Learning As Participation in Grains Research, Development and Extension in Australia

By
David Norman Lawrence
Bachelor of Agricultural Science
Bachelor of Business

A thesis submitted to
the School of Vocational, Technology and Arts Education,
Faculty of Education, Griffith University

in fulfilment of the requirements of the degree of
Doctor of Philosophy
(January 2006)

© DN Lawrence, 2006
Abstract

This thesis is grounded in the introduction of participatory research, development and extension (RDE) to Australian agriculture. The emphasis on participatory processes emerged as the Transfer-of-Technology (ToT) model is no longer considered adequate to deal with complex farming systems and their diverse stakeholders (Packham 2003). However, RDE agencies are introducing participatory processes with a limited understanding of how they may work in Australia’s developed agriculture sector (Vanclay 1994). Consequently, the initiation of three participatory Farming Systems RDE projects in Australia’s northern grains region provides opportunity to explore and understand participatory approaches and their impact on participants. Three related themes are developed by exploring the nature of participants’ diversity across these projects, the characteristics of participation in each project and the subsequent learning of participants: (i) that increased participation implicitly increases diversity in the conduct of RDE; (ii) that participatory RDE provides opportunities to integrate stakeholders’ diverse experience and knowledge; and (iii) that participants’ learning can improve current farming systems.

Participatory action research was used to understand how participatory RDE should be enacted, and to involve project participants to help them also understand and improve their project processes and goals. The research utilised a range of qualitative and quantitative procedures including: participant and nonparticipant observation at project meetings and activities with farmers; focus groups and semi-structured interviews with project teams, their managers, and participating farmers; a team learning survey of team members; and custom-made questionnaires to quantify participants’ perceptions of the projects, their processes, and impacts on learning and behaviour.

These interventions identified participants’ demographic, organisational and informational diversity. They also identified and elaborated their diverse aims, expectations and passions for participatory RDE, revealed individuals’ preferred RDE methodologies and suggested their underlying worldviews. Indeed, ToT paradigms and positivist worldviews remained entrenched in most project staff and their managers. The teams consequently used participation to help farmers better understand technical issues, not build interdependent projects with integrated RDE processes.

Farmers generally appreciated their increased participation and influence in RDE activities. While their initial consultative and functional participation did not extend to process decisions or project strategy, farmers valued the opportunity to work with the projects and influence the issues addressed. The projects consequently improved farming practices and management of issues that have long-eluded traditional RDE. For example, the widespread use of: (i) zero tillage and controlled traffic systems to control soil erosion; (ii) nitrogen fertilisers to match crop requirements; (iii) ley pastures to address soil fertility in grain and grazing systems; and
(iv) new crops to diversifying grain systems away from monocultures. The projects provided farmers with opportunities for increased participation and learning over time. Functional participation developed in on-farm research that addressed issues identified with farmers, and action learning workshops provided proximal opportunities for farmers to understand existing information and use their own farm data in real decisions. In this way, the behaviourist learning of the ToT approach was supplemented by guided learning to integrate new meaning schemes with farmers’ experiential knowledge. Some on-farm research and action learning activities extended to reflecting on their processes, and involved farmers in deciding the most appropriate RDE methodology and methods for subsequent activities. This opportunity to reflect on the values and assumptions of different approaches was critical in developing interactive participation and higher level learning for participants.

Nevertheless, the initial participation in each project team failed to meet some team members’ expectations. The expected task and process conflicts emerged, but small activity groups with shared values and RDE paradigms developed within each team. Team members’ process conflict about the ‘best’ RDE methodologies for specific issues then developed into worldview conflicts about the relevance and rigour of these methodologies. Some smaller groups subsequently worked independently, with damaging relationship conflict developing from unresolved process issues between some individuals. Team members communicated, but their participation remained largely passive and consultative.

Factors that shaped participation were identified, and a framework to support opportunities for stakeholders to plan, manage and evaluate RDE was developed. These helped increase participation in the projects. Participation within the projects’ constituent activities subsequently fluxed from isolation to interactive participation. Individuals within activities now expected, and usually had, equality in content decisions (i.e. functional participation), which often extended to process decisions (i.e. interactive participation). Yet, the levels of participation between members of different activities varied across the projects. One project remained a series of parallel and relatively independent activities with passive and consultative participation. A second project had functional and interactive participation imposed for some activities, but otherwise used passive and consultative participation. The third project developed to provide functional and interactive participation in major project decisions.

It then became apparent that the learning outcomes of each project varied. Individuals continued to learn from their participation in the projects, but the contributions of diverse sources and participation were major shapers of this learning. Participation within the less diverse activity groups produced mainly technical learning through participants’ existing meaning schemes. Again, the level of participation between activities with diverse values, RDE paradigms, and worldviews, shaped the nature of learning. Passive and consultative participation produced mostly technical learning through existing meaning schemes. Yet, teams that embraced their diversity, and reflected on the assumptions of their different RDE
methodologies, transformed their approach to learning. With high levels of diversity, the level of participation determined the level of learning. Essentially, participation became learning.

This thesis confirms the potential of participatory RDE to improve farming practices. Consultation to identify priority issues, and functional participation to develop proximal opportunities for farmers to understand these issues and make their own decisions had a major impact on farming practices. Yet, participatory processes must rise above the prevailing ToT paradigms of RDE agencies to integrate participants’ knowledge, and so achieve sustainable development in Australia. Three main process contributions are made to support this development. Firstly, the evaluation framework provides a challenge and structure to encourage the contributions of all participants at each stage of project activities. It provides a checklist for effective participation in Farming Systems RDE. Secondly, a typology of participation in Farming Systems RDE extends that proposed by Pretty (1995). It provides a catalyst and means to better understand and identify the most appropriate levels of participation in RDE projects. The associated checklist for assessing modes of participation allows monitoring of the participation developed in practice. Finally, the re-conceptualisation of a broader continuum of participation in Farming Systems RDE for developed agriculture is proposed.

The subsequent development of the Doing successful on-farm research process is a culmination of the understandings developed in this thesis. It facilitates the development of interactive participation within the on-farm research process that is central to these projects. Recognising the technical focus of most current RDE agency staff, it guides their development of participatory on-farm research processes before reflecting on the appropriateness of different research methods to their research issues. The findings here cannot ensure the development of Australia’s RDE beyond the ToT paradigm. However, this thesis provides important insights into the nature of diversity, participation, and learning in the Farming Systems projects, and a series of tools to support this development. Conceptually, it proposes that different kinds of participation will be shaped by participants’ diversity from their prior experiences and their expectations that are in turn transformed through evidence of improved practice.
Statement of original authorship

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material that has been previously published or written by another person except where due reference is made in the thesis itself.
# Table of contents

Abstract ................................................................................................................................................................. ii  
Statement of original authorship ........................................................................................................................... v  
Table of contents ........................................................................................................................................................ vi  
List of figures .......................................................................................................................................................... viii  
List of tables ............................................................................................................................................................ ix  
List of boxes ............................................................................................................................................................ ix  
Acknowledgments ................................................................................................................................................... x  

Chapter 1. Understanding and informing participatory research, development and extension ......................... 1  
1.1 The trend towards more participatory RDE ...................................................................................................... 1  
1.2 Understanding and improving participatory RDE practice ............................................................................ 4  
1.3 Current concepts of participation and team learning .................................................................................... 5  
1.4 The research problem .................................................................................................................................... 6  
1.5 An action research methodology .................................................................................................................. 7  
1.6 Delimitations of scope and key assumptions ................................................................................................ 9  
1.7 Outline of the thesis ...................................................................................................................................... 10  
1.8 The conceptual contribution of this thesis ................................................................................................. 12  
1.9 Conclusion ................................................................................................................................................... 12  

Chapter 2. Understanding participation in Farming Systems research, development and extension ............... 13  
2.1 The emergence of a Farming Systems approach ............................................................................................ 13  
2.2 Systems and systems thinking ....................................................................................................................... 18  
2.3 Exploring diversity in work groups ................................................................................................................ 21  
2.4 The notion of participation ............................................................................................................................ 29  
2.5 Conclusion ................................................................................................................................................... 43  

Chapter 3. Individual and collective learning through participation ............................................................... 46  
3.1 What is learning? .......................................................................................................................................... 46  
3.2 Underlying theories of learning ................................................................................................................... 47  
3.3 Facilitating learning in Farming Systems RDE ............................................................................................. 54  
3.4 Teams and team learning ............................................................................................................................. 60  
3.5 Levels of learning ....................................................................................................................................... 65  
3.6 Conclusion ................................................................................................................................................... 67  

Chapter 4. Methodology and methods .............................................................................................................. 69  
4.1 Philosophical considerations .......................................................................................................................... 69  
4.2 A methodology for the research philosophy and problem .......................................................................... 73  
4.3 A multi-method approach ............................................................................................................................. 85  
4.4 Conclusion ................................................................................................................................................... 98
List of figures

Figure 1. An integrated model of demographic impacts on group process and performance.................24
Figure 2. Eight rungs on a ladder of citizen participation .................................................................39
Figure 3. The structural dimensions of experiential learning ............................................................50
Figure 4. An organisational learning cycle ......................................................................................56
Figure 5. A model of team learning..................................................................................................62
Figure 6. A model of power relationships in team learning ..............................................................64
Figure 7. Applying the organised use of rational thought to this thesis ................................................74
Figure 8. The four overlapping cycles of action research in this thesis ..............................................83
Figure 9. A model of workgroup productivity ..................................................................................117
Figure 10. A model of diversity and group performance in Farming Systems RDE..............................119
Figure 11. The impact of alignment and empowerment in diverse teams ............................................121
Figure 12. A framework to support participation and learning in Farming Systems RDE .................160
Figure 13. A continuum of participation in Farming Systems RDE for developed agriculture ...........218
Figure 14. A model of synergistic team learning processes in diverse RDE teams ...............................220
Figure 15. A model of fragmented and pooled team learning processes in diverse RDE teams ..........221
List of tables

Table 1. Combining process and influence approaches to participation in organisations ..........................34
Table 2. A typology of participation in development projects .................................................................42
Table 3. A summary of dialogue theorists’ perspectives .........................................................................59
Table 4. Features of teams versus working groups .................................................................................60
Table 5. Team learning processes and conditions ....................................................................................62
Table 6. A summary of selected authors ‘levels of learning’ .................................................................66
Table 7. Team members’ perceptions of their experience in Farming Systems RDE ..............................100
Table 8. Team members’ use of the Farming Systems literature ............................................................101
Table 9. The content and RDE process expertise in the Western project in Queensland ......................102
Table 10. Project teams’ relative emphasis of dimensions of Farming Systems RDE ..............................103
Table 11. The Farming Systems project teams’ perceptions of on-farm research ....................................108
Table 12. Managers’ expected outcomes of Farming Systems RDE ......................................................111
Table 13. A typology of participation in Farming Systems RDE ............................................................138
Table 14. The team learning survey assessments of each project by the author ......................................168
Table 15. Team members’ assessments of their projects using the team learning survey ......................168
Table 16. Frequency of team members’ assessments of the projects’ modes of learning ......................169
Table 17. Participants’ perceptions of the Nitrogen in ’95-99 workshops ..............................................191
Table 18. The impact of the Nitrogen in ’95-99 workshop participants’ fertiliser rates ............................192
Table 19. The mean fertiliser rates of Nitrogen in ’95-99 workshop participants ....................................192
Table 20. The rates of nitrogen proposed by the Sustainable nitrogen decisions workshops ..............196
Table 21. Farmers’ assessment of the Central projects’ impact on their understanding of issues ............207
Table 22. Dimensions of diversity observed in the Farming Systems projects ....................................214

List of boxes

Box 1. Focus group discussions with RDE agency and GRDC industry managers ...............................114
Box 2. Prompts to support the ‘Evaluation framework’ for Farming Systems RDE ..............................161
Box 3. The Nitrogen in ’95-99 development process ............................................................................190
Box 4. Basic process to guide reflection and dialogue in on-farm research activities ..........................205
Acknowledgments

I have been fortunate to undertake this study and develop the broad network of agricultural scientists, administrators and farmers from Emerald to Tamworth who have supported my endeavours over recent years. I thank the farmers and commercial agronomists that gave their time and information to me over a number of years. I also thank the QDPI&F and GRDC managers who funded this work and provided support to undertake formal study. Thanks also to my many peers within the Farming Systems projects for their time and patience, and especially their good humour in project activities.

I must extend my special gratitude to the leaders of each Farming Systems project; Peter Carberry, John Doughton and Scott Cawley who were always busy but had time to talk and supported my endeavours…sometimes against their better judgement. Thank you for your continuing time, support and friendship. Similarly, I must thank David Freebairn and Jeremy Whish for their friendship, experience and encouragement.

I am especially indebted to Nick Christodoulou (QDPI&F, St George). Nick spent countless hours helping develop our thinking about participation and processes to support participation, dialogue and learning in authentic settings. Nick was always in good humour, engaged openly, and as a friend knew just when to suggest we stop taking ourselves too seriously. Thanks for the company, the friendship and the perspective.

I wish to acknowledge my supervisors; Dr Ron Passfield, A/Professor Stephen Billett, Dr Gus Hamilton and A/Professor Brendan Bartlett. Ron provided the gentle but critical support I needed throughout the conception and field research in this thesis. Stephen supported my investigation of socio-cultural learning and really helped me to focus and knuckle down in the later writing stages. Stephen, your insight and perceptive, direct and very prompt feedback was always appreciated. Thanks also to Gus for his long-term guidance, and Brendan for his comments. Your collective contributions have helped me understand the notions of diversity, participation and learning in RDE, and to better understand myself. I would also like to thank Dr Darryl Dixon for his editorial assistance and ideas.

Finally, a special thanks to my family - Jim, Gus, Hannah, and especially my wife Janet - for their ongoing support and patience while I completed this thesis. I know you all made sacrifices.

Thank you to you all!
Chapter 1. Understanding and informing participatory research, development and extension

This thesis aims to understand how participatory research, development and extension (RDE) practices may be effectively enacted in Australia’s grains industry. These practices are suggested to have the potential to develop reciprocal processes of knowledge building across the grains industry, and secure continued innovations for more effective farming practices. The means to continually develop socially and individually effective practices has long been a focus of Australia’s agricultural sector. However, there has been a recent trend to extend beyond the traditional approaches of the Transfer-of-Technology (ToT) paradigm, and participatory RDE that encourages co-learning with the exchange of ideas and experiences among participants is emerging as the new paradigm. This thesis attempts to understand how such participatory processes may impact on participants in Australian agriculture. In doing so, it elaborates the basis by which diverse teams may function, learn and improve their practice. This initial chapter introduces the thesis, its context and its rationale. It begins with an overview of the trend towards participatory RDE and establishes the importance of understanding how they may be employed effectively in Australia. Then, the research problem of this thesis, and the action research methodology used to answer the associated research questions, are introduced and described. Finally, an outline of the rest of the thesis and its structure is provided.

1.1 The trend towards more participatory RDE

1.1.1 The traditional ‘Transfer-of-Technology’ paradigm

Agricultural RDE has a long history of innovation and increased effectiveness in producing food for the world. The ToT paradigm has dominated this RDE process since British universities began to extend their research findings to the community in the 1840’s (van den Ban & Hawkins 1996). Agricultural extension has subsequently become a process to provide information, opportunity and persuasion to gain the voluntary ‘adoption’ of new practices (Bloome 1991). Each innovation is then held to ‘diffuse’ throughout the community as it is ‘adopted’ by other farmers (Rogers 1983). This process provides rapid use of technologies that have direct financial benefits, minimal complexity, acceptable risk, and are easily integrated into existing practices (Marsh 1998). Yet, it represents a top-down model of implementing change, and assumes innovations are externally developed and tested. Indeed, this model has a profound impact upon policy and practice as it reflects policy makers’ and scientists’ control of RDE funding and determination of what are improved practices (Röling & Jiggins 1994).

However, the ToT approach has limitations when issues are complex and people have different understandings of the problem situation (Ridley 2005; Vanclay 2004). It may create awareness of these issues, yet this awareness might not translate into understanding or change, nor
transcend community barriers (Blacket 1996). Indeed, people may value different things and not recognise any problem, or may recognise a problem but need different or more specific information for their own situations. Most reviews of agricultural extension have consequently concluded that ToT alone is no longer adequate to deal with the increasingly complex nature of modern agricultural systems (Packham 2003; Russell et al. 1989). This realisation has created deliberations about the role and effectiveness of extension, and agricultural RDE in general (Coutts 1994; Hamilton 1995). These debates are now fuelled by the reduced importance of agriculture in developed economies, subsequent reductions in public expenditure for agricultural RDE, and a focus on services with community benefits rather than the direct ‘private’ benefits to individuals which ToT advisory services emphasised (Black 2000). These factors reinforce the need for innovation in RDE practices to ensure the continued improvement of farming practices with potentially reduced public resources. RDE agencies have typically responded by encouraging more farmer participation in the RDE process (Vanclay & Lawrence 1995).

1.1.2 Participatory RDE as a viable alternative

Increased participation of the people who implement innovations is a common thread in recent arguments for better planning and implementation of innovations in agricultural RDE in Australia (Dart 2005). Indeed, a more sophisticated braiding of the ‘technical innovation’ tradition of RDE and the more participatory ‘human resource development’ alternative is suggested to overcome the limitations of the ToT model alone (Russell et al. 1989). This suggestion aims to support the development of farmers’ capacities to assess and implement change, and encourage more relevant research that considers the practical aspects of implementing innovations. Participatory RDE has similarly been proposed for emerging issues with no apparent ‘win-win’ technological solutions, such as balancing environmental and productivity concerns (Blacket 1996; Ridley 2005). In these situations, participatory RDE provides an opportunity for communities to negotiate acceptable compromises, or pool their experiences to develop new solutions. Furthermore, RDE based on simple recipes is perceived to be inadequate for complex productivity issues. The Grains Research and Development Corporation (GRDC) consequently commissioned a review of RDE on nitrogen management, despite the fact, or perhaps because, it is one of the most studied topics in agriculture. GRDC perceived a worrying gap between scientists’ understanding of nitrogen management and actual farming practices (Henzell & Daniels 1995). This review recommended more farmer participation in RDE to improve the balance between ‘understanding the science of nitrogen’ and ‘understanding how nitrogen was managed on farms’. That is, participatory RDE was again proposed as the way towards this better braiding of the ‘technology’ and ‘human development’.

Interest in participation and learning in agricultural RDE is not just an Australian phenomenon. It has emerged globally as international development agencies grapple with the notion of
sustainable development, and the trade-offs between its ecological, economic and social sustainability (Dixon 2003; Gibbon 2003). Local theorists have drawn upon these international experiences to propose Farming Systems Research (FSR) and Participatory Action Research (PAR) as the most appropriate participatory RDE methodologies for Australia (Guerin & Guerin 1994; McCown 2001a; Petheram & Clark 1998). FSR provides a diagnostic process, a basket of methods for researchers to elicit a better understanding of farm households, their decisions and decision-making processes (Collinson 2000), while PAR is action research in which researchers become full collaborators with members of organisations to study and transform those organisations (Greenwood, Whyte & Harkavy 1993). These methodologies are further explored in Chapter Two, but together have the potential to extend beyond the past ToT approaches, and better involve farmers in RDE (King 2000).

However, the RDE agencies appear to be moving towards more participatory approaches with a limited understanding of how these approaches may work in Australia’s developed agriculture. There is little data to support their effectiveness in Australia (Carberry 2004; Guerin & Guerin 1994), and agencies have not always considered the likely problems from increased farmer participation in the RDE process (Murray 2000). For example, researchers may still think in terms of the linear ToT model, and some growers may be accustomed to being told what to do, even if they choose to do something else (Henzell & Daniels 1995). Participatory RDE may therefore require more than a proclamation to work together. Petheram and Clark (1998) identified five key challenges for introducing participatory methodologies to Australian RDE agencies: (i) to develop participatory models that fit the institutional settings; (ii) to convince traditional researchers of the methodologies’ relevance, and the need for real participation by farmers and specialists; (iii) to develop means of achieving high levels of participation; (iv) to develop and access facilitation skills; and (v) to achieve recognition through outcomes on farms, peer review and publication. This move away from discrete technical solutions towards building the capacity to meet the needs of participants with unique capacities, readiness and requirements will be a learning process for everyone. New knowledge and skills must be developed for participatory processes to achieve their potential (King 2000).

It was recognised that participants in the Australian projects discussed in this thesis would have to learn how to conduct participatory RDE. The evaluation project that supports this thesis was funded to develop this understanding and to develop supporting theories, principles and procedures as the projects progressed (Lawrence 1997a). This thesis has national significance because it documents an exploratory process to inform planners and practitioners of the nature, possibilities and consequences of Farming Systems RDE in Australia.
1.2 Understanding and improving participatory RDE practice

The Farming Systems projects are Australia’s first large-scale coordinated attempt at participatory grains RDE. They confirm the trend towards participatory RDE, and the need to understand how such processes impact on participants. As such, a better theoretical understanding of participation and learning in teams will help to develop appropriate tools and processes to support the continued development and contribution of grains RDE to the Australian economy.

1.2.1 The value of understanding participation and team learning

Public extension has faced crises of effectiveness and theory in Australia for some time. Extension practices are perceived not to be working, with farmers failing to adopt many recommended practices, and RDE agencies rejecting the traditional extension model without a coherent or widely-accepted alternative (Vanclay 1994). So, while participation is encouraged, the absence of alternative theories may explain why the ToT paradigm, despite its perceived limitations, still underpins the structure of most RDE agencies (Guerin & Guerin 1994). Participatory RDE must be understood and implemented effectively to be a viable alternative.

The need to address the gap between the theoretical understanding and practical procedures of Farming Systems RDE is a key goal for this thesis. Existing theories and notions of participation have developed to understand citizen’s participation in democracies, commercial organisations and their workforce, and international development work may need to be modified. Examining participatory processes within the Farming Systems projects will help to better understand the notions of participation and team learning, and develop alternative extension theories that are grounded within Australian agriculture. This thesis aims to elaborate how Farming Systems approaches can impact on the learning and behaviour of researchers, extensionists and industry. This is critical for participatory RDE to prosper in Australia and effectively harness the increased diversity that greater participation will bring. To enforce conformity and quell diversity may defeat the purpose of participation, alienate some participants, and preclude ownership for people whose views are discounted.

Despite extensive research on groups and teams, little research has been conducted on how teams learn (van Offenbeek 2001). It may be easy to propose participatory RDE projects, but ‘even the most well-meaning directives to work together, cooperate and be a team’ have not always been sufficient to create productive cooperative efforts amongst members (Johnson & Johnson 1997). Adequate attention to the processes of participatory practice is needed to ensure the potential of teams is not wasted. Without functional theories of how to effectively harness the diversity in participatory RDE projects, they may become ineffective and inefficient.
1.2.2 Participatory tools and processes
Functional theories of how participatory RDE impacts on participants’ learning and behaviour should help develop appropriate tools and process to support participation and team learning. For example, tools to assess the extent of participation achieved, and frameworks to support increased participation and social learning may be critical to improving participatory grain RDE and providing insights for other industries.

1.2.3 National economic goals and investment
Agriculture is a major sector of the Australian economy, and grains industries contribute over $7 billion a year in farm production alone (‘About GRDC: Summary’ 2005). Given the size of the industry, its investment in RDE and the trend towards more participatory processes, understanding and improving participatory RDE is of national economic importance. For example, GRDC invests over $110 million annually to drive innovation for a profitable and environmentally sustainable Australian grains industry (Lovett 2003). Within this, the National Farming Systems program has 20 projects and an annual budget of $22 million. The three projects described in this thesis are a major investment to develop more participatory RDE approaches within this program. They have annual funding of $1.5 million from GRDC, $4.5 million from State and Commonwealth governments, and large ‘in-kind’ contributions from participating farmers and industry. This investment highlights the projects’ importance and justifies the research in this thesis. Indeed, the significance of this research prompted GRDC to provide additional funds for the evaluation project (DAQ403) that supported this thesis.

1.3 Current concepts of participation and team learning
Farming Systems approaches may be new to Australia. Yet, this thesis draws upon an extensive literature on participation from democratic theory, organisational participation, and citizen participation, and introduces the notions of team learning from the organisational learning literature. The literature confirms that ‘participation’ is not a unitary concept. It is not easily defined and provides no ‘recipe’ to overcome the problems of traditional RDE in agriculture.

In fact, participation theories highlight an underlying tension between providing opportunities for many farmers to have input, or ‘equity’ in decisions, and the subsequent ‘equality’ of decision-making power envisaged by the classical democracy theorists (Pateman 1970). These tensions have resulted in three broad arguments for participation in modern organisations (Strauss 1998a): improved efficiency from better decisions to which people contribute ideas and so are motivated to implement; personal growth; and redistributed social power to protect people who may be manipulated. Similar arguments arise in agricultural development, with participation ultimately considered a means to increase the adoption of research outcomes from improved farmer understanding and support; or a fundamental right for farmers to mobilise for
collective action and empowerment (Pretty 1995). Indeed, numerous typologies to clarify the
different types of participation have arisen from frustration with the different ‘participatory
intent’ of these perspectives, and the cynical use of ‘participation’ to sometimes justify the
control of the State, to justify external decisions, and collect data (Pretty 1995). Arnstein’s
(1969) ‘Ladder of citizen participation’ is perhaps the most widely quoted and describes a
progression of power across eight levels of what she calls ‘non-participation’, ‘degrees of
tokenism’, and ‘degrees of citizen power’. However, Pretty’s (1995) typology develops these
issues of power and influence on decision-making in the context of agricultural RDE. It
provides a starting point to consider participation within the Farming Systems projects as the
teams learn how to participate effectively with their stakeholders.

The notion of team learning (Dechant, Marsick & Kasl 1993) is used in here to consider how
and what people learn by participating in the Farming Systems projects. This model of team
learning highlights the learning processes of teams framing and reframing problems,
experimenting and crossing team members’ physical and mental boundaries, and integrating
their perspectives to develop new ways of thinking, new understandings and improved
performance (Dechant, Marsick & Kasl 1993). As such, this model is consistent with the current
convergence of cognitive and socio-cultural theories of how people think and learn (Billett
1996). Kasl, Marsick and Dechant (1997) subsequently define team learning as the process
through which a group creates knowledge for its members, for itself as a system and for others,
and propose three modes of learning in teams: (i) fragmented learning in which individuals learn
but the team does not; (ii) pooled learning in which views are offered but the team seeks the best
perspective rather than integrates them into new shared understandings; and (iii) synergistic
learning in which teams actively integrate their perspectives and test new ideas that may alter
some of their long-standing assumptions. Indeed, synergistic team learning and participation for
empowerment may be required for Farming Systems approaches to reach their potential as they
directly challenge long-held assumptions of the ToT approach to RDE.

1.4 The research problem

The problem this thesis addresses is that RDE agencies are moving towards more participatory
approaches with a limited understanding of how such approaches work in the Australian
agricultural sector (Vanclay 1994). This realisation at the start of the Farming Systems projects
led to the central research question and the sub-questions that are developed in Chapter Two:

*How can participatory Farming Systems RDE impact on the learning and behaviour of
its participants in the Australian grains industry?*
1. What is the diversity of participants’ experiences, understandings and expectations of Farming Systems RDE?

2. How can the Farming Systems RDE teams participate effectively?

3. What is the consequent learning and behaviour of participants in Farming Systems RDE?

It is generally accepted that Farming Systems RDE provides opportunities for stakeholders to participate and learn, and to change their practices through more informed decision-making. However, it is argued in this thesis that the nature and extent of learning in RDE is a function of the forms and extent of the diversity that exists amongst stakeholders, and the quality of participation that they develop in their interactions. For example, there may be less conflict and it may be easier to learn with people who hold similar values, worldviews and paradigms to one’s own. Yet, what one can learn may be constrained within those shared perspectives and provide only a limited form of engagement and development. Conversely, there may be greater potential to maximise engagement and extend learning beyond these pre-existing shared perspectives if participants have diverse values, worldviews and paradigms. Such diversity creates greater opportunities to inquire into and better understand others’ perspectives of their farming systems (Argyris & Schön 1996; Bateson 1972; Habermas 1974). To achieve this potential, participants may need to participate at very ‘high’ levels, with dialogue and disclosure of those values, worldviews and paradigms.

Finally, it is argued here that ‘evaluation’ provides a powerful catalyst for greater engagement and the necessary dialogue to expose and learn from participants’ fundamental values, paradigms and worldviews. Yet paradoxically, the use of evaluation may also be determined by the same values, paradigms and worldviews. These differences need to be acknowledged, understood and managed by participatory RDE teams if they are to maximise the potential synergies, and minimise any harmful and inefficient competition among otherwise incompatible RDE paradigms in contemporary agriculture.

1.5 An action research methodology

1.5.1 Participatory Learning and Action Research

Participatory Learning and Action Research (PLAR) is the core methodology of the research described here. It combines action research and participatory learning in a process guided by the collaborative determination of multiple goals and values (Hamilton 1995). This form of action research was used to ensure congruence with the author’s constructivist views on the nature of reality (ontology), and with the relationship between a researcher and the subject of their
research (epistemology). In other words, multiple realities exist as mental models that people construct based on their experiences and social interactions. These realities are therefore ephemeral, emergent, and cannot be known independent of the knower. These views are consistent with the view of team learning as a process that transforms experience into individual and collective learning through a socially-based search for meaning and appreciation.

