Experiences of transdisciplinarity in research on agricultural sustainability

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Abstract: *The Agricultural Research Group on Sustainability (ARGOS), a transdisciplinary research programme funded by New Zealand's Public Good Science Fund and business organisations interested in primary production, aims to improve the resilience and sustainability of New Zealand agriculture by comparing organic, integrated and conventionally managed farms and orchards. Researchers from ARGOS write of the programme's context, research design and major results, but especially they share the highs and lows of their experiences of working in a team made up of researchers from farm management, economics, ecology and social science, in the process of becoming transdisciplinary. These experiences are interpreted through the lens of Bourdieu's Theory of Practice to demonstrate how researchers respond to working in a field, transdisciplinarity, in which they do not know the 'rules of the game' and which, in fact, may not yet have rules. Despite frequently referring to the contestation that occurs in this situation of challenges to identity and making meaning, this is a programme that through continuing negotiation has been adapted to move into its seventh year. As such those who are working or about to work in similar programmes can take heart. If they are having difficulties and disagreements - this is a 'normal' experience, to be expected and celebrated as part of a growing and creative process. It does not mean that the transdisciplinary research endeavour should be abandoned but that it requires structural support frameworks at both international and research institute level for a 'space' in which it can happen more effectively.*

Keywords: *sustainability, transdisciplinarity, experiences, resilience, Bourdieu, field, symbolic capital*

Introduction

In this paper we present the experiences a group of people engaged in a research programme moving towards transdisciplinarity. The purpose is three-fold: to reassure others involved in inter-disciplinary research that they are not odd or necessarily difficult, contrary people if they are finding the process of transdisciplinary research personally demanding; to demonstrate that there are basic structural reasons why problems arise; and to show its creative possibilities. We do not aim to produce a list of recommendations on how transdisciplinary research should be done[1], what sort of people can do it[2], or tell a cautionary tale. By attempting to stay true to our experiences by reflecting on the embodiment of our thoughts in our practices, our work may have relevance not apparent in writing which often emphasises how things 'should' be.

This paper supplements one presented by Henrik Moller and Hugh Campbell at the University of Leige (Moller et al. 2008), a complex and thorough reflection on the experiences of five ARGOS researchers in search of a transdisciplinary utopia. In contrast, this paper reports on the views of a

[1] For example, Tress et al. (2007); Dewulf et al. (2007); MacMynowski (2007) (steps to make transparent the power associated with knowledge claims) and Ledford (2008) (ten questions to be discussed before starting).
[2] See Schoot and Vlek (2007).

wider group involved in ARGOS positioning them in a Bourdieuian framework which is able to provide an overarching explanation for their experiences.

It is acknowledged that many of the seemingly intractable problems of the world like global warming/climate change and sustainable food supplies, will not be understood, managed or solved using science alone (Gunderson and Holling, 2002; Berkes et al., 2003; Fish et al. 2006; Hinrichs, 2008; Longstaff, 2009; Lowe et al., 2009). In particular, rural sustainable development is identified as facing major economic, social, environmental and technological challenges that cut across disciplinary boundaries (Fish et al. 2008; Lowe and Phillipson, 2006; Schoot Uiterkamp and Vlek, 2007; Robinson, 2008). If research results are to enhance policy and practice then stakeholders must be engaged throughout all stages of the research process (Lowe and Phillipson, 2006), hence research is being initiated that involves different disciplines working together in diverse ways. Common features are involving the social sciences, focusing on the future and improving economic competitiveness (Horlick-Jones and Sime, 2004). For example, ecologists in the RELU programme, sought social scientists as partners because they brought "contrasting and complementary perspectives" and alternative forms of interpretation and judgement (Phillipson et al., 2009), as social sciences "are concerned with elucidating the limits and extent of human agency" and this is important in issues to do with "the place of humans in nature" (ibid.).

