (e.g. Fischer et al., 2012) has shown this requires active engagement with potential change agents, such as policy makers, researchers and industry leaders, who may hold different and potentially conflicting perspectives about broader systemic problems and underpinning institutional logics (Beers et al., 2015; Turner et al., 2016). This engagement would seek to develop a shared understanding of systemic problems, challenge prevalent institutional logics, and identify actions that potential change agents might individually and collectively undertake to bring about system innovation in the AIS.

The aim of this paper is to describe a process for achieving this using key systemic problems and their underlying institutional logics to stimulate dialogue, formation and ongoing interaction among actors, in what we refer to as Communities for Change. The activity described in this paper is part of a large Government-funded programme, Primary Innovation, that seeks to facilitate change in the New Zealand AIS to effectively support co-innovation in the primary sector (Botha et al., 2014). Our contribution to the literature on AIS is addressing a challenge identified by Turner et al. (2016) – that of developing interventions in the AIS in order to institutionalise policies to stimulate co-innovation (Howells & Edler, 2011).

The paper is organised as follows: section two provides a description of the methods used to implement system innovation of the New Zealand AIS; the third section presents results so far from the initial stages of the formation and ongoing interaction among Communities for Change around key systemic problems, and we conclude the paper with a discussion of the main insights on potential for triggering system innovation in AIS.

2. Methodology

The aim of the process described here was to actively engage a diverse and distributed Community for Change in reflexive policy learning to collectively challenge and address institutional logics underpinning AIS-level systemic problems. To achieve this, a collaborative process was designed with four elements (Table 1).

Table 1: Elements guiding the design of the process for triggering system innovation derived from AIS and system innovation literature

Element	Rationale for the element	References
Include multiple actors from the AIS	To engage and motivate multiple actors in maintaining a strategic focus on systemic problems relevant to them and wider structural change in the AIS. This encouraged the inclusion of a heterogeneous group of actors from multiple	Amankwah et al., 2012; Gildemacher et al., 2009; Hermans et al., 2015; Totin et al., 2012

	sectors: Government, research organisations, industry, farmers and growers	
Support reflexivity to challenge underlying institutional logics	To support reflexivity by actors on underlying institutional logics regarding systemic problems and potential solutions	Arkesteijn, van Mierlo & Leeuwis, 2015; van Mierlo, Arkesteijn, & Leeuwis, 2010; Kivimaa & Kern, 2016
Encourage an iterative process of practical experimentation that challenges current practices and supports systemic changes	To encourage an iterative process of practical experimentation that challenges current practices and supports systemic changes, by encouraging innovative actions that may prove useful in bringing about systemic change. This enables: (i) a process that is flexible enough to respond to new understanding of the systemic problem and potential systemic instruments, (ii) the seizing of new opportunities as they emerge , and (iii) the development of solutions that are better tailored to the systemic problems	Smart, Bessant & Gupta, 2007; Douthwaite, Keatinge & Park, 2002; Hueske, Endrikat & Guenther, 2014; Klerkx, Aarts & Leeuwis, 2010; Beers, et al., 2014
Encourage generative collaboration	To encourage actors to collaborate in ways that are generative so that the outcomes of the whole are greater than could be expected from the sum of actions of the individual actors involved.	Beers et al., 2006; Franco, 2013; Midgley et al., 2013

These elements were used to guide the design of the process described in the following sections. Additionally, from a practical standpoint the process also needed to utilize fit-for-purpose, low-cost processes and infrastructure to work with a Community for Change distributed throughout New Zealand and with limited time to contribute. These considerations limited the opportunities for face-to-face meetings.

2.1 Identifying key systemic problems in the AIS

To engage and motivate multiple actors to maintain a strategic focus on systemic problems relevant to them and wider structural change in the AIS, 30 actors in the AIS were interviewed using a systemic policy analysis framework (Wieczorek & Hekkert, 2012) to take a holistic innovation systems view (see Turner et al., 2014, 2016 for details). The individuals interviewed were assumed to play a key and catalysing role in shaping the direction and speed of innovation (Turner et al., 2016). The semi-structured interviews probed the actors' roles in the New Zealand AIS and the perceived systemic problems (or barriers) to innovation. The interviews were also used to identify different needs from enhanced innovation. This information was used to link potential solutions to actor needs. Interviewees were then brought together in a workshop to collectively validate, reflect on and explore the key systemic problems.