Different levels of participation emerged in aspects of the research because the project participants had varying levels of interest in the process and innovations investigated. They sought differing levels of involvement and detail in the specific issues that are reported in this thesis. However, using action research with varying levels of participation provided opportunities to:

- research and simultaneously seek action to enhance learning in the projects (Dick 1993);
- generate data and develop interpretations in situations where controlling variables was impractical or unethical (Roberts 1997a);
- participate in the research with team members and contribute to a collective understanding of local farming systems and participatory RDE (Altrichter, Posch & Somekh 1993);
- reiterate and reinform the investigation as more sophisticated understandings emerged from the cyclic process (Zuber-Skerritt 1991);
- ground propositional knowledge from the literature as the author’s experiential knowledge developed in these cycles;
- utilise an eclectic mix of methods as the emergent needs dictated (Passfield 1996); and
- produce scientific and socially meaningful results (Greenwood, Whyte & Harkavy 1993).

The flexibility and responsiveness of action research suited the complex social settings envisaged for this investigation. But critically, it provided opportunities to develop understanding and encourage purposeful change. It allowed investigation of how participatory RDE should be enacted while involving others in the process to also understand and improve their projects and processes. This approach ensured each research sub-question was grounded in the experience of the projects, but reflected the propositional concepts in the literature. A purely experimental, positivistic methodology would have been at odds with the orientation adopted here, the concepts of team learning, and the participants’ stated goals for the projects explored in this thesis. In sum, the understanding of the interpretative processes that underpin participation in collective and individual terms may be best served with this approach.
1.5.2 Incorporating case studies
Case studies were also used to gain the depth of experience and understanding of the interactions in teams, and to cope with the sheer size and breadth of the Farming Systems projects. Case studies, like PLAR, can deal with a range of evidence and specific research methods. In fact, the case study’s strength is its ability to deal with a full variety of evidence from documents, artefacts, interviews and observations, including participant observation that does allow some informal manipulation of the phenomenon (Yin 1989). As Yin (1989) suggests, case studies are a preferred research option when ‘how’ and ‘why’ questions are being posed, when the investigator has little control over the events, and when the focus is on a contemporary phenomenon within a real-life context.

1.5.3 Employing multiple methods
Within the frameworks of PLAR and case study research, a range of more specific methods was used to gather appropriate evidence for each specific research question from the opportunities that arose, primarily:

- Focus group discussions with the project teams (6+), funders and host agency manager groups (2) and individual farmer groups (25+);
- Semi-structured interviews with team members (78) and participating farmers (30+);
- Participant and nonparticipant observation, and indirect interviewing at regular manager meetings (10+) and many project team and farmer group meetings;
- Team learning survey (Dechant & Marsick 1993a) of project team members (62); and
- Custom-made questionnaires to quantify team members’ and farmers’ perceptions of the projects, the processes used, and the impacts on their learning and behaviour.

These methods provided the flexibility to incorporate activities into each Farming Systems project and gather a diversity of data despite lack of control over the variables of interest (Graziano & Raulin 2004). This was critical as each project had different goals, operating procedures, and stakeholders with varying interest in each issue addressed in this thesis.

1.6 Delimitations of scope and key assumptions
This thesis is based on research conducted with three Farming Systems projects in northern Australia. The projects used industry funding and were administered by the RDE agencies in the region. In contrast, most Farming Systems projects in other regions of Australia are administered by farmers groups that are funded directly from industry. The results and conclusions of this thesis may therefore be limited to agency-funded projects in Australia’s northern grains region. However, the research was conducted with the key grains RDE agencies and participants in this region in order to understand the likely extent of diversity within these
projects, the impacts of such diversity on participation, and the subsequent learning in participatory grains RDE. Consequently, there may be some implications beyond the situations studied. Finally, different regional and climatic conditions, different organisations with unique cultures, individuals with different personalities and experience with participatory RDE, and other contextual factors may limit any claims of generalisability beyond the boundaries described.

1.7 Outline of the thesis

Chapter One (‘Introduction’) provides an overview of the research problem and the research questions that explore diversity, participation and learning in the context of Farming Systems RDE in Australia. The background to the research problem, its importance, and the conclusions of the thesis are then provided. Finally, an overview of the methodology and delimitations of the research is provided to help readers put the findings and conclusions into context.

Chapter Two (‘Understanding participation in farming systems’) reviews and discusses the development of FSR and contemporary concepts of human development on which the Farming Systems projects and this thesis are based. Concepts of diversity, systems thinking and participation are discussed, and their relationship to this project and the emergence of the research questions are elaborated.

Chapter Three (‘Individual and collective learning through participation’) discusses learning from both individual and collective bases. It deploys existing learning and developmental theories to propose the means by which individual needs and collective processes might be successfully combined to achieve the desired outcomes of team-based participatory RDE.

Chapter Four (‘Methodology and methods’) argues for the selection of Participatory Learning and Action Research, and Case Studies as the most appropriate methodologies to address the research problem. The chapter then elaborates the application of these methodologies and details the range of methods used for data collection and analysis. It subsequently describes how these specific methods were applied to investigate the research sub-questions on diversity, participation and learning within the Farming Systems projects.

Chapter Five (‘Diversity within grain Farming Systems RDE’) places participants’ experiences, understandings and expectations of Farming Systems RDE within the field of diversity research and its underlying theories. It considers the notions of diversity developed in Chapter Two to better understand the differences that emerged from the experiences, understandings and expectations of participants in these projects. The chapter also highlights the underlying ontological diversity that is reflected in participants’ experiences, understandings and
expectations. Finally, the chapter argues that the diversity and opportunity for participation within Farming Systems projects provide great potential for team members to learn and make more informed decisions.

Chapter Six (‘Initiating participation in teams’) describes, elaborates and discusses the findings on participation within the project teams and identifies the factors that shaped their participation across the projects. Specifically, the chapter identifies and discusses the impact of participants’ diversity on the nature of the teams’ participation. The chapter subsequently highlights differences in individual’s expectations of participatory processes and the ways they were used. It concludes by proposing that this ‘participatory intent’ reflects individual’s preferred RDE paradigms and underlying ontology.

Chapter Seven (‘Participation for learning in teams’) describes the learning and behaviour that result from participation within each project. It describes, discusses and draws conclusions from the qualitative and quantitative interventions that explored and analysed the nature of the learning processes, knowledge and behaviours that emerged within each team. It concludes that the nature and extent of such learning is a function of team members’ diversity and the levels of participation they develop in their interactions.

Chapter Eight (‘Participation and learning with farmers’) describes the learning and behaviour that resulted from the participation of farmers in each project. It is proposed here that the projects teams improved participation with farmers and had major impacts on regional farming systems. An analysis of participation and learning within the projects’ structured action learning and on-farm research activities is also included. This analysis confirms that farmers’ participation, like team members’ participation, is shaped by their participatory intent and the opportunities provided by the coordinators of each activity. The chapter concludes that the learning outcomes for farmers again depend on the diversity of participants and the levels to which they participate.

Chapter Nine (‘Conclusions and implications for Farming Systems RDE’) reviews the research problem and concludes that participatory processes can improve grains RDE and farming practices. It also concludes that the level of learning (L) in teams, is a product of the nature of their diversity (D), and the levels of participation they achieve (P), that is, \[ L = D \times P \]. Furthermore, a broader conceptualisation of participation between scientists and farmers in Australia, and modifications to current models of team learning are proposed. Finally, the potential of evaluation to catalyse and support participation and learning within project teams is highlighted. Here, it is concluded that encouraging team members’ participation in evaluation planning and interpretation exposes their different assumptions and values, and so enhances
opportunities for learning. This chapter concludes with the author’s reflections on the research methodology itself, the emerging challenges for the practice of Farming Systems RDE, and future research needs.

1.8 The conceptual contribution of this thesis
The conceptual contributions of this thesis are fully explored in Chapter Nine. However, answering these specific research questions provided improved understanding of:

- the nature of diversity within the Australian grains RDE community;
- the relationship between diversity, levels of participation and the nature of learning;
- the factors that shape participation in Australian grains RDE;
- the dynamic nature of participation; and
- the role of evaluation in making values explicit and encouraging dialogue

Consequently, this thesis proposes modifications to Pretty’s (1995) typology of participation to reflect the likely learning outcomes, and provides processes and tools to encourage dialogue and evaluate participation. The thesis also proposes a broader conceptualisation of participation between scientists and Australian grain farmers, a typology for understanding their diversity, modifications of current models of team learning, and a framework for facilitating evaluation and learning in participatory grains RDE in Australia.

1.9 Conclusion
This chapter has briefly described the context of the thesis. It has outlined the research problem and its associated research questions. The background and justification for the research were then provided, and its methodology described and briefly justified. Finally, this chapter has presented important definitions and outlined the structure of the thesis and its delimitations. Following chapters build upon this introduction by identifying and exploring salient issues in the development of effective participatory RDE in the grains industry.
Chapter 2. Understanding participation in Farming Systems research, development and extension

The RDE projects investigated in this thesis were developed as ‘Farming Systems’ projects. That is, they focus on farming as a system of biophysical, economic and social interactions. However, several forms of such Farming Systems approaches have evolved through the different contexts and understandings that have developed over the last 30 years (Gibbon 2003). Consequently, an overview of the evolution of Farming Systems RDE and its introduction to Australia are provided in this chapter. The theoretical perspectives that emerged to inform modern Farming Systems projects and inform this thesis, are then identified and discussed, namely, the key concepts of systems thinking, diversity and participation. The relationships of these concepts to the research problem are then elaborated and the final research questions developed. The final key concept, that of participants’ learning, is elaborated in the next chapter. These theoretical understandings, the central research question, and the specific sub-questions of this thesis emerged from an iterative, and at times, self-evolving research project with several cycles of action research. Investigations of propositions in the literature during this process, both informed, and arose from the research. Consequently, some of the concepts discussed in this chapter emerged during the research but contributed useful insights through reflection after the event. The resulting concepts and insights are summarised here to avoid the repetition of a strict chronological account.

2.1 The emergence of a Farming Systems approach

Recent reviews trace the origin of Farming Systems approaches to the emergence of Farming Systems Research (FSR) in the 1960s and its development within international agricultural research centres (e.g. Gibbon 2003). A diversity of views exists about what constitutes FSR and a Farming Systems approach (Ashby & Lilja 2004). However, it will be shown in this chapter that FSR is now typically viewed as a general approach to research and development that uses a range of methods to elicit a better understanding of farm households, their decisions and decision-making processes (Collinson 2000).

FSR emerged when technological solutions from agricultural research at universities and research stations were recognised as inappropriate for the priorities and circumstances of farmers in developing countries (Packham 2003). The emerging approach has since taken a broader and more socially sensitive perspective (Gibbon 2003). Indeed, the marrying of FSR and participatory methods with its recognition of different stakeholders is becoming more common in agricultural RDE. Perhaps this marriage occurs because the combination of processes offers more deeply contextualised information that identifies contradictions in participants’ different experiences, and tends to focus attention on constraints and opportunities.
rather than problems that provide little inspiration for major advances (Jiggins 2000). In any case, the continuing evolution of development processes has seen Farming Systems approaches achieve relevance in developed countries such as Australia (McCown 2001a; Ridley 2005). While traditional reductionist research on production is perceived to have provided big gains in farm productivity, it is also perceived to have ignored the associated environmental externalities that emerged (Packham 2003). RDE funding agencies have also worried about the gap between scientists’ understanding and actual farming practices (Henzell & Daniels 1995), while farming families have become increasingly critical of research outputs and the advice they receive (Carberry 2004; Packham 2003).

Participatory RDE has subsequently been proposed to address emerging issues that currently defy discrete ‘win-win’ technological solutions, such as balancing environmental and productivity issues (Ridley 2005), and to encourage more relevant research that considers the practical aspects of applying innovations to commercial practice (Carberry, Hochman & McCown 2004). However, Farming Systems approaches are evolving processes, not blueprints for success, because their application is sensitive to situational factors (Packham 2003). Consequently, practitioners must understand the underlying concepts and develop processes to apply them to greatest effect to their own systems. History is a good teacher for revising and refining practice. So, Australian practitioners may benefit from the history of Farming Systems approaches and appreciating the major lessons of the last 40 years.

**2.1.1 Early Farming Systems Research**

Early FSR developed to adapt research and overcome the constraints to small landholders in developing countries adopting the findings of international research agencies. Consequently, researchers modified their technology from research stations to make it more compatible to local farm contexts (Dixon 2003). Indeed, an early model of this form of FSR, ‘New farming systems development’ (Reddy & Wiley 1982) anticipated whole new farming systems to replace those in use (Simmonds 1985). However, this has generally been discredited as farmers rarely adopt whole systems designed by scientists. The management changes of such transformations are simply too great for most farmers and are typically out of date before they become operational (Collinson 2000). This suggests a need to develop more manageable changes and to support farmers to implement these changes in a timely way. It also indicates a need to make the underlying research more relevant to the end-users, the farmers.

In the 1980s, FSR began to encompass activities from the realm of agricultural extension and rural development to address these needs (Biggs 1990). Most previous research had been undertaken in highly controlled experiments in the artificial setting of research stations. However, getting ‘off-station’ and conducting ‘on-farm’ experiments in farmers’ own paddocks
with all their constraints became an imperative during this second phase of FSR (Gibbon 2003). Such on-farm research within the context of FSR used on-farm experimentation and considered interactions of the research with external influences to better understand farmers and their circumstances (Stroud & Kirkby 2000). This helped researchers appreciate farmers’ knowledge, location specificity, the influence of external factors, and why farmers compromise optimal technical practice (Stroud & Kirkby 2000). This model was a useful intermediate step between experimental research stations and extension that could help validate new technologies, establish ‘appropriate’ input levels, and develop packages of recommended practices for extension to farmers (Horton 1991).

This second phase of FSR developed feedback processes to help researchers demonstrate the relevance of their research and support farmers to implement the subsequent recommended practices. The approach echoed Röling’s (1988) exemplar questions of the ToT approach, ‘How do I get (farmers) where I want them?’ and ‘Why don’t (farmers) do what I want them to?’ On-farm research developed interaction with ‘segments’ of the farming community, and the experience was used as market research to develop specific extension messages for them. FSR consequently developed into the broader concept of Farming Systems Research and Extension (FSR/E) to provide more relevant research to farmers. However, it remained largely within the ToT paradigm with scientists firmly in control (King 2000). The process remained essentially extractive for most FSR/E scientists as they continued to do research for, or sometimes even on, their farmer clients, rather than with them (Cornwall, Guijt & Welbourn 1994).

A third phase of FSR subsequently emerged with an imperative for further stakeholder participation. This arose with an increased emphasis on sustainable development, that is, development in terms of economics, the environment and the communities’ capacity to develop in the future (Hawke 1989; Hediger 1997). Participation was proposed to do more than help people see the relevance of research, but to also make the research itself more relevant, to secure farmers’ contributions, and support communities to develop their ability to engage with others for the ongoing development of their farming systems (Christodoulou 2000). This recognised sustainable agriculture was more than an imposed model or package, but a process for learning and continued innovation (Pretty 1995). The move towards sustainable development put stakeholder participation at the forefront of models of agricultural RDE.

2.1.2 Introducing farmer participatory methods to the Farming Systems approach
Perhaps the greatest impact of sustainable development on Farming Systems approaches was a shift from the farm per se as a framework, to a hierarchy of systems with the farm at one level, along with communities, watersheds and policy makers at others (Collinson 2000). Farmer participatory methods (Okali, Sumberg & Farrington 1994) and the notion of multiple
stakeholders with diverse perspectives were consequently proposed for FSR (Biggs & Clay 1981). Embracing participatory processes and getting ‘off-station’ and ‘on-farm’ helped some researchers work with farmers’ own agenda and capabilities in a more collegiate mode (Gibbon 2003). One development was ‘farmer–driven’ research, exemplified in the ‘Farmer first’ approach (Chambers, Pacey & Thrupp 1989), which used participation to honour farmers’ indigenous knowledge. However, it was underpinned with the ideal of common goals, interests and power, and processes to reach consensus solutions to problems identified through managed interventions (Scoones & Thompson 1994). Continuing experiences in integrating FSR and participation resulted in the ‘Beyond farmer first’ (Scoones & Thompson 1994) model, which argues a need to move beyond this approach because farmers and scientists are both active participants, and do not have common goals, interests and power. To reconcile these differences requires processes that support process learning and implementation of negotiated outcomes, not just those determined by the controlling forces (Scoones & Thompson 1994).

In summary, these propositions suggest that major problems are unlikely to have universal solutions. A range of adaptive local solutions negotiated between all parties is more likely. So, how we learn about farming systems that include people is important. Yet, how we come to understand farming systems and farmers’ livelihoods has rarely featured in methodological debates according to Scoones and Thompson (1994). They conclude that new RDE approaches may be needed for real communication and understanding to be realised. Indeed, high levels of participation may be required to fully utilise participants’ diverse interests and perspectives and use them to achieve their goals for farming. Because knowledge is socially constructed and continuously negotiated (Berger & Luckman 1967), it may be accessed and shared through interaction with others (Habermas 1971).

Participatory Action Research (PAR) has been proposed to help advance beyond the notion of consensus in farming systems. With its assumptions of differentiated interests, goals, power and access to resources, PAR provides a process for mediating conflict, process learning and empowerment (Scoones & Thompson 1994). Indeed, it may empower farmers by catalysing local learning, analysis and action (Chambers 1994). Consequently, many of the ‘Beyond farmer first’ authors see the introduction of PAR as progress beyond FSR, FSR/E, and the TOT paradigm (Scoones & Thompson 1994). Yet, others consider the introduction of PAR as just another step in the evolution of Farming Systems approaches (Gibbon 2003). This latter view of a modern Farming Systems approach that encompasses PAR is reflected in Petheram and Clark’s (1998) review of the relevance of Farming Systems Research for Australia. They define modern FSR as a participatory systems approach that incorporates all the types of inquiry considered appropriate by the participants, be they applied social, economic, or biological science, hard science or even basic science.
As such, Farming Systems approaches have developed and broadened since the initial development of FSR. It is also possible to conclude that considerable diversity in the definitions, understandings and terminology of FSR still exists. However, several definitive elements of modern participatory Farming Systems approaches have endured (Gibbon 2003; Packham 2003; Petheram & Clark 1998): systems thinking; participation; learning with interdisciplinary (diverse) stakeholders; and evaluation. An understanding of these key elements will be important for people considering such an approach in Australia.

2.1.3 Bringing participatory grains RDE to Australia

Agricultural scientists have historically wanted to maintain precision and control in their research (Carberry, Hochman & McCown 2004). Consequently, they have continued to use the research processes of their training until a new technology was ‘ready’ for farmers to ‘verify’ and use (Stroud & Kirby 2000). However, the extreme situations of the developing world highlighted and helped define the nature of the gap between theory and practice in farming (McCown 2001a). These same gaps are now fuelling the argument to reframe the nature of agricultural RDE in Australia. For example, McCown (2001b) argues for a move from the predominant ‘policy research’ that produces knowledge before it is modified in practice and extended, to ‘action research’ in which the production for knowledge and the modification for a given reality occur as part of the research process (Onquist 1978). The current Farming Systems projects exemplify this latter argument as one of the first large-scale, formally funded attempts at participatory grains RDE in Australia (Lawrence, Christodoulou & Kuskie 2003). With references to FSR, PAR and action learning (Revans 1982), they reflect a Farming Systems approach that encompasses farmer participation (Carberry 2004; Packham 2003). Yet, details of the specific methods to be employed in each project were scarce in their project specifications to industry funders. It was unclear how they would enact the notion of participation.

The levels of participation in participatory RDE in Australia continue to evolve, and vary from groups of farmers running trials that involve local advisers, to formal programs run by technical specialists who seek farmer participation to contribute and evaluate ideas from research stations, models or farms (Petheram & Clark 1998). Yet, few projects have been applying PAR principles (Guerin & Guerin 1994) despite the growing interest in Farming Systems approaches and PAR over the last decade (Dart 2005; McCown 1989). As suggested in Chapter One, the move towards participatory RDE presents significant challenges within the prevailing positivistic TOT culture of Australian agriculture (Ridley 2005). The participants in the Farming Systems projects are unlikely to be immune from these challenges. They will have much to learn about Farming Systems approaches, their underlying concepts, and how they may work in Australian agriculture (Lawrence, Christodoulou & Kuskie 2003). So, it is perhaps surprising
that few people have made much reference to the international literature in their search for appropriate ‘Farming Systems’ models for Australia (Petheram & Clark 1998). Indeed, the RDE agencies appear to be rejecting the traditional extension model without a clear, coherent or widely accepted alternative (Vanclay 1994). This realisation that RDE agencies are moving towards more participatory approaches, with only a limited understanding of how they may work, especially in Australia’s grains industry, led to the central research question of this thesis:

*How can participatory Farming Systems RDE impact on the learning and behaviour of its participants in the Australian grains industry?*

The scope of this question is established in the rest of this chapter by reviewing and analysing key theoretical perspectives that underpin these RDE approaches and the conceptual premise of participation in this thesis. Consequently, the concepts of: (i) systems thinking; (ii) diversity in work groups; and (iii) participation and participatory processes are now reviewed. Participants’ learning is further elaborated in the next chapter.

### 2.2 Systems and systems thinking

Systems and systems thinking are identified as key concepts in the Farming Systems approach. Conway (1985) suggests that farmers apply a multi-disciplinary and holistic approach to their work, and highlights the potential value of a systems approach for agricultural RDE. For agricultural scientists, the use of systems theory to integrate different disciplinary views into an holistic analysis is described as a breakthrough (Brouwer & Jansen 1989 cited in Hayman 2001). However, the terms ‘system’ and ‘systems thinking’ are now ubiquitous in the FSR literature and the may now be too ‘shop-soiled’ to ever recover them as useful terms (Checkland 1992), especially as what people mean by them is often neglected (Packham 2003).

#### 2.2.1 Defining ‘systems’

Dyer (1993) defines a system as *an assembly of components connected together in an organised way; the components are affected by being in the system and are changed if they leave it. The assembly of components does something, and the assembly has been identified by a human being as being of interest* (p. 408). As such, systems thinking can be described as considering a part in detail while keeping the whole in focus (Mant 1977). This definition also suggests that systems are situations perceived by people (Flood & Jackson 1991b), that is, they are ultimately constructs of the mind (Packham 2003). So, choosing the system of interest, its boundaries, and the level of detail, are subjective and value-laden judgments (Hayman 2001). Consequently, different individuals may enter the same situation and frame the systems, their boundaries and their issues quite differently. It is therefore critical to draw a clear and transparent boundary around the system of interest for a particular purpose.
Hayman (2001) identifies three lines of systems thinking in the ways people define systems: firstly, a ‘hard systems’ approach from the natural sciences to understand and describe a phenomenon; secondly, a ‘hard systems’ approach from the applied sciences of management, engineering and operational research to discover how to manage it; and thirdly, a ‘soft’ systems approach from the social sciences to explore people’s different perspectives of the phenomenon. These lines of systems thinking echo the three phases of FSR described earlier. The first, FSR based on natural sciences, reflects a hard systems approach that seeks to efficiently achieve the goals of people by engineering natural systems (Checkland 1985). It provides a more detailed description of the farming phenomenon by considering the external and wider systems factors that influence it. Yet, the emphasis remains on improving scientists’ understanding (Bentley 1994). The second phase emphasises management and operational research to address the outcomes of research efficiently. It aims to understand how to implement the subsequent recommended practices. Finally, the third phase of FSR aims for greater farmer participation and encourages a soft systems approach. This acknowledges that scientists, farmers and others may have totally different perceptions of situations, and that these perceptions may drive their individual farming decisions. Indeed, farmers are part of the farming system and Farming Systems RDE approaches must provide a better understanding of their perceptions and values to be effective. Farmers are not an external influence and must be considered within the boundaries of the farming system (Christodoulou 2000).

2.2.2 Placing people within farming ‘systems’

This evolution of systems reflects the increasingly broad framing of farming systems. Modern participatory Farming Systems RDE now extends beyond biophysical issues to include farm management issues and the social aspects of agricultural practice, such as labour requirements and information networks (Hamilton 1995). In this way, agriculture is now recognised as a complex social process, not just a complex, diverse and risky technical activity (Scoones & Thompson 1994). People are part of farming systems and their views cannot be ignored.

Human systems are different, and dealing with them requires approaches that are sensitive and respond to diverse human needs (Vickers 1983). Engineering methodologies based on defining goals or objectives simply do not work when applied to ‘messy’ and ill-structured real-world problems that involve people (Checkland 1985). Part of the problem is the inability to define objectives or decide whose objects are most important. Consequently, soft systems approaches are necessary. These approaches are distinguished by the unstructured or messy problems they address, and an emphasis on greater participation to negotiate the meanings and the subsequent issues (Dyer 1993). Yet, soft systems’ underlying constructivist paradigm is perhaps what most challenges people’s thinking and reinforces the need to recognise people as part of the farming
system, including, that the properties of a system are determined by the worldview of the observer. While a ‘hard’ approach assumes the world contains real systems that can be modelled and engineered, the ‘soft’ tradition regards them only as models relevant to arguing about the world and learning about it, not models of the world (Checkland 1985).

Soft Systems Methodology (SSM) is proposed to help people learn about such messy social situations, develop a shared appreciation of the problem situation, and take action to improve them (Checkland 1985). SSM makes peoples’ different definitions of systems explicit by naming their: customers - who would be the beneficiaries of the system?; actors - who would carry out the activities of the system?; transformation process - what input is transformed into what output?; weltanschauung - what worldview makes it meaningful?; owner - who could abolish it?; and environmental constraints - what external constraints does this system take as given? It consequently provides a framework to explore the different worldviews, perceptions of reality, and the nature of knowledge and learning within agriculture (Gibbon 2003). Yet, placing people with different worldviews, values and perceptions within the boundaries of a system creates the potential for conflict through competition for resources, or transformations that work against each other. Flood and Jackson (1991a) propose more ‘critical’ systems thinking to match the most appropriate systems methodologies to the situations encountered. Their typology of systems is based on the likely system purpose and the dynamics of relationships between actors, that is: unitary systems with clear and agreed objectives such as breeding programs to select the highest yielding varieties; pluralistic systems with coalitions of overlapping interests but a similar goal such as projects to increase farm profitability by better varieties, better fertiliser management and better planting machinery; and coercive systems in which the actors have conflicted purposes such as land clearing in a world heritage area (Flood & Jackson 1991b). They consequently propose that operations research and its rational intervention in human affairs (Checkland 1985) may be appropriate to unitary contexts, soft systems methodology as described above for pluralistic contexts, and critical systems approaches that reflect on the rationale of different systems approaches for coercive contexts with conflicting values and purposes (Flood & Jackson 1991b). Identifying the nature of grain farming systems will help develop appropriate methodologies for the projects that are discussed in this thesis.

Calls for greater farmer participation in RDE and the funding of the Farming Systems projects reinforce the notion that Australia’s grain RDE is not unitary in purpose. Otherwise, the traditional TOT paradigm would likely suffice for the agreed goals and processes, and there would not be calls for change. As such, there is a diversity of interests and purposes amongst stakeholders of grain RDE. But do the Farming Systems projects present pluralistic systems in which participants all contribute to a similar goal? Or are they coercive, with individuals working against each other for different outcomes? Indeed, what is the nature and extent of
diversity amongst participants in the projects? This understanding may be a critical first step to identifying common goals and ‘reframing’ their systems to build alignment to this purpose? Consequently, it is important to explore and understand the concept of diversity and its impact on groups and group work.

2.3 Exploring diversity in work groups

Implicitly, increased participation increases diversity. Involving people from different disciplines and organisations will result in different perceptions and expectations of any project. This chapter confirms that ‘farming systems’ are contested concepts and that individuals frame systems of interest and undertake activities to match their worldviews. The Australian projects are the first major initiative of their kind in the grains industry. The nature and extent of any diversity and its effect on stakeholders’ participation, learning and behaviour are unclear. However, the participatory nature of the projects means participants’ notions of Farming Systems RDE will impact on the specific aims and methods of each project. Thus, diversity amongst participants has emerged as the initial focus of this thesis through the sub-question:

What is the diversity of participants’ experiences, understandings and expectations of Farming Systems RDE?

The following review and discussion considers the notion of diversity to develop insights and a structure to better understand the emerging differences in the experiences, understandings and expectations of the project teams, participating farmers, and managers of RDE agencies.

2.3.1 ‘Diversity’ is not a unitary construct

Although social scientists have long been interested in group-composition, the term ‘diversity’ is not a well-established scientific construct (Jackson & Ruderman 1996). The term is common in the literature on group dynamics, organisational demography, organisational learning, and participatory RDE. However, it is used to describe a multitude of differences between individuals and groups and there is no consensus on what constitutes diversity (Guzzo & Dickson 1996). Individuals are unique, so there is an infinite range of bases upon which to define and study their diversity within groups. Yet, these definitions are often implicit and reflect the disciplines and specific situation of each study. For example: organisational demographers use visible attributes like age, sex, and race, or job related attributes like functional background or tenure; while decision-making researchers typically use expertise or information attributes and largely ignore demographics (Williams & O’Reilly 1998). It is therefore important to clarify the term ‘diversity’ and the domains of interest in this thesis.
Defining diversity

The effects of diversity can result from any attribute people use to tell themselves apart (Williams & O’Reilly 1998). Consequently, Jackson, Stone and Alvarez (1993) use ‘diversity’ to refer to situations in which the people of interest are not alike with respect to some attribute(s). However, two recent classifications may help explore the notion of diversity in the Farming Systems projects. The ‘domains’ of diversity suggested by Jackson and Ruderman (1996) encompass several emerging areas of research. These are: demographic diversity (e.g. gender, ethnicity, age); psychological diversity (e.g. values, beliefs, knowledge); and organisational diversity (e.g. tenure, occupation, hierarchical level). Similarly, Jehn, Northcraft and Neale’s (1999) review of past research on groups proposes the classification of diversity into: informational diversity (knowledge bases and perspectives of group members); social category diversity (explicit categories such as age, race, gender); and value diversity (what group members think the group’s real task, goal, target or mission should be). Jehn, Northcraft and Neale (1999) do not distinguish organisational diversity, but they effectively separate Jackson and Ruderman’s (1996) psychological diversity into informational diversity and value diversity. Integrating these two classifications provides a typology with four domains that characterise the diversity observed in initial activities with the Farming Systems project teams:

1. Social/demographic diversity - salient attributes (e.g. age, gender, location);
2. Organisational diversity (e.g. employer, hierarchical status, occupation, tenure);
3. Informational diversity - content and process knowledge, experience, skills; and
4. Values diversity - attitudes and beliefs about the vision and aims of the group.

