Analysis of the Role of an Innovation Broker Appointed by an Environmental Innovation Partnership in the Cotton Industry, Queensland, Australia

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Abstract: Outcomes from contemporary Agricultural Innovation Systems (AIS) can be viewed as the product of interacting plural, multi-level and often short term, concomitant initiatives. The new language of Environmental Innovation Partnerships (EIP), Organisational Groups (OG) and Innovation Brokers (IB) appears to engage with this perspective. Reflecting on our 2007 Australian case, members of an AIS developed what could now be considered to be an EIP. Their objective was to support accelerated adoption of better irrigation practices within an Australian cotton catchment. One of the members of the partnership was operating an Agri-Environmental Scheme (AES) that was seeking to monetarily incentivise the on-farm implementation of environmentally-sensitised irrigation practices. The members pooled their resources, and appointed a short term IB to facilitate the use of the financial incentives by local irrigators and their agronomic advisors to purchase knowledge based on their self identified irrigation knowledge needs. The IB was to also facilitate better linkages between all relevant initiatives in relation to irrigation, water, cotton and the catchment. The hypothesis was that new or modified OGs would emerge, driven by the knowledge needs of the participants, and that practice change would ensue. Members of the EIP also reasoned that if these OGs could be sustained post-project that a legacy of on-going systemic change could be achieved. Our research shows that the EIP was successful in terms of exceeding short term objectives. However, the EIP was not successful in terms of generating a post-project legacy, by new or altered OGs that could drive further practice changes in the AIS. An analysis of these results allows us to consider innovation processes supported by AESs, EIPs, multi-level OGs and IBs within short time frames. It also allows us to explore the implications for evaluation of such initiatives.

Keywords: Agricultural Innovation Systems, Innovation Broker, Organisational Groupings, Agri-Environmental Incentives, Evaluation, Cotton Farming Systems, Australia

Introduction

Contemporary Agri-Environmental Systems (AES) throughout Europe (Dwyer 2013) and the world (Kiers et al., 2008) are continuously challenged by complex, dynamic and multi-leveled issues. We define AESs as soft systems (Ison et al., 2007 ; Steyaert & Jiggins, 2007 ; Ison, 2010), in which boundaries are re/constructed in active multi-level social-ecological interactions pertinent to agriculturally relevant ecologies. Such intractable issues and their local manifestations require that the multi-leveled actors within AESs across Europe (EUSCAR, 2012 ; Dwyer, 2013) recognise this circumstance and therefore build knowledge and skills to safely manage non-linear and lively interrelated sets of challenges. Supporting "innovation" has emerged as a key goal since the early 2000s within European directives to build such requisite knowledge and skills in a number of sectors, not least agriculture (Hermans et al., 2011).

In a review of European Union (EU) innovation policy documents relevant to agriculture, Hermans et al. (2011, p. 8) present a list of contemporary EU rural development measures. They

also assert that these measures do not operate in isolation of each other but rather interact along with many other policies and measures that are generated by non-governmental (i.e. NGOs) and part governmental (i.e. Quangos (Goodwin, 1998)) organisations in complex systems of agricultural learning, development and innovation. Moreover, these concomitant initiatives tend to be impermanent, operating under contractual arrangements extending over various time periods.

Campbell (2006, p. 17) has illustrated the complexity of the innovation context in Australian AESs by stating that in relation to Australian agriculture there are over "several hundred organisations managing formal, scientific Natural Resource Management (NRM) knowledge" with an estimated 134 000 farming businesses (National Farmers NFF, 2013) nationally. He also states that this is only a subset of the effort as his analysis does not include the policies and actions of other knowledge developers such as Agribusiness for example. Hence both within the EU and Australia, the social and ecological outcomes for AESs can be viewed as the product of interacting plural (public, private and market), multi-level (local, state, federal, regional, international), often short term, concomitant initiatives.