The interviews, workshop and subsequent data analysis identified underlying causes of systemic problems that hinder effective functioning of the New Zealand AIS, which were then clustered into three themes (Turner et al., 2016). Table 2 describes these themes, the systemic problems they relate to, and the underlying institutional logics.

Table 2: Underlying systemic problems in the New Zealand AIS, explanatory institutional logics and associated themes (Source: Turner et al., 2016)

Systemic problems	Institutional logics	Themes
Competition for resources for individual innovation agendas and activities	Competitive science in silos	Coordination of innovation agendas and activities
Insufficient capacity in small to Medium-Sized Enterprises to undertake market formation, entrepreneurial activities and knowledge development	Laissez-faire innovation	Build entrepreneurial activity to support implementation and commercialisation
A focus of science organisations on science-driven knowledge development to generate revenue	Science-centred innovation	Embed other forms of knowledge in research projects

We used Value Add Documents (VADs) (Beers et al., 2015) to describe the three themes (Table 2) in order to support actors' reflexivity on institutional logics underlying systemic problems and potential solutions. Each VAD was structured to include (Beers et al., 2013; 2015): (i) a description of Primary Innovation research activities, (ii) identification of a systemic problem in the New Zealand AIS, from the multiple perspectives of different actors in the AIS, (iii) relevant research results, and (iv) multiple potential activities that different actors might carry out to deal with the problem. The three systemic problems have distinct foci that overlap. The VADs were not intended to provide change agents with a definitive diagnosis and prescription for change, but served to stimulate discussion among them about what actions might be possible and/or desirable by different actors in the AIS.

2.2 Stimulating reflexivity and coordinated action in the AIS

The purpose of establishing Communities for Change, was to engage AIS actors with innovation system level change in a way that would stimulate reflexivity and lead to coordinated action in the AIS. To encourage actors to collaborate around each of the three systemic problems (Table 2) in ways that are generative, problem structuring methodologies (see below) were used to support change agents to develop not only a shared understanding of these problems, but also to understand the role that inter-relationships, perspectives and boundaries play in defining issues and potential solutions (Midgley et al., 2013). This explicitly systemic approach opens up new framings, strategies and actions (Franco, 2013).

2.2.1 *Community for Change Workshops*

To date there have been two workshops aimed at establishing the Communities for Change drawing on invitees from across industry, Government, and research organisations in the New Zealand AIS. The first, with seven participants, had the explicit purposes of: (i) creating a shared ambition for change, (ii) beginning collaborative problem structuring to understand and plan for relevant change, and (iii) forming Communities for Change around each systemic problem. The second workshop, with 20 participants, had a similar purpose.

Each of the workshops used the VADs as 'catalysts' for problem structuring and as triggers for action. As such they can be considered boundary objects (Klerkx et al., 2012); an entity that has sufficient shared meaning between diverse actors to enable collaboration, but sufficient plasticity of meaning to enable each actor to use the object in their own situation (Star & Griesemer, 1989). The workshops followed the four design elements (Table 1):

1. Multiple participants from a range of expertise were gathered

2. Systems thinking tools were used to support critical reflection on what constitutes the problem area and prompt new problem framings leading to alternative institutional logics that might contribute to systemic change ('problem structuring' – Mingers & Rosenhead, 2004)
3. Possible change initiatives that were co-created in an interactive and iterative manner
4. The process brokered the bringing together of solution elements to promote outcomes greater than participants could devise separately.