The projects have many staff distributed across a large geographic area. So, demographic diversity is to be expected. Organisational and informational diversity were also explicit as the projects developed across agencies to reduce duplication of effort and provide multi-disciplined teams with the necessary technical knowledge and process skills. Finally, the importance of values diversity is highlighted by the emergence of participation in farming systems, soft systems thinking and the ‘Beyond Farmer First’ conferences (Section 2.1.2). This diversity may not always be considered in projects’ design, but is likely to impact on their processes and outcomes. This new typology provides a basis to describe participants’ diversity in the projects and consider its impact on their behaviour and project outcomes.

2.3.2 Diversity's impact on group work

Diversity among individuals may create opportunities, but there is potential for either positive or negative outcomes (Kochan et al. 2003). Indeed, empirical research on the effects of diversity produces mixed results. Diverse groups out-perform homogenous groups in some studies, but in others, the homogenous groups avoid the process losses from the poor communication and
excessive conflict that can plague diverse groups (Mannix & Neale 2005). This inconsistency needs further consideration. Firstly, no theory proposes that diversity on outward personal characteristics such as age and gender should have benefits, except to the extent it creates diversity in other domains such as information or values (Jehn, Northcraft and Neale 1999). Secondly, while demographics and these outward personal characteristics are most often what people refer to when discussing diversity, they may not be good indicators of other types of diversity (Tsui & O’Reilly 1989). For example, age does not necessarily reflect values or even work experience. Finally, small groups must also be expected to have varying abilities to capture the potential benefits of diversity and minimise the costs. Consequently, effective groups may be those that learn to be productive with diverse memberships (Foster & Harris 2005). Those that do not learn may fail to be effective.

In summary, lack of consensus about diversity goes beyond ‘what constitutes diversity’ and extends to how diversity affects group performance (Guzzo & Dickson 1996). Lawrence (1997) attributes this lack of consensus to organisational demographers’ ‘black box’ processes, through which they map relationships between demographic variables and organisational outcomes using questions like ‘Does increased diversity lead to increases or decreases in measurable outcomes?’ She argues the instrumental approach advocated by Pfeffer (1983) results in loosely specified and unmeasured theoretical concepts to explain observed outcomes. Consequently, it remains difficult to generalise and predict outcomes in new contexts as the most appropriate theories and sensitive predictors for them remain unknown.

Similarly, Williams and O’Reilly’s (1998) review of 40 years of diversity research concludes there are no main effects of diversity on organisational performance. They acknowledge the contradictory predictions that diversity research can deliver, but argue there is good empirical evidence from testing each theory separately. They conclude it is the external validity of these findings, and the interaction of different theories in organisational settings that need further examination. Williams and O’Reilly’s (1998) subsequently propose their integrative model to summarise the ways that theories of diversity may interact to influence group processes and performance (Figure 1). Their model focuses on demographic diversity but includes the three basic theories of diversity research; similarity/attraction (Byrne 1971), social categorisation (Tajfel 1981), and informational diversity and decision-making (Tziner & Eden 1985). Williams and O’Reilly (1998) use these underlying theories to explain the impact of demographics on other domains of diversity and on subsequent group performance.
Figure 1. An integrated model of demographic impacts on group process and performance
(source: Williams & O’Reilly 1998)
Similarity/attraction theory

Firstly, Pfeffer (1983) observes that demographic differences in groups, that is, the degree to which members perceive themselves to be similar or different to others in the group, results in variations in communication, cohesion and integration. Indeed, decades of research confirm Byrne’s (1971) proposition that people prefer similarity in their interactions (e.g. Brass 1985; Byrne, Clore & Worchem 1966; Ibarra 1992; Triandis 1960). Similarity of attributes ranging from attitudes and values to demographics does increase interpersonal attraction and liking (Williams & O’Reilly 1998). People with similar backgrounds may share common life experiences and values. Consequently, they find it easier, more desirable, and positively reinforcing to interact with each other. This suggests individuals in RDE will tend to align to interests they identify as close to their own. Participation may then be more likely to be within homogeneous groups. This may reduce opportunities to participate with others who are different, and so learn from the diversity within projects.

Social categorisation theory

Social categorisation is a theory that assumes individuals want to maintain a high level of self-esteem (Tajfel 1981). The assumption is that belonging to a social group is an important and emotionally significant aspect of an individual’s self-concept (Brewer 1991). Individuals achieve and maintain this self-concept by self-categorising themselves into social identities for comparison with others (Hogg & Abrams 1988). Not surprisingly, ‘otherness’ is seen as a deficiency, that is, people develop positive opinions of their own category and negative opinions of other categories (Turner 1975). Categorising oneself as a member of one social group rather than another is a fundamental and powerful process. It simplifies our information rich world and makes our perceived world more predictable and controllable (Pelled, Eisenhardt & Xin 1999; Zimbardo & Leippe 1991). Yet, these social processes typically lead to category accentuation, in which differences between groups are exaggerated, while those within groups are minimised (Brewer 1996). These processes of categorisation and accentuation increase stereotyping, distancing and disparaging members of other categories (Williams & O’Reilly 1998). Members of these other social categories may resent this treatment, and groups may become polarised, with anxiety and hostile interactions erupting (Reardon 1995). The potential impact for the Farming Systems projects is that people may categorise themselves into subgroups with the risk that they may work against each other, rather than together. The benefits of diversity may then be lost and the potential positive impacts of participatory RDE destroyed.

Information and decision-making theories

Finally, information and decision-making theories propose that diverse group composition can have direct positive impacts through the increased skills, abilities, information and knowledge that it brings (Tziner & Eden 1985). Demographically diverse groups are expected to have a
broader range of knowledge and experience than homogeneous groups. Given people typically communicate more with similar others (Williams & O’Reilly 1998), individuals in diverse groups may have greater access to informational networks outside their normal work group. This access to more knowledge and experience has the potential to add information to decision-making and enhance performance of the Farming Systems projects.

The net impact of diversity on the performance of these projects will depend on at least two factors. These are the nature and extent of diversity that exists, and the extent to which each project can balance its likely positive and negative consequences. Williams and O’Reilly’s (1998) integrative model suggests that the ultimate positive (+) and negative (−) effects on group performance are not only a function of the ‘variation in demographic composition of groups’, the immediate social impacts of the three underlying theories, and their subsequent effects on group processes, but also the potential moderators of a specific situation (Figure 1). For example, information and decision-making theory initially suggests increased problem-solving perspectives and increased information availability for the group. The effect on group process is likely to include greater cognitive processing demands and more careful analysis. With situations that encourage task independence, this may improve group performance with greater problem-solving ability and creativity. Yet, the model also uses the social categorisation theory to suggest that diversity may increase ‘ingroup/outgroup’ biases and stereotyping. This may ultimately increase conflict and the communication problems that reduce group performance through a lower commitment and ability to meet members’ needs.

Ultimately, this integrative model highlights how the composition and diversity of each project may impact on its processes and performance. From a decision-making perspective, there is an enhanced capability for problem-solving. Diversity in each project is therefore proposed to increase the information available for problem-solving and enhance its capacity to develop creative solutions to problems. However, social categorisation and similarity/attraction theories highlight the divisive potential of increased cognitive biases and decreased liking on group function in each project. Diversity is proposed to increase conflict, factionalism and communication difficulties in the projects. Whether these communication difficulties will outweigh the benefits of increased information for decision-making is unclear. The net result may depend on situational factors. For example, creating a common goal may provide some positive stereotyping and promote solidarity. Similarly, tasks that require independence and cooperation may focus attention on similarities rather than differences.

In summary, the performance of the Farming Systems projects will be affected by the teams’ diversity and how they manage it. The first sub-question in this thesis explores the diversity of participants’ experiences, understandings and expectations of Farming Systems RDE.
Consequently, the nature and extent of each domain of diversity will be better understood. But how each project manages this diversity will then determine the extent of conflict and its consequences for project performance. This notion of conflict is addressed in the following section prior to considering the notion of participation and how participants may subsequently interact.

2.3.3 Diversity gives rise to conflict

Implicit in theories of diversity research is the notion that increased diversity leads to increased conflict. Increased participation in grains RDE may then produce more conflict. Managing this conflict, and utilising diversity as a source of creativity, productivity and energy will be a challenge for the projects. Indeed, this is emerging as one of the major challenges facing the field of group dynamics (Johnson & Johnson 1997).

Most modern organisations view conflict as negative and something to be avoided (Jehn 1997). Historically, conflict has been considered detrimental to performance and satisfaction; although some claim it may generate more fresh insights in groups (Eisenhardt, Kahwajy & Bourgeois 1997a). The consensus suggests potential cognitive benefits in the increased skills and knowledge proposed by information and decision-making theories are overwhelmed by conflict from the negative ‘affective’ aspects of the social categorisation and similarity/attraction theories. However, benefits of organisational conflict are recognised and processes that focus on ‘learning’ are being proposed to make conflict productive (Kayes, Kayes & Kolb 2005; Pelled 1996). In part, this reflects recent developments in the types of conflict studied.

Two types of conflict have been emphasised in organisational studies. The first, ‘substantive’ or ‘cognitive’ conflict involves ideas and differences in opinion about the group’s task. The second type, ‘affective’ conflict, refers to interpersonal relations that are not directly related to the group task (Amason & Sapienza 1997; Priem & Price 1991). Research into substantive conflict has focused on the differing goals of group members. However, Kabanoff (1985) suggests people may have difficulty working together effectively even when they generally agree on goals and believe they should be working together. He concludes that conflict is normal, that is, conflict develops primarily from people’s normal attempts to cooperate and coordinate their efforts. McGrath (1984) goes further to conclude that conflict can just as easily occur about ‘means’ to achieve these goals, even when they are shared. Consequently, conflict is unavoidable if diverse groups try to work together as a team. Jehn and Mannix (2001) also recognise this distinction and differentiated substantive conflict into ‘task conflict’ and ‘process conflict.’ They then propose three types of conflict in work groups: relationship (affective), task and process conflict:
1. **Relationship conflict** is an awareness of interpersonal incompatibilities. It involves personal issues such as dislike among group members, and feelings such as annoyance, tension and frustration. Relationship conflict may be explained by social categorisation and similarity/attraction theories. It is typically considered detrimental to individual and group performance, group members’ satisfaction and the likelihood of a group working together in future. For example, individuals may avoid contact and communication with people they dislike. The anxiety from interpersonal animosity may also inhibit cognitive functioning and distract team members from the task;

2. **Task conflict** is an awareness of different viewpoints and opinions pertaining to group tasks. Like cognitive conflict, it pertains to conflict about ideas and differences of opinion about the task. In participatory RDE, there may be different opinions about the most important issues to address. These task conflicts may coincide with animated discussions and personal excitement. But by definition, they are without the intense interpersonal negative emotions associated with relationship conflict. Moderate levels of task conflict typically improve group performance of complex cognitive tasks as the teams may benefit from different ideas and opinions about the work being done. Task conflict improves the quality of decisions as the synthesis that emerges is generally superior to the individual perspectives themselves; and

3. **Process conflict** is an awareness of controversies about how tasks will be accomplished. It pertains to issues of duty and resource delegation, such as who should do what, and how much responsibility different people should get. For example, should Farming Systems researchers conduct highly controlled small-plot experiments, or support farmers to do their large-scale trials with their own commercial equipment? Process conflict is the least studied of the conflict types. However because of the uncertainty it creates, process conflict has been associated with decreased productivity, lower group morale, and a desire to leave a group. It may also interfere with the task content quality, and misdirect the focus to irrelevant discussions of individual team member’s ability.

This discussion is critical to Farming Systems RDE because it highlights the likely costs and benefits of diversity in projects. It also provides an explanation of the underlying processes and provides frameworks to assess and describe the diversity in the projects. Yet, this discussion concludes that the impact of a participatory approach depends on the nature and extent of the diversity that exists, and how project members deal with it. Will they use the inevitable conflict constructively, or descend into relationship conflict that distracts them from their ultimate goals? (Jehn & Bezrukova 2004) In other words, how will members of the Farming Systems projects interact and communicate to manage their relationships and utilise their informational diversity
to improve decisions and team performance (Mannix & Neale 2005). The impact of diversity on the projects’ performance will ultimately depend on how team members participate with each other. Understanding the key notion of participation is therefore essential in addressing the fundamental research question, ‘How can participatory Farming Systems RDE impact on the learning and behaviour of its participants in the Australian grains industry?’

2.4 The notion of participation

Participation has become one of the underlying tenets of the modern Farming Systems approach, with its inclusion of people as part of the farming system. However, directives from RDE funders to work together, cooperate and be a team, may not be enough to create productive cooperative efforts among diverse project members (Johnson & Johnson 1997). Consequently, participation stands as both a fundamental metaphor and a concept that must be generated within the projects.

The pursuit of stakeholder participation is not unique to agricultural RDE. Rather, it is part of a wider trend in western society since the 1960s (Farrell 2000). This trend may have revitalised public administration but interest in participation has varied over this period. In the late 1960s and 1970s, most American environmental legislation required public participation (Creighton 1999). Yet in the 1980s, the notion of participation remained on the political margins as the recession focused the attention of planners on strategic planning and economic development (Glass 1994 cited in Day 1997; Ventriss 1985). While public participation did not disappear during that period, it was secondary to economic prosperity (Day 1997). Currently, stakeholder participation is again being emphasised in both the private and public sectors such as health (e.g. Frankish et al 2002; Thurston et al. 2005), education (e.g. Bolger & Somech 2005), and resource management (e.g. Busenberg 2000; O’Rourke 2005). How to best involve citizens in public decision-making remains a key administrative issue for decision-makers (Stern & Fineberg 1996). The resilience of this challenge suggests a need to better understand participation and its impact.

McGregor (1960) claims participation is one of the most misunderstood ideas in the study of human relations. This is because the idea of broadly-based citizen participation is relatively new on the stages of social and political history, and only gained general credibility in the 18th century (Ventriss 1985). Yet, when ‘participation’ entered the popular political vocabulary of mass media in the late 1960s, it was used with such attendant rhetoric to describe such a variety of situations that it risked losing any real meaning (Arnstein 1969). Pretty (1995) identified the same phenomenon in agriculture 25 years later. While it is now fashionable for people in agricultural development to say participation is part of their work, there are contradictions in how it is used (Cornwall & Brock 2005). Paradoxically, ‘participation’ is used to justify
extending control of the State but also to build local capacity and self-reliance, to justify external decisions but also to devolve power and decision-making away from external agencies, and for data collection as well as for interactive analysis (Pretty 1995). Indeed, participation may be considered a ‘fad’ (Marchinton et al. 1993), or even an imperative for new project proposals to gain acceptance and sponsorship. This reflects social scientists’ tendency to follow fashions and managers’ pursuit of simplistic recipes for ‘instant coffee’ management without clear understandings (Heller 1998a; Hilmer & Donaldson 1996). Therefore, participation as a concept and as a practical policy remains simultaneously the source of ambiguous interpretations, satisfaction, and frustration (Bolle de Bal 1989).

In sum, participation remains a socio-political goal for managers of private enterprises and public institutions today. Yet, many participatory initiatives are undertaken with little theoretical understanding to inform and improve practices (Webler & Tuler 2000). There is a need for planners to better understand participation and narrow the gap between participatory theory and practice (Day 1997; Wengert 1976). This is critical for people directly involved in ‘participatory’ initiatives such as Farming Systems RDE. The remainder of this chapter is devoted to developing a better understanding of participation and its possible impacts on grains RDE. It draws upon the past experiences of private sector organisations, the wider public service, and international agricultural development programs. The consequent insights into participation and participatory practice provide a basis to understand how the Farming Systems project teams participate, and to propose how effective participatory RDE practices could be enacted in the Australian grains industry.

2.4.1 Conceptualising participation

As foreshadowed, ‘participation’ is not a unitary concept, nor a simple solution to the complex of problems for which Farming Systems approaches are proposed. Rather, participation is a ‘contested concept’ with prolific empirical and theoretical research, and implications that require expertise to appreciate (Day 1997). There are numerous definitions of participation that vary from the brief to those stretching over pages, from the general to others mapped in detail, and from the exclusive and dogmatic to those inclusive of differing views. Yet, Heller et al. (1998) provide an inclusive definition of participation in private sector organisations which has been adapted to the broader context of public life, and used in this thesis:

1. Participation is how people interact with each other in an organisational context, a range of behaviours and choices rather than a standardised type of interaction among people (Heller 1998b). This description implies there are different types of participation.
2. Participation is a process that allows people to exert some influence over their life and living conditions (Strauss 1998a). This reflects a central process of influencing outcomes of personal importance.

3. Participation is the totality of interactions by which individuals, groups and collectives secure their interests, or contribute to decisions through self-determined choices during decision-making (Wilpert 1998). The form of these interactions may be direct and personal, or indirect through representatives of institutions. Similarly, the intensities range from the minimal to the comprehensive. In essence, participation highlights the relative influence, or power, used by different parties on the outcomes of decisions.

This definition arose from considering three conspicuous domains of participation literature; democratic theory, organisational participation, and citizen participation. The following summaries show considerable overlap in the rationale for participation in each domain, and highlight how the relative importance of desired outcomes for stakeholders shapes how participation is used in practice. This inclusive definition embraces the various reasons for encouraging participation in each domain and the extent of participation actually sought. An inclusive definition also focuses attention on developing a better understanding of the nature of participation in interactions rather than debating whether interactions are participatory or not.

**Insights from Democratic theory**

Pateman (1970) argues that ‘participation’ and ‘democracy’ are not the same and should not be used interchangeably. For Pateman, participatory democracy is only one form of democracy. A discussion of democracy may seem out of place in this thesis. However, Pateman’s (1970) distinctions underpin how we understand participation, its literature, and how participation is explicitly, or more often implicitly, applied in agriculture and the other domains. She argues that modern representative democracies may provide ‘equity’ in decisions, but not the ‘equality’ in decision-making advocated by ‘classical’ democracy theorists (e.g. Cole 1920; Mill 1963, 1965; Rousseau 1968). For example, Schumpeter’s (1943) ‘realistic’ definition of a modern pluralistic democracy views democracy as a political method through which people compete for leadership to represent others and the power to decide. This is not ‘full-participation’ (Pateman 1970), a process in which each member of decision-making bodies has equal power to determine the outcome of decisions. Rather, representative democracy utilises two more common phenomena:

- Partial-participation, a process in which two or more parties influence each other in the making of decisions, but the final power to decide rests with one party only;
Pseudo-participation, a process in which no participation in decision-making in fact takes place, but may include techniques to persuade people to accept decisions that have already been made.

Representative democracy and pluralism dominate western cultures (Laird 1993). That is, they emphasise the breadth of involvement (i.e. equity) in decision-making with organised interest groups and competition for indirect influence (Furlong & Kerwin 2005). This leads to tensions between democratic governance and professional expertise, especially in environmental politics where citizens challenge experts who impose theories and ignore local knowledge that can relate technical facts to social values (Fisher 2000). Farming Systems approaches encourage participation and equality in decision-making for these same reasons (Scoones & Thompson 1994) and this tension is apparent in Australia’s grains RDE. For example, the Grains Research and Development Corporation (GRDC) is structured around Regional Advisory Committees (RACs) that represent stakeholders and interest groups. These RACs are advisory and may exert influence. Yet, funding decisions are ultimately made centrally in Canberra. In the northern grain region, the GRDC provides direct funding to the RDE agencies that administer the Farming Systems projects. The assumption is that they will encourage the participation of other stakeholders, principally farmers, in the process. It remains to be seen how the projects will balance these demands for equity and equality in decision-making. Indeed, this conundrum prompted the second specific sub-question of this thesis:

*How can the Farming Systems RDE teams participate effectively?*

This exploration begins by examining how the demands for equity and equality are addressed within the other domains of the participation literature, namely organisational participation in the private sector, and citizen participation in public sector endeavours.

**Insights from organisational participation**

Organisational democracy has a literature full of overlapping labels and categories (Warner 1984). Favoured names for democratic organisational structures and behaviours included ‘industrial democracy’ in the 1960s, ‘involvement’ in the 1980s and ‘empowerment’ in the 1990s (Heller 1998a). Indeed, this literature often uses the terms ‘organisational democracy’ and ‘organisational participation’ interchangeably. ‘Participation’ is used here as it is the oldest and most widely used term (Heller et al. 1998). It is also the term used in agricultural RDE.

The pursuit of greater participation in private sector organisations can be traced to the 1960s (Argyris 1957; Likert 1961; McGregor 1960). The initial impact of these authors was limited, but they are now credited with establishing the philosophical basis for a more participatory
management paradigm (Lawler 1989). Heller (1998a) notes the idealism and innovation of movements such as the Cornell Participatory Action Research Network (1997), but suggests the harsh reality of life in competitive organisations is different. This has made participation a hotly debated topic. So why have organisations become more participative, and just how participatory have they become? There are three broad arguments to support participation for both employees and management within modern organisations (Strauss 1998b):

- Humanistic – participation can contribute to personal growth and job satisfaction to enhance human dignity;
- Power sharing – participation can redistribute social power, protect employee interests, strengthen unions, and extend the benefits of political democracy to the workplace; and
- Organisational efficiency – participation can improve decisions with better information, enhanced motivation, improved communication, and better execution of decisions that people had input into (e.g. Scott-Ladd & Marshall 2004). Finally, participation can help staff learn new skills to do a better job, which builds efficiency and human dignity.

The notion of participation supporting human development and improving an organisation’s performance is attractive. However, participation may have a disadvantage for every advantage. If participation shares power, some people will lose some control. Also, the conflict associated with increased diversity in decision-making does not always result in better performance (Kochan et al. 2003). So, how has participation evolved in a competitive private sector in which participation must support enhanced performance? Again, three general forms of participation are seen commonly in these organisations (Strauss 1998a; Wilpert 1998):

- Direct, also called ‘informal’ or ‘personal participation’ - has no explicit mechanisms, but looks at people’s relative involvement in decision processes and the extent to which people are in fact able to influence the resultant decision (or more frequently the extent to which they see themselves as influencing decisions);
- Indirect, also called ‘formal’ or ‘representative participation’ - people have explicit representation to meet with other groups and contribute their views to decision-making and decisions. These representatives rather than each individual are involved in decisions. However, these representatives can be changed;
- Co-ownership, or employee ownership – stock ownership, buyouts of troubled organisations and cooperatives are the main forms of co-ownership.
Few companies are majority-owned by employees and employee ownership is rarely associated with substantial employee control. Consequently, organisational participation sees Pateman’s (1970) fundamental issues of equity and equality in decision-making re-emerge under different labels as direct and indirect participation. Both Strauss (1998a) and Wilpert (1998) imply cynicism about espoused participation and the real extent of power and influence over others. However, Crouch (1983) openly questions the extent to which claims of instituting participation within organisations really yield power, and suggests it is often merely camouflage to maintain control. This highlights the importance of a project leader’s ‘participatory intent’ and may help understand the extent and impact of participation achieved in the Farming Systems projects. Are project decisions made formally by the project leader, jointly, or by the project participants, and what is the actual extent of participants’ power or ability to influence those decisions? A summary of scenarios that flow from these questions is presented in Table 1.

Table 1. Combining process and influence approaches to participation in organisations

<table>
<thead>
<tr>
<th>Process</th>
<th>Subordinates’ influence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low</strong></td>
<td></td>
</tr>
<tr>
<td>Direction</td>
<td>Leaders make decisions ignoring participants’ preferences completely</td>
</tr>
<tr>
<td>Consultation</td>
<td>Leaders meet with participants, ask for agreement on decisions, but make it clear by mannerisms that no disagreement will be accepted</td>
</tr>
<tr>
<td>Delegation</td>
<td>Participants are formally free to make any decisions they want, but know from prior experience they will be punished if they deviate from the leaders’ preferences</td>
</tr>
<tr>
<td><strong>High</strong></td>
<td></td>
</tr>
<tr>
<td>Direction</td>
<td>Leaders make the kinds of decisions they think participants would want them to make. They follow the polls</td>
</tr>
<tr>
<td>Consultation</td>
<td>Leaders chair meetings but give no indication of their preference</td>
</tr>
<tr>
<td>Delegation</td>
<td>Participants are completely free to make decisions on their own</td>
</tr>
</tbody>
</table>

(source: adapted from Strauss 1998a)

The left-hand column describes the apparent formal process of decision-making, while the other columns depict the degree to which subordinates can really influence those decisions. Strauss (1998a) stresses the importance of leaders’ ‘participatory intent’. For example, project leaders may say, and even believe, they are using a consultative approach. But if they are not really interested in other team members’ views, they are unlikely to listen to them, learn from them, or accommodate them in final decisions. Similarly, leaders may commission market research, but it will have little impact if they do not bother to read the results. These examples may be extreme, but illustrate the dominance of participatory intent over espoused processes. This is not to say that direct participation does not exist in the private sector. Rather, it will depend on the perceived benefits of specific issues to organisational efficiency.
The emphasis of organisational participation is on the participation of employers, managers and employees. Few customers would expect a right to direct participation in a company’s decisions. However, Farming Systems approaches aim to increase several aspects of participation. The Farming Systems projects are funded by both farmer levies and government taxes. They aim to enhance participation between the research and extension disciplines, the different RDE agencies, but above all they aim to increase farmers’ participation in RDE processes. Farmers are taxpayers who also contribute grains levies. Consequently, they may expect a right to direct input into project decisions. Indeed, much of the participation literature has developed within this domain of public, or citizen participation.

**Insights from citizen participation**

Many of the insights from organisational participation apply in the public sector. For example, the rationale for citizen participation mirrors Strauss’s (1998a) humanistic, power equalising and improved efficiency arguments for organisational participation. Indeed, the humanistic notions of democracy and citizen power may have greater resonance with public sector initiatives and their relationships with their stakeholders, that is, with the public. Firstly, participation as postulated by Aristotle draws upon and develops the highest human capacities and is essential for individuals to realise their full potential as humans (Kweit & Kweit 1990; Stivers 1990). Secondly, the notion of power equalising is apparent in Arnstein’s (1969) assertion that citizen participation is ‘citizen power’. Participation is considered a way for the oppressed, people ‘without power’, to have a voice and to influence decisions (Day 1997). Finally, it is argued that citizen participation provides more complete information for decisions because the community is a rich source of information about community desires, their conditions, and collective wisdom (Burke 1979; Rich 1986). However, as Arnstein (1969) observed, ‘the idea of citizen participation is a little like eating spinach: no one is against it in principle because it is good for you (p.217).’ Just as the ideals of a fully participative organisation are yet to be fulfilled (Heller 1998c), Arnstein and others argue that the practice of citizen participation rarely matches the espoused principles and rhetoric.

Despite deficiencies in past participatory practice, the 1990s heralded renewed scholarly interest in participation and community involvement in planning (Perlstadt et al. 1998). Consequently, Box (1998) proposes four eras of control in public organisations: elite control; democracy; professionalism; and citizen governance. The challenge in this era of citizen governance is to achieve the efficiencies of professionalism, and realise a community vision chosen and enacted by its residents (Box 1998). To this end, notions of participatory democracy are being revived to support citizens to contribute local contextual knowledge to the professionals’ expertise, and reduce the divide between environmental scientists and ordinary citizens (Fisher 2000). Indeed, the Farming Systems projects face the same challenge. Bureaucracy may increase material
efficiencies but lead to loss of human values (Dennis 1972). So, how can the Farming Systems projects continue the efficiency gains of professionalism and technology transfer, but maintain community values? Can participatory RDE maintain technical progress and minimise any loss of human values?

For Dennis (1972), participation’s main contribution is not the opportunity for individuals to press their own interests, or find personal fulfilment in civic activity. Rather, it is the opportunity to question the very rationality of the behaviour and beliefs of the bureaucracy itself (Dennis 1972), that is, the data and the logic of its factual and social-philosophical arguments. He appears to suggest participation to avoid ‘groupthink’ (Janis 1983) by questioning and learning about the appropriateness of the underlying assumptions of behaviours. This is what Pretty (1995) calls ‘interactive’ participation, which shares decision-making power and focuses on learning and learning processes to develop activities that address the needs of all parties.

However, are Australia’s RDE agencies and the wider grains industry ready for interactive participation and the scrutiny it brings? This question reinforces the importance of the second sub-question of this thesis:

**How can the Farming Systems RDE teams participate effectively?**

For sustainable development, that is, sustainability in terms of agriculture’s natural, social, human, physical and financial assets (Pretty 1999), these projects must encourage enough participation to best utilise the diversity of their participants. However, what is the most appropriate type of participation, who decides, and how can it be encouraged? Pretty (1995) suggests this requires interactive participation with groups taking control over decisions, seeking multiple perspectives of problems, and undertaking joint analysis with other stakeholders to develop action plans that utilise their available resources. Participation is then akin to citizenship, and seen as a right, not just the means to achieve the goals of a project. Indeed, Pretty’s (1995) ultimate notion of participation is self-mobilisation with initiatives independent of external institutions. However, this notion reflects participatory development projects’ focus on empowerment in developing countries (Cornwall & Pratt 2003) and may not be appropriate in Australian agriculture.