Since the 1990s, Agricultural Knowledge and Information Systems (AKIS) theorists have worked on intervention theories that are cognisant of this perspective of the context (Klerkx et al., 2012). According to Klerkx et al. (2012, p. 54) these theories have informed and been informed by agricultural policies and their implementation globally such as those based on Farmer First and Participatory Technology Development models. More recent theoretical endeavors under the rubric of Agricultural Innovation System (AIS) theory has added emphasis on certain aspects and is found to be in the logic and evolution of recent initiatives such as Support of Learning and Innovation Networks for Sustainable Agriculture (SOLINSA) (Brunori et al., 2013) and Convergence of Sciences: Strengthening Innovation Systems (CoS-SIS) (Hounkonnou et al., 2012). That is, AIS theories engage with the complexities introduced by the increasingly recognised multi-level reality of the local AES, the increasing specialisation and pluralisation within and across the interactive domains and levels of AISs embedded in AESs, the increasingly recognised impact of the interplay between short term policy measures within such complexes and therefore the need for evaluation measures that recognise the processes of systemic change. These theories of innovation in agriculture appear to inform the EUs Agricultural Environmental Innovation Policy (EIP-Agri) of 2013 (European EU, 2013).

Explicitly the innovation sought by the EIP-Agri "goes beyond speeding up the transfer from laboratory to practice (referred to as the linear innovation model)" by seeking a more "interactive innovation model" (European Commission 2013) in European AESs. It does this by formalising a process that provides support for the development of Organisational Groupings (OGs) and the deployment of Innovation Brokers (IB) that facilitate linkages between components to drive the re-arrangements necessary for innovation. OGs are defined in the EIP-Agri as groups that "will bring together farmers, researchers, advisors, businesses, NGOs and other actors to implement innovation projects pursuing the objectives of the EIP-Agri" (European Commission, 2013). IBs are defined as individuals or organisations that act as the "go-between, discovering innovative ideas, connecting partners, finding funding sources and preparing project proposals. Ideally, innovation brokers should have a good connection to and a thorough understanding of the agricultural world as well as well-developed communication skills for interfacing and animating" (European Commission, 2013). This is consistent with theoretical definitions of IBs (Koutsouris, 2012). As a direct consequence of appearing to view the context for innovation from a systems perspective it also seeks to direct these components to brokering between concomitant initiatives developed under several EU agricultural policies across various levels.

As this is a newly launched policy that appears to seek a distinct turn towards latest AIS understandings of innovation within AESs, research that helps us to better understand aspects of the implementation and evaluation of such ideas in practice is timely (IFSA, 2013). We present an

account of a case from 2007 within an Australian AES that utilised an approach that is reflexively assessed to be grounded in AIS type thinking and can now also be considered to be consistent with the intent of the EIP-Agri. This case study is of a short term initiative developed by a multi-level Environmental Innovation Partnership (EIP) intended towards transitioning an AIS within an Australian AES towards ecologically sensitised environmental management regimes. This is a reflexive examination of this case through the lens of those understandings of innovation in AISs that have appeared to inform the encouragement of EIPs, OGs and IBs under the pillar two of the European CAP reforms of 2013. Before we reflect on our case it is important to be clear about the approach we are taking, the questions we will seek from the case, the theories that are relevant to these questions and the propositions we expect to examine (Yin 2009).

Methodology

To be consistent with AIS theory we propose that an explanatory case study is an appropriate methodology. This methodology is grounded by a view of social phenomena as emergent systemic properties from irreducible sets of context specific social variables (Yin, 2009). A single case study is also chosen because of the view of AIS theorists that extension research should move away from developing "best practice" extension models to designing methods to produce "best fit" in context models (Birner et al., 2006). We have adapted Stake's (1995) approach to organizing the case study in this paper. Stake's (1995, p. 123) approach follows a cyclic or reflective and inductive approach to researching a social phenomenon through a case study that moves through several stages that are consistent with soft systems approaches to organising applied research.

The lead author was the appointed IB for the case we develop here. The account of this case is produced from the field notes she amassed for reflexive management and reporting purposes. The field notes collected were from 'participant as observer' participant observations (Robson, 2002, p. 317) of several meetings of the EIP and the OG and individual discussions with the members of these groups. The EIP meetings focused on developing and consolidating project proposals and the on-going delivery and assessment of the project as it unfolded. The meetings with the OG were organised as Participatory Action Research (PAR) meetings (Dick, 1993) and therefore included observations made during discussions about research plans and reflecting upon the implementation and refinement of such research plans. PAR is a research methodology that is used when both action and research are required outcomes (Dick 1993). The researchers are experienced facilitators of PAR and borrowed from a range of tools as the research unfolded. An approach consistent with implementing a "best fit", or contextually relevant and emergent, action research project that seeks to generate both theoretical and practical knowledge. The field notes also included farm visits when participants were delivering upon their knowledge development plans whether in groups (e.g. training and service certification) or individually (i.e. when participants requested specific advice from self identified potential co-developers of knowledge).