The core of the workshops was the second element; make visible how different institutional logics shaped how problems were understood to structure dialogue among participants with differing viewpoints and generate fresh perspectives on 'the problem' and action planning. Soft Systems Methodology (Checkland, 1999) helped participants from diverse perspectives consider how to express the desired system transformation, who that transformation may affect, who may be needed to make it happen, what underlying assumptions may shape the transformation, who functions as the effective 'owner' of the system, and what factors are givens in the environment around the system that may influence outcomes. Activity Theory (AT) (Engeström, 2001) teased out potential components operating together in key activities. This enables groups with diverse viewpoints to consider what formal or informal procedures, enabling technologies, divisions of labour, and collaborations make up a given activity, and what might be worth introducing in an improved activity.

2.2.2 *Online Network Hub*

An online network Hub was used to encourage an iterative process of practical experimentation that challenges current practices and supports systemic changes, while also addressing a key challenge of maintaining dialogue among a distributed community of time poor participants. The Hub is a purpose-built social networking site to support sharing resources, hosting discussion and reporting actions by change agents working on each of the three systemic problems (Table 2).

Experience shows that realising the collaborative potential of the Hub is neither automatic nor simple (Ellison, Gibbs & Weber, 2015). There is currently limited understanding of how social networking sites may function for knowledge management and collaboration (Razmerita, Kirchner & Nabeth, 2014). Social networking sites, have been classified into: (i) information dissemination and sharing; (ii) communication, collaboration and innovation; (iii) knowledge management; (iv) training and learning; (v) management activities; and (vi) problem solving (Razmerita et al., 2014). The Hub attempts to facilitate all six. Peters and Manz (2007) argue that three interdependent antecedents are necessary for virtual collaboration: trust, shared understanding and depth of relationships. These typically need to be established and nurtured through face-to-face interaction. For this reason the online Hub communities will be invited to further face-to-face workshops. In addition, the Hub will be actively facilitated by members of the research team, and contributions to the Hub discussions and resources will be made from people generally trusted.

2.3 Evaluation of the process for triggering system innovation

In the two Community for Change workshops, feedback sheets were used to: (i) evaluate the extent to which participants experienced the process design elements (Table 1), (ii) evaluate the extent to which participants identified with the description of the systemic problems (Table 2), and (iii) gather intended actions for systemic change. Workshop participants scored statements from 1 strongly disagree to 10 strongly agree. The data from feedback sheets were supplemented with outputs from the workshops.

Follow-up interviews three months after the last workshop were undertaken with 14 of the workshop participants. The interviews, conducted by three programme team members, explored four themes through semi-structured questions: (i) the extent to which participants experienced the process design elements in the workshop, (ii) to what extent participation in the workshops is supporting their understanding of co-innovation and encouraging them to take relevant actions in New Zealand's AIS, (iii) actions taken and intent to take further actions at the system level, and (iv) what participants need

in order to effectively work as a group to improve primary sector innovation, including participating in the online Hub.

3. Results

Here we present evidence to date of progress toward triggering system innovation, organised by the extent to which the participants experienced the guiding elements for the design of the process (Table 1), identified systemic problems, and motivated actions.

3.1 Evidence of process design elements

Feedback sheets and follow-up interviews provided evidence that participants perceived the design elements (Table 1) as present, especially in the face-to-face workshops. In particular, there was a sense that the process was accommodating multiple perspectives and providing a systems view of innovation.

3.1.1 *Including multiple actors from the AIS*

Interviewees agreed that a range of perspectives were present, and this enabled consideration of the wider context of innovation and an understanding of others' points of view, including recognition of shared issues. A challenge is that the breadth of perspectives made it difficult to identify a focus (goal or vision) for action. A few interviewees identified the need for more industry representation in the Community for Change, including farm advisors, especially as these actors were seen as key to implementing co-innovation.

3.1.2 *Reflexivity to challenge institutional logics*

There was limited evidence that reflexivity to challenge underlying institutional logics was achieved, however, one interviewee observed: "*By having industry present at the workshop and enabling them to voice their concerns you opened up the dialogue and enable that to challenge of the current regime.*" Interviewees from research organisations did, however, identify tensions in the current AIS: (i) an emphasis on science outputs that encouraged scientists to share ideas only once they were well formed, and (ii) an emphasis on generating revenue for research organizations that did not encourage time to understand multiple innovation agendas and actor expectations. This suggests that these members of the Community for Change are beginning to question embedded institutional logics.