Lower levels of participation may achieve specific short-term goals, but interactive participation is needed to develop the capacity for ongoing development (Pretty 1995). Such interactive participation enacts methodologies for collective learning, represents diversity with multiple-perspectives as individuals and groups evaluate situations, and has an enhanced capacity for action through analysis and dialogue (Pretty 1997). This requires participants to become involved and to adapt ideas to progress their own situations. They must also consider potentially
different perspectives and ways to account for any differences in joint activities. The emphasis for RDE is then on learning and adapting within diversity (Kayes, Kayes & Kolb 2005) rather than adopting predetermined practices.

Fostering interactive participation may help participants in the grains industry ‘learn to learn’ with each other for continued innovation. Yet, if interactive participation is desirable, the challenge is how to achieve it. Furthermore, perceptions of how much participation is achieved depend on who you ask. In the Australian work of McCreddin et al. (1992, cited in Marsh 1998), ‘both parties desired a similar level of participation, (but) those being consulted perceived a lower level of involvement than those doing the consulting (p.31).’ This work highlights two issues: firstly, participation develops at different levels on a continuum; and secondly, that people emphasise different things in assessing their own opportunities for participation. These issues are pursued by Cooke and Kothari (2001) who suggest participation is ‘the new tyranny’ in development, and highlight conflicts between institutions’ rhetoric of empowerment and what actually happens in the practice of development projects. They conclude that naïve assumptions of both power and the authenticity of motivations and behaviour in participatory processes can obscure and sustain broader inequalities. For example, the act of inclusion, of being drawn in as participants, can symbolise an exercise of power over individuals, rather than their empowerment (Kothari 2001). Consequently, participatory processes may develop new power structures that favour specific individuals, groups, or bodies of knowledge. Indeed, Taylor (2001) notes similarities between participation debates within management and development, and reaffirms that the rhetoric of ‘participation’ can camouflage manipulation and lead to disillusionment (Crouch 1983).

Despite these criticisms, the role of participation in development has deepened and is further extending into developed countries such as Australia (Hickey & Mohan 2004). So, what do the different types of participation look like and how can they be described? Pateman (1970) suggests the progression of pseudo, partial and full participation. Similarly, Strauss (1998a) and Wilpert (1998) suggest the broad categories of direct and indirect participation. However, other typologies provide more detail to help describe and inform this debate on participation. The remainder of this chapter is devoted to an exploration of these typologies, and their usefulness in assessing the extent of participation in the Farming Systems projects.

2.4.2 Typologies of participation

There are numerous typologies and descriptions of participation in the literature. Those of Dennis (1972), Arnstein (1969) and Pretty (1995) are reviewed in this study. These typologies echo Pateman’s (1970) ideas of equity and equality, and expand on the notions of direct and indirect participation from the organisational domain. Essentially, the authors highlight the
apparent power relationships of stakeholders and illustrate how participation can be used altruistically, or cynically to maintain existing power relations (Kothari 2001). The first of these, Dennis (1972), conceptualises participation in six ways that were empirically common in the planning of housing estates:

1. Participation as attention to consumer demands. This market research approach to participation maintains the responsibility and power with the bureaucracy. Citizens are informants not decision makers. This is consistent with Schumpeter’s (1943) representative democracy, which at least in theory, allows people to remove bureaucracies that ‘get it wrong’;

2. Participation as partaking of benefits. Views participation as a passive acceptance of outcomes for citizens who are unwilling, unworthy, or too incompetent to participate. Dennis asks just who is incompetent, to what degree, and in what areas of private and public life? He concludes that planners may view many citizens in this light and propel participation into a device for manipulation rather than discovery;

3. Participation in decision-making processes. Wide and direct participation with equality in decision-making as advocated by classical democratic theory (Pateman 1970);

4. Participation for dissolution of organised opposition. Co-opting leaders of agitating groups and reducing their representative functions by loading them with administrative functions while maintaining the initiator’s relative power in decision-making. He summarised this as ‘Forward! At a snail’s pace. You’ll get tired before I do’;

5. Participation as employment in programs. This suggests people should be involved not only in decision-making, but also in carrying out the work as either employees or volunteers; and

6. Participation as grass-roots radicalism. The most conflict-oriented form of participation is the paid employment or volunteer work of representing citizens. In the 1960s this led to participation by conflict, and some attempts to tear up social institutions even if there was nothing better to replace them with.

While not directly related to agriculture, Dennis (1972) provides insight into the participatory intent of the traditional power-wielders and subordinates. He makes no claim that these descriptions provide a logically coherent model of participation. However, Arnstein (1969) and Pretty (1995) structure their typologies to represent participation as a continuum of relative
power relations. Arnstein (1969) was frustrated with the mismatch between the rhetoric of the participation movement and its implementation. She proposes the ‘Ladder of citizen participation’ based on stakeholders’ relative power and decision-making control of programs to encourage a more enlightened dialogue. This typology describes eight levels of participation spanning three forms of ‘non-participation’, ‘degrees of tokenism’, and ‘degrees of citizen power’ (Figure 2). Each rung on the ladder represents the extent of citizens’ power in determining the end-product (Arnstein 1969):

<table>
<thead>
<tr>
<th>8. Citizen control</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Delegated power</td>
</tr>
<tr>
<td>6. Partnership</td>
</tr>
<tr>
<td>5. Placation</td>
</tr>
<tr>
<td>4. Consultation</td>
</tr>
<tr>
<td>3. Informing</td>
</tr>
<tr>
<td>2. Therapy</td>
</tr>
<tr>
<td>1. Manipulation</td>
</tr>
</tbody>
</table>

**Figure 2. Eight rungs on a ladder of citizen participation**
(Source: Arnstein 1969)

Non-participation – contrived substitutes for genuine participation. The real objective is not to enable people to participate in planning, but to enable the power-holders to ‘educate’ or ‘cure’ participants. Exemplars include;

1. Manipulation that may involve people on rubberstamp advisory committees to help them understand or engineer their support, and
2. Therapy that involves much group activity for citizens, but still aims to overcome what power-holders see as the citizens’ problem, not the underlying cause.

Degrees of tokenism – allow citizens to hear and to be heard. However, they have no follow-through or assurance to change the status-quo if participation ends here. For example;

3. Informing citizens of their rights and options is an important first step. However, a one-way flow of information from power holders to citizens provides no opportunity for feedback or power for negotiation,
4. Consultation and inviting citizens’ opinions is again a legitimate activity. But without additional forms of participation, it remains a ritual without any assurance that citizens’ opinions will be taken into account, and
5. Placation occurs when hand-picked individuals represent others on public bodies. However, they may have little influence if they are not accountable to a constituency, or if they are outnumbered by the traditional power holders.

Degrees of citizen power – provide citizens with increasing levels of decision-making clout;
6. Partnership redistributes power and enables citizens to negotiate and engage in trade-offs with traditional power holders in planning and decision-making.
7. Delegated power sees citizen achieving dominant decision-making authority in specific projects or areas. Indeed, it is the power holders who need to initiate bargaining to resolve differences, and finally
8. Citizen control sees citizens with overwhelming control and no intermediaries between them and the source of funds. This sees them in full charge of policy and management, and able to negotiate the conditions under which ‘outsiders’ may change them.

Arnstein’s typology implies that more participation is better, suggesting that ‘degrees of citizen power’ are desirable, especially ‘citizen control’, to overcome the failures of community programs in which planners have decided what is best for citizens. For example, she uses a student-poster slogan, ‘I participate, you participate, he participates, we participate, you participate…they profit’ to illustrate that participation without the re-distribution of decision-making power may be an empty and frustrating process. This allows ‘powerholders’, her description of those who wield power, to claim all sides were considered, but makes it possible for only some of them to benefit (Arnstein 1969). The typology may have been designed to be provocative and to illustrate how participation can be used altruistically or cynically. Yet, Arnstein’s insights have helped make the application of participation more transparent. Her typology details a progression of increasing participation, but it also suggests key features of the interaction at each level. Ultimately, Arnstein’s legacy may have been to refocus discussion on most appropriate type of participation for a given scenario. However, her typology also provides a framework for assessing progress towards the desired participation. For example, planners who actively consult the public with meetings and surveys would have to acknowledge the serious limitation of opportunities for citizens to participate if they maintain full decision-making power with their survey results.

Pretty’s (1995) typology also reflects a progression of relative power relationships and control in decision-making, but it focuses on how these notions of power and control are used within international development programs (Table 2). The aim is to understand and resolve the
apparent paradoxes of how development organisations employ participation (Pretty 1995). These paradoxes may arise because development agencies both need and fear people’s participation. They need people’s agreement and support, but fear that this wider involvement is less controllable, less precise, and so likely to slow down planning and progress (Pretty 1995). The relative emphasis placed on the need for participation and fear of its consequences may underpin what he describes as two overlapping schools of thought and practice for participation. Both involve people in aspects of the planning and implementation of RDE programs, however:

one views participation as a means to increase (RDE) efficiency, the central notion being that if people are involved, then they are more likely to agree with and support the new development or service; (and) the other sees participation as a fundamental right, in which the main aim is to initiate mobilisation for collective action, empowerment and institution building (Pretty 1995, p. 1251).

The efficiency view predominates in development projects. So, while most development projects say participation is part of their work, for the local people this typically means simply having discussions, or providing information to the external agencies (Guijit 1991).

Pretty’s ideas are important to this thesis for two related reasons. Firstly, his typology is grounded in the specific challenges and terminology of agriculture. Secondly, the conundrum of balancing the needs and fears of participation is also likely to confront the Farming Systems projects because Australian scientists and farmers have traditionally operated within a ToT paradigm. As he concludes, the term ‘participation’ should not be accepted without appropriate clarification in development organisations, or in Australian RDE for that matter. His typology suggests that development agencies may use seven types of participation (Pretty 1995). These range from manipulative and passive participation where people are told what is to happen and act out pre-determined roles, to interactive participation and self-mobilisation in which people take initiatives largely independent of external institutions. Like Arnstein (1969), Pretty highlights the lack of stakeholders’ influence in the first four types of participation shown in Table 2. For him, stakeholders at these levels are essentially passive recipients of information in manipulative and passive participation, informants in consultative participation, or paid labourers. They have no direct control over decisions, so as Arnstein suggests, these types are participation may best be called types of non-participation. Rahnema (1992) suggests that achievements from participation used in this way may have no positive lasting effect on people’s lives. For example, subsidies to implement more sustainable farming practices, may not guarantee their continued use once the subsidies are removed.
Table 2. A typology of participation in development projects

<table>
<thead>
<tr>
<th>Typology</th>
<th>Characteristics of each type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manipulative participation</td>
<td>Participation is simply a pretence with ‘people’s’ representatives on official boards, but who are unelected and have no power.</td>
</tr>
<tr>
<td>2. Passive participation</td>
<td>People participate by being told what has been decided or has already happened. It involves unilateral announcements by administrators or project management without any listening to people's responses. The information being shared belongs only to external professionals.</td>
</tr>
<tr>
<td>3. Participation by consultation</td>
<td>People participate by being consulted or by answering questions. External agents define problems and information gathering processes, and so control analysis. Such a consultative process does not concede any share in decision-making, and professionals are under no obligation to take on board people's views.</td>
</tr>
<tr>
<td>4. Participation for material incentives</td>
<td>People participate by contributing resources, for example labour, in return for food, cash or other material incentives. Farmers may provide the fields and labour, but are involved in neither experimentation nor the process of learning. It is very common to see this called participation, yet people have no stake in prolonging technologies or practices when the incentives end.</td>
</tr>
<tr>
<td>5. Functional participation</td>
<td>Participation seen by external agencies as a means to achieve project goals, especially reduced costs. People may participate by forming groups to meet predetermined objectives related to the project. Such involvement may be interactive and involve shared decision-making, but tends to arise only after major decisions have already been made by external agents. At worst, local people may still only be coopted to serve external goals.</td>
</tr>
<tr>
<td>6. Interactive participation</td>
<td>People participate in joint analysis, development of action plans and formation or strengthening of local institutions. Participation is seen as a right, not just the means to achieve project goals. The process involves interdisciplinary methodologies that seek multiple perspectives and make use of systemic and structured learning processes. As groups take control over local decisions and determine how available resources are used, so they have a stake in maintaining structures or practices.</td>
</tr>
<tr>
<td>7. Self-mobilisation</td>
<td>People participate by taking initiatives independently of external institutions to change systems. They develop contacts with external institutions for resources and technical advice they need, but retain control over how resources are used. Self-mobilisation can spread if governments and Non-Government Organisations provide an enabling framework of support. Such self-initiated mobilisation may or may not challenge existing distributions of wealth and power.</td>
</tr>
</tbody>
</table>

(Source: Pretty 1995)

For sustainable development, Pretty (1995), like Arnstein (1969), suggests that more participation is better. While Arnstein (1969) calls for citizen control, Pretty (1995) implies ‘self-mobilisation’ is the desired end-point for development programs. However, he describes two other types of participation that bridge the gap between the lower forms of ‘non-participation’ and ‘self-mobilisation’. The first, ‘functional’ participation, gives stakeholders the opportunity for joint decision-making, but only after external agencies have made the major decisions. Consequently, people are still participating to meet the pre-determined needs of the agencies. For instance, farmers may participate to decide the key research questions for research projects to address. This may be most beneficial when the needs of the agencies and the stakeholders are similar, or at least pluralistic, but not conflicted (Flood & Jackson 1991b). Finally, ‘interactive’ participation views participation as a right. It provides people with the opportunity to participate in joint analysis and the development of action plans. Pretty (1995)
argues that interactive participation is required to fully utilise the diversity of participants and other available resources for sustainable development. He suggests that most other types of participation will threaten, rather than support, the goals of sustainable agriculture, that is, the sustainability of the environmental, economic and social capital of a farming system (Pretty 1999). The Farming Systems projects have these same basic goals. They aim to develop more profitable and sustainable farming systems through a partnership between RDE agencies, farmers and agribusiness (Eastern project specification 2002). Consequently, these projects may need to achieve interactive participation for a sustainable impact on grains RDE and future farming practices. Ultimately, Pretty’s (1995) typology provides an important starting point for this thesis. It builds upon Arnstein’s (1969) issues of power and control in decision-making and employs them in the context of agricultural RDE. It is consequently used in this thesis to consider the extent of participation within the Farming Systems project teams and to understand how they can effectively participate with their diverse stakeholders.

2.5 Conclusion

This chapter has highlighted the trend towards greater participation in RDE and identified the key considerations for the development of effective Farming Systems RDE in Australia. This is important as the rejection of the ToT paradigm, and the move towards participatory RDE, is occurring with only a limited understanding of how these approaches will work in Australia. Consequently, the insights and lessons from international development experiences, and the rich literatures on participation and diversity may be invaluable to ensure that the Farming Systems projects can achieve their potential. Indeed, these understandings provide a starting point to address the basic question of this thesis:

How can participatory Farming Systems RDE impact on the learning and behaviour of its participants in the Australian grains industry?

The development of a Farming Systems approach is a long and continuing journey. Early FSR began as an extension of the ToT approach to help farmers see the relevance of agencies’ research. The approach subsequently developed into a more socially aware, and participatory basket of methods to better understand farmers, their decisions and decision-making processes. With systems thinking and the emergence of soft systems methodology, farmers and others were for the first time included within the farming systems, not the external environment. Moving beyond such hard, biophysical definitions of farming systems introduces a raft of new challenges for Australia where ToT perspectives still underpin most RDE structures. But, human systems are different (Vickers 1983). They can be messy, with ill-defined or contested objectives. Consequently, new concepts have emerged to help understand and progress these messy farming systems. Perhaps the most challenging of these is the underlying constructivist
paradigm of a soft systems approach. For example, it is quite easy to say that a project is going to include people as part of the farming system, undertake participatory RDE, or even employ a constructivist approach. But, what does this mean for participants in the RDE process? What will they learn and how will they behave? Fortunately, the participation, diversity, and learning literature provide some clues.

This chapter has shown that diversity can be described within the domains of social/demographic, organisational, informational and values diversity. While participatory RDE implicitly will increase diversity, the inevitable conflict must be understood and managed for more effective RDE processes. Effective groups will be those that learn to be productive with diverse members. This may not always be the case, and those that do not learn may fail to be effective. Indeed, empirical research on the effects of diversity confirms these mixed results. Consequently, this chapter has explored the underlying theories of diversity and reviewed an integrated model of diversity’s impact on group process and performance. Through this model, the impacts of diversity and likely types of conflict are illustrated. It was also apparent that an awareness of the diversity of the projects and their stakeholders is critical, prompting the first specific sub-question of this thesis:

What is the diversity of participants’ experiences, understandings and expectations of Farming Systems RDE?

Possible responses to this question are fully explored in Chapter Five. However, the review and discussion of diversity in the current chapter concludes that the ultimate impact of the participatory approach of Farming Systems RDE depends not only on the nature and extent of diversity that exists, but also on how the project members deal with it, that is, how they participate with each other. Consequently, this chapter finally addressed the fundamental notion of participation in modern Farming Systems RDE. While directives from RDE agencies to work together, cooperate, and be a team are admirable, they will not ensure productive cooperative efforts amongst diverse project team members. The project teams will have to balance the emerging issues of equity and equality in the decision-making of RDE. Indeed, the teams, and especially their leaders, must understand the basic notion of participation and how to facilitate it, in order to address the issues of the second sub-question:

How can the Farming Systems RDE teams participate effectively?

To investigate this question, the penultimate section of this chapter explored the whole notion of participation and its use in the private and public sectors. Democratic theory provides insights into differences between the equity of a representative democracy, and the equality of influence in decisions promised by full participation. However, these basic differences pervade the
ensuing reviews of participation and its management in the private and public sector. While the private sector emphasises equity in decision-making and more efficient operations, the public sector continues to wrestle with the concept of citizen participation. Public sector managers need people’s agreement and support. However, they typically fear this wider involvement as less controllable, less precise and more likely to slow progress. Consequently, participation is used in a variety of ways.

The apparent paradox of ‘participation’ has led to frustration and cynicism in the literature. There have been strong calls for clarification of the participatory intent of initiatives such as the Farming Systems projects. This chapter appraised several typologies that were designed to do this. Each provided a view on how participation is used in different contexts. However, Pretty’s (1995) typology is grounded in agriculture and provides a good starting point to investigate how the Farming Systems project teams can participate effectively. Pretty (1995) argues that the sustainable agriculture envisaged by Farming Systems RDE projects requires interactive participation to fully utilise the diversity of its participants. He suggests lower levels of participation that emphasise equity over equality are unlikely to develop the capacity for ongoing development. Indeed, Pretty (1995) and his typology introduce the notion of learning and learning processes for participants in agricultural RDE projects. This emphasis is apparent in the aims of the Farming Systems projects. They propose moving beyond a passive ToT paradigm and embracing more active participatory processes based on learning and incorporating the different participants’ knowledge. This reinforces the need to understand and support the learning processes of RDE organisations and the ‘on-the-ground’ teams engaged with a diversity of participants. Further, what can be gained if these projects succeed and gain the effective participation of their diverse stakeholders?

*What is the consequent learning and behaviour of participants in Farming Systems RDE?*

This final research sub-question is explored in Chapter Three (Individual and collective learning through participation). Current theories of learning and development are also considered to understand how both individual and collective processes of learning may support effective team-based participatory RDE.
Chapter 3. Individual and collective learning through participation

This chapter discusses the concepts and processes of individual and collective learning as they occur through the teamwork expected in participatory Research, Development and Extension (RDE). There is growing support for more participatory RDE that can embrace diversity and facilitate learning amongst stakeholders in Australia’s grains industry. However, while it is easy to say a project is going to facilitate learning, it is necessary to identify what constitutes learning and the features and processes of individual and collective learning. Consequently, this chapter first introduces a definition of learning and key perspectives on learning. Secondly, it provides an overview of how the cognitive and socio-cultural theories of learning are converging to provide a fuller understanding of how people think and act. This convergence of cognitive and socio-cultural perspectives is then elaborated through a discussion of their value within the instructional approaches most commonly used in agricultural RDE. It is proposed here that current instructional approaches have a potential to support open dialogue and the collective learning that underpin participatory RDE approaches. However, participants in the Farming Systems projects may need to reflect more critically on their own paradigms and understandings to achieve their full potential. Finally, this chapter introduces current models of team learning to assess the extent of learning in the projects, and to understand the likely outcomes as team members participate in Farming Systems RDE.

3.1 What is learning?

Learning is a much researched but elusive phenomenon. The term ‘learning’ has more meanings than there are theorists (Brown & Palinscar 1989) and defies easy definition because it is variously used to describe a product, a function, or a process (Knowles 1990): (i) as a product, learning represents the acquisition and mastery of what is already known about something; (ii) as a function it is the extension and clarification of meaning of one’s experience; and (iii) as a process it is an intentional and organised process of testing ideas relevant to problems. Ultimately, the ways people define learning reflect how they theorise it and the processes they use to facilitate it (Knowles 1990). For example, Boyd, Apps and Associates (adapted from Knowles 1990) illustrate the distinction between ‘education’ and ‘learning’:

*Education is an activity undertaken or initiated to effect changes in the knowledge, skill and attitudes of individuals, groups, or communities. The term “education” emphasises the educator, the agent of change who represents stimuli and reinforcement for learning and designs activities to induce change. In contrast, “learning” emphasises the person in whom the change occurs, or is expected to occur. Learning is the act or process by which behavioural change, knowledge, skills and attitudes are acquired, refined or transformed.*
The educational ‘learning-as-a-product’ approach above parallels the teaching approach of the Transfer-of-Technology (ToT) paradigm, which aims to gain the understanding or adoption of what scientists believe is best. In contrast, ‘learning-as-a-process’ emphasises the learner and does not pre-determine the correct knowledge or best outcomes. The latter is consistent with participants negotiating better understandings of their farming systems through their different interests and goals (Scoones & Thompson 1994). It is proposed here that learning can be understood as change in individual’s thinking processes, ways of knowing, and ways of engaging with the world beyond the individual. This definition emerged from reviewing the underlying theories of learning and the results of interventions with participants of the projects in this research. Importantly, this review emphasises both the individual and social influences on this process of learning.

3.2 Underlying theories of learning

The plethora of learning theories reflects ongoing developments in our understanding of how people think, act and learn. Yet, these theories are typically grounded within one of four perspectives (Anderson 2000; Jarvis, Holford & Griffin 1998; Matlin 2002; Ormrod 1999):

1. Behavioural perspectives – dominated the early 20th century and focus on the connection between a stimulus (S) and a response (R). They emphasise observable behaviour where learning is to attain the ‘correct’ response to stimuli (S-R). It is difficult to locate examples of ‘pure behaviourism’ as organisms’ mental processes (O) are now recognised to mediate their response (R-O-S). The essence of behaviourism, gaining correct responses to stimulus, is reflected in ToT approaches to RDE that seek the adoption of ‘best’ practices. Farmers’ mental processes are seen in their consideration of the financial benefits, complexity, risk and ease of integrating new practices into existing farming systems (Marsh 1998);

2. Information processing perspectives – emerged in the 1950s and contend that human thinking and acting involve more than stimulus-response. This perspective speculated that human thoughts (i.e. their mental processes) could be analysed as in communication science and computer science (Reed 1997). Thus emerged the metaphor of the human brain as a computer with inputs of information (i.e. sense organs), performance operations in stages one step at a time (i.e. memory), and display of outputs (i.e. nerves and muscle systems to give action) (Matlin 2002);

3. Cognitive theories – further emphasise the internal processes of the mind. They contend that knowledge resides in memory as representations, that is, cognitive structures comprising interpretations of ideas. Thinking in cognitive theory involves the manipulation of these
internal representations of the external world to construct new representations, that is, knowledge (Hunt 1989). This implicitly recognises that individual farmers have different knowledge based on different experiences, and reach different conclusions about how appropriate new practices are for them. Consequently, decisions not to use specific practices need not be considered to be failures to adopt best practices; and

4. Socio-cultural theories – assert that learning and thinking are influenced by the physical and social contexts in which people are immersed (Ormrod 1999). They emphasise the social, cultural, and historical contributions as a source of knowledge to thinking and acting. That is, learning becomes a process of appropriating socio-historically derived knowledge. So, while each farmer may have a unique understanding of their farming system, widespread agreement about many aspects of the system may develop over time.

Each perspective contributes to how we understand human learning. However, the cognitive and socio-cultural perspectives encompass aspects of the earlier theories, and more comprehensively inform the participatory methodology of Farming Systems RDE and this thesis. Indeed, current understandings of how individuals think and act are increasingly considered in a convergence of cognitive and socio-cultural perspectives (Billett 1996). These cognitive and socio-cultural perspectives underpin the investigation of learning that is reported in this thesis.

3.2.1 Cognitive theory and representations of knowledge

Cognitive theory emphasises peoples’ knowledge and their mental processes to acquire, store, transform, and use this knowledge (Matlin 2002). However, it is fundamentally distinguished by its claim that the mind operates on internal representations of knowledge (Anderson 2000). While knowledge is stored in memory as representations, thinking is the manipulation of these internal representations of the external world (Hunt 1989). Consequently, cognition is concerned with how people organise and use this information in their memory. From a cognitive perspective, ‘understanding’ means a person has constructed an internal representation of the problem (Matlin 2002). These ‘meaning-based’ representations reflect individuals’ past experiences, but they will also shape their perceptions and understanding of new situations. Consequently, each person may ‘construct’ different understandings of each phenomenon. For example, an agricultural researcher and extension officer may have different understandings of traditional RDE processes. These understandings will therefore influence their expectations of participatory RDE, their perceptions of the new activities they are involved in, and their ultimate understandings of Farming Systems approaches. But will they have a ‘good’ understanding of participatory approaches? As Greeno (1991) suggests a good understanding provides coherence, correspondence and relationship to background knowledge, that is:
1. Coherence - a pattern connected so that all the parts make sense;
2. Correspondence - a close correspondence between the internal representation and the material that is being understood; and
3. Relationship to background knowledge - the material to be mastered must be related to the individual’s background knowledge.

It is argued here that a good understanding must also be useful because cognitive theory views learning as problem-solving, that is, a process of turning an ill-defined problem into one that is defined, categorisable, solvable, and solving it (Best 1992). Problem-solving requires the integration of two distinctive types of knowledge (Anderson 1982):

1. Conceptual (propositional) knowledge or knowledge “that” (Ryle 1949) comprises facts, information, assertions, concepts and propositions. This conceptual knowledge contains varying levels of knowledge that provide varying depths of understandings from simple facts to complex concepts such as the strength of relationships and philosophy (Novak & Gowin 1984); and

2. Procedural knowledge, or knowledge “how” (Ryle 1949) enables skilful action and comprises techniques, skills and the ability to secure goals (Stevenson 1994). Procedural knowledge also contains varying orders; for specific routine tasks, to link means and ends, and those with executive functions to manage these lower orders (Scandura 1982).

This combination of conceptual and procedural knowledge gives people their unique abilities to understand situations and learn by resolving problem situations. They do this by using, testing and modifying their existing cognitive structures (Glaser 1990; Stevenson, McKavanagh & Evans 1994). Kolb (1984) calls this experiential learning, the process of creating knowledge through transformations of experience. His model for these transformations is based on an iterative cycle of concrete experience, reflective observation, abstract conceptualisation and active experimentation (Figure 3). Four forms of knowledge result from the combination of grasping experience and transforming it within this cycle. For example, an individual may experience a situation, perhaps notice something unexpected, relate this apparent cognitive problem to their existing experiences and cognitive structures, (re)-organise or modify their existing cognitive structures to integrate and comprehend this new experience, and perhaps finally test this new conceptualisation in future situations. Consequently, increased knowledge and expertise reflect more developed cognitive structures and people’s capacity to effectively organise and recall them for more sophisticated thought (Ormrod 1999). This organisation of knowledge is facilitated by the development of schemata (Glaser 1990), which are individuals’
generalised knowledge about a situation (Matlin 2002), and their subsequent ‘mental models’ of what a particular system contains, how it works, and why it works that way (Carroll & Olson 1988; Craik 1943). Together, they can be conceived as providing enough knowledge of a situation to mentally test possible actions before choosing one to use (O’Malley & Draper 1992). These mental models are peoples’ road maps for life, yet they are typically tacit and not publicly tested (Senge et al. 1994). Testing these mental models in participatory RDE may provide great learning opportunities for the Farming Systems project teams.

Figure 3. The structural dimensions of experiential learning
(Source: Kolb 1984)

However, having the ability to solve a problem is one thing. Applying it is another. People do not apply their skills to all the situations and problems they encounter. They may only put effort into things they are interested in, or consider worthwhile from their past experiences and social interactions. These tendencies are called ‘dispositions’ (Perkins, Jay & Tishman 1993a). These non-cognitive attitudes, values, affect, interests and identities (Prawat 1989) consequently influence peoples’ approaches to learning, how much effort they put into specific learning activities, and their resulting understanding of situations. This intentionality and goal orientation of behaviour and learning (Bereiter & Scardamalia 1989) underpins both conceptual and procedural cognitive structures (Perkins, Jay & Tishman 1993b). Yet, if dispositions reflect and influence people’s underlying cognitive structures, they may become self-sealing for individuals’ development. For example, some members of Farming Systems projects may be happy with traditional RDE processes. If they do not perceive any problems with these
processes, they are unlikely to put much effort into developing participatory processes. They may then learn little about participatory RDE and continue to see little value in putting in much effort to change their existing practices and the knowledge schemata that underlie them.