In addition to the field notes there were reports and media that were generated from within (i.e. by the IB and/or partnering organisations such as State Government newsletters and Cotton Industry media) and external (e.g. external evaluations) to the EIP and OG. These documents produced data about how others were evaluating the experiences they were having and what they considered relevant knowledge development both in terms of content and process. As part of the reporting process the IB conducted unstructured interviews (Robson, 2002, p. 270) with each participating grower and each agronomic consultant at the end of the project. These interviews supported growers and agronomic advisors to reflect upon the project, identify what they had learned and predict what aspects would remain viable post project. The second, third and fourth authors acted as mentors to the IB and in doing so supported her reflexive praxis. The second and third authors also had reporting and evaluation roles in two of the organisations that made up

the EIP. They did not interact directly with the EIP or OG but the second author did interview agronomic consultants as part of an external industry wide evaluation of a cache of industry delivered projects aimed at developing environmental capacities of members of the Australian cotton industry. In the next section we re-present this body of data as a rich description of the case within Stake's (1995) framework. Our rich description includes one cycle of observation and reflection due to the short time frame of the initiative being investigated in this case.

The Case

Entry Vignette

This section describes the context of the case and establishes the antecedent conditions that were relevant to the emergence of the best fit approach that is the subject of this research. The AIS case that is researched in this study is located within an AES that is produced geographically and socially by the interactions of several multi-level initiatives relevant to the development of water knowledge and innovation about a single Australian cotton catchment. The case is bounded temporally by a short term, one year, initiative that aimed to drive innovation in this AIS by providing Agri-Environmental Incentives (AEI) to remedy self identified knowledge gaps, by facilitating interactions between several concomitant initiatives to enhance this knowledge development process and by securing synergies as a result through the amalgamation of resources and activities. We define AEIs, also known as Agri-Environmental Schemes or Market Based Instruments (Dobbs & Pretty, 2004), as incentives, usually monetary, generally provided by public institutions to support farmers to produce and therefore develop markets for non-production, non-private outputs such as clean water, improved soil or increased biodiversity. It was also reasoned by the co-developers of this initiative that if new relations were brokered within the knowledge development system that an organisational change could occur leading to sustained innovation post project.

At the time when the case was being developed there were several multi-level approaches aimed at improving water management within the Australian cotton industry. Previously an industry wide assessment of irrigation knowledge within the Australian cotton industry had been completed (Callan et al., 2004). This report had identified that the commercial agronomic advisor and cotton grower was a key knowledge interface in the irrigation knowledge system. Several of the projects in operation at this time were focusing on this grower-advisor interface. These included funding from the National Program for Sustainable Irrigation (NIPSI), the evolution to Phase 3 of the Rural Water Use Efficiency Initiative (RWUEI3) which was providing workshops previously developed for growers to agronomic advisors and lastly the Murray Darling Basin Association (MDBA) initiatives aimed at increasing the number of irrigation accredited advisers through co-investment in their certification.

Australian cotton consultants were also re-defining their roles in response to the reduction of public extension infrastructure and the second generation of gene technology in Australian cotton crops that rendered traditional roles obsolete (e.g. inbuilt resistance transforming weed and pest management responses). In fact at the time of the project the Australian Cotton Consultants Association had re-named the organisation to Australian Crop Consultants Association. This pluralisation and transformational phenomenon in agricultural knowledge systems has been observed elsewhere, causing Birner et al (2006, p. 2) to develop a typology of service providers within "pluralistic agricultural advisory" contexts.

However this phenomenon was emerging within a broader context of environmental issues and initiatives relevant to water and the Australian cotton industry. Most of the Australian cotton crop is produced within the Murray Darling Basin (MDB). In 2007 the federal government in

partnership with the Basin State Governments had enacted a Water Act (AG, 2007). This Water Act was aimed at reducing water extraction throughout Basin catchments in order to restore regenerative flows. Although complex in itself, it is suffice to say that most cotton growers were expecting a reduction in allocation as they were generally operating within those catchments of the MDB identified as most over-allocated. Other broader initiatives included the addition of a water module to the industry's best management practices programs (Cotton BMP), cross compliance between State Government requirements, environmental organisation mandates and these industry self regulatory processes and a broad provision of AEIs to increase water use efficiency or protect riparian zone and fish habitats for example. All of these initiatives were not operating in isolation from each other or with any degree of permanency. This demonstrated that the context for knowledge development and innovation in our case is complex and dynamic.