3.1.3 *Process of practical experimentation*

Interviewees identified a number of existing and planned actions that challenge current practices. These tended to be at the project-level, e.g. by providing practical, readily accessible tools such as monitoring and evaluation, AIS diagnostic questions, and experts to support the implementation of co-innovation. More broadly there was reference to investigating different models of science-industry interaction. These models and associated practices were identified as more tangible for actors to work on as a group and have "*better scope for change and influence*." The need for focus within the Community for Change around a practical area (or project) in which to collectively test systemic actions (perhaps through identifying and experimenting first at a project level) was called for. There were fewer examples of practical experimentation with systemic changes, although one interviewee highlighted the need for Government agencies to resource the collection of statistics that evidence the impact of co-innovation.

3.1.4 *Generative collaboration*

Interviewees suggested that the beginnings of generative collaboration were present, referring to trust, a common language and hence the opportunity to share perspectives, which stimulated a recognition of new perspectives. One interviewee highlighted a challenge was intermittent face-to-face interactions. However, examples of the need for generative collaboration were identified, such as the desire from a research organisation member for research funders to stimulate demand for co-innovation. The need for generative collaboration was also recognised in terms of the inter-relationships among the systemic problems (Table 2).

3.2 Evidence of being motivated and able to take action

3.2.1 *Identifying with systemic problems*

Feedback sheets from the workshops provided evidence that participants did identify with the systemic problems and they themselves experienced them in their day-to-day activities. Participants at the second wworkshop agreed that the systemic problems identified (Table 2) were ones they recognised (Avg score = 7.9 out of 10, with a range of 4 to 10, from 14 responses) and that they were also dealing with (8.0, range 5 to 10). However, there was less agreement with the solutions identified prior to the workshop (6.4, range 3 to 10) or confirmation that they might be able to contribute to the solutions (7.0, range 3 to 10). The aim of the second workshop was to increase the intent of participants to embark upon solutions by involving them in identifying solutions that they could contribute to. To this end, participants at the second workshop were more positive about where possible changes could be made (7.4, range 3 to 9) and felt challenged to take action (7.5, range 6 to 10).

The follow-up interviews suggest that members of the Community for Change identified with the desire to implement co-innovation in projects. This included to better understand what co-innovation means in practice for different Government, industry and research actors; use a co-innovation project as a focus of action for the Community for Change; and work together to create tangible success. There was a view that the terms co-innovation and co-development were being more widely used in the AIS, but that these concepts had different meanings to different actors.

3.2.2 *Planned actions by the Community for Change*

We found limited evidence of actors beginning to develop systemic instruments. Actions are being taken, however these tend to be at the project-level, e.g. implementing co-innovation in existing projects, tools to support co-innovation, and ways to extend the use of co-innovation into other projects. Another example was the plan to run a co-innovation showcase at Fieldays, New Zealand's largest agricultural event, to encourage agribusiness companies that traditionally compete to instead co-innovate.

Other actions described linking with other participants to share knowledge or to take coordinated action by linking separate activities in their organisations. Examples included: (i) learning how another research organisation had developed Key Performance Indicators for encouraging co-innovation, (ii) utilising knowledge from Primary Innovation in other innovation projects and organisational changes, and (iii)developing university courses to build capabilities for co-innovation, innovation brokerage and entrepreneurship by science students.

3.3 Evidence of the beginnings of a distributed Community for Change

Twenty people attended the second one-day workshop and 32 individuals signed up for the Hub in response to an email invitation, and, for some, a follow-up conversation. This action by Community for Change members suggests a first step toward distributed online collaboration. At the time of writing, seven of the 32 signed up have elected to join a specific theme group. However, activity on the Hub is low and the team is trialling strategies for stimulating and supporting collaboration using the Hub.