In summary, cognitive theory proposes that people do not passively absorb information from the outside world. Rather, the cognitive perspective is that learning is a process of active construction of knowledge from the information received by individuals (Ormrod 1999) using their awareness of appropriate and timely information and routines to assist the construction (Bartlett 2003). People organise the information they perceive, relate it to their existing cognitive structures to make sense of it, and construct new knowledge. This knowledge then influences how they think, understand situations and act. Individuals may learn different things from the same situation because this construction of knowledge, or ‘cognitive experience’ (Valsiner & van der Veer 2000), is premised on what they already know. For example, project members may perceive the development of agricultural RDE quite differently and frame a problem that the projects are addressing differently as well. By solving their own problem situations to their own satisfaction, they may learn very different things and reach quite different understandings of Farming Systems RDE and how it works. This sense-making has been considered from the perspective of the individual, but there are social aspects to this process (Berger & Luckman 1967). People continually interact with others who provide information and help them to clarify their cognitive processes and the meanings they attach to them (Matlin 2002). Indeed, the call for greater participation in RDE and the emergence of Farming Systems RDE in Australia is, at least in part, to gain more sharing of people’s different understandings and clarify what constitutes more profitable and sustainable farming systems.

An increasing number of theorists is therefore arguing for more socially ‘situated’ theories of learning (e.g. Collins, Brown & Newman 1989). They believe the traditional cognitive approach is too simplistic as people and their cognitive processes are immersed in an information rich environment with complex social interaction (Greeno & MMAP 1998). However, socio-cultural theories do not suggest only that learning and thinking are influenced by the physical and social contexts in which people are immersed (Ormrod 1999) - they argue that people’s cognitive development is inseparable from their social milieu (Rogoff 1990; Wertsch 1998), in this case, the development of participatory RDE in the Australian grains industry.

3.2.2 Socio-cultural theory, placing cognition within social milieu
Socio-cultural theory still holds that learning results from engaging in goal-directed activity and has cognitive consequences. But while cognitive theory focuses on the development and management of representations of knowledge in the mind, socio-cultural theory emphasises social, cultural, and historical contributions as sources of knowledge to thinking and acting. For
example, Rogoff (1990) still defines cognition and thinking broadly as problem-solving, but focuses on social and emotional processes and their impact on cognitive structures as they are negotiated and developed over time. Learning is considered a process of appropriating socio-historically derived knowledge through joint problem-solving, a socially and culturally mediated experience within a set of evolving socio-historical events (Lave 1993; Rogoff 1995). ‘Socio-historical’ means the cultural practices have evolved over time through social interactions within communities and societies (Scribner 1985), in this case, the grains RDE practices that have developed in Australia. The material products of these socially determined practices and socially organised knowledge are activities, which are historical in nature, are embedded within practice, and convey implicit sets of norms and values (Billett 2003).

Vygotsky (1978) uses Mead’s (1934) notions of ‘mind’ and ‘self’ as socially-defined processes to argue that cognition must be studied within the social practices where it develops. Indeed, he asserts that people’s knowledge does not exist without the socio-historical context of its relationships to past events, other individuals, or societal structures. Consequently, the basic unit of analysis moves from the internal workings of the individual to the processes of socio-cultural activity and the active participation of people in socially constituted practices (Rogoff 1990). Vygotsky’s notion of the dialectic between ‘inter’ and ‘intra’ psychological processes focuses attention on a learner’s context as an important variable for knowledge development (Davydov 1995; Mathews & Candy 1999). Indeed, four levels of knowledge development are now conceptualised by Rogoff (1990) who includes Scribner’s (1985) addition of socio-cultural development to Vygotsky’s three original levels:

- **Phylogenetic** – the slowly evolving species history that leaves a genetic legacy;

- **Socio-cultural (adapted from Scribner 1985)** – the changing cultural history that leaves a legacy for the individual in terms of technologies such as literacy, number systems, and value systems, scripts and norms for handling the situations people meet;

- **Ontogenetic** – changes in thinking and behaviour arising in individuals’ histories. This is the level that interests most psychologists; and

- **Microgenetic** – an individual’s continual learning in specific problem situations, built on their genetic and socio-cultural background (Billett 1996).

In this system, the roles of the individual and the social world are interrelated and learning reflects developments at each level over their respective time frames (Rogoff 1990). For example, individuals’ microgenetic development through ongoing everyday interactions with
others in specific activities of the Farming Systems projects, may lead to greater changes in their own thinking about Farming Systems RDE and how best to conduct it; that is their ontogenetic development. In cognitive terms, their intra-personal schemata and mental models may change as they develop new ways of interacting with participants of the projects. Yet, any changes in their behaviour will also leave socio-cultural artefacts, such as accepted ways of conducting participatory RDE and written material that supports their continued development of participatory processes. Farmers are similarly engaged in the active process of remaking and transforming farming practices. Finally, learning and knowledge development will likely vary with each situation because they arise through such participation of people in socially constituted practices. Consequently, it is important to consider the specific social learning contexts of interest. In socio-cultural theory, these social contexts for participation and learning are called ‘communities-of-practice’ (Lave & Wenger 1991).

3.2.3 Learning as participation within communities-of-practice

A community-of-practice is a group of people who share a concern or passion about something, and interact on an ongoing basis to deepen their knowledge and expertise in this area (Wenger, McDermott & Snyder 2002). For example, the participants of Farming Systems projects may be considered a community-of-practice, and there may be smaller communities-of-practice within them that have a keen interest in specific aspects of the projects. Therefore, communities-of-practice are common and may overlap with each other. Echoing Vygotsky (1987), Lave and Wenger (1991) argue that communities-of-practice are an intrinsic condition for the existence of knowledge. As such, learning focuses on the social context and the situated nature of human understanding and communication. Rather than defining learning as the acquisition of propositional knowledge in the heads of individuals, learning is located in the processes of co-participation (Hanks 1991). The conventional view of learners internalising knowledge maintains a dichotomy between inside and outside. Whether knowledge is discovered, transmitted from others, or experienced in interactions with others, this view suggests that knowledge is largely cerebral and takes the individual as the non-problematic unit of analysis (Lave & Wenger 1991). Yet, learning as participation in communities-of-practice concerns the whole person acting in the world and focuses on the ways in which it evolves as a continuously renewed set of relations (Lave & Wenger 1991). This notion locates access to socio-cultural knowledge in particular practices.

Importantly, the notion of learning as participation remains consistent with cognitive psychology and the contention that social circumstances provide clues and cues for the development and indexing of knowledge (Billett 1996; Brown, Collins & Duguid 1989). This reinforces the convergence of underlying cognitive and socio-cultural theories in current understandings of how people think (Billett 1996). However, it also suggests social practice can
be analysed by accounting for the diversity of a situation and its social influences (Billett 2001). These current understandings of learning and the analysis of social practice provide a solid base from which to explore both participation and learning in the Farming Systems projects. These projects may represent an attempt to move grains RDE beyond the traditional ToT paradigm and its behavioural notions of farmers learning to adopt recommended practices. However, this transition will require an understanding of current learning theories that account for participatory processes and the social dimensions of everyday practice.

### 3.3 Facilitating learning in Farming Systems RDE

Part of humanity’s success as a species has been humans’ ability to build upon others’ experiences and insights. Sharing propositional knowledge that has proven to be credible over time is important. Therefore, helping farmers acquire and master what is already known about farming systems cannot be ignored in Farming Systems RDE. However, instrumental learning with a purely behavioural emphasis on getting accepted practices used has been criticised as indoctrination that does not encourage people to think for themselves (Bawden 1989; Jarvis, Holford & Griffin 1998). Indeed, Pretty (1995) argues that this need to build people’s capacity for ongoing development is essential for sustainable development. Consequently, the trend to more participatory RDE has encompassed a move ‘From telling, to teaching, towards learning’ (Lawrence & Cawley 1999) where principles of self-directed adult learning (Knowles 1990) are used to help farmers understand the existing information on key issues such as nitrogen management to make real-time decisions for their own farms. These initiatives have typically used adult learning to enhance adoption (King 2000), not to jointly develop new technology and facilitate personal development through critical reflection in a social context (Brookfield 1985). The Farming Systems projects must therefore embrace theories and processes that support co-learning with critical reflection if they are to advance beyond participation as a means to increase RDE efficiency. This introduces the final sub-question of this thesis:

**What is the consequent learning and behaviour of participants in Farming Systems RDE (given their diversity and the extent of participation they achieve)?**

Kolb’s (1984) model of experiential learning provides a useful starting point to consider learning and answer this research sub-question. Kolb (1984) emphasises the process of adaptation and learning as opposed to content or outcomes, that knowledge is a transformational process being continually created and recreated, and that we must understand the nature of knowledge to understand learning. An implication is that the simple perception of experience is not sufficient for learning; something must be done with it. Indeed, experience is not what happens to you, it is what you do with what happens to you (Dixon 1999). There must be some intention of learning from experience.
Part of this understanding of experiential learning is that knowledge and learning have socio-cultural dimensions with cognitive consequences (Miller & Boud 1996). Yet, people cannot consider every word and action in every social situation before doing anything. Indeed, people do not always learn from their experiences, and much of our knowledge of the world cannot be gained from first-hand experiences (Jarvis, Holford & Griffin 1998). They consequently employ secondary experiences such as theoretical discussions that provide opportunities to learn vicariously through other people’s experiences and interpretations (Jarvis, Holford & Griffin 1998). Kolb’s model suggests great potential for people with different experiences to provide divergent knowledge in their reflective observations on their collective experiences, to develop more sophisticated conceptualisations, and even plan joint experiments to test their new understanding. This is a key reason for the multi-disciplinary Farming Systems projects and their charter to participate with grains industry stakeholders to develop better farming systems. However, diversity research shows that this potential may be difficult to achieve. As Lewin (1952), an intellectual ancestor of experiential learning suggests, learning is achieved most productively in groups whose members interact and reflect on their mutual experiences. Active participation is therefore critical for effective learning in groups.

### 3.3.1 Collective learning in Farming Systems RDE

The preceding review focused on individuals and their learning. However, interest in learning within groups, most notably in the field of organisational learning, is also relevant to the Farming Systems projects. Some of this work maintains a focus on the learning of individuals within groups. For example, Action Learning is a philosophical framework to help combine existing knowledge with peoples’ emergent understandings of complex issues (Revans 1982). Within this framework, Revans (1997) describes learning \( L \) as the sum of existing programmed instruction \( P \) and questioning insight \( Q \), that is; \( L = P + Q \).

While the ToT approach in agriculture may provide much \( P \) with less emphasis of \( Q \), participatory RDE might provide greater questioning insight to extend the sense-making and mental models of active participants if the diversity of participants results in an active, engaged community of practice. Nonetheless, the prime focus for learning will remain on individuals in their own farming systems, and their learning may or may not be shared. This notion of social learning is quite distinct from the ‘collective learning’ that is implicit in the organisational learning literature and everyday conversation (Argyris & Schön 1996). This literature considers collective learning to be learning which is more, or less, than the sum of the individual learning of the members of the group or organisation (Jarvis, Holford & Griffin 1998). There is debate about whether such collective learning is possible. For example, Novak and Gowin (1984) assert that meanings can be shared and agreed upon, but that learning is an activity that cannot be shared. Similarly, King (2000) asserts that individuals are subject to social pressures and may
arrive at shared meanings, but learning is an individual activity, process and responsibility, not a collective activity. Perhaps this dissent echoes the issues of systems definition and boundary selection within systems thinking, that is, our ideas of learning continue to reflect an individualistic paradigm while collective learning is increasingly accepted as a useful way of analysing organisations (Jarvis, Holford & Griffin 1998).

The need for organisational learning parallels that of sustainable development, a process of building the capacity to constantly revise and update knowledge to keep up with change (Senge 1990). The notion of collective learning embraces the diversity of understandings in an organisation to adapt to this change. Dixon (1999) proposes an organisational learning cycle that results in private meaning structures of individual members that may not be made public, individual meaning structures that are made accessible to others, and collective meaning structures that are shared. This model suggests that each member of diverse groups such as the Farming Systems projects must still engage in the steps of Kolb’s (1984) experiential learning cycle to develop their individual meaning structures (Figure 4). An opportunity for active participants to develop, share and apply new understandings is then developed through a cycle of generating information across individuals, integrating this information into the current context, and collectively interpreting its meaning. Communication is critical to this process. Indeed, numerous authors assert that developing meaning amongst the diverse members of any organisation requires a special type of communication called dialogue (e.g. Dixon 1999).

Figure 4. An organisational learning cycle
(Source: adapted from Dixon 1999)
3.3.2 Dialogue to share understandings in Farming Systems RDE

Dialogue is a critical process for knowledge creation and collective learning (Brooks 1994; Dixon 1999). Indeed, individuals clarifying their mental models and inviting others to inquire and understand their assumptions is essential to appreciate alternative views within organisations (Schein 1993). Consequently, dialogue may be critical in developing participatory processes to learn from the different knowledge systems in agricultural RDE (Christodoulou 2000). But what is dialogue, and how can it be developed in Australian grains RDE with its diverse participants and the predominance of advocacy over inquiry that Argyris and Schön (1996) assert is typical of western cultures?

Market research methods, such as ‘in-depth’ interviews and focus groups, stimulate people to reveal their inner thoughts and beliefs (Schiffman & Kanuk 1987), and projective techniques use people’s descriptions and interpretations of vague objects to divulge their backgrounds, attitudes and values (Tull & Hawkins 1993). These methods are typically used on people, or done to them. In contrast, dialogue encourages the capacity and disposition of groups to reveal and understand their own mental models within their ongoing activities (Senge et al. 1994). Simple definitions of dialogue are elusive. However, Dixon (1996) provides an accessible review of the perspectives of the key theorists; Argyris (e.g. Argyris, Putman & Smith 1985), Bohm (1996), Johnson and Johnson (1989), Freire (1970), and Mezirow (1991). This provision is shown in overview in Table 3. Dixon’s resulting view of dialogue is that:

‘Dialogue is a special kind of talk that affirms person-to-person relationships between discussants and acknowledges their collective right and intellectual capacity to make sense of the world...The relationship between individuals and the collective is reciprocal and mediated through talk...Dialogue brings people to new ways of perceiving issues that may be of concern to all... people have collectively constructed new meaning.’

While the key theorists reviewed by Dixon vary from the highly structured approach of Argyris (Argyris, Putman & Smith 1985) to the largely unstructured approach of Bohm (1996), the notion of dialogue is perhaps best explained by its contrast with discussion and debate. Dialogue focuses on inquiry into people’s assumptions, understandings of situations, and creating shared meanings unlike discussion and debate, which break things down into parts and focus on advocacy to decide the ‘best’ solution (Ellinor & Gerard 1998). Dialogue offers the opportunity to develop people and systems to handle the complexity of the modern world. It is consistent with other modern organisational changes such as empowerment, self-managed teams and flatter management structures. Yet, dialogue is a long-term, non-scientific solution in an age when people want immediate answers and are most comfortable trusting science (Dixon 1996).
Nevertheless, dialogue has a potential to support scientists and farmers to better understand each other’s knowledge bases and to learn from their experiences in the Farming Systems projects.

Capacity in Farming Systems projects to develop participation and dialogue for effective learning beyond discussion and debate may determine how successfully they utilise the potential of their diversity. However, Argyris’ articles *Skilled incompetence* (1986) and *Teaching smart people how to learn* (1991) suggest this is not easy for professionals who typically find it difficult to make their mental models explicit. They often send ambiguous messages to avoid potentially confronting situations and to prevent their own and others’ assumptions from being tested. This avoids comparisons between their espoused ‘theories-of-action’ and their actual behaviour, or ‘theories-in-use’ (Argyris & Schön 1996). Such ‘defensive routines’ shift the blame for problems, but also negate the potential to learn from putting their beliefs and behaviours under public scrutiny (Argyris 1991). Action Science is Argyris and Schön’s process for dialogue. It supports the communication of values and assumptions to appreciate, understand, and learn from others (Argyris, Putman & Smith 1985). They relate learning to changes in peoples’ behaviour (their theories-in-use) and conclude that peoples’ espoused theories and their actions are typically inconsistent (Argyris & Schön 1996). Behaviour that does not confront these apparent contradictions is called Model I behaviour, while behaviour that can help draw out and confront the underlying assumptions of these theories-of-action is called Model II behaviour (Table 3). The learning that arises from Model I and Model II behaviour is described as ‘single-loop learning’ and ‘double-loop learning’ respectively.

Dialogue is relevant to the nature and extent of learning in Farming Systems RDE. For example, it may help to describe and predict which of the available RDE methods each project team will use in the specific situations they encounter. The Farming Systems project teams are consciously, or unconsciously, attempting to alter the balance of power of the stakeholders in RDE, so feelings of embarrassment and threat may be expected. Dialogue offers potential to extend beyond advocating and refining the methods that individual team members are most familiar with (single-loop learning). It offers opportunity to inquire into the assumptions of these methods and reach a collective understanding of the most appropriate approach for each situation (double-loop learning). As this discussion shows, the central issues and processes of learning become more sharply focused when the notion of organisational learning is directed on the emerging base unit of organisational activity, the team. Indeed, the Farming Systems projects that support this thesis are structured around several teams in the northern grains region. The prime focus of the research in this thesis is on the impact of Farming Systems RDE on these teams, their participation, and participants’ subsequent learning and behaviour. Therefore, it is important to understand the notions of teams and team learning.
Table 3. **A summary of dialogue theorists’ perspectives**

<table>
<thead>
<tr>
<th>Theorist</th>
<th>Purpose</th>
<th>Process</th>
<th>Skills and attitudes</th>
<th>Target audience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argyris</td>
<td>To uncover errors in one’s own reasoning, and the defensive routines that prevent learning of the whole organisation</td>
<td>Raise issues in small groups; Use left and right-hand column case analysis to uncover individual’s reasoning so they may choose to change them; Map groups’ defensive routines for public discussion so they may choose to change them</td>
<td>Model II skills of advocacy and inquiry that publicly test inferences, offer one’s reasoning and seek disconfirmation</td>
<td>Individuals, their organisations</td>
</tr>
<tr>
<td>Bohm</td>
<td>To develop ‘social intelligence’ to create shared understanding</td>
<td>Minimally structured dialogue in large ongoing groups (20 or more). Groups may be facilitated initially.</td>
<td>Readiness to suspend one’s own assumptions while reflecting on the ideas, feelings, and actions of the group</td>
<td>Society as a whole</td>
</tr>
<tr>
<td>Johnson &amp; Johnson</td>
<td>To increase the learning and concomitant productivity in groups</td>
<td>Face-to-face interaction in which individuals encourage each other to achieve, complete tasks, and produce in order to reach the group’s goals</td>
<td>Provide effective help and feedback to others, exchange resources, challenge other’s conclusions and reasoning, act in trusting and trustworthy ways, advocate and be motivated to exert effort to achieve mutual goals</td>
<td>Groups who need to learn with and from each other (e.g. teams, study groups)</td>
</tr>
<tr>
<td>Mezirow</td>
<td>To free individuals of distorting assumptions imparted through institutions and education</td>
<td>Deliberate on a topic to achieve a broad consensus of those who are informed, rational, and objective</td>
<td>Ability to weigh evidence and objectively assess arguments; able to critically reflect on pre-suppositions and their consequences; be open to other perspectives; accept informed and rational consensus as a legitimate test of validity</td>
<td>Individuals; institutions that unknowingly impart distorted assumptions</td>
</tr>
<tr>
<td>Freire</td>
<td>To free groups and individuals from tacit assumptions that keep them oppressed</td>
<td>Talk as equals without differentiated teaching and learning roles</td>
<td>Humility, love, faith, hope, critical thinking</td>
<td>Populations oppressed by cultural norms and political processes</td>
</tr>
</tbody>
</table>

(Source: adapted from Dixon 1996)
3.4 Teams and team learning

Project teams are increasingly common as organisations try to coordinate activities and use more integrative networks considered to be appropriate for the knowledge era (Ingram 1999). Indeed teams, not individuals, may be the fundamental learning unit in modern organisations (Senge 1990). But what is a team?

3.4.1 Not all groups are teams

Teams are groups of people. But conflict may reduce cooperation and hinder the performance of many groups (Mannix & Neale 2005). So, placing people in the room and calling them a team does not make them one. Indeed, people may be in error if they believe directives to work together, cooperate, and be a team are sufficient to create productive cooperative efforts among members (Johnson & Johnson 1997). Teams are a special type of group as indicated in Table 4. A team is more than the sum of its parts. It may comprise a small number of people who have complementary skills, and are committed to a common purpose and hold themselves accountable to shared performance goals. This ideal mix of these attributes cannot be relied upon. However, it is the level of interdependence and shared responsibility that distinguishes teams from other types of working groups.

Table 4. Features of teams versus working groups

<table>
<thead>
<tr>
<th>Working Groups</th>
<th>Teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>A strong focused leader</td>
<td>Shared leadership responsibility among members</td>
</tr>
<tr>
<td>The group shares the organisation’s mission</td>
<td>Teams have a specific and well-defined purpose. Members know who is and is not in the team</td>
</tr>
<tr>
<td>Products are from individual work and people may work independently</td>
<td>Products develop from team and individual work. Members have specific roles but must work interdependently to achieve their mutual goals</td>
</tr>
<tr>
<td>Effectiveness is measured indirectly by their impact on others (e.g. financial performance of business)</td>
<td>Effectiveness is measured directly by assessing teamwork products</td>
</tr>
<tr>
<td>Only individual accountability is evident</td>
<td>Team and individual accountability are evident</td>
</tr>
<tr>
<td>Individual achievements are recognised and rewarded</td>
<td>Team celebration. Individual’s contributions to team successes are also recognised and celebrated</td>
</tr>
<tr>
<td>Meetings are short and efficient as members discuss, decide and delegate</td>
<td>Meetings have open-ended discussion and include active problem-solving as members discuss, decide, and do real work together</td>
</tr>
</tbody>
</table>

(Source: adapted from Johnson & Johnson 1997; Katzenbach & Smith 1993)

The multi-disciplinary Farming Systems projects are emerging because the knowledge and expertise to understand and continually improve farming systems is dispersed across the scientific and farming community. Consequently, ‘real’ teams will need to develop within the projects if they are to reach their potential and learn to develop their understandings of local farming systems and Farming Systems RDE. Unless the teams can learn to effectively use their
diversity for better outcomes, or if prolonged conflict emerges from incompatible values, it may be more effective to return to funding discrete projects and ‘working groups’. ‘Psuedo-teams’ that cannot, or will not, overcome conflicts have reduced impacts because the conflicts then distract them from their individual achievements (Katzenbach & Smith 1993). As diversity research has shown, conflict can often reduce performance. So, what happens with respect to learning in apparently ‘intelligent’ and less ‘intelligent’ teams? Until we understand what happens when teams learn, as opposed to individuals in teams learning, we will be unable to distinguish ‘group intelligence’ from ‘group think’ and individuals conforming to group pressure (Senge 1990).

3.4.2 Team learning processes

There is much literature on teams and teamwork. However, it is largely discursive and more anecdotal than empirical (Ingram 1999). Indeed, this literature has only recently proposed several revised definitions of team learning, as opposed to teambuilding and training:

- Brooks (1994) - learning is the construction of new knowledge, and collective team learning is the construction of new knowledge by a team;

- (Kasl, Marsick & Dechant 1997) - the process through which a group creates knowledge for its members, itself as a system, and for others; and

- (van Offenbeek 2001) - an iterative team process in which information is acquired, distributed, convergently and divergently interpreted, and stored and retrieved to change the range of a team’s potential behaviour.

These definitions are similar. However, Kasl, Marsick and Dechant (1997) explicitly define team learning as a ‘process’ and identify learning for the collective, the individuals, and the wider organisational system. Furthermore, van Offenbeek (2001) suggests such learning may result in divergent views, not always convergence and the integration of perspectives. This thesis uses Kasl, Marsick and Dechant’s (1997) more inclusive definition but notes that this learning may have divergent and convergent dimensions. Dechant, Marsick and Kasl (1993) and Brooks (1994) provide models to support their definitions of team learning. These models are consistent, but with their different emphases they together provide a fuller understanding of team learning. Dechant, Marsick and Kasl’s (1993) model draws concepts from the fields of group dynamics and knowledge construction (Figure 5). It accounts for a team’s own learning conditions and for support from the wider organisation, which are transformed through thinking and action processes to produce learning outputs for the team and organisation.

A team’s learning conditions include members’ appreciation of teamwork and their openness to others’ views, their opportunities for individual expression and input to team decisions, and the
presence of operating principles for effective and efficient action. These conditions, together with the wider support for teams and their collaboration across the organisation, support the development of team learning processes. These transformational ‘team learning processes’ comprise the heart of the model as team members engage in dialogue to appreciate others’ views, and experiments to resolve contested situations. A team subsequently learns and provides better outcomes for the organisation by reframing problem situations and integrating team members’ perspectives into more sophisticated representations (Table 5).

Figure 5. A model of team learning
(Source: Dechant, Marsick & Kasl 1993)

<table>
<thead>
<tr>
<th>Team learning processes and conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aspects of team learning</strong></td>
</tr>
<tr>
<td><strong>Team learning processes</strong></td>
</tr>
<tr>
<td>Framing</td>
</tr>
<tr>
<td>Reframing</td>
</tr>
<tr>
<td>Experimenting</td>
</tr>
<tr>
<td>Crossing boundaries</td>
</tr>
<tr>
<td>Integrating perspectives</td>
</tr>
<tr>
<td><strong>Team learning conditions</strong></td>
</tr>
<tr>
<td>Appreciation of teamwork</td>
</tr>
<tr>
<td>Individual expression</td>
</tr>
<tr>
<td>Operating principles</td>
</tr>
</tbody>
</table>

(Source: adapted from Kasl, Marsick & Dechant 1997)
Critically, this integration may require dialogue for people to suspend their judgements, and cross their philosophical boundaries to inquire and gain an appreciation of other team members’ perspectives. Experiments may then be used to further explore any important unresolved issues.

While the organisational learning conditions may provide support for teams and their processes, Dechant and Marsick (1993b) propose that the dynamic between the team’s own learning conditions and their learning processes determines the focus and operation of learning processes across teams. They reach no conclusions on the exact nature of the subsequent learning outcomes, but propose that three ‘modes’ of learning reflect the balance between individual learning and team learning in work groups. These modes are (Dechant & Marsick 1993b):

1. Fragmented learning – individuals in new or dysfunctional teams may be learning, but the group as a whole is not. Team learning is inhibited by barriers posed by individual differences, by varying levels of commitment to the team’s mission, and by diverse professional backgrounds with their differing information, knowledge and skills. The views of most individual members remain largely unknown because only superficial and safe information is shared. Members are hesitant to test out their ideas and different viewpoints are generally withheld. Fragmented learning may be exemplified in agriculture by independent or competitive RDE activities;

2. Pooled learning – Some group learning occurs along with considerable individual learning. Individual views may be offered but are typically defended as the team seeks the ‘best’ perspective rather than shaping and integrating multiple perspectives into new knowledge. Such teams operate most effectively within existing frameworks rather than break new ground or challenge strongly held organisational assumptions. Therefore, team learning is incremental rather than innovative. Many teams can function well at this level because they can solve problems, make decisions, and develop recommendations. However, they generally are not viewed as high-performing teams with widespread member satisfaction. Pooled learning may be exemplified in agriculture by multi-disciplinary RDE activities that are conducted in parallel; and

3. Synergistic learning – Teams are doing a good job using their thinking and action learning processes. They actively experiment with new ideas and behaviours that add to individual and group capabilities. Members are committed to their team roles and pull together their ideas, skills and resources to create, innovate and challenge. They actively create new knowledge that often alters or discards individual member’s long-standing assumptions to accomplish the team’s mission. Synergistic learning may be exemplified in agriculture by interdisciplinary RDE activities in project teams.
This model of team learning provides a framework to understand and investigate how RDE project teams may participate and learn to improve their farming systems. However, Brooks (1994) highlights the importance of power relationships in producing new knowledge in teams (Figure 6). Her model suggests the collective production of knowledge by teams requires them to engage in both active and reflective work. Yet, members with insufficient formal power may have difficulty in carrying out either the active or the reflective work in the group. Brooks (1994) proposes that this shapes the type of learning that occurs. That is, ‘technical’ knowledge is produced when power differences among individuals are controlled and ‘social’ knowledge is produced only when no power differences exist among team members. As Arnstein (1969) and Pretty (1995) emphasise, the power relationships of stakeholders may influence the extent to which they contribute to decisions, and by inference to the construction of new knowledge.