In this context, what is now considered to be a type of multi-level Environmental Innovation Partnership (EIP) began operating. The EIP was financially supported by the Federal Government' Sustainable Industries Initiative (SII) and the Federal and State government's community Natural Resource Management (NRM) arrangements. It was also supported by relationships built over many years of co-research and co-development interactions between the Cotton Catchment Communities Cooperative Research Centre (Cotton CRC) and its partners such as the Water Team, Cotton Australia's Cotton BMP Team and the Cotton Research and Development Corporation. It is labeled an EIP to recognise that it was aimed at environmental innovation within an Australian agricultural sector and is therefore similar to the types of European Innovation Partnerships that are expected to develop under the EIP-Agri for sustainable agriculture within the EU member states. That is "EIPs should provide favorable conditions for research and innovation partners to co-operate and achieve better and faster results compared to existing approaches" (European Union 2013). This partnership was interested in facilitating fast results in a short time frame in relation to the water outcomes of that part of the industry located within the Australian cotton relevant catchment that bounds our case.

Given the number of industry and local initiatives focusing on the irrigator-advisory interface, the motivating factors for both the cotton growers and the agronomic advisors in terms of pending water cuts and relationship re-definition, it was decided by the EIP to work specifically upon facilitating a group to support innovation within the agronomic advisor-cotton grower water knowledge networks. A type of OG that brought together a group of actors that included farmers and their agronomic advisors as well as relevant others as the project developed. This is akin to an EIP-Agri defined OG. To ensure that the process of knowledge development supported by the OG was structured, PAR (Dick, 1993) was built into the milestones of the project.

One of the participants of the EIP was operating an AEI and had funds available to stimulate adoption of practices that would have both public and private outcomes by supporting the production of the expected public ones. Within Australia's community NRM program AEIs have been consistently shown to stimulate the rate and reach of adoption of practices which provide public goods (Coutts & Samson, 2008). The EIP decided to redirect the available funds to co-invest in the filling of the OG's self-identified knowledge gaps rather than purely supporting on-farm predetermined ideal or best types of infrastructural change. This was a novel departure from the use of incentives at this time. Utilising evidence gleaned from examining the results of projects that facilitate "Research Pull" as opposed to "Research Push" (Klerkx et al., 2012), along with the evidence of increased rates and reach of adoption when AEIs are in use (Coutts & Samson 2008), the EIP reasoned that together these approaches would deliver rapid innovation that is more likely to be sustained.

To further ensure that the knowledge development was rapid they decided that some of the funds should be utilised to secure a facilitator that could support the OG to identify their knowledge needs, facilitate linkages between the OG and other actors to encourage novelty as well as quick-

ly link up the OG with actors that could help solve the issues identified and to administer the delivery of the project in one year time frame. Consistent with IB theory the EIP specifically required an IB with the knowledge, skills and legitimacy to facilitate this process. This was akin to appointing an IB as defined in the EIP-Agri. However the EIP in this case from Australia were further reasoning that if they could appoint an IB to facilitate the restructuring of relations that this could also contribute to a legacy of sustained innovation post project.

In summary the context described is not dissimilar to the current context in EU member states where innovation is emerging as a key theoretically informed driver in policies aimed at rural development within AESs. That is, within the context of EU AESs, there is a multiplicity of action driven by initiatives within and between the two pillars of the CAP and those that are initiated by the private sector, Quangos and NGOs that are similar to those described in our case. Also in the EU member states the pluralisation of agricultural advisory arrangements has initiated much research about this phenomena and the responses made by agronomic advisors. Moreover in this complex and dynamic context within the EU, new policies have emerged seeking to drive innovation through EIPs, OGs and IBs. Finally, the responses that were made by the actors in our case share many similarities with the type of responses that are expected to be supported under the auspices of the EIP-Agri. Therefore what happened in our case could inform design and evaluations of initiatives that respond to the latest policy development under the EIP-Agri.