Framing theory: Bourdieu's Theory of Practice

Bourdieu's Theory of Practice (1990, 1998) is a particularly appropriate framework for the interpretation of the data presented in this paper, as it can help to explain how the structural and societal constraints of disciplinary and other ways of thinking, impact on transdisciplinary research. For Bourdieu (1990), actions take place in a 'field' governed by culture or norms which place value (capital) on actions. Value comes in three main forms – economic, social and cultural, and provides people with symbolic capital, giving them status and meaning, reinforcing their existence in a particular reality. Through life-long interaction with fields, individuals develop a habitus, a disposition to act in certain ways (Adams, 2006). They come to 'know' how to act in certain situations and what is the 'right thing to do' (Bourdieu, 1998), therefore some behaviour becomes 'unthinkable' (Bourdieu, 1990), as a person is like a 'fish in water' (Bourdieu and Waquant, 1992). Actions become embodied as practices. Bourdieu's concern was also emancipatory. He felt that people are entrapped and positioned in fields by symbolic violence, and if they understand how a field operates on them (through revealing the 'water' in which they swim) they will be freer to act differently (Grenfell, 2004).

Context

A description of the ARGOS programme

The Agricultural Research Group on Sustainability (ARGOS)[3] has been funded by the New Zealand government's Public Good Science Fund (PGSF) since 2003 to research the sustainability of New Zealand's primary production in a transdisciplinary fashion, bringing together the expertise of researchers from the disciplines of farm management, ecology, and social science (economics, sociology, anthropology and geography). The programme also has the support of a meat company, ZESPRI – New Zealand's single desk kiwifruit marketing organisation, Ngai Tahu – a Māori tribal group, Fonterra – an international dairy company and the Merino Company. As audit systems are considered the most appropriate pathway to sustainable agriculture within New Zealand's policy arena, ARGOS compares organic, integrated and conventional management systems in the sheep/beef, kiwifruit and dairy industries, along with studies of high country pastoral farming and Māori development farms.

[3] See www.argos.org.nz.

What has New Zealand got to offer?

As Campbell (2004) outlined, when addressing an international audience, many academics in New Zealand encounter a common problem. Why is New Zealand relevant? What is there about a country of four million people, situated between the Pacific Rim and the South Pole, that can speak to global problems or processes? One answer is that New Zealand provides a case study of what happens when successive governments adopt a hard-line neo-liberal approach to policy, economy, and society. Also, given that New Zealand is a country founded on and deeply enmeshed in primary production, it provides the 'purest' example of whether a country can successfully move towards more sustainable primary production down the commercial market-driven pathway in a de-regulated environment. This question is relevant not only for New Zealand, but for all countries that see themselves as globally exporting primary producers, that may look to us to provide evidence of what might happen if the safety net of subsidies and state intervention disappear.[4]

The ARGOS context

ARGOS is an expression of the ideas the three 'founding fathers', Hugh Campbell, John Fairweather and Jon Manhire developed around a shared interest in the emergence of organics in the 1990s and involvement in New Zealand's Royal Commission on Genetic Modification (RCGM) at which it was suggested by agricultural scientists that conventional agriculture was in trouble and could only be 'rescued' by the genetic modification (GM) of agricultural plants and animals. The resulting moratorium on GM made it apparent that there was no clear idea about what sustainable agriculture was. The Government decided it was an important area to be researched. After much negotiation with other researchers of various scientific/agriculturally-oriented disciplines, and one unsuccessful bid, the ARGOS group achieved funding for six years (2003-2009). Having the leadership of Jon Manhire, an agribusiness consultant, who was able to connect the project with many important industry partners, is regarded as an "astute political move" and a key element of this success. The other key move was to enlist the support of Ngāi Tahu, the chief Māori tribe in the South Island, in the study of the development of Māori farms.

In other words, ARGOS actors, through a little trial and error, learnt the 'rules' of the field of government funding, and found that their proposal was 'acceptable' and valued in this field. With their combined social capital they were able to enrol other useful actors/stakeholders to increase their chances of success and success resulted in increased economic and symbolic capital, and incidentally, increased their cultural and social capital, useful for further interactions with funders and other stakeholders.

Method

As one of the ARGOS research team the primary writer of this paper has been a participant/observer since the beginning of the funded programme in 2003. She interviewed other long-term researchers and drew material from the interviews together through emergent themes, restricting her analysis to these interviews in order to reduce the influence of her own experiences of ARGOS, though obviously this still plays a part. Themes presented represent experiences of several of the researchers. As could be expected, quotes sometimes present divergent views on the same topic and do not represent the experience of every participant. Quotations remain anonymous. Unreferenced text in double quotation marks, indicates a quote by a member of the ARGOS team. Individualised copies of the first draft were circulated among those interviewed identifying their material, in order for them to edit or further add their contributions and comments. The last draft was also much amended after consultation with the team. This paper should therefore be regarded as a product of the whole team, initiated by the first author.