![Diagram of Team Learning Cycle with Reflective and Active Work Phases]

**Figure 6. A model of power relationships in team learning**
(Source: Brooks 1994)

In summary, Kasl, Marsick and Dechant (1997) emphasise Schön’s (1983) concept of reframing situations and integrating perspectives to reconcile apparent conflicts through more sophisticated representations, while Brooks (1994) highlights the influence of power on the type of new knowledge created by teams. Indeed, this concept of creating qualitatively different ‘technical’ and ‘social’ knowledge introduces the notion of ‘levels of learning’ that recurs throughout the learning literature.
3.5 Levels of learning

Cognitive theory proposes different levels of conceptual knowledge as a basis of deep understanding (Prawat 1989) and levels of procedural knowledge to manage and monitor activities (Scandura 1982). Socio-cultural theory similarly proposes levels of knowledge development based on the differing time frames of species, cultures and individuals (Rogoff 1990). However, Bateson (1972), Mezirow (1991), Argyris and Schôn (1996) and Habermas (1971, 1974) frame different depths of knowledge as ‘levels of learning’ (Table 6). Each author frames these levels differently but develops a progression that expands the focus of learning from more routine behaviour towards more reflective activity. This reflection moves from an emphasis on improving current processes towards judging the most effective processes. Indeed, there is a common progression from what could be called:

Level 1, where learning is about the matter at hand without conscious attention to the learning strategy used; to
Level 2, where learning is about the learning strategy in use at Level 1 and evaluating its appropriateness; and
Level 3, where learning is about how to learn and about appreciating the limitations of one’s assumptions.

Firstly, Bateson’s (1972) concern is with the psychological frames that shape people’s perceptions and sense-making. His four levels of learning reflect a better understanding of specific contexts, but also a growing appreciation of how psychological frames influence people’s choices and the appropriate sets of alternatives from which they choose. These levels also deal with the processes of how change occurs (Roberts 1997a). Mezirow (1991) emphasises the outcome of learning, that is, people may change their interpretations of situations within their meaning schemes, but they may also modify their concepts, or develop new ones to interpret situations (Cell 1984). Mezirow (1991) differentiates four forms of learning using the extent to which these meaning ‘schemes’ and ‘perspectives’ change. This notion of redefining a problem reflects the cognitive definition of learning as problem-solving and Schôn’s (1983) notion of reframing that underpins the model of team learning in Figure 5. As noted earlier, dialogue is critical for this reframing as it helps team members recognise and appreciate their own psychological frames by contrasting and inquiring into each other’s frames and perspectives.
<table>
<thead>
<tr>
<th>Theorist</th>
<th>Learning level 1</th>
<th>Learning level 2</th>
<th>Learning level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bateson (1972)</td>
<td>Zero Learning – extends pre-existing habitual responses (meaning schemes) to cover additional facts.</td>
<td>Learning II – learning about contexts (meaning schemes). A change in the process of Learning I, in which the learner seeks knowledge of the process of learning to change the set of alternatives from which to choose.</td>
<td>Learning III - learning about the ‘context of contexts’ in which learners seek knowledge for change in the process of Learning II. A change in the system of sets of alternatives.</td>
</tr>
<tr>
<td></td>
<td><em>Learning I</em> – learning about habitual responses. Learners seek knowledge to choose within a set of alternatives but the habitual response (meaning scheme) is unchanged</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mezirow (1991)</td>
<td>Learning through meaning schemes – Learning within our acquired frames of reference to differentiate and elaborate existing meaning schemes. Includes habitual responses to information received through existing categories of meaning. Includes rote learning, in which one behaviour becomes the stimulus for another, and the only change within a meaning scheme is a specific response.</td>
<td>Learning through transformation of learning schemes – Involves reflection on assumptions when specific points of view (beliefs) become dysfunctional and we feel a sense of inadequacy of our old ways of seeing and understanding meaning. Other meaning schemes derived from the same stereotypical role may be transformed at the same time. This accretion of transformed meaning schemes can lead to a transformation in meaning perspective.</td>
<td>Learning through perspective transformation – reflection and critique of presuppositions upon which a distorted or incomplete meaning perspective is based, and transforming that perspective through a reorganisation of meaning. Illumination comes only through a redefinition of the problem. This redefinition in turn is achieved by critically reassessing the assumptions that support the current meaning scheme(s).</td>
</tr>
<tr>
<td></td>
<td>Learning new meaning schemes – creating new meanings that are sufficiently consistent and compatible with existing meaning perspectives to complement them. The meaning perspective is extended but not changed. This may strengthen prevailing perspectives because the new meaning schemes resolve inconsistencies in the older belief system.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argyris and Schön (1996)</td>
<td>Single-loop learning – instrumental learning involving changes to the strategies to achieve the same end. The underlying values remain the same (e.g. a thermostat’s ability to maintain a room at a set temperature)</td>
<td>Double-loop learning – changes the underlying values, and the strategies to achieve the same or new ends. It highlights inconsistencies in people’s behaviour that they are unaware of and allows improved decision-making. Using the thermostat example, double-loop learning asks if the current temperature setting is the most appropriate</td>
<td>Deutero-learning – specific double-loop learning about the learning process and the assumptions of individual’s learning strategies. That is, ‘learning how to learn’, as people discover their learning system and modify it. The term is borrowed from Bateson (1972). It may be called ‘triple-loop learning’ in agricultural RDE (King 2000)</td>
</tr>
<tr>
<td>Habermas (1971, 1974)</td>
<td>Technical cognition (instrumental learning) – how we control and manipulate our environment. It involves determining cause-and-effect relationships, task-oriented problem-solving, and instrumental action involving predictions about observable events, based on empirical knowledge and technical rules.</td>
<td>Practical cognition (communicative learning) – Learning through communication to understand others, what they mean, and to make ourselves understood as we share ideas. Communicative action occurs when individuals with specific aims communicate with others to arrive at an understanding about the meaning of a common experience so they can coordinate their actions to pursue their aims. The inherent aim is to reach an understanding</td>
<td>Emancipatory cognition (emancipatory learning) – concerns the dynamics of identifying and challenging our distorted meaning perspectives in the technical and practical domains. Its focus is the knowledge that results from self-reflection. That is, how we see ourselves, our assumptions about learning and the nature and use of knowledge, and our social expectations. In emancipatory learning we come to see our reality more inclusively, understand it more clearly, and integrate our experience better.</td>
</tr>
</tbody>
</table>
This progression to transformation of learning schemes and perspectives is reflected in Argyris and Schön’s (1996) double-loop learning, that is, the extent to which people’s underlying assumptions are identified and open to change. Their work comes from the organisational literature but is increasingly used in agricultural extension. While people can improve the effectiveness and efficiency of specific behaviours, there may be other more efficacious behaviours with appropriate outcomes. The introduction of participatory RDE, rather than simply placing more resources into the traditional ToT approach may be one such example. The self-awareness and understanding of deuto-learning (Argyris & Schön 1996) aligns most closely with Habermas’ (1971) emancipatory learning. However, Habermas’ domains of learning provide perhaps the widest context for the categories of learning discussed. Habermas (1971) recognises that humans are social beings and proposes that they use communicative action to achieve consensus, or at least to reach an understanding amongst themselves. People’s ability to participate in communicative action to negotiate meanings and purposes extends beyond passively accepting the social realities defined by others (Mezirow 1991). This communicative competence to overcome traditional power imbalances and to develop consensus appears to be at the heart of Brooks (1994) model of team learning. Consequently, the ability of teams in Farming Systems RDE to develop their communicative competence may determine how effectively they use conflict to harness the potential of their diversity.

3.6 Conclusion
This thesis focuses on the introduction of participatory Farming Systems approaches and how this may impact on the Australian grains industry. Indeed, this research aims to help understand how participatory RDE practices should be enacted. The Farming Systems approach has been used in international development programs but is relatively new to Australia. The participatory approach aims to embrace the diversity of industry stakeholders to provide opportunities to share their experiences, and to use their new more sophisticated understandings to better manage local farming systems. Consequently, the central question of this thesis focuses on the impact of a Farming Systems RDE approach on the learning and behaviour of participants:

How can participatory Farming Systems RDE impact on the learning and behaviour of its participants in the Australian grains industry?

The previous chapter demonstrated that the potential benefits of participatory RDE cannot be taken for granted. Indeed, the impact of diversity on groups and their performance is mixed. Some groups are overwhelmed by conflict, while others manage their diversity and learn how to use it to achieve better results. That is why the previous chapter introduced the first two sub-questions of the thesis: to explore the extent of diversity within participants of Farming Systems RDE, and understand how Farming Systems project teams can participate effectively. However,
what can be gained if these projects are successful and gain the effective participation of their diverse stakeholders? What can be learned and what may change as a result? The current chapter has built upon these underlying concepts of diversity and participation, and explores the notion of learning to help answer the final research sub-question:

*What is the consequent learning and behaviour of participants in Farming Systems RDE?*

To move beyond the ToT paradigm and its behaviourist notion of learning, will require an understanding of the current concepts and theories of learning and human development. This chapter had introduced the converging cognitive and socio-cultural perspectives on learning that give a fuller understanding of how people think and act to propose the means by which individuals’ needs and collective processes can be combined in team-based RDE. While individuals may store their experiences and subsequent understandings as representations, these are framed, tested and refined in social settings. Indeed, these understandings may have real meaning only within the social setting in which they developed. Dialogue has consequently emerged as a critical factor for learning from these different knowledge systems. It provides a process for inquiry into people’s assumptions and creates shared meanings. Such dialogue therefore supports development beyond individual’s initial meaning schemes for higher levels of learning that may transform their learning schemes and perspectives. In small groups, this process of developing new shared meanings can be conceived of as team learning. Keys to this process are the constituent thinking processes of synthesising divergent views, that is, framing and reframing, crossing boundaries, experimenting, and finally integrating perspectives into more sophisticated shared understandings (Dechant, Marsick & Kasl 1993). This understanding provides a framework to investigate the final research sub-question of this thesis and to understand how participants of the Farming Systems projects can learn and improve their farming systems.
Chapter 4. Methodology and methods

The rationale for using an action research methodology to investigate the impact of Farming Systems RDE is advanced in this chapter. Here, ‘methodology’ is used in its classic sense, to consider the epistemological assumptions of approaches to look at phenomena, rather than to describe discrete ‘methods’ that may then be applied to address the object of study (Marshall 1994; Tuchman 1994). The philosophical assumptions of the research are therefore elaborated to explain the appropriateness of Participatory Learning and Action Research (Hamilton 1995), before the complementary use of case studies and the choice of research units for analysis are justified. Only then, are the specific qualitative and quantitative ‘methods’ used to investigate the research sub-questions on participants’ diversity, participation and learning described.

4.1 Philosophical considerations

There is a broad body of literature describing specific research methodologies and their appropriate methods for specific research contexts (e.g. Graziano & Raulin 2004). However, reviews of these methodologies, their underlying values, and their consequent costs and benefits highlight the difficulty of such methodological choices (Shadish, Cook & Leviton 1991). These costs and benefits relate not only to the match between the research problem and the methodology, but also to the values of the researcher and other interested parties, and their tests of rigour. Roberts (1997a) concludes that a lack of attention to ontological and epistemological assumptions has contributed to the methodological monism that has developed in rural sociology. Echoing Jackson (1982), he calls for greater awareness of these philosophical assumptions and the theoretical preconceptions that underpin researchers’ choice of methodology and their attempts to change the world. The underlying ontology and epistemology of each inquirer and inquiry approach are therefore critical and must be clarified to select an appropriate methodology. These philosophical issues can be presented as the following questions which are adapted from Guba and Lincoln (1994):

- The ontological question. What is the nature of reality and, therefore, what can be known about it? If a ‘real’ world is assumed, then what can be known about it is ‘how things really are’ and ‘how things really work’; and

- The epistemological question. What is the relationship between a researcher and what can be known? The answer to this question is constrained by the answer to the ontological question; that is, not just any relationship can now be postulated. For example, if a ‘real’ reality is assumed, the researcher’s posture must be one of objective detachment or value freedom to be able to discover how things really are and how things really work.
To answer these questions, it is appropriate to review my ‘positionality’, the research context and the subsequent methodological requirements for the research problem of this thesis.

4.1.1 My positionality

My own assumption, and subsequently the assumption of this research, is that there is no single reality in human interactions. Rather, there are multiple realities comprised of the representations and mental models that people construct from their experiences and social interactions. These realities are ephemeral and emergent, and cannot be known independent of the knower. That is, we participate and create our own environment. Consequently, the understandings I developed while investigating the impact of Farming Systems RDE on participants are described in this thesis - it is my construction of this phenomenon. These understandings were developed and contrasted through propositional knowledge in the literature, and tested and refined with my observations and other stakeholders’ perceptions of the same phenomena. They are not provided as ‘the answer’. They are but a means to reconcile the observed behaviours of participants and develop the capacity to facilitate further learning in the future. These understandings may subsequently provide some insights and tools to help others in similar endeavours. However, there are two key aspects of my positionality that may explain, or at least help others understand, the philosophical stance and methodological choices of this research. These are: (i) my career experiences, and (ii) the context of the evaluation project that supports the research in this thesis.

Career experiences

Agricultural Science training and a career as an Extension Agronomist ensured my comfort with the superiority of technical rationality and the Transfer-of-Technology (ToT) paradigm. I was confident as a farm advisor to review farm practices and provide solutions to any apparent problems. I was oblivious to other ways to conduct extension, or to view the world for that matter. Röling’s (1988) questions, ‘How do I get (farmers) where I want them?’ and ‘why don’t (farmers) do what I want them to do?’ encapsulated this confidence in science and its capacity to improve farm practices. Yet, this second question began to concern me. I turned to the social sciences and studied marketing research to understand farmers’ decision-making, and tailored extension messages to the decision-making processes of each farmer ‘segment’. In retrospect, this marketing approach exemplified Röling’s (1988) call to target extension messages to each category of farmers in the Agricultural Knowledge and Information System. Yet, this approach remained consistent with the ToT philosophy and adult education, as opposed to learning.

It became increasingly apparent that individuals’ aspirations and the bases on which they made decisions were qualitatively different. This questioned the sustainability of ‘adoption’ if it was achieved without farmers understanding the fundamental impacts of these changes on their
aspirations. The notion of helping farmers learn to improve their own situations became increasingly attractive. I then used Action Learning processes (Revans 1982) to help farmers understand current propositions on agronomic issues such as nitrogen management, and use their own data to make better decisions on authentic rather than hypothetical problems (Lawrence & Cawley 1999). However, while championing this new approach in a government department dominated by the ToT paradigm I became entangled in ‘paradigm clashes’ as people (including me) seemed unable to appreciate each other’s approaches. The frustration, personal vitriol and overt antagonism between individuals galvanised competitive programs within the Department. The inability of staff to rise above the boundaries of their paradigms and at least appreciate others’ perspectives fuelled my interest in team learning and processes to facilitate it.

Elaborating my development helped focus the content of this thesis, its underlying methodology and the specific methods that were selected and enacted. For example, the methodology needed to support and honour participants’ different constructions of Farming Systems RDE. While individuals may reach agreement on some of its impacts on participants, other unique and conflicting understandings of these impacts are likely. The central research question and its sub-questions arose from this synchrony of my evolving interests and the transforming context of the Farming System projects in which individuals’ struggled to work and learn across their individual disciplines, backgrounds and RDE philosophies.

4.1.2 The research context and relation to other projects
The Farming Systems projects commenced within this environment of competing paradigms. The ‘Western’ project began in 1995 and planners tried to avoid this antagonism by breaking the project into four ‘modules’ that reflected the different RDE paradigms and methodologies of project staff: traditional small-plot field experiments; participatory large-scale on-farm research with farmers; action learning farmer groups; and decision support/modelling. These modules were perceived to be operating as independent mini-projects when the ‘Central’ Queensland and ‘Eastern’ projects subsequently began in 1997. In these new projects, the module structure was avoided in an attempt to build multi-disciplinary teams that could conduct participatory on-farm research and learning activities with farmers across each region.

The practices of an evaluation project that also commenced in 1997 are reported and discussed in this thesis. It arose because the funders and leaders of each project realised that there was much to be learned about conducting Farming Systems RDE in Australia’s developed economy. The evaluation project’s title, Developing best research/extension practice through evaluation of process and impact highlighted the goal of developing a better understanding of participatory RDE processes and how to implement them, not simply quantifying impacts. The methodology therefore required research for better understanding and action to improve the RDE outcomes.
The participatory nature of Farming Systems approaches also encouraged a participatory evaluation approach to honour the different perspectives of stakeholders. As leader of the evaluation project, I became a ‘de facto’ member of each project and supported participants’ use of evaluation to better understand and improve their RDE processes. The role was specifically to: evaluate the projects’ impact on client learning, decision-making and outcomes; participate with the teams and clients to develop their understanding of participatory processes; and develop principles and procedures to plan and evaluate Farming Systems RDE. An inclusive methodology was preferred because the introduction of participatory RDE was judged to require the participation and learning of stakeholders at different levels of the industry. For example, highly developed process understandings of the project teams would be of little value if the funders and host agency managers did not understand and support them.

In summary, this research context presented several methodological pressures, that is, the methodology had to match: (i) my constructivist philosophy; (ii) the convergence of cognitive and socio-cultural perspectives to facilitate process understanding amongst the project participants; (iii) the structure of the evaluation project and the expectation of a participatory approach within each Farming Systems project; and (iv) the range of stakeholders and their already apparent diverse expectations. These pressures shaped the intention of the investigation, but were insufficiently developed to identify and enact the most appropriate methodology.

### 4.1.3 The methodological features required

Engagement and reflection on how to accommodate the underlying methodological pressures and progress my understanding of how Farming Systems RDE can impact on participants’ learning and behaviour, identified eight methodological requirements for this study. It was concluded that this study required a methodology that could:

1. Facilitate my research while acting to improve each project. The projects were not hypothetical. Yet, their impact on participants’ learning and behaviour in grain RDE was not understood. Chapter Three locates learning in the processes of co-participation within specific social contexts, so socially constituted practices and their consequent learning will vary with each situation. Thus, it was considered best to investigate this learning and behaviour in the projects’ authentic settings;

2. Guide my research and generate data from these authentic situations over which I had little control. As leader of the evaluation activities, I had influence within each project, but could not control the context or the enactment of their specific interventions;

3. Facilitate wider learning. My role included helping others to understand participatory processes and apply their learning to better RDE. The methodology needed to support data collection and analysis to strengthen, not undermine, wider team learning;
4. Incorporate emergent learning to reinforce continuing research activities. My understandings of Farming Systems RDE and its impacts, and those of each project team, were expected to develop over time. The methodology needed to allow better RDE and better processes to investigate its impacts as the research progressed;

5. Permit ongoing incorporation and grounding of propositional knowledge from the literature as my experiential knowledge developed;

6. Provide opportunities for diverse stakeholders to participate throughout the research. While participation cannot be forced, opportunities to participate in all stages of the research were consistent with the participatory nature of Farming Systems RDE. A thesis is ultimately the construction of an individual but opportunities for participants to help frame the research context, provide alternative interpretations, and develop collective interpretations may also develop more sophisticated constructions for the author;

7. Support a range of different methods and tools to be developed and used. Emergent learning and limited influence over major project activities meant that specific methods and tools had to match opportunities that arose. A flexible methodology was needed to select specific methods that were responsive to emerging opportunities; and

8. Produce scientifically and socially meaningful results for the diverse stakeholders.

In conclusion, the most effective research methodology is one that generates data and interpretations that are appropriate to this context (Dick 1995). The required features of the research and the selection of an iterative participatory action research methodology are reconciled in the next section.

4.2 A methodology for the research philosophy and problem

Checkland (1985) has encouraged researchers to be explicit about their assumptions and frameworks when choosing a methodology, especially in understanding human affairs. Indeed, it is rational to accept that studying purposeful human action and initiating change is not a simple matter of discovering the phenomenon’s governing laws (Checkland 1985). People may deliberately act in ways to confirm or refute them. ‘Rational’ interventions cannot separate theory and practice like natural sciences, and require a steady interaction between theory and practice in a process of inquiry (Checkland 1985). Consequently, all practical action is theory-laden. Indeed, to link theoretical ideas and their appropriate use in practice, Checkland (1985) proposes people consider a framework of concepts and ideas \(F\) to establish an appropriate methodology \(M\) for applying the framework to inquire into their chosen area of application \(A\) to learn about the framework, methodology, and area of application. Figure 7 depicts the application of this framework to develop the research reported in this thesis.
This framework is useful because it draws together the theoretical concepts of Farming Systems RDE from Chapters Two and Three, and my constructivist assumptions to develop and explain an appropriate methodology to investigate how Farming Systems RDE impacts on participants:

- **F**: The framework of concepts and ideas is based on the current theories of participation and learning. This convergence of cognitive and socio-cultural perspectives underpins the opportunities for diverse stakeholders in Farming Systems RDE to develop their capacity to share different experiences and develop farming systems that continue to benefit from their collective insight;

- **M**: The methodology is based in participatory action research to allow for understanding, progress, and opportunities for all stakeholders to participate. This iterative methodology facilitates the use of specific methods to be determined as the needs of the study continue to emerge.
A: The area of application focuses on encouraging the effective participation of diverse stakeholders for sustainable development of Australia’s grains industry. This includes the application of the emerging learning outcomes of this research (L) to ensure lasting economic, environmental and social benefits;

L: The learning outcomes are to develop the practice of Farming Systems RDE in Australia’s developed economy. This requires a better understanding of how Farming Systems RDE impacts on participants’ behaviours through their diversity, participation, and their consequent learning and behaviour. It also requires tools and processes to be developed to apply these understandings in practice. Finally, this research is to develop my own understanding and capacity to facilitate Farming Systems RDE and appropriate research processes to further develop it.

The application of this framework (Figure 7) provides an overview of the philosophy, methodology and focus of the research reported in this thesis. The rest of Section 4.2 is devoted to explaining and justifying the Action Research methodology on which it is based.

4.2.1 A constructivist paradigm

The research was framed within the phenomenological paradigm of constructivism and the notion that ‘perception is reality’. This reflected my philosophical position, and was consonant with the apparent range in ontological and epistemological positions of the project team members. Constructivism denotes ontological relativism with a series of local and specifically constructed realities, rather than the fully, or imperfectly, apprehensible single ‘reality’ of positivism (Guba & Lincoln 1994). It is asserted that the mind is active in the construction of knowledge, which is a result of concepts, models, and schemes that humans invent to make sense of their experiences (Schwandt 2000). Constructivism is a cognitive paradigm, but is commonly called ‘social constructivism’ as it reflects the socio-cultural dimension of humans constructing their interpretations against a backdrop of shared understandings, practices and language (Schwandt 2000). Consequently, constructivism encompasses the convergence of cognitive and socio-cultural perspectives on learning that was noted in Chapter Three. It was judged to be the most appropriate paradigm for this research because it spans the other paradigms, and can help project team members with different backgrounds to understand and learn from each other, rather than to compete to be right. A strict positivist position may proclaim the ‘correct’ understanding of Farming Systems RDE and its impacts on participants, but may not develop the collective understandings needed to improve on-ground practice.
4.2.2 A need for research and action

The research in this thesis was based on action research to bridge the gap between the concrete experience of the projects and the abstract ideas of participatory RDE (Christodoulou 2000). Action research is context-bound and addresses real-life problems (Levin & Greenwood 2001). Yet, it is best known for its dual aims: (i) action, to bring about change and improve practices in programs such as the Farming Systems projects; and (ii) research, to increase understanding of such phenomena for researchers, stakeholders, or both (Dick 1993). Recognising that all practical action is theory-laden (Checkland 1985), this praxis in action research is made explicit with the interdependence and integration - not separation - of theory and practice, research and development, thought and action (Zuber-Skerritt 2000). Essentially, action research comprises an iterative cycle of four steps (Zuber-Skerritt 2000):

1. Plan – analysis and strategic planning in a problem situation;
2. Act – implementing the plan;
3. Observe – monitoring the actions and outcomes of the action; and
4. Reflect – critical and self-critical reflection on the results of (1) planning, (2) acting and (3) observing, before re-planning, further acting, observing and reflecting.

This iterative cycle makes action research useful to understand and develop interventions to improve situations that may be too complex and dynamic to control in a conventional research sense (Susman 1983). For example, leading the evaluation project provided some influence on the Farming Systems projects but no direct control over their activities. Furthermore, the projects were funded to improve grains RDE for levee-paying farmers, so excluding some groups to establish experimental control groups was inappropriate (GRDC national program team - personal communication). The selection of action research was therefore justified by its ability to generate data and develop interpretations in ‘real-life’ settings where the external control of variables is unethical, or impractical even within a positivist paradigm (Roberts 1997a).

Action research typically starts ‘small’ and develops through a self-reflective spiral (McTaggart 1991). Dick (1995) describes its cyclic progression from fuzzy questions and methods to fuzzy answers, to less fuzzy questions, methods and answers. This aligns with the cognitive view of learning as a process of turning an ill-defined problem into one that is defined, categorisable, solvable, and solving it (Best 1992). As such, the action research process supports the continuous improvement of practice that extends both personal and field knowledge (King 2000). Zuber-Skerritt (1991) draws on Kolb’s (1984) experiential learning process to suggest that the basic assumption of action research is that people can learn and create knowledge:
1. on the basis of their concrete experience;
2. through observing and reflecting on that experience;
3. by forming abstract concepts and generalisations; and
4. by testing the implications of these concepts in new situations that lead to new concrete experiences and new cycles of (action research).

Action research may subsequently be viewed as connected cycles of experiential learning, or a different perspective of the same phenomenon (Roberts 1997a). That is, experiential learning may be conceived as the process by which experience is transformed into knowledge for personal adaptation to a changed situation, while action research takes action for intended change in a situation and learns about the nature of the change. Regardless, the cyclic nature of such research provides opportunities to access, integrate and ground propositional knowledge from the literature into plans for more informed and focused research with the benefit of past research cycles. This cyclic process also provides rigour through the processes of collecting and interpreting data in each research cycle before retesting them in later cycles, seeking to disconfirm emerging interpretations in each cycle, and seeking out disconfirming data to challenge the literature and data already collected (Roberts 1997a).

In summary, action research was used to produce knowledge and action directly useful to the project teams through research, adult education and socio-political action; and empower them at a deeper level through the process of constructing and using their own knowledge (Reason 1994). It was an appropriate methodology for the research in this thesis because it: (i) is consistent with cognitive and socio-cultural learning perspectives; and (ii) is pragmatic because it is knowledge creation, reflection and application in action, but remains essentially scientific because it tests the validity of these understandings in action (Levin and Greenwood 2001). These features meant it could help:

- develop ‘grounded’ understandings of this new FS approach;
- incorporate new propositional knowledge as the initially ‘fuzzy’ problems of implementing Farming Systems RDE were clarified and understood by participants;
- improve the RDE processes used in the projects; and
- understand and improve my own RDE processes.

Different types of action research are characterised by their balance between ‘research’ and ‘action’, and the extent of participation that is developed in practice (Dick 1993). Indeed, participation is not necessarily part of the process. Genuine participation cannot be forced (King 2000). Consequently, learning in action research may be individually focussed, where issues or
project directions are unilaterally planned, enacted and interpreted (Christodoulou 2000). However, participatory action research was considered most appropriate for this thesis because it provides opportunities for the participation that underpins modern Farming Systems RDE.

4.2.3 Opportunities for participation in action research

Action research contributes to the practical concerns of people in problem situations, and to the goals of social science by joint collaboration within a mutually acceptable ethical framework (Rapoport 1970). This description recognises ‘action’ through the concerns of people, and ‘research’ through the goals of social science, but it also emphasises collaboration. In a review of early action research (e.g. Kemmis 1981; Lewin 1948), Peters and Robinson (1984) identify these three features as fundamental to all action research. Consequently, most action research has been enacted as participatory action research in which some of the people in the group under study participate actively with professional researchers throughout the research process; from the initial design, to the presentation of results, and discussion of their action implementation (Whyte 1991). The ‘participatory intent’ of social researchers to provide real opportunities for continuing participation is therefore critical in participatory action research. Yet, participation is best viewed as an important goal because full participation at all stages of the research process is impossible to impose (Greenwood, Whyte & Harkavy 1993). Consequently, action research is an ongoing research approach that emphasises co-learning, participation, and organisational transformation (Greenwood, Whyte & Harkavy 1993). The six key features in this description of Participatory Action Research (PAR) that made it appropriate as the fundamental methodology for the research in this thesis (adapted from Greenwood, Whyte & Harkavy 1993; Levin & Greenwood 2001) are:

1. It is context-bound and addresses real-life problems such as the Farming Systems projects;
2. It is collaborative and incorporates knowledge across the whole research process – PAR supports knowledge generation through collaborative processes in which farmers, RDE teams and my own contributions would be taken seriously;
3. It is an emergent process – it is an intensifying process in which the meanings constructed in the inquiry process lead to social action, or these reflections on action lead to the construction of new meanings. These intensifying deliberations between differing interpretations are the cornerstone of the meaning construction process;
4. It is case orientated – PAR is an intrinsically case-oriented activity to build theory and method. It could therefore facilitate attempts to identify general lessons from specific cases in Farming Systems RDE, to operationalise concepts, and to develop comparisons through repeated case applications;
5. It is eclectic and diverse – PAR treats the diversity of experience and capacities within groups like the Farming Systems project team as opportunities to enrich research/action processes. Being multi-disciplinary and eclectic, it encourages theories, methods and information to be mobilised from any sources that participants believe are relevant; and 

6. It helps link scientific understanding to social action – the credibility/validity of PAR knowledge is measured according to whether actions that arise from it solve problems and increase participants’ control over their situation. Available qualitative and quantitative data are used. However, the nucleus of the scientific activity is deliberate, democratic sense-making amongst professional researchers and local stakeholders. PAR is not only scientific, but insists on strong criteria and processes for creating new knowledge. Theories must be negotiated by the involved parties, but the knowledge must also pass the test of creating workable solutions to real-life problems.