Issue identification and framework for examination

In order to assess how this case could inform the design and evaluation of EIP-Agri supported initiatives we need to identify what design attributes in our case that we are interested in and the evaluation of such. We have established that in terms of this case several contextual factors drove the subsequent design that were consistent with the context that initiatives developed through the EIP-Agri could operate within. However in this case there is one contextual factor that facilitated three design attributes that are worthy of particular attention. The contextual factor is the short term, one year time frame for the project. The first design attribute of subsequent interest is the decision to appoint an IB with certain skills, knowledge and legitimacy. The second related attribute was that these skills, knowledge and rapport were necessary to facilitate a PAR (Dick 1993) process of rapid Research Pull by coordinating self directed and reflexive learning cycles and facilitating linkages between potential co-developers of self identified learning needs. The third subsequent design attribute was the decision to support this IB facilitated PAR process with the re-deployment of AEIs from 'hard" infrastructural change towards the co-investment in 'soft' self identified knowledge development. Together these attributes were theorised to be drivers of rapid innovation in the short time frame within the complex and dynamic context described that could lead to on-going innovation post project.

Much has been theorised about the new praxeology of systemic facilitators within such contexts. Klerkx et al. (2012, p. 56) tabulates a summary of this literature under three main roles of: Articulation of Problems and Possibilities, Network Building and lastly Supporting Negotiation and Learning Networks. Each of these roles was evident in the design of the IB appointment and the process they were expected to facilitate in our case. Whilst the problems that this literature deals with include legitimacy, neutrality and on-going funding issues (Koutsouris, 2012) it does not explicitly deal with design approaches that are cognisant of the endemic nature of short term funding arrangements and therefore seek to purposefully facilitate innovation regardless. The short term intervention is a wide spread contextual factor for the application of theory of extension pedagogy within AISs in the era of privatization, divestment, specialisation and fragmentation of extension across the world. Moreover, the concomitancy of multi-organisational short term contracts complicates this scenario further. This means that experimenting with models for

implementing and evaluating short term intermediaries in AISs that are seeking systemic (i.e. sustained post intervention) innovation is of interest.

AIS theorists have also explored how innovation can be evaluated. In this vein AIS theorists have posited that innovation has various levels ranging from incremental to revolutionary (Brunori et al., 2013). We therefore assert that the praxeology of the IB could be evaluated in relation to these levels of innovation outcomes. Incremental innovation is often associated with doing something differently whereas revolutionary innovation is associated with complete re-structuring of the arrangements relevant to knowledge development including to the limits of the knowledge production sphere (Steyaert & Jiggins, 2007 ; Hounkonnou et al., 2012). Therefore in terms of the IB roles documented by Koutsouris (2012) how problems are viewed and what possibilities can be explored in the remedying of problems becomes a key indicator of the degree of innovation. Moreover the structure or relations and how they are transformed is related to problem framing and solution finding and also means that the type of network relations facilitated becomes another indicator in the degree of systemic intervention. In the next section we present our findings through the framework of levels of innovation and the Koutsouris' (2012) three roles of IB praxeology. We look in particular at the use of AEIs in this process.

Description and Reflection

The relationships between level of innovation and the three roles as documented by Koutsouris (2012) frame the description and reflection section. We also seek to explicate if these outcomes were sustained post intervention.

Facilitation of Learning

The project achieved the participation and adoption targets that had been set for it by the funding contracts between Federal and State Governments that the EIP had creatively amalgamated in the design of this initiative. The following outcomes are listed in the final report (Hood, 2008). Of the agronomic advisors advising cotton growers within the case catchment, 25% participated in this project. These agronomic advisors partnered with farmer clients whom together managed 31% of the possible area of the case catchment and approximately 10% of the groundwater resources diverted by agricultural within the catchment annually. Together these agronomic advisor-cotton grower relationships drew $130 000 worth of knowledge in the form of consultancies and training and subsequently invested in $390 000 worth of on farm works that would save from seepage or evaporation some 700 Megalitres of water per annum This is considered a rapid rate of adoption and therefore a successful delivery of the project. The investment in water saving measures made by the growers proceeded without further co-investment and will sustain water savings post project. But the development of further measures by participating growers resulting in further water savings per annum post project or the provision of new services by agronomists resulting in wider dissemination of these activities post project was deemed unlikely by these participating growers and agronomists. Therefore rapid incremental adoption can be considered an outcome of this successful delivery.

However, what is not obvious in these figures is the range of responses that were made. For example even though the participating growers as a group purchased so many dollars of knowledge or implemented so many dollars of changes on farm, not all growers proceeded with implementation plans in full and some chose to not make any. Likewise, although so many agronomic advisors participated, some did not remain engaged and although those that did stated that some aspects of their service delivery would be enhanced as a result of their participation in the project they generally decided to not adopt the new services they had experimented with. These results (Hood, 2008) indicate that the knowledge development process was self directed and effective, in

that it allowed people to articulate a range of decisions, including the decision to not change their approach and is therefore central to the production of these outcomes.