[4] Also see Fish et al. (2008).

Others' experiences of transdisciplinarity

We will not provide a review of inter[5]- and trans–disciplinarity theory but wish to concentrate on writing about experiences of working in such programmes. In a transdisciplinary (as compared with an interdisciplinary) programme it can be assumed that researchers from different disciplinary backgrounds come together with other stakeholders to bring the riches of their own disciplines and businesses into a new arena which transcends (Attwater et al., 2005; Maasan et al., 2006) and/or transgresses (Nowotny, 2003) disciplinary boundaries. But they should not seek to colonise that arena nor forget where they came from. In other words, when working transdisciplinarily, researchers should expect contestation (Fish et al. 2008; Hinrichs, 2008) as they become entangled in issues of trust, power and legitimacy (Fish et al. 2008). The major focus of much writing on inter- and trans-disciplinarity is about this contestation between disciplines. The implication is that being involved in transdisciplinarity is not going to be plain sailing: "it may turn out to be painful as well as rewarding" (Schoot Uiterkamp and Vlek, 2007), "no-one who has not worked in a team with people from other disciplines can understand how hard it is" (Longstaff, 2009), "… we know from experience, 'border zones' can be inhospitable places in which to work" (Horlick-Jones and Sime, 2004). These descriptions are open to a Bourdieuan interpretation. The field of transdisciplinarity has not yet been defined in the way disciplinary fields have been, hence people coming into the transdisciplinary field bring their old 'rules of the game' and because they come from different fields contestation about what the 'new' rules are is sure to arise.

Further writing backs up this interpretation. Robinson (2008) found that bringing the "underlying assumptions of participants to the surface" and allowing "them to be examined" did not resolve the tensions within the research team. "While this was not always a comfortable process for our partners or indeed our research team, it is an indispensible component of issue-driven interdisciplinarity" and "the project gave rise to some important disagreements among the research team". Similarly, Tress et al. (2007) who interviewed and then surveyed researchers working in 'integrative' research identified barriers to integration as: difficulties in communication and cooperation across disciplinary boundaries, no interest in cooperation, lack of recognition of integrative research in the academic merit system and lack of knowledge of other disciplines. Other barriers identified were lack of resources (time and money) and project organisation and design. They also identified issues to do with having different starting times for researchers and their being spatially separated.

Other authors acknowledge the lack of a transdisciplinary field in which it is not yet clear what people need to do to achieve status and value. Lélé and Norgaard (2005), Robinson (2008) and Hinrichs (2008) describe how the academic world is structured along disciplinary lines defining prestige and value, making assessment/evaluation and publication of interdisciplinary research difficult (Lowe and Phillipson, 2006; Feller, 2007; Robinson, 2008). Schoot Uiterkamp and Vlek (2007) describe it as there being no space for multidisciplinary research to be published as it takes place in a "science-society arena" which "plays the game of science" (ibid.; see also Nowotny, 2003). Robinson (2008) even proposes that while participating in transdisciplinary research, researchers should still publish within their own disciplines if they wish to further their careers as interdisciplinarity is a "risky activity" and not a "fast track to academic success".

The way in which value or 'capital' is assigned in different disciplines can be seen as a problem of epistemology: "what can we know?", and what is the "status of knowledge about a particular reality?" (Cundill et al., 2005). MacMynowski (2007) associates the power dynamic with the physical sciences' claim to objectivity and how to deal with subjectivity. "A claim to pure objectivity is a claim to know the "truth", and therefore a claim to authority and power". "Knowledge is at the heart of science and therefore, so is the exercise of power" (ibid.). Beilin and Bender (2010) indicate that it is not only science that makes these claims: "… all disciplines have the capacity to act as 'science', that is, to safeguard their ways of knowing and doing ... an expectation of differential power between disciplines ... can be used to undermine effective collaboration processes". Hence, when different

[5] Most of the literature cited here is about interdisciplinarity rather than transdisciplinarity. The difference between the two is the necessary involvement of non-academics in the research (Nowotny, 2003).

disciplinarians are expected to come together there is competition for symbolic status or power. Who is going to make the rules? What are the rules going to be?