Participatory action research was selected as the most appropriate methodology for this thesis. It provided opportunities for others to contribute and learn from the experience of Farming Systems RDE while broadening theirs and my understanding of participatory RDE, its impacts on participants, and ways to facilitate effective participation and learning in grains RDE. Yet, an apparent diversity of participatory action research has arisen from the plethora subjects to which it is applied, and the variety of worldviews with which it is used. Indeed, three modes of action research that align to these worldviews can be identified and described (adapted for Grundy 1982; Kemmis 2001):

1. **Technical action research** aims for more effective or efficient practice in terms of the facilitator’s pre-existing ideas and goals. This pragmatic problem-solving is regarded as successful when outcomes match these pre-determined goals, but these goals or how the context of the research has been constructed are not questioned. The impacts of technical action research may not be sustained once the driver of the research process leaves. The ideas are the source of power, and as they typically reside with the facilitator, the facilitator controls the project. As such, technical action research is consonant with the ToT paradigm of RDE, technical cognition (Habermas 1971), single-loop learning (Argyris & Schön 1996), and consultation to functional participation (Pretty 1995);

2. **Practical action research** has technical aspirations for change, but seeks to improve practice through the practical skill and decision-making of participants. To avoid the self-deception of solitary reflection (Habermas 1974), practical action research is facilitated with cooperative groups that use group reflection and dialogue to inquire into individual’s practice, theories and assumption to assess the appropriate action. Practitioners aim to improve their practices in functional terms, but also see how their
goals and bases for evaluating the outcomes are shaped by their ways of understanding themselves in context. It is therefore a process of self-discovery for the practitioner. Power is distributed across the group, but the emphasis is upon individuals’ power for action. As such, practical action research facilitates reflection on an idea and an event for praxis, practical cognition (Habermas 1971), double-loop learning (Argyris & Schön 1996), and interactive participation (Pretty 1995); and

3. **Emancipatory action research** seeks to improve outcomes and the self-understanding of practitioners, but also to assist practitioners critique their social and work setting. That is, it seeks action in the wider social system as well as individual practice, by focussing upon particular practices, and the theoretical and organisational structures and social relations that support them. This provides practitioners with a critical and self-critical understanding of their situation. Power develops with the group, not just the facilitator or individuals within the group. As such, emancipatory action research supports critical theories for enlightenment, emancipatory cognition (Habermas 1971), duetero-learning (Argyris & Schön 1996), and self-mobilising participation (Pretty 1995).

The basic methods may be the same within each of these PAR modes, but participants’ assumptions, worldvews, and power relationships determine how these methods are applied (Grundy 1982). These modes of PAR may overlap and vary with time to produce a range of technical, practical and emancipatory action research cycles for the multiple goals and overlapping interests of participants. Consequently, this thesis used Participatory Learning and Action Research, a form of PAR that recognises multiple goals and values (Hamilton 1995), as its core methodology.

**Participatory Learning and Action Research**

Participatory Learning and Action Research (PLAR) is more than action research and action learning alone. It combines both to support learning that is guided by the collaborative determination of multiple goals and values (Hamilton 1995). PLAR was consequently used as a methodology to provide opportunities for participation when dealing with multiple actors, and their manifold definitions, interpretations, and interests in specific phenomena related to the central research question in this thesis. It was a framework for combining dimensions of action research with varying levels of participation, and action learning activities in which participants helped each other plan and interpret activities addressing their specific individual interests. In other words, PLAR provided an ‘umbrella’ to support participation but avoid the ‘lowest common denominator’ that may result from forcing consensus on each aspect of each person’s activities. Regardless of the specific methods used, participants are encouraged to collectively interpret the data and their meanings in the tradition of action learning (Revans 1982). The
resulting collaboration may create some tension as part of the ‘meaning-making’ process, as participants wrestle with their diversity from the different lived experiences they bring to the inquiry process. However, collaborators may successfully engage in joint inquiry for divergent reasons, and even have different perspectives about what constitutes knowledge, as long as they agree to democratic participation, authentic reflection on their motivations, and honour a holistic perspective on the construction of valid knowledge (Bray et al. 2000). Consequently, the methodology described in this thesis could embrace the inherent tensions of multiple actors in Farming Systems RDE, their multiple framing and definitions of learning, and their subsequent interpretations of research findings. These tensions were anticipated to provide the scope for major insights and learning from the research.

Stakeholders’ varying interest in the specific research questions of this thesis became manifest in the dimensions of action research, participatory action research and action learning they embraced. Indeed, stakeholders matched their participation to their level of interest in specific phenomena. For example, most stakeholders were generally interested in how to develop and improve participatory processes across the projects. The investigations of these general questions embraced the dimension of participatory action research in PLAR, with widespread and interactive participation (Pretty 1995). Yet, it rapidly became apparent that stakeholders’ definitions of ‘participation’ and ‘learning’ varied, so their interest and participation in specific activities to investigate these phenomena also varied. An action learning dimension of PLAR was then employed to collectively interpret the data, regardless of whether each investigation was based on action research, surveys or traditional scientific experiments. For example, some interventions to study the details of the specific research questions in this thesis were of prime interest to me. They were recognised as important by many participants and included in the planning and analysis of the project teams’ efforts to develop and improve more participatory RDE. However, the detailed interest and final decisions on these issues were mine. As such, action research with a functional level of participation (Pretty 1995) was employed for many of the interventions described in this thesis.

This thesis represents my conceptualisations of how participatory Farming Systems RDE impacted on the behaviour and learning of participants in these projects. These conceptualisations were developed through participatory investigations. However, the sheer size and breadth of the Farming Systems initiative justified the selection of specific cases to progress my understanding of Farming Systems RDE as it evolved throughout the thesis.

4.2.4 A case-oriented approach
Participatory action research is typically case-oriented (Greenwood, Whyte & Harkavy 1993) and the PLAR methodology supported the use of case studies to focus on the emerging issues
reported in this thesis. Yet, case study is not simply a methodological choice, and is not defined by the methods of inquiry used (Stake 1994). Rather, it is a choice of object, and researchers choose the cases that provide opportunities to investigate their issues of interest (Stake 2000). However, case studies are not useful for all research questions. They are a preferred research option for ‘how’ and ‘why’ questions, especially within real-life contexts in which the investigator has little control over activities (Yin 1989). A case oriented approach is therefore well suited to investigate the Farming Systems projects in their natural setting and answer the question, ‘How can participatory Farming Systems RDE impact on the learning and behaviour of its participants in the Australian grains industry?’

Both Yin (1989) and Stake (2000) identify and describe different types of case studies based on the researchers’ level of control over the phenomenon and the breadth of understanding they are seeking. Yin (1989) suggests three overlapping types of case studies: (i) Descriptive studies where there is no control over the phenomenon; (ii) Exploratory studies that ask ‘what’ questions when there is little control over the phenomenon; and (iii) Explanatory studies of ‘how’ and ‘why’ questions when there is only margin control over the phenomenon. However, Stake (2000) focuses on the boundaries of the case and the context of the proposed application to identity three forms of case studies: (i) Intrinsic studies to better understand a particular case; (ii) Instrumental studies for insight into an issue or refine a theory; and (iii) Collective studies that jointly investigate a number of cases. The studies in this thesis feature each of these categories. Multiple cases have been selected for joint investigation (collective) based on my interest in understanding specific ‘teams’ (intrinsic), and to refine other authors’ team learning theories for an agricultural context (instrumental). While clarifying the extent of diversity in participants’ experiences, understandings and expectations of Farming Systems RDE is exploratory in nature, the research in this thesis is typically explanatory to understand how and why the project teams subsequently participate and learn in grains RDE.

The extent to which a research question is broad or narrow depends on purpose, the resources available, the time available, and the interests of those involved (Yin 1989). Consequently, Stake (2000) suggests selecting cases of most intrinsic interest to the researcher, that is, the case from which the researchers believe they can learn most. These are not choices between good and bad, but choices among alternatives that all have some merit. Ultimately, the cases in this study were selected for each of the major cycles of action research that developed. Not all the initial cases were maintained for the duration of the research. Rather, the strengthening focus on the teams and their subsequent interaction with farmers meant cases were selected and interventions developed to provide the best available insights into these phenomena as they emerged. Indeed, four overlapping cycles of action research focused on the developing research sub-questions described in this thesis (Figure 8):
Cases: participating farmers in the Eastern, Central and Western projects in Qld and their action learning workshops on nitrogen
Methods: semi-structured interviews, focus groups, observation, and quantitative surveys

Figure 8. The four overlapping cycles of action research in this thesis
Cycle 1 - The extent of participants’ diversity. Early interventions to explore the diversity of participants’ expectations of Farming Systems RDE focused on cases across the broad stakeholder groups of the project. That is, the thesis initiated and utilised opportunities to study each project team, the GRDC industry fund managers, RDE agency managers, and farmers as they arose;

Cycle 2 – The initial participation in the project teams. This second cycle of research was narrower and used each project team, that is, the ‘Western’, ‘Central’ and ‘Eastern’ projects as case studies to investigate how RDE teams can participate effectively;

Cycle 3 – The ongoing participation and learning in these teams. The third cycle maintained the same case studies, but the Western team was restricted to the Queensland sub-project after the NSW sub-project cut its links with the evaluation project; and

Cycle 4 - The consequent participation and learning with farmers. The farmer cases in the fourth cycle of research are based on opportunities for interventions across the life of the evaluation project. Evaluations therefore provided insights into the participation and learning of farmers in each project. However, these insights are supported by more detailed case studies of the Nitrogen in ’95-99 workshops and the subsequent Sustainable soil nitrogen decisions workshops that are reported in Chapter Eight.

In conclusion, the selection of cases in this research emphasised a breadth of understanding, rather than depth. This met my personal interests, and those of grains industry stakeholders who were grappling with how to effectively utilise participatory approaches. Sacrificing ‘some depth for greater breadth’ met the political imperative of a ‘visible’ evaluation project, and provided support to participants across the Farming Systems projects. Consistent with the philosophy of action research, the initial cases and interventions informed the selection of subsequent cases and interventions as the research narrowed to understand how Farming Systems RDE teams can participate effectively. This subsequent selection of cases was increasingly based on access and convenience as the research was in ‘real’ situations in which I had little control. However, the breadth of the initiative provided ample opportunities to investigate the diversity, participation and learning of participants.

The often opportunistic engagement through participatory action research required a range of different methods and data sources to meet the needs of different participants. This led to the collection of data from a wide range of evaluation activities, including: over 30 focus group discussions with the project teams, RDE agency managers, industry funders, and individual farmer groups; over 100 semi-structured personal interviews with project team members and
participating farmers; participant and nonparticipant observation and indirect interviewing at numerous meetings with these funders, managers, project teams and farmers; and several large custom-made questionnaires to quantify team members and farmers’ perceptions of the projects, their processes, and impacts. The remainder of this chapter is devoted to describing the specific methods that were selected and enacted within the PLAR methodology that informed this thesis.

4.3 A multi-method approach
Case-oriented PLAR can accommodate a range of evidence and specific research methods. A real strength of case studies is the ability to deal with a variety of evidence from documents, artefacts, interviews and observations, including participant observation that allows some informal manipulation of the phenomenon (Yin 1989). Within this PLAR framework, more specific ‘action’ approaches and specific methods of gathering evidence were used to match the needs of each research question and the ongoing activities of the ‘case study’ project teams with their different ways of operating. Despite this need to match research methods to the needs of each team, consistency in the research was provided by using a core-group of qualitative and quantitative methods throughout the research.

4.3.1 Integrating qualitative and quantitative methods
Both qualitative and quantitative methods and analysis were sought to help understand the contexts and interpretations of the phenomena studied, determine the strength of participants’ perceptions and beliefs, and clarify the extent of convergence and divergence in these perceptions and beliefs within and between the project teams. The advantage of qualitative research is that it is likely to be a more situated activity through interpretative practices that locate the observer in the world to make it visible (Denzin & Lincoln 2000). This involves the studied use and collection of empirical materials – including case study; personal experience; introspection; life story; interview; artefacts; cultural texts and productions; observational and historical texts – that describe the meanings of these situations in the world (Denzin & Lincoln 2000). Finally, qualitative research uses multiple methods and ‘triangulation’ to gain a deeper understanding of the situations of interest through added rigour, complexity, and richness of the inquiry (Flick 2002). In contrast, quantitative research provides measurement and the analysis of causal relationships between variables, not processes (Graziano & Raulin 2004).

The long-running debate ‘for’ and ‘against’ qualitative and quantitative approaches is exemplified by the notion that it is better to be ‘vaguely right’ than ‘precisely wrong’ (Hayman 2001). This debate may be equated to positivistic empiricist positions promoting quantification, versus interpretive positions promoting qualification. Yet, much qualitative research shares an empiricist streak with quantitative research, and quantitative research may share qualitative researchers’ concern for subjects’ interpretations (Bryman 1988). Rather, it is the ontological
position of the researcher that shapes how qualitative and quantitative methods are used (Christodoulou 2000). The research in this thesis combines qualitative and quantitative methods because it is critical to understand the context of any study and the factors involved, before quantifying the extent of these factors and their impacts (Tull & Hawkins 1993). Rigour in research is more than quantifying observations and applying tests of statistical significance. Rigour requires understanding what is being measured and ensuring that the salient issues are included (Graziano & Raulin 2004). For example, rushing into quantification may result in surveys that omit the most critical factors and do not allow respondents to answer questions accurately. Such quantitative research could be statistically analysed, but misleading.

Consequently, this thesis is based upon qualitative research using focus groups, semi-structured interviews and observation, to understand the context of each research question before developing, testing, and using surveys to quantify the salient factors. Within a constructivist framework, the use of this approach acknowledges that participants are unlikely to perceive phenomena in the Farming Systems projects in exactly the same way. However, there will be some shared elements of their perceptions. These shared perceptions and interpretations can be developed into a useful collection of constructs, that is, indicators, not perfect measures, which can be quantified to help share and explore participants’ understandings of the projects. The resulting indicators may be of greatest value if they are developed in a participatory manner to enhance the shared understanding of what they represent. From a constructivist perspective they remain representations of reality, not true measures of reality.

In summary, the relative strengths and weaknesses of qualitative and quantitative methods have been identified and acknowledged, and a range of widely recognised qualitative and quantitative methods used to address the research questions described in this thesis. For example: the qualitative explorations were based primarily on focus groups and semi-structured interviews, supplemented by ‘participant’ and ‘onlooker’ observation (Patton 1990); while quantitative self-administered questionnaires and observations were developed with participants to supplement these qualitative investigations.

4.3.2 Semi-structured interviews to understand the situation

The most common way to obtain information about the behaviour, attitudes and other characteristics of people is to ask them (Tull & Hawkins 1993). Interviewing has consequently evolved into one of the most common and powerful ways to better understand other people. This evolution has resulted in three main styles of interviews that employ face-to-face, telephone, or mail interaction (Fontana & Frey 2000): (i) structured interviews, (ii) unstructured interviews, and (iii) semi-structured interviews.
1. Structured interviews produce simple descriptive information very quickly. The interviewer rigidly controls the direction of the interview, asking all respondents the same series of predetermined questions with a limited set of response categories and an established coding system. This allows large samples and easy quantification of data to test hypotheses (Arksey & Knight 1999). However, direct questioning is not always desirable because people may be unable, or unwilling, to answer questions that invade their privacy, affect their self-image, embarrass them, or address motivations they do not fully understand or cannot verbalise (Tull & Hawkins 1993). Further, the researcher may not understand the topic well enough to know the most important questions to ask.

2. Unstructured interviews are often called as ‘in-depth’ (Tull & Hawkins 1993) or ethnographic interviews that may provide a greater breadth of data because there is no specific set of pre-specified questions (Fontana & Frey 2000). The interviewer decides in only general terms upon the main themes, and there is freedom to create open questions using their own language and ideas. Unstructured interviews consequently help interviewers build their understanding of research topics. This is very time consuming and difficult to analyse, so unstructured interviews are most often used to generate a script for subsequent semi-structured interviews (Arksey & Knight 1999).

3. Semi-structured or ‘focussed’ interviews (Merton & Kendal 1946) fall between the structured and unstructured format. They are closest to the latter because they generate qualitative data, and semi-structured interviews are commonly included as ethnographic interviews (Flick 2002). This is the most common form of interviewing in qualitative research because it allows the interviewer to hear what people have to say on the topics and areas identified by the researcher, yet maintain the flexibility to improvise and develop probing questions to clarify and extend answers (Arksey & Knight 1999).

Semi-structured interviewing was selected as a key method for the research in this thesis. The interest was to hear and collect data about the introduction of Farming Systems RDE in participants’ own words, and to better understand its impacts in their terms (Arksey & Knight 1999). Three series of semi-structured interviews were consequently undertaken to complement my observations and detail participants’ understandings, expectations and experiences of Farming Systems RDE, comprising: 53 initial interviews with the project team members and selected agency stakeholders; follow-up interviews with 25 project team members; and 30 interviews with participating farmers as part of ongoing evaluations of each project.
Initial project team interviews

This first series of interviews explored project team members’ initial experiences, understandings and expectations of their projects. Other key people, such as agency managers and outspoken critics were also interviewed. These subjects were selected on two bases. Firstly, all the significant team members as nominated by each project leader were interviewed. Secondly, several informed stakeholders were also selected because they were either outspoken critics of the projects, or managers in RDE agencies that were not specifically included in concurrent focus groups. The process of conducting, transcribing and analysing the data from these detailed interviews was labour intensive. Yet, the teams were the prime focus of this research and these interviews were designed to establish and reinforce relationships with the Farming Systems project team members, and encourage their explicit reflection on the projects and their experiences. These interviews provided a baseline against which to evaluate the development of team members’ individual and collective understanding and learning, and provided team members with the opportunity to reflect on their own learning to date.

These interviews also provided opportunities to investigate team members’ views on their participation in the projects and the factors that shaped it. Were the team members’ views of participation similar to those I was developing as an observer? These interviews were conducted approximately 12 months after the evaluation project began, that is, after one to three years of each project. This allowed the interview schedule to be developed from my initial interventions, observations and unstructured informal interviews while negotiating and establishing the evaluation project. The resulting semi-structured interviews ranged in length from 30-120 minutes, and focused on the following four themes (e.g. Appendix 1):

- Philosophical concepts and experience with participatory Farming Systems RDE;
- Expectations and perceptions of these participatory grains projects;
- Personal aspirations and expectations; and
- Evaluation and the evaluation needs of the projects.

Potential interviewees were typically contacted by telephone, and the aims of the evaluation project were explained before they were asked to participate. All potential interviewees agreed to participate and convenient times to conduct the interviews were arranged. Notes were taken during the interviews which were also recorded on audiotape with the consent of each interviewee to allow further notes to be made afterwards. In practice, the majority of each audiotape was reviewed to clarify and elaborate the initial interview notes. Draft interview notes were returned to each respondent to ensure accuracy of the content and context. The final interview notes were modified to address any errors, clarify ambiguous issues, omit confidential information as requested, and include and additional comments. These activities provided an
opportunity to more clearly define the diversity in team members’ understandings of Farming Systems RDE, their paradigms of RDE, and their perceptions of each projects’ progress to date. They also encouraged the critical reflection of individual team members, supported collective reflection when teams interpreted their collated interview notes, and developed a detailed evaluation baseline of the teams’ perceptions and understanding of their projects.

**Follow-up project team interviews**

A smaller series of 25 interviews was conducted with project team members two years after the initial interviews. These interviews enabled changes in peoples’ understanding and behaviour to be collected. They also investigated apparent contradictions that emerged between the qualitative interview data and quantitative assessments of team learning processes and outcomes. While the process for these interviews was essentially the same as the initial interviews, the interview schedule was modified to reflect these different information needs (Appendix 2). The results were not discretely documented for wider distribution amongst the project teams. Rather, data and my interpretations were included in formal project reviews, subsequently discussed by the teams, and are reported in this thesis.

**Interviews with participating farmers**

Semi-structured interviews were the prime qualitative data collection method for the project teams, but a secondary method for farmers. These interviews supplemented focus groups that were conducted with farmers as part of each teams’ evaluations of their project. The emphasis of these activities was on participants’ perceptions of the projects, but included questions of how farmers participated, what they learned, and what they did differently as a result. These semi-structured interviews used interview schedules that were developed with members of the Farming Systems projects. The interviews were typically conducted in pairs, with one person interviewing and one taking notes and making an audio recording. Pairs were used primarily to train and involve a wide range of project staff in the process. The notes from these interviews were not returned to each interviewee for clarification before they were collated and interpreted by the project teams.

**4.3.3 Focus groups for coverage and efficiency**

Focus groups involve people who possess certain characteristics and provide qualitative data in a focused discussion to help understand the topic of interest (Krueger & Casey 2000). A focus group is an interview with a small group of people on a specific topic, typically six to eight people and lasting for one-half to two hours (Patton 1990). The aim is to collect data that are of interest to the researcher, typically to find the range of opinions of people across several groups, not to reach consensus (Krueger & Casey 2000). Consequently, a focus group may be viewed as the group equivalent of a semi-structured interview.
However, there are differences between focus groups and individual interviews. Individual interviews may be more effective for mapping differences between individuals’ behaviour because they can provide more detail, highlight personal preferences and idiosyncrasies, and describe subtleties, nuances and shades of difference that are masked in group settings (Tull & Hawkins 1993). In contrast, focus groups have an advantage for research into group norms, the group meanings that underpin these norms, and the group processes by which those meanings are constructed (Bloor et al. 2001). Consequently, using semi-structured interviews and focus groups may provide a richer understanding of the individual and group processes in team learning, and perhaps some sense of data ‘triangulation’ (Denzin & Lincoln 2000). Finally, focus groups are an efficient way to collect a range of people’s perspectives on a topic (Arksey & Knight 1999), that is, they are more cost and time effective than individual interviews and may reduce the risk of information overload and interviewer burnout in large studies (Tull & Hawkins 1993). Ultimately, the research reported in this thesis used focus groups in three ways:

1. To supplement the semi-structured interviews and observations of the project teams that are central to this thesis. The focus groups provided opportunities to gain more insight into group meaning and processes. They were based on 1-2 hours sessions within regular team meetings to explore emerging issues. These sessions were not audio taped, and data collection was by note taking and by ‘butchers’ paper’ in open team discussions;

2. To collect primary qualitative data from participants who were less accessible, that is, host agency managers, funders, and the farmers participating in each Farming Systems project. Together with observation, and a limited number of semi-structured interviews when practical, focus groups provided a time and resource efficient method to explore and understand issues for later quantification. These focus groups were typically run by two people, with audiotapes used to support notes taken during the group interviews; and

3. To facilitate discussion of research data with the participating project teams, farmers, and other participants throughout the conduct of the evaluation project (Bloor et al. 2001). This approach was used to introduce, encourage, and facilitate dialogue amongst these participants at key stages of the project. Data collection was based on observation, notes, audiotapes, and the butchers’ paper used in discussion.

In summary, the participatory research in this thesis combined semi-structured interviews and focus groups to explore participants’ understanding, expectations and experiences with Farming Systems RDE. However, these methods focus on testing people’s memories, or their espoused theories-of-action (Arghris & Schön 1996), and the memories and behaviours that they are
willing to admit to an interviewer privately or publicly in focus groups (Tull & Hawkins 1993). Consequently, additional insights of key issues were gained through observations focused directly on the behaviour of members, that is, their theories-in-use (Argyris & Schön 1996).

4.3.4 From participant observation to observation of participation

Observation may be the fundamental base of all research methods (Adler & Adler 1994). Indeed, practices may only be accessible through observation, as interviews make the accounts of practices accessible, not the practices themselves (Flick 2002). The main criticism of observational methods is that without the subject’s analyses, the interpretations are based solely on the researchers’ perceptions (Christodoulou 2000). Interviews and observations are therefore complementary. In practice, the two are applied together. For example, much of the data gathered in participant observation comes from informal interviewing in the field (Lofland 1971), and studies based on direct interviews employ observational techniques to record cues that lend meaning to conversations and note additional behaviours (Angrosino & Mays de Perez 2000). Indeed, participant observation can be viewed as a field strategy that combines document analysis, interviewing, direct participation, and observation and introspection (Denzin 1989).

Participant observation was therefore used to supplement the findings of the semi-structured interviews and focus groups. The aim was to better understand participants’ behaviour, not just their attitudes and perceptions. During the evaluation project, I attended many meetings and activities of the Farming Systems projects to better understand how the teams operated, discuss their evaluation needs, and to help them develop appropriate evaluation processes. These meetings provided a natural setting to observe team members’ participation and interactions. Together with my ongoing interviews, focus groups and normal project interactions (e.g. field days, trial planning and review days, emails, meetings, social interactions), there were many opportunities to observe team members’ participation in the strategic development and planning of the projects, their operational decision-making, and the implementation of activities in each project. These observations were again guided by the schedules developed for the semi-structured interviews (Appendices 1 & 2), but emphasised team members’ participation, that is, how they participated with other team members, with farmers, and with agency managers and funders.

Pretty’s (1995) typology of participation (Table 2) provided an initial framework to observe the extent of participation within the projects and understand how team members can effectively participate with their diverse stakeholders. Using Pretty’s (1995) typology as a diagnostic tool resulted in different people assessing the type of participation in the same activity quite differently. This encouraged dialogue for a better understanding of participation. However, it became apparent that the descriptions of each level of participation in the typology emphasised
different issues, and these issues were not all explicit for each level of participation. It was sometimes unclear what the discriminating factors were and how they compared for each level of participation, so Pretty’s (1995) typology was modified. The resulting typology contains more explicit discriminating factors to distinguish between the different modes of participation and presents benchmarks for these discriminating characteristics in each mode of participation. These modifications and a checklist to structure observations and assess participation are key outcomes of this research.

Finally, while interviews, focus groups and observation provided understanding and insight into how participatory RDE impacts on participants; the evaluation project was also expected to quantify some of these. With 75 people directly involved in the projects, and numerous farmers involved in specific project activities, there was an opportunity to quantify the impacts of the projects on participants’ learning and behaviour.

4.3.5 Quantifying diversity, learning and behaviour

Qualitative data was emphasised to explore and understand how participatory Farming Systems RDE impacts on participants. However, quantification was used to address three aspects of the central research question and the sub-questions discussed in this thesis. That is, surveys were used to assess the extent of diversity amongst the project team members, to assess the impacts on participants’ learning, and to assess their consequent behaviour. Three distinct approaches were used to collect this quantitative data.

Quantifying the extent of diversity within the Farming Systems RDE teams

The initial semi-structured interviews with all significant project team members provided a rich source of qualitative data for the thesis. However, these 53 interviews provided an opportunity for meaningful quantification of the data without the follow-up survey that was originally planned. The value of this data for quantification was increased because they were collected and compiled by a single interviewer using a uniform approach. The interview notes from these semi-structured interviews were subsequently coded and quantified to clarify the extent of diversity amongst team members. The development of categories and coding responses to open-ended questions after surveys have been administered is not uncommon in market research where sample sizes are manageable (Tull & Hawkins 1993). Indeed, the open-ended questions with comparable levels of prompting and probing, were treated as research using ‘unaided recall’, that is, questions that do not provide clues to potential answers (Tull & Hawkins 1993). While all interviews covered the full range of the interview schedules, there was some variation in the depth and detail of several interviews in which time was limited. Interviews that provided insufficient information to assess some response categories were treated as missing data. This
The quantification of interview notes had limitations, but provided a deeper sense of the extent of the teams’ diversity that is reported in Chapter Five.

The remaining surveys, to quantify the impact of Farming Systems RDE on participants learning and behaviour, were more traditional in their development and use. They followed the traditional market research approach of using qualitative research to establish the context and salient factors, before quantifying factors of specific interest.

**Custom-made impact surveys**

This thesis draws upon the results of numerous quantitative surveys with team members, participating farmers and farmers in the wider farming community. These surveys were developed to quantify participants’ perceptions and the impacts across all projects in the initiative, each individual project, and specific activities in each project. For example:

- **Across project surveys** – this included a questionnaire to rate the ‘importance’ and ‘achievement’ of ‘success factors’ that team members proposed to be critical to the successful conduct of Farming Systems RDE (Lawrence et al. 2001). This survey of 67 items across 11 categories of success factors (Appendix 3) was completed by 42 of the 50 team members to whom it was distributed.

- **Whole project surveys** – this included major questionnaires to quantify participating farmers’, the wider farming communities’, and team members’ perceptions of the projects. These surveys used a consistent format to quantify the salient issues identified in focus groups and semi-structured interviews (e.g. Appendix 4). Typically, they were developed for use with approximately 100 participating farmers to ensure sufficient responses for reliable information, modified for use by the teams, and shortened for the wider farming communities.

- **Specific activity surveys** – this included numerous small survey tools developed for specific activities of each project. For example, questionnaires and interactive assessment processes were developed for field days, bus trips, on-farm research trials and action learning workshops.

The custom-made surveys consequently varied in length, but the ‘whole project’ questionnaires (e.g. Appendix 4) were very large. These large questionnaires were self-administered mail questionnaires with a consistent layout and comparable rating scales. For example, 5-point Likert scales were used in all surveys to allow ‘unsure’ and ‘neutral’ responses. Discussion of the detailed development of each survey is provided in other publications, for example...
Lawrence et al. (2001). However, each survey followed good market research processes that ensured response rates consistently above 70%. For example, the surveys were compiled with each relevant project team based on their prior qualitative interview and focus group data, were applied to the whole population of team members or used representative and random sampling for farmer surveys, were piloted and reviewed to ensure respondents understood the questions and had the information required, were supported with an initial telephone call to potential respondents and a follow-up call a week later, edited, coded and entered to maintain consistency, and were interpreted with the project teams that helped develop them (Bradburn, Sudman & Wansink 2004; Luck & Rubin 1987; Tull & Hawkins 1993).