The project proposal had stipulated that the IB utilise PAR to structure the learning process, and the delivery of monetary incentives (CCCCRC, 2007, p. 3). It is evident that project designers considered PAR coordinated encouragement of Research Pull as opposed to Push was a key attribute in the delivery of rapid project outcomes and sought to value add to this theoretically informed design attribute by supplying monetary support in the form of AEIs to stimulate this process. However, when reflecting upon the PAR that was facilitated in this research the IB demonstrated that this was not a smooth process of an OG whom together participated in learning cycles from problem identification, research design, implementation, observation, reflection and through to re-identification of problems. But rather that it was a process of supporting the reflexive praxis of each actor with which the IB interacted with, whether they were members of the EIP, the OG or engaged as the project evolved, and allowing synergies to stop and start between actors when stages or interests in their practice converged and diverged, whilst also equally allowing PAR cycles to operate in isolation of others and never converging. Equally this, IB praxeology supports actors to disengage but does so in a way that helps people to articulate their reasons. After King (2000) this is a PAR process informed by systemic understandings of social learning. Diagrammatically, this approach would resemble a mess of learning cycles that are sometimes operating in isolation, sometimes stagnant, sometimes hidden, other times converging and equally diverging.

From post project interviews with consultants and via an external evaluation of the project (Coutts, 2008b) it was evident that this approach to PAR was a key factor in the project's success. One agronomic consultant reflected that "It is important to be in a group and talk about things and learn in a group actually doing stuff as you go. The fact that we planned stuff, went out and did it and then was able to talk about our experiences was really helpful" (Hood 2008, p.23). They also felt that what they had learnt by participating in the project was useful. Moreover, decisions to dis-adopt or non-adopt were cited as well informed given their participation in the project (Hood, 2008).

However, the results also show that such effective PAR can achieve rapid results if the knowledge development is stimulated by monetary incentives. Incentives were a major factor for grower participation with one explicitly saying, "I would not have paid for it" "(Grower #6, 10/10/2008). The consultants felt that incentives were most helpful in engaging their grower clients regarding WUE, as one said, "Incentives helped get a few guys who probably would not have done it otherwise" (Agronomic consultant #5, 02/06/08) and another said, "Economic investment helped in selling it to clients" (Agronomic consultant #3, 2/06/2008). Together the PAR and incentives were identified by participants as critical to engagement, learning, adoption, dis-adoption and non-adoption. Thereby demonstrating that incentivised PAR can lead to rapid and sustained incremental innovation. However as the next section shows the designed facilitation and mobilisation of new linkages within the knowledge networks is also considered to be an important factor in these rapid results. Although equally an indicator of the limits to achieving sustained revolutionary innovation in short time frames.

Network Building

There was a strong emphasis on the development and consolidation of the partnerships best able to facilitate immediate and on-going co-innovation within the project proposal (CCCCRC 2007). Specifically networks between the cotton industry and environmental organisations as well as between agronomic advisors that could be sustained post project was being sought by their coor-

dinated involvement in identifying and working on immediate knowledge gaps. Consequently the project facilitated the development of linkages that did not exist prior to the initiation of the project. According to one agronomist the project "has given us another network to consult with" (Coutts, 2008a). Another commented that "it was good to be able to work in small groups. It gave us one on one time and the opportunity to access information from researchers" (Coutts, 2008a). Several examples of the network linkages made include with cotton funded researchers that had mutually discovered research interests with the agronomic consultant-grower research interests, or the deployment of irrigation engineers that were Cotton CRC partners and had previously worked with other agronomic advisors but not the agronomists or the farmers that were involved in this project.

Therefore, a closer look at the relationships that were quickly operationalised in this project stimulated by the PAR identified knowledge needs of the agronomic-advisor relationship and the provision of monetary incentives reveals that the linkages that were made internally re-organised the relevant cotton research, development and extension network more than it drew in participants from external networks. A participating consultant alerts to the insularity of the networks developed when in an industry publication (QG, 2009) he states "it was really good to be part of a team of interested consultants, extension personnel and researchers to address these issues together". This triad is historically relevant to knowledge development in the Australian cotton industry and notably does not include other entities such as the environmental organisations that had been involved for example. In social capital terminology the relationships made were more bonding then bridging or linking types (Pretty, 2003). To reiterate the linkages made in this project could be considered as filling antecedent gaps in the existing cotton irrigation knowledge network of this catchment.