There are indications that a field of transdisciplinary research is emerging. Nowotny (2003) asserts that because transdisciplinarity has a responsibility to different users, it needs to produce "socially robust knowledge" (ibid.). Therefore, publications may be 'different': "… only some of the products … will take the form of refereed publications. The social learning … and real world contributions are often difficult to capture in such publications" (Robinson 2008). That this field is emergent and therefore risky is documented by Robinson (2008) whose funding was not extended because their work was overbalanced towards "contributing directly to real world problems" rather than "writing academic papers documenting and evaluating these processes" in traditionally peer-reviewed journals and books on which "academic stature and grants depend". Further, there are not yet rules about apportioning credit for multi-authored papers as many people can be involved in transdisciplinary research and it can be especially difficult when collaborators are from different institutions (Feller, 2007). Neither have rules developed around the ownership of data (Ledford, 2008) nor about how to deal with different disciplinary perspectives on data. Cundill et al. (2007) found that the complexity of transdisciplinary 'data' made it more difficult to interpret, but more 'real'. If different disciplinary fields had something in common it was easier to build transdisciplinary rules for data as Phillipson et al. (2009) found. Ecologists thought that though it would be rewarding to collaborate with qualitative social scientists they actually felt more able to work with those using quantitative approaches, particularly economists.

Because the collaborative exchange required in interdisciplinary research "goes well beyond that required in disciplinary and discipline-based interdisciplinary research" (Robinson, 2008), there were many references to how "… we significantly underestimated the amount of effort and budget that needs to be devoted to interdisciplinary research …" (ibid.). Many others also mentioned this (Tress et al., 2007; Cundill et al. 2007; Ledford, 2008). There is a need to dedicate "more than token time to deliberate collective reflexivity about the process and experience of interdisciplinary research (Hinrichs, 2008). Phillipson et al. (2009) required "significant time and commitment" to work through "methodological and philosophical differences". Robinson (2008) also thought that "such work will typically not yield publishable results as quickly as more conventional disciplinary work".

From these reflections on others' experiences of bringing different disciplines together it can be seen that the experiences of researchers working in the ARGOS programme can be interpreted through a Bourdieuian lens and therefore placed within a broader transdisciplinary context, one in which a field of transdisciplinarity is not yet established. Players come into the transdisciplinary field bringing with them the social, economic, cultural and symbolic capital that had enabled them to build on and gain prestige, identity and a place where they belonged in their discipline/field. They attempt to colonise the new field in which the rules are not clear, with their rules. Giving up their own discipline's rules is not easy because they have embodied these in their practices. This is the world of their habitus, the world that they know how to behave in, the world in which they know who they are, whereas the new field is unknown and uncertain and therefore risky, so they want to give it familiar rules or at least to know what the new rules are so that they can learn how they are to make meaning or gain value/capital/status in the new field.

Seeing experiences of ARGOS researchers through a Bourdieuian lens

The ARGOS field

When asked what ARGOS was about, there was a general consensus among those interviewed that the ARGOS team "possessed a shared belief in what we were doing – the outcome is vital for NZ". This developed from "the first focus [which] was on social indicators of sustainability but broadened out to link in with industry partners and a triple bottom line and market access foci". Overseas markets want imported agricultural products to be produced sustainably. "How did this suit New Zealand and what was the evidence to back up such a claim?" Apart from this researchers had different dreams and expectations of what ARGOS was about and excitement about what could be

achieved. "The government was putting up a significant amount of funding for a transdisciplinary programme that had scope and potential to do something well". It was "a chance to have a research design that would lead to something innovative and interesting"; "a comparison of three management systems to take the best practices from each to help agriculture in New Zealand"; "to quantify the impacts of New Zealand farms"; and to develop an "understanding of what contributes to good production". These comments contain both an academic and a practical interest. How will the design work out? "What will the on-farm measurements show – the numbers?"