Interviewee feedback on using the Hub was mixed, with some indicating they would be unlikely to use the Hub due to a lack of time or a preference for face-to-face interaction. Community for Change members that did indicate an interest in using the Hub, emphasised the need for new information to be regularly added and for reminders to contribute to the Hub.

4. Discussion

There is evidence of the beginnings of a Community for Change through multiple actors developing wider perspectives of innovation and the AIS, and identifying opportunities to challenge underlying institutional logics. Such collective system-level learning towards transformative structural changes has previously been observed in the Dutch poultry (van Mierlo et al., 2013) and agricultural (van

Mierlo et al., 2010) sectors. This system-level learning has already increased networking and coordination of activities among the Community for Change to support co-innovation, however, actions planned tend to be at the innovation project-level, rather than the AIS-level. This may be due to participants in the NZ context: (i) still developing their understanding of co-innovation as a practice within their own realms of experience and influence before committing to actions that might embed it across the AIS; and (ii) feeling limited in their capacity to enact change at the AIS-level.

4.1 Moving from project- to system-level changes

Our findings suggest that moving from project to AIS-level change remains a challenge. Members expressed a desire to investigate different models of science-industry interaction, such as co-innovation. These were identified as more tangible to work on as a group and have "*better scope for change and influence*." Simultaneously there were calls for top-down commitment to co-innovation, e.g. in Requests for Proposals, so that the co-innovation practices are first mandated and then become business as usual.

Simultaneous AIS and project-level change suggests a need for better linking of project-level implementation of co-innovation with barriers and opportunities in the New Zealand AIS. This is similar to niche and regime relationships in the multi-level perspective (Geels, 2004; 2010) where transitions in the making feature important boundary-crossing processes between initiatives and their environment (Beers et al., 2015). The Community for Change included tactics to support these boundary-crossing processes through: (i) the inclusion of project-level actors with system-level actors in the Community for Change, and (ii) the Value Add Documents' translation of innovation project insights into potential strategic-level actions (Beers et al., 2015). A future step could be organising the Community for Change around a specific innovation project to identify actions they can simultaneously take at these different levels in order to further stimulate co-innovation in the project.

4.2 Agency at the system-level

A need for leadership to stimulate AIS-level change was identified, and expressed as a sense that large changes are needed at the organisational and AIS-level, which are beyond their individual influence. The concept of institutional entrepreneurship may help to resolve this tension between system-level institutional change and limited actor agency to enact this change (Battilana et al. 2009; Bremmer, Bos,& Klerkx, 2014), by identifying actors that are able to strategically transform existing or create new institutions (DiMaggio 1988). Tactics that these institutional entrepreneurs may apply to implement change projects (Pacheco et al., 2010; Battilana et al., 2009) include: (i) framing and re-framing by developing a vision that can convince others, (ii) coalition building by mobilising others to support change, and (iii) motivating others to achieve and sustain the vision.

There is evidence of some members of the Community for Change implementing the first tactic. For example, the inclusion of the Ministry for Primary Industries' extension framework, which includes co-innovation as an approach, in Over the Fence (Casey, Rhodes, Payne, Brown & Dynes, 2015) and in the Ministry's Science Strategy (Ministry for Primary Industries, 2015). This high-level endorsement of co-innovation as a desirable practice is shaping expectations of innovation project funders and influencing project planning and management across primary sectors. This example and other institutional entrepreneurship tactics could be concrete actions encouraged and supported in the Community for Change.

5. Conclusion

Our findings provide early evidence that involving multiple actors from the AIS in challenging underlying institutional logics and encouraging generative collaboration is stimulating project-level actions to enable co-innovation and recognition of AIS-level barriers and opportunities. This confirms the benefits of collective system analyses using an innovation systems perspective to identify and address structural changes in the AIS (Bremmer, Bos & Klerkx, 2014; van Mierlo et al., 2010; 2013). It also suggests that such collective system analyses can enable identification of actions that may

address underpinning institutional logics with the intention of enhancing the performance of the AIS. A challenge still to be addressed is how to simultaneously resolve innovation project-level actions with AIS-level actions, reflecting niche and regime relationships in the multi-level perspective.

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