Regardless of the types of network connections made, the networks that were created in this project were not sustained post-project. However, the agronomic consultants did consider the merit of collaborating further in the final stages of the project. They requested that an economist whose services had been built into project delivery by the EIP assess the cost-benefit of various scenarios of new business delivery. Scenarios included: one (or a subset of) consultants developing a specialist irrigation and environmental advisory service and the others utilising this with their clients; develop partnerships with existing specialist consultant advisory services; or undertake new services individually. Following these deliberations it was decided that they felt that the services they currently delivered had been enhanced by their participation and that future individual or collaborative business development into new areas was not feasible. The economics of delivery and the willingness of clients to demand these services were the main determinants of the decision to truncate the network post project.

The IB reflected that the bridging and linking relations (i.e. with other industries, or interest groups) were not immediately (i.e. short term) identified as relevant to the agronomic-farmer knowledge needs. However, the IB also reflected that the ease with which these connections were made were related to the relationships she had amongst the eventual collaborators and within the cotton industry and the specific catchment. This highlights a potential relationship between short term time frames, legitimate IBs, self directed learning processes, monetary incentives and the facilitation of incremental as opposed to revolutionary change. As Pretty (2003) observes the dark side of bonding relations is that they tend to consolidate internally palatable problem frameworks and reinforce relations that share these frameworks. The results of which are limits to the types of networks that can be facilitated. Moreover antecedent discontinuities between some groups and others can become reinforced. The network relations formed in this project allowed rapid incremental innovation and are not sustained after the fact. Here the issue is the time required to create the opportunities to challenge the view of the problems and consider second order learning issues such as the frameworks within which the identified research issues are located

(Steyaert & Jiggins, 2007). Providing the opportunity for participants to work on second order issues as well as first order ones has been shown to be critical to revolutionary change (Hounkonnou et al., 2012).

However, this highlights the role of problem framing in the construction of who should be involved, for how long, as well as what are considered possible solutions in terms of incremental and revolutionary innovation. Moreover the development of indicators that can evaluate the evolution of problem framing and the types of relations supported by initiatives aimed at innovation is highlighted.

Articulation of Problems and Possibilities

The talk and text produced about the project illustrated that it was pursuant of broad environmental objectives for improved outcomes for water at the industry and catchment level. The project proposal includes the following objectives: "Increase the adoption of Water Use Efficiency practices that deliver on industry and catchment natural resource targets" and "coordinate and facilitate the delivery of Natural Resource Management outcomes through best management practice in Water Use Efficiency"(CCCCRC, 2007).

However, these statements indicate that broad objectives are able to be translated into more concrete aims of increasing and promoting responsible stewardship of water resources by cotton farmers on cotton farms within the catchment. Of course there are difficulties in terms of monitoring the impact of farm level action if the problem remained a catchment level problem. However, by continuing to reduce the problem definition in this way catchment level outcomes remain unable to be examined. Moreover the use of the term "natural resource" instead of environment or ecological management reiterates that the problem is a farm problem as opposed to an environmental or ecological or catchment problem. That is, by labeling environmental commons integral to production outcomes "natural resources" they are able to be constructed narrowly as a resource base which contrasts with a more holistic view that would include the need to consider the on-going regeneration of the resource base as well.

It seems that that these problem definitions were refined and worked on in the subsequent project. For example, in a paper delivered at a national cotton conference after the project had been finalised it was stated that the project had allowed the cotton industry and its partners to: "collaborate to improve water management and achieve both production and environmental outcomes. Improving water use efficiency leads to not only decreased deep drainage, reduced water logging and reduced risk of salinisation from a catchment health perspective but also the production of more bales per megalitre and compliance with industry best practice guidelines" (Spanswick & Jones, 2008, p. 6). In this statement, rates of adoption of on farm "best practice" within catchments are constructed as a proxy for "catchment health". Ultimately the relationship between improved farm practice and catchment health remains diffuse and not able to be measured (e.g. level of salinisation risk reduced) and the relationship between improved on farm management and the private economic benefit (e.g. more bales per megalitre) remains measurable and indicative of success.