Rules of the game: valuing capitals

Capital can be thought of as a currency to trade and build on. The rules of the field decide the degree of value to be attached to capital. For example, it appeared to some that a high value was placed on extroverts: "70-80% of the talking [at meetings] happened between three people" and the "quiet ones are never involved". However, one researcher has "learned [he] can make a contribution … at the ground level, more quietly".

What is to be valued?

Integrity is a quality to be valued and it was measured in many ways. Some researchers wished people employed in ARGOS to be passionate about it and/or committed to environmental issues. For some integrity was to do with responding to the often contradictory demands of either funders, stakeholders or academia, and for some it was about not making judgements about what is 'good' for farmers and how they should change. Some related comments were: there is a "reluctance to say what 'ought to be' … an emphasis on the need to provide causation … a cautious political management approach".

Researchers value research at different levels. Some are macro thinkers (the agri-food system), some micro (the farm, the farmer and the paddock); some are activists; and some are interested in policy making.

There are different expectations of commitment to ARGOS amongst team members. For one objective this is just one project among many - ARGOS is "only a small part of life – not so important", in another, students have gathered seasonal data or studied for higher degrees, and for some ARGOS has been the main source of work.

One of the currencies of a transdisciplinary programme is time. In ARGOS a lot of time has gone into meetings indicating the importance and general agreement that it takes time to be transdisciplinary. As researchers said, "Six years is not enough", and, "It takes longer than you would ever dream of". Meeting time and budget constraints has been difficult. The programme "takes on a life of its own and takes resources from elsewhere – it is hard to have tight control of a budget!" "Team interactions cost and we need to allow for this." "Everyone is busy so contacting people and getting them together is not easy – it all takes time and lots of waiting/patience." There was conflict between time and money spent on transdisciplinary work and meeting disciplinary priorities within objectives. Does this mean that we have tried to do too much and been unrealistic? It takes time to learn what data to gather and for some of it to arrive. It takes time to build relationships with farmer participants. Sometimes it can take four to five years. "You have to keep coming back to them with something to encourage their continued involvement. Farm maps were good at the beginning, then the bigger picture stuff. Soil tests give them something concrete."

There was competition over who 'owned' ARGOS. The 'founding fathers' sought to maintain their symbolic capital for being there 'at the beginning' as they had prior trusted working relationships. Their shared involvement in the bid writing made it "our programme", and others felt excluded from the bid writing process[6], later leading to the "ones who wrote the funding proposal controlled the

[6] Note: Because obtaining funding requires the submission of a funding application the core ideas are likely to be owned by the group who prepare this application. As the system is competitive the preparation of a bid requires secrecy. These

process". There was also awareness that founding ideas will be challenged as "researchers coming into a programme don't necessarily subscribe to the core ideas of the design and change it to suit their interests and politics".

How is leadership exercised within ARGOS? There was discussion and difference over the need for a strong leadership style compared with one that evolves and allows things to happen. The latter, the strategy adopted by the present programme leader, can lead to confusion – "What is it all about, really? What are the results to be used for?" How much should "niceness" rule? The present leader was described as "inherently integrating", while he himself said that, "looser leadership has given [ARGOS] the flexibility to evolve … which have saved it from becoming a pedestrian programme".[7]

Valuing disciplines and disciplinary knowledge

A major issue was whether the cultural capital - the know-how and status acquired in a disciplinary context would carry over into ARGOS. Are we 'doing' science? "We have to get the science right". "I'm not sure that I understand science without problems … [we] have so many problems that need science to address". For one scientist, all his training was in "reducing complex problems to small components so they could be 'solved'". In itself, adherence to the design of the project became a source of difference because it encouraged hypothesis thinking. Cundill et al. (2005) point out that pre-designed frameworks are convenient but eliminate alternative perspectives. ARGOS has managed to negotiate this framework by focusing on alternative pathways in addition to audit for the next two years and by moving from disciplinary objectives over to transdisciplinary ones.

Academics are constrained to 'knowing' within their own discipline. Data challenges our very basic ways of 'knowing', how we value that knowledge and how we position ourselves academically. As one person commented, "We tend to try to simplify other's (disciplines) data but promote the complexity of our own", indicating how we try to increase our symbolic capital against the claims of others. Our identities are under challenge – another researcher said, "To go into a transdisciplinary programme – you need a confidence that comes with age – 'old age and treachery'. You need to be less concerned about 'getting on'/being ambitious, already have an established career, and to have reached the point where you are not worried about what others think."