This articulation of problems and possibilities was largely set by the EIP beholden to funding programs that they had deployed in this partnership and the evaluation measures that these funders required. However there was evidence that the EIP were attempting to achieve systemic objectives as well. This is evidenced in the desire of the EIP to allow theory to inform practice, to consider the opportunities to rapidly drive innovation that could lead to on-going change, and to reflect upon this by explicitly requesting documentation of the results of such experiments. However, the successful delivery of targets related to incremental change such as numbers participating, distributional effects and megalitres saved overshadowed the purposeful consideration of

how the project had contributed to systemic change within the catchment management regime (Birner et al 2006, p. 3).

Assertions

The context of our case is relevant to contemporary AESs throughout the globe and the problem of impermanency of IBs is endemic within these. Here we have shown that through purposeful design within these contexts rapid incremental change can be facilitated. However we also show that such efforts may be at risk of not contributing to on-going systemic change at the level of revolutionary change. We assert that the development of extension and evaluation methodologies that facilitate both incremental and revolutionary change and that have a post-project legacy are required. To this end we have generated some assertions from our reflexive account of a relevant case in Australia.

In this case knowledge development and practice change is rapid. This result is the outcome of several factors purposefully designed by the EIP. Firstly, the project explicitly required that a PAR approach to knowledge development was employed within an OG. The EIP also explicitly sought an IB with the knowledge, skills and legitimacy among prospective participants to deliver the project. The use of AEIs to stimulate Research Pull was both novel and effective. The incentivised PAR approach to Knowledge development created new linkages in the cotton extension network that did not exist prior to the project.

However, knowledge development was bounded, network connections were observed to be more bonding then bridging or linking types and the networks created were temporary and truncated by project finalisation. The AEIs deployed stimulated the Research Pull but also contributed to the limits on the types of networks that could form and the problems that could be researched by participants. Therefore innovation in this case was unable to move towards sustained revolutionary change. Klerkx et al. (2012) warned of the propensity for innovation projects to contribute to the delay of revolutionary innovation because they tend to support more of the same. In reflection upon our case, indicators and measures that move beyond assessing incremental change were perhaps required. However, the move by the EIP to work creatively and reflexively within their context, in the case we represented here, cannot be discounted.

We assert that measures that can reveal the types of networks formed will provide information about whether the networks reached beyond their bonds and formed bridges and linkages with other sectors and interests and whether articulations of research problems that consider contextual issues as well as operational issues within PAR activities at all levels (EIP, OG and Individual) may remedy this disjunction. Social Network Analysis (SNA) is an area of social science that has built a set of theories and methods based on the premise that social relations are observable and measurable phenomena in which patterns can be empirically identified (Bodin et al., 2006). Recently these theories and methods are proving useful in environmental governance research (Bodin et al., 2006 ; Bodin & Crona, 2009). For example Beilin et al. (2013) have illustrated the usefulness of SNA in developing participants' understandings of transitions in multi-scalar social networks relevant to Landcare arrangements in Victoria, Australia.

Conclusion

In our research, we have been able to consider the innovation process through financial incentives, EIPs, multi-level OGs and IBs within short time frames from a systems perspective. We have also explored the implications for evaluation of such initiatives. We have closed with some assertions that require further experimentation and reflection.

Firstly, taking a systems approach to innovation within the EIP, OG and IB's praxeology is fundamental. All of which, including the EIP requires space, and perhaps time, to be creative at the

level of problem definition and in managing network developments. In relation to the IB praxeology specifically, there is a requirement for systemic understandings of social learning within complex settings that results in a messy multiplicity of multi-level, dynamic and uncontrolled cycles of PAR. In sum, a systems approach may destabilize the formal delineations between the EIP and OG and produce a more fluid definition of such networks facilitated by an IB working across all these domains in this way.

Secondly, by building in indicators that map changes in problem definition and network arrangements and that considers all levels of the system (IB, OG and EIP) the short term initiative may be able to overcome barriers to revolutionary change. Our research suggests that monetarily lubricated PAR coordinated Research Pull may not be an effective substitute for the time required to challenge problem definitions and in an interrelated way integrate previously disparate networks. This assertion would need more purposeful examination in order to be able to draw a more definitive conclusion.

Finally, the novel deployment of AEIs to assist knowledge developers to purchase self directed knowledge requirements appears to require anchoring within an approach that ensures that the requirement of receipts does not limit the types of knowledge and networks that can be developed. We believe the EIP-Agri 2013, which appears to seek the facilitation within the EU member states of the types of initiatives that our case in Australia is an example of, offers a context within which to consider these assertions further.

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