Stages towards transdisciplinarity

ARGOS passed through various stages. At first the team worked hard at being transdisciplinary but there was "lots of posturing between disciplines". A researcher related how it was for them: "I was totally puzzled when I started – all those meetings where nothing happened – people just reverting to their disciplinary corner. I wondered why we couldn't just state what the research question was and how each of us could contribute. This seemed to be totally beyond people. Then no-one seemed to be able to say sorry, or this is not working, or give anything away that might have lost them some mana [prestige] or impression of 'not knowing' something." It was not expected that "developing a team and a working rapport" would be so difficult. One person summed up the stages as:

1. a strident phase of sorting out working relationships (Years 1 and 2);
2. an armed neutrality – some giving up, accommodation and a smoother ride by a resolution to support research and publication to within our own disciplinary fields as we embedded ourselves within the ARGOS subject from our own perspectives, while restricting attempts at transdisciplinarity to certain topics (Years 3 to 5);
3. the beginnings of synthesising information – "creating the bone to chew on" – (Year 6);

factors limit participation at the problem definition stage, going against much of the advice in the literature. For example, Nowotny (2003) suggests that "problems should be formulated in a dialogue with many different actors of different perspectives". Others place great emphasis on the development of 'contestable concepts' (Attwater et al., 2005; BioDIVA in these proceedings).

[7] Nowotny (2003) suggests that because transdisciplinarity is an emergent form of knowledge making "loose organisational structures, flat hierarchies, and open-ended chains of command" also emerge from it.

4. this year (Year 7) – redesigning a new study based on reflexive exercises.

The differing issues exposed here indicate that tensions are not just about disciplinary differences. The remarkable thing is that "the major players are still there. In some ways there is increasing trust!" The need for a broad understanding of what different perspectives bring to an understanding of farming has been taken up by Field Officers in particular, who have been prepared to do a diversity of things and respect the reasons for data gathering to translate these to farmers to get their buy-in. We have been fortunate with our Field Officers that they have seen this learning and participation as part of the attractiveness of the work.

The emergent transdisciplinary field: the foreseen and the unexpected

The strength and unexpected nature of transdisciplinary thinking is apparent in our main result so far. As years went by and the amount of collected information grew, those with a simple understanding of what might be obtained became increasingly aware of the complexity of farming and of humans; there was – "no clear characterisation of a farming system and what contributes to making it better or worse". In other words, we have not yet found major differences between management systems (Manhire et al., forthcoming). There is no 'right way' to farm sustainably. This finding is unthinkable in the field of science and has been difficult for some to accept: "After 6 years to say "don't know", because we have no evidence [is unsatisfactory]". Others still have a yearning for some simplicity and want "some data which enables us to 'act' ". Some "really want to have found something". Another said, "Did we ask the right questions - questions that would have given us the knowledge to make some definitive statements? E.g., water – placing a cap on nitrogen and phosphates? Can we say to plant hedgerows, have biodiversity corridors? Maybe we should have concentrated on some basics – practical things." For others this is an obvious result: "farmers learn from each other" so a sustainable system is a little bit of everything. The different management systems have a "synergy – so we need all for sustainability".

There is a growing feeling that we are producing some "real" results as we are now able to bring together results linking farmer practices and attitudes. Most importantly, in the big picture, ARGOS has contributed to the development of audit programmes in New Zealand, and in a major way, to the international debate about food miles, protecting New Zealand's primary product export market when it was under scrutiny internationally, due to the distance and cost of getting our products to market (Saunders et al., 2006).

Individuals have found they have benefitted in different ways from being part of ARGOS. "I have learnt about process - working as a team. I am using it daily in everything I do". This person has also formed valuable relationships and networks. Another person says that over time he has found where he fits, and he is more "comfortable and confident". He has developed his "own ontology". For him it is "the perfect job".

One of the advantages of having a larger programme with many people participating is that there is always something going on somewhere: "Even when there are down periods, they don't negate the whole – we are still trundling on". "Energy fluctuates – if a programme is big enough, when some are exhausted there are others there to pick it up." Transdisciplinarity "provides a new challenge, and a release from the boredom of doing things in the 'old way'." However, it is also associated with risk, taking on something that is unfamiliar. One person said he "feels like a fraud", as if he is "skating on thin ice". He finds that he "vacillates" and becomes like a "simple minded idiot. Who is he to think he can contribute at this meta-level?" One researcher summed it up, saying, "Did everyone get equally nurtured? No. Did one person capture the agenda? No." This points to the inevitable – the experience will be different for everyone, but at the same time, so far, in the ARGOS programme, no one person or discipline has dominated and that is a good achievement.

Transdisciplinary research needs to be properly resourced, and part of this is that it is "critical to have people for whom ARGOS is full time". At the same time it "would be good to have the same people in future – now that we know each other". It is suggested that the best way of tackling trans-

disciplinarity in the future would be through "learning to work together by doing it … It may take 12 years to get outcomes and then it is established and can spin off more. It means we would be vulnerable for 6 to 14 years". Satisfactory resources, particularly in the way of increased and inflation adjusted funding would be required.

We have a "unique opportunity for longitudinal project in NZ", an "amazing world class data set", an "emerging respect and understanding for each other's disciplines", "recognised what can and can't be done – the reality" and we are "getting stronger", some areas better supported by stakeholder funding, and it is getting "more exciting". The looseness of the management and the diversity of the team has been like "journeying without a roadmap" and might have been uncomfortable but may well be the spark that has led to surprising breakthroughs. Forming a new field has been emancipatory. It has led to rules which give greater value to adaptability and diversity and move away from the value binaries of authoritarian versus consultative/collaborative leadership, complexity and inaction versus simplicity (reduction) and action, problem solving versus normative explanation, a static versus a dynamic/adaptive/temporal state, and universalism versus relativism.

Discussion and conclusion

Like (Fish et al. 2008), we have found transdisciplinary research leads to "more interpretive, situated and messy engagements with the practice of sustainable agriculture". By using Bourdieu's Theory of Practice we have been able to understand why operating in a transdisciplinary field is so difficult and contested by the players as they try to sort out the 'rules of the game'.

Transdsciplinarity can be seen as a new field and being new it does not come with an established discourse, doxa or norms that indicate what has value - what is regarded as 'knowledge'. Our identities have developed in conjunction with other fields in which we have learned to live in a way that has made our lives there meaningful and given us feelings of importance and usefulness. The 'water' that we swam in, in our other worlds/fields is exposed. What we had taken for granted is no longer so. Certain unthinkable things become thinkable! This is an uncomfortable experience. At first we tried to colonise the new world with our old world values. Some of us had nothing to lose, while others had everything to lose, but the transdisciplinary reality slowly enforced a gradual acceptance of, and still emerging proficiency in meeting the demands of transdisciplinary work.

Over time Bourdieu became rather depressed about his interpretation of the way the world worked – that people will always produce ways of valuing each other to produce a social hierarchy. His exposure of such 'rules' did not earn him popularity. His hope was that by exposing these systems, and encouraging more diverse ways of value and more of them, people would become more emancipated and be able to make 'good' choices (Grenfell, 2004: What ARGOS and other transdisciplinary programmes are demonstrating is that it is most important to have a 'space' in which people who wish to take the risk of transgressing the boundaries of other disciplines can do so, and that to achieve the creativity and innovation these interactions should be uncomfortable as long as the discomfort is not disabling for too long. Transdisciplinarity is a space for research that recognizes, celebrates even, the idea that in spite of there being "no simple resolution to these dilemmas" (Lowe et al., 2009), "knowledge as well as expertise, is inherently transgressive. Nobody has anywhere succeeded for very long in containing knowledge" (Nowotny, 2003). The answer is not to try to do away with difference but to explore it, even if this is a "risky activity" (Dewulf et al., 2007). In this space there will be no solidity or assurance of having a universal 'right' way though there will be much debate over this, and possibly some accommodation and shared understanding for a particular group and mix of disciplines. This will provide the yresilience and the redundancy of diversity as we attempt to tackle the 'wicked' problems (Ludwig, 2001) that threaten the world we live in.

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