In summary, the quantitative data in this thesis was collected using surveys developed with each Farming Systems project team. These surveys served the purposes of the evaluation project and this thesis. While the evaluation project had a broader focus, the surveys to assess the impacts of the Farming Systems projects on participants learning and practices were easily modified to include questions of specific interest for this thesis. Indeed, the research for this thesis provided more detailed data on issues of interest to individuals in each project.

**Team Learning Survey**

The final source of quantitative data for this research was the Team Learning Survey (Dechant & Marsick 1993b) to quantify key aspects of team learning model described in Chapter Three (Dechant, Marsick & Kasl 1993). This model provided a framework to investigate how the members of each project team learned from, and with, each other. The survey provided a dedicated tool to assess the extent of team learning that developed in each project team. The survey comprised a series of 60 statements to which participants rate their agreement or disagreement on a 7-point Likert scale (Dechant & Marsick 1993b). These statements relate to the processes and outputs of the team learning model, so individual and team scores can be used to identify the teams’ modes of learning, measure changes, or provide a catalyst and framework for ‘team dialogue’ on their learning processes and contributions. The survey was used in this thesis to confirm and further understand the extent of team learning in the three projects. Yet, the survey results apparently conflicted with the qualitative data from semi-structured interviews, focus groups and participant observation. These different results precipitated further interviews and dialogue with the project team members to reconcile the apparent conflicts.

**4.3.6 Processes to encourage dialogue**

The survey results and interview notes were used for more than simple discussion. A range of processes were used to encourage inquiry into individual’s assertions and assumptions, and to highlight inconsistencies between their espoused theories of participation and their behaviour that commonly emphasised independent and individual action. These interventions used
qualitative and quantitative data to facilitate greater disclosure and inquiry in evaluation planning sessions, meetings to interpret trial results, and free ranging dialogue sessions in the style of Bohm (1996). Key examples of these processes include:

**Interpreting semi-structured interviews with Farming Systems RDE teams** - The confirmed notes from each semi-structured interview with team members were collated and summarised under the headings of the interview schedules. They were then collated into a group report for each project, again following the structure of the interview schedules. These reports aimed to help each team member appreciate other team members’ understandings of Farming Systems RDE, their expectations of each projects and their experiences to date. They were highly descriptive with text simply to summarise and introduce direct representative quotes from across the team. These reports made no major conclusions, other than to identify the range of views and highlight major sources of diversity. The reports were then returned to all team members and discussed at subsequent team meetings. For example, each member of the Western project in New South Wales (NSW) was asked to read the compiled reports and nominate the three most important issues for the team to address. These issues were compiled and provided a focus for dialogue to understand each other’s perspectives at a subsequent meeting. Only after these key issues had been explored and appreciated, were action plans developed.

**Interpreting trial results with participating farmers** - Each project team advocated farmer participation at each stage of the research process. Yet, the initial experience was that scientists still drove the process and tended to default to their traditional ToT approach, especially when interpreting trial results. They typically presented trial data and their interpretations, before asking if farmers agreed, had different views, or had any specific questions. Farmers’ contributions to interpretations and hence the incorporation of different knowledge bases was limited. Consequently, an alternative process was developed to encourage farmers’ public interpretation of research data, and so support more balanced power relations between scientists and farmers. This process structured meetings and observations around a scientific framework for reflection with the following prompts:

Part A: presented by individual farmer who had conducted the on-farm research trial

1. *Rationale* – the farmer’s reasons/aims for the trial
2. *Process* – how the farmer went about it
3. *Observations* – what the farmer saw, how the season went, what the treatments looked like
4. *Results* – presented as charts (prepared with assistance from project staff)
5. *Interpretation/learning of results* – what the farmer thought the results said/meant, and why
Part B: Facilitated group discussion to understand each others’ interpretations and

6. *Group interpretation/learning of results* – what other farmers and the scientific team thought the results said/meant, and why

7. *Group reflection on objectives and the OFR process* – were the aims achieved? Should it be done differently next time?

8. *Future directions* – whether to continue, what needs to be done?

**Interpreting impact evaluations with Farming Systems RDE teams** – Each project team was supported to conduct their own evaluations, that is, evaluations were not simply done for them. Consequently, processes were also developed to encourage dialogue and the contribution of all team members’ knowledge to the evaluation of each project. This was most apparent in the initial qualitative evaluation of the Western project in Queensland, which aimed to evaluate the project and develop team members’ evaluation expertise. This was a critical intervention because the project had developed a competitive culture with conflict between its different modules. An interview schedule was developed by the team to guide a series of two focus groups and 20 semi-structured interviews. These interviews were conducted in pairs over two days, with the data recorded as previously described. A further two days and several stages of data interpretation were used to ensure the input of all team members, and to develop a collective understanding of the project, its impacts and participants’ perceptions of it:

- Firstly, the interview notes and audiotape were used to collate a record of each interview. This comprised a one-page summary for each of the major themes of the interview schedule, notes on any emergent themes, and a summary of the interviewers’ general impressions from each interview;

- Secondly, each team member was then asked to summarise the data across all interviews for each theme. This required them to read everyone else’s interview summaries for every theme and summarise what these interviews as a whole were saying. The aim was to ensure individuals honoured others’ interpretations and did not base all conclusions on their own interviews alone;

- Thirdly, these summaries were discussed and pairs then summarised the compiled interpretations for each theme. This provided a concise collective understanding of the participating farmers’ and agronomists’ perceptions of the project and its impacts;

- Finally, several hours were devoted to discussing the implications of these perceptions, and then developing draft recommendations for the project.
The conclusions, implications and recommendations from this activity were then compiled over the following month and published in an evaluation report (Cawley & Lawrence 1998). These recommendations provided a focus for the team to better integrate their activities and established key criteria for subsequent questionnaires to quantify the impacts of the project.

A similar activity was conducted within the Central project near the end of its first phase. A two-day meeting drew upon data from eight focus groups with farmers, semi-structured interviews with all team members, and quantitative surveys of farmers’ and team members’ perceptions of the project, its processes, and impacts. Pairs of team members collated all evaluation data for key project areas prior to the meeting, and provided a summary for discussion by the team. These key issues spanned specific technical topics, the internal processes of the project and participation in project decisions. Small group discussions were then used to explore the projects’ impacts in these areas and identify future needs, before team developed recommendations to improve the second phase of the project.

**Cross project dialogue sessions** – The evaluation project leader also developed a reference group comprising the leaders of each Farming Systems project, key RDE agency managers and the national program managers of the industry funders. This group’s initial role was to guide and support the evaluation project but it grew to become the prime venue for dialogue and learning across the projects. As such, it assumed the strategic leadership of the initiative in northern Australia. Yet, this forum did not set out to make firm decisions on behalf of all projects. Rather, it helped develop participants’ understanding of emerging issues for Farming Systems RDE in Australian grains. These meetings included short dialogue sessions to explore issues of interest or concern to individual project leaders. The concept of dialogue was explained to participants, who were even involved in ‘blindfold’ sessions to focus on listening and understanding rather than advocacy (Senge et al. 1994). Indeed, a key feature of the meetings was the opportunity for each project to have a dedicated session of 30-60 minutes in which all participants helped explore its current conundrums and opportunities. For example, new statistical approaches that could be used in on-farm research trials if harvesters were fitted with continuous grain yield monitors. Again, the role was not to make decisions for other projects, but to use dialogue to help them think through the issue. Notably, the focus of this dialogue was to understand the evaluation needs of each stakeholder, and how ‘participation’ impacted on RDE in the projects. These sessions provided a rich source of observational data for use in this thesis.

This range of dialogue-based processes provided opportunities for people to share their experiences, review the basis for their assertions, and build collective interpretations and
actions. Yet, these interventions had varying success. Not all project groups embraced the concept of dialogue and collective interpretation. Similarly, some project members embraced some opportunities but missed others due to time constraints. Nevertheless, this provided the opportunity to study the impact of these processes on the learning and behaviour of these teams.

4.4 Conclusion

The investigations that support this thesis provided opportunities to collect a wide range of qualitative and quantitative data to address the question, ‘How can participatory Farming Systems RDE impact on the learning and behaviour of its participants in the Australian grains industry?’ Research to support this thesis was easily integrated into the ongoing activities of the broader evaluation project. However, the expectation that the evaluation project would support both learning and action to further develop the projects’ participatory processes ensured a participatory action research methodology was used. This entailed numerous case studies, or interventions, across the Farming Systems initiative, with each project team, and the sub-project groups that conducted each activity. These interventions are too numerous to report individually. Consequently, the following chapters that explore the extent of diversity within the projects, the team members’ participation, and the consequent learning and behaviour of participants, draw upon and summarise data from across the interventions described above.
Chapter 5. Diversity within grains Farming Systems Research, Development and Extension

Increasing participation implicitly increases diversity because it introduces new people to the context of research, development and extension (RDE). So, involving different disciplines and organisations in RDE will result in different perceptions and expectations of any project. The Farming Systems projects were the first major initiative of their kind in Australia’s grains industry. Consequently, the nature of their diversity, its effect on stakeholders’ participation, and their consequent learning and behaviour were unclear. The opportunity to work within the projects, and reconcile this diversity amongst participants, is reflected in the first sub-question:

How diverse are participants’ experiences, understandings and expectations of Farming Systems RDE?

Concepts from the field of diversity research are used in this chapter to understand participants’ experiences, understandings and expectations of Farming Systems RDE. These concepts from Chapter Two are used to elaborate and analyse the differences that emerged in the project teams, their agency managers, industry funders and participating farmers. My *a priori* knowledge of diversity research was limited. Yet, my understanding of diversity and its nuances matured as I developed a clearer focus, deeper insights, and more informed interpretations grounded in my ongoing interventions with the projects and the propositional knowledge of diversity in the literature. The findings, insights and deductions that developed through interventions across several cycles of action research are subsequently summarised in this chapter. For example, interventions initially established evaluation criteria for the projects and a baseline of participants’ knowledge of Farming Systems RDE. These interventions confirmed the demographic, organisational, and informational diversity of the projects teams, but ultimately exposed their ‘values diversity’ and their underlying RDE paradigms and ontology. This required considerable interaction and could not be accurately estimated from superficial interactions with participants: seeing people, hearing them speak, and knowing their names (McGrath, Berdahl & Arrow 1996). Rather, this insight arose through ongoing engagement with participants and participation in their deliberations over the life of their projects. Finally, this chapter includes analyses of this diversity and presents deductions on the nature of diversity amongst participants, the emerging types of its associated conflict, and discusses their potential implications for the projects. The impact of this diversity on how the teams participate, and the consequent learning and behaviour of participants is elaborated and discussed in subsequent chapters.
5.1 The Farming Systems project teams

The RDE agencies, industry funders, and farmers negotiated these multi-disciplinary projects to address the interactions of real-world cropping systems. Like any large RDE project, they comprised considerable demographic diversity. Each project involved up to 20 men and women of different ages at up to 10 locations. They were also organisationally diverse, with six employers, individual time commitments of 10% to 100%, permanent and contract employees, and varying pay scales. Such aspects of diversity were obvious. Yet, other less obvious differences in their personal histories and perspectives were inevitable. This informational and values diversity must also be recognised and managed for effective participation and teamwork (see Chapter Two). Each project spanned the research, extension and management disciplines, and contained technical specialists with crop, pasture, soil fertility, soil conservation, economic, and modelling expertise. Beyond these broad labels, the technical contributions and values that staff could contribute to the projects were unclear. Consequently, the specific research focus on participants’ experience, understanding and expectations of Farming Systems RDE was necessary to clarify and consider this informational and values diversity.

5.1.1 Informational diversity

Farming Systems RDE experience

Farming System processes are new to Australia. Table 7 presents interview data about team members’ experience of Farming Systems RDE. The left-hand column provides categories of team members’ experience that range from ‘little’ to ‘significant’. The data suggests the majority of team members had limited RDE experience or had experiences based in more traditional RDE. Some individuals had experience in aspects of Farming Systems approaches such as longer-term sustainability issues, yet few claimed to have significant experience in Farming Systems RDE. These latter staff indicated their views of these approaches had broadened from initially ‘doing research on farms’ and ‘being farmer orientated’ to ‘systems research, including organisational systems thinking’, which reflects broader systems boundaries with people included within the system as proposed in Chapter Two.

<table>
<thead>
<tr>
<th>Previous experience in Farming Systems RDE</th>
<th>Team members (N=48)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Little RDE experience (e.g. new officers)</td>
<td>11</td>
</tr>
<tr>
<td>Previous experiences in more traditional RDE</td>
<td>13</td>
</tr>
<tr>
<td>Experienced in aspects of Farming Systems RDE</td>
<td>21</td>
</tr>
<tr>
<td>Significant experience in Farming Systems RDE</td>
<td>3</td>
</tr>
</tbody>
</table>

This incomplete experience was exacerbated by the teams’ narrow engagement with the literature and limited disposition to understand the theoretical concepts of Farming Systems RDE. Table 8 depicts the data from interviews about team members’ familiarity with this
literature. The left-hand column presents a scale of familiarity with this literature that ranges from very limited to a high level of familiarity. As with the previous data, this suggests little engagement with the concepts that underpin Farming Systems approaches. While a majority of team members used some literature, they concentrated on traditional component research that emphasises experimental design and internal validity. Few serious users of farming system literature were identified. Indeed, opinion on the value of this literature was polarised. People experienced in traditional RDE typically considered a Farming Systems approach to be largely irrelevant because it emphasised experiences in developing countries. They saw little advantage of the literature over ‘tuning into our own intuition’. Individuals with the most experience in Farming Systems approaches believed this literature presented important lessons for the projects. Yet, individuals with the least experience in these approaches did not engage with the theories of the ‘new’ RDE paradigm. Perhaps it threatened them.

Table 8. **Team members’ use of the Farming Systems literature**

<table>
<thead>
<tr>
<th>Use of Farming Systems literature</th>
<th>Team members (N=48)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read little or no formal literature</td>
<td>16</td>
</tr>
<tr>
<td>Read mostly traditional component research</td>
<td>12</td>
</tr>
<tr>
<td>Only read a bit, or scan Farming Systems literature</td>
<td>12</td>
</tr>
<tr>
<td>Read some Farming Systems literature</td>
<td>6</td>
</tr>
<tr>
<td>Read a lot of the Farming Systems literature</td>
<td>2</td>
</tr>
</tbody>
</table>

**Specific content and process experience**

Despite this inexperience, team members contributed a broader range of specific technical and process skills to each project than had been the case in most previous RDE. This informational diversity is illustrated in Table 9 which depicts the data from interviews and the survey on diversity of expertise available in the Western project in Queensland. This technical and RDE process expertise is categorised and listed on the basis of its frequency. The teams certainly lacked representation of locally important enterprises and expertise, such as beef, sheep, and grazing management. As the table shows, there was considerable expertise in crop agronomy and less in grazing management, but this was because the projects were negotiated with grains industry funders to focus on grain farming systems. Some stakeholders noted that the projects’ notion of being ‘multi-disciplinary’ was narrower than international development programs that proposed input from every conceivable disciplinary background such as: socio-economics, anthropology, gender research and health (Atta-Krah 1994; Chambers 1994; Fujisaka 1994). Yet, team members’ specialisations within agronomy and soil science, and their differing experiences and skills in specific RDE methods within the negotiated project boundaries created significant informational diversity for the projects to manage. A diversity of RDE methodologies and methods was evident in each project: the Western project had four modules within which team members used different methods; the Central project was also based on tasks that were based on different methods; and the Eastern project comprised on-farm research and
action learning activities with groups. Consequently, the members of these project teams had much in common but retained diverse skills, roles, and perspectives. Explicit questioning of team members’ understandings of Farming Systems RDE revealed the extent of this diversity.

Table 9. The content and RDE process expertise in the Western project in Queensland

<table>
<thead>
<tr>
<th>Specific technical expertise</th>
<th>Specific RDE process expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>General agronomy (3)</td>
<td>Conduct of small-plot experiments (3)</td>
</tr>
<tr>
<td>Crop-pasture rotations (2)</td>
<td>Soil monitoring (2)</td>
</tr>
<tr>
<td>Soil water dynamics</td>
<td>General extension processes (2)</td>
</tr>
<tr>
<td>Soil water and nitrogen interactions</td>
<td>Small-plot experimental design</td>
</tr>
<tr>
<td>Crop response to nutrients</td>
<td>Laboratory analysis</td>
</tr>
<tr>
<td>Laboratory analysis</td>
<td>Large-scale on-farm trial research</td>
</tr>
<tr>
<td>Quantitative soil characteristics</td>
<td>Heuristic modelling and tools</td>
</tr>
<tr>
<td>Economics &amp; grain marketing</td>
<td>Crop simulation</td>
</tr>
<tr>
<td>Participation</td>
<td>Project management</td>
</tr>
<tr>
<td>Project management</td>
<td>Group facilitation</td>
</tr>
<tr>
<td>Sustainability monitoring</td>
<td></td>
</tr>
<tr>
<td>Temporal/spatial analysis of results</td>
<td></td>
</tr>
</tbody>
</table>

Understandings of Farming Systems RDE

Team members were asked how they understood the notion of Farming Systems RDE to gauge their initial conceptions and values base. Table 10 depicts the project teams’ relative emphasis of specific dimensions of Farming Systems RDE. The left-hand column lists the dimensions that emerged in team members’ descriptions and the numerical data are the number of individuals in each project who emphasised these dimensions. The dominant dimensions in each team were studying the interaction of technical components of farming and integrating them as part of a wider biophysical system. Yet, individuals’ understanding and emphasis of this within the projects were quite distinct. Some people questioned whether the whole farming system, or interactions between specific components, was the most appropriate unit of study. Consequently, each project differed in how they defined their farming system, its boundaries, and the interactions that interested them. For example, members of Western project in New South Wales (NSW) emphasised the biophysical aspects of farming systems, while those in Queensland placed more emphasis on participation and integrating biophysical and sociological aspects. Yet, despite this greater emphasis on sociology, the ‘practical’ boundary of the Western project in Queensland was typically considered to be biophysical, with sociology important for the subsequent communication of research results. These apparent boundaries highlight all teams’ lack of confidence to handle the complexity of considering a whole system, and the comfort of their predominant training in applied and reductionist biophysical sciences. Consequently, the three most common dimensions in team members descriptions of their own projects were: (i) emphasising sustainability and effects across seasons; (ii) considering issues as part of a wider system and not just components in isolation (reductionism); and (iii) using group-based processes and networks. Developing more participatory RDE processes and supporting understanding and co-learning were much less commonly mentioned. It appears
from the data that developing high levels of participation with farmers and other team members was not the highest priority for most individuals. It is therefore proposed that the large majority of team members remained firmly entrenched within a Transfer-of-technology (ToT) paradigm.

Table 10. **Project teams’ relative emphasis of dimensions of Farming Systems RDE**

<table>
<thead>
<tr>
<th>Dimensions of Farming Systems RDE</th>
<th>Team members in each project highlighting specific dimensions of Farming Systems RDE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Western Queensland (N=10)</td>
</tr>
<tr>
<td>Interaction of biophysical components</td>
<td>6</td>
</tr>
<tr>
<td>Interaction of biology and sociology</td>
<td>6</td>
</tr>
<tr>
<td>Sustainability and effects across seasons</td>
<td>2</td>
</tr>
<tr>
<td>Stakeholder participation (esp. farmers)</td>
<td>3</td>
</tr>
<tr>
<td>Large commercial scale investigations</td>
<td>0</td>
</tr>
<tr>
<td>Includes economic analysis</td>
<td>1</td>
</tr>
<tr>
<td>Includes other enterprises (eg cattle)</td>
<td>1</td>
</tr>
</tbody>
</table>

Perhaps the most revealing interview question was whether team members believed that Farming Systems RDE was ‘new’. Individuals were variously excited, indifferent or cynical about the concept and the rationale for their projects. Approximately a third of the teams each believed the approach was ‘fundamentally new’, ‘not new at all’, or had emerged from developing countries with some new aspects being incorporated into Australia RDE. The five perceived ‘new’ aspects of the current projects were:

- RDE agencies recognising participatory processes and the limits of ToT (n= 15);
- Formalising existing practices to recognise this type of work (n=14);
- Increasing farmer involvement throughout the RDE process (n=10);
- Merging RDE processes (n=4); and
- Integrating the perspectives of different stakeholders (n=5).

The first two aspects imply the RDE agencies were simply ‘catching up’ with practitioners who were already implementing participatory processes. Yet as the discussion above suggests, the teams overwhelming perspectives were aligned to the concepts of early farming system research (FSR) that operated within a ToT paradigm. Few team members highlighted the integration of stakeholders’ perspectives, which interactive participation and modern Farming Systems approaches are proposed to achieve. Instead, the interview data suggest that the projects were variously conceptualised as: a way for people to fund their existing work; a part of the evolution towards better RDE; or an organisational change initiative to develop a new RDE paradigm for Australian grains. These differences may reflect the diverse professional backgrounds and experiences that could be expected for similar innovations in agricultural RDE. In market research terms, the teams comprised several diverse ‘market segments’ based on individuals’ experiences and interest in traditional and Farming Systems RDE:
New RDE officers with little RDE experience. They typically empathised with participatory approaches that were promoted as an emerging trend for future RDE;

Traditional RDE officers with direct experience in traditional RDE. They used literature on biophysical component research, with little use of Farming Systems literature;

Interested and aspiring Farming Systems RDE officers with experience in traditional RDE and aspects of participatory approaches. They recognised weaknesses in the ToT approach and were not anti-participatory processes. They infrequently read traditional RDE literature and may have only skimmed some Farming Systems RDE; and

Advocates of Farming Systems RDE with significant experience in a Farming Systems approach or aspects of it, they were advocates of the approach and read its literature.

There was considerable diversity in team members’ expertise and the information that they might draw upon to improve project activities and outcomes. Yet, these interviews also illuminated the diversity of team members’ conceptions and expectations of Farming Systems RDE, the degree to which it was warranted, and what it could likely achieve. The interviews also highlighted the diversity of values within the teams that must be managed to ensure improved performance through the collaborative effort of the available informational expertise.

5.1.2 Values diversity

Explicit statements about greater participation and more sustainable and profitable farming systems were included in the project specification of each project. However, the discussion above concluded that team members and each project had different understandings and expectations of Farming Systems RDE and its constituent concepts of sustainability and participation. Indeed, these different conceptions also extended to the associated constructs of ‘research’, ‘learning’ and ‘evaluation’ in the projects. For example:

The Western project team’s expectations of the project were polarised in line with the project’s modules and their respective RDE methods. People involved in controlled small-plot experiments stressed the development of new scientific knowledge. They expected to ‘learn about the farming systems, not just yield with respect to nitrogen, but how to improve the system...there are new principles (like) nitrogen accumulation, nitrogen mineralisation and nitrogen losses’. Conversely, those involved in participatory on-farm research and action learning activities with groups, stressed the project’s aims in terms of improved RDE processes to support co-learning with farmers, but little consideration of new scientific knowledge. For example, ‘(its) a process by which farmers and DPI&F people go about research together...set up, plan, identify questions, analyse and interpret results together...to help with decision-making, to help
all landholders understand what they know and how they know it. These two perspectives may not be mutually exclusive, but they were quite distinct and team members did not emphasise their integration;

- The Eastern project team was similarly polarised. Many team members suggested that the project had been ‘sold on its potential to do valid research on farms with farmers’. They focused on developing on-farm research as a legitimate scientific research approach and emphasised new scientific knowledge as a key evaluation criterion. However, others strongly believed Farming Systems RDE was really about extension and asserted that ‘GRDC have really funded the project to get greater adoption on farms’. This latter group believed participatory on-farm research were inappropriate for scientific research. The raw emotion of these views and the unflattering references to their protagonists reflected considerable conflict within the project;

- The emphasis of the Central project on development and extension rather than research is exemplified by team members’ comments that, ‘we have the knowledge but do not have the farms to put it into place... (it’s) a nifty development and extension process... It’s essentially a development and extension project... process research will suffer, but the advantages outweigh the disadvantages’. Nearly all team members were focused on changed farming practices and had much less expectation or interest in improved scientific knowledge and RDE process development.

While different perceptions were anticipated, the degree of diversity and depths of associated emotion across the projects were not. The teams’ expectations of RDE, their perceptions of Farming Systems RDE, and the consequent aims of each project were polarised. Their proposed bases to evaluate the projects delineated their diverse expectations and values. Improved farming practice was important for everyone. However, their emphases of the ecological and economic impacts of practice changes, farmer learning, improved scientific knowledge, RD&E process developments, participation, and social capital varied enormously. These differences were consonant with the second and third phases of development in Farming Systems approaches as discussed in Chapter Two. Most team members were interested in conducting scientific research and then extending that to farmers. Participation represented the ‘feedback’ to ensure the research was more relevant. A focus on sustainable development and modern Farming Systems approaches that include people within the farming system and focus on participation, co-learning with farmers, and formative evaluation (Gibbon 2003; Packham 2003; Petheram & Clark 1998) was only apparent in the minority views of the Western project.
The Farming Systems project teams contained significant informational and values diversity that created task and process conflict. Some task conflict may improve group performance of complex cognitive tasks. However, process conflict is commonly associated with reduced group performance (Jehn & Mannix 2001), and the emotion of some opinions suggested that relationship conflict was developing. For example, one module leader in the Western project simply refused to sit next to another member while travelling in a light aircraft because of their differences. There was a significant risk that the potential of these projects might be reduced if such conflict was not managed and channelled into more productive ways to conduct RDE. Certainly, the antecedent conditions of diverse capacities, disciplines, values and expectations constitute a significant issue for the successful implementation of Farming Systems RDE. However, individuals’ ability to communicate across these differences and appreciate them may reflect deeper differences in their RDE paradigms and worldviews.

5.1.3 Worldview and paradigm diversity
The projects comprised individuals with different theoretical understandings of RDE and the terminology that was used in the projects. Team members consequently had different and confounded visions and aims for their projects. Exploring their notions of on-farm research and participation only reinforced this values diversity. However, it also highlighted team members’ preferred RDE paradigms and their antecedent worldviews, ontology and epistemology.

Perceptions of on-farm research
On-farm research (OFR) was universally considered critical to draw research, extension and farmer experience into each stage of the RDE process. Yet, there was diversity around the expectations of OFR. For example, can OFR achieve both relevance and scientific rigour, or are these two dimensions of compromise in agricultural research (Carberry 2001)? Furthermore, which dimension is most important if compromise is required? Can treatment effects and non-treatment variability from real world situations be separated, or does it really matter? Some team members emphasised understanding biophysical processes, while others emphasised on-farm management and applying this understanding. Ultimately, team members’ views on on-farm research produced debate on three dimensions within the teams:

- Was OFR real research on technical issues, research suited to management and implementation, or simply demonstrations of known technology to help farmers understand, apply, and perhaps ‘fine-tune’ key principles for their local environment? (Carberry 2001; McCown 2001), that is, to better implement scientific ideas;
- Consequent differences about the role of experimental controls, replication, traditional statistical approaches, and simulations; and
Distinctions between ‘on-farm research’ with farmer participation throughout the research process, and ‘research-on-farm’ that like early modes of FSR was conducted on farms without ongoing farmer input (Cornwall, Giijt & Welbourn 1994).

These debates reflected the tension between scientific rigour and relevance through participation. Concerns for scientific rigour were exacerbated by the difficulties the teams experienced in progressing from general ‘issues’ to clear research questions of interest to all parties in a participatory setting. The result was a range of views about the capacity of OFR to provide new scientific understanding, let alone be on the ‘cutting edge’ of science to develop ‘new’ knowledge. Table 11 depicts interview data on the extent of these views of OFR across the projects. The left-hand column shows team members various perceptions of OFR. Two basic views of OFR predominated. Critically, the interviews identified that these views were considered to be ‘either/or’ options by most team members.

- OFR was most commonly considered to be primarily about development and extension. Significant scientific learning was not envisaged. Researchers consequently employed consultation and functional participation to involve and so help farmers to more effectively understand the ‘science’ that was developed in more controlled contexts. This view was most apparent with experienced researchers, who with several notable exceptions, believed highly constrained, replicated small-plot experiments with objective measures were essential for scientific knowledge. The quest for relevance may have been useful for extension, but it compromised these researchers’ notions of rigour to accurately measure the ‘real’ relationships. This ‘real’ research was conducted in other projects, or the small-plot trials of the Western project. Several team members similarly dismissed any findings from crop simulations and any form of non-replicated trials. Under questioning, team members who viewed OFR as a development and extension tool subsequently structured it without the controls, replication, or intensity of measures they themselves demanded to establish statistical significance. Indeed, this ‘self-sealing’ perception of OFR precluded the potential scientific advances they desired.

- A second sizeable minority considered on-farm research to be a complete RDE process. This group proposed high levels of participation throughout this process and believed OFR was adequate for, if not synonymous with, Farming Systems RDE. For them, OFR could identify and address most issues of concern to modern farming systems. Indeed, some people advocated OFR for all situations and suggested there was no need for small plots and highly constrained research at all. OFR was their new research paradigm.
Table 11. The Farming Systems project teams’ perceptions of on-farm research

<table>
<thead>
<tr>
<th>Perceptions of on-farm research (OFR)</th>
<th>Number of team members in each project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Western (Qld)</td>
</tr>
<tr>
<td>OFR as development and extension.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Western (Qld)</td>
</tr>
<tr>
<td>OFR as a complete RDE process.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Western (Qld)</td>
</tr>
<tr>
<td>OFR as part of a wider multi-method approach.</td>
<td>1</td>
</tr>
</tbody>
</table>

OFR as development and extension. This perspective was grounded within the ToT paradigm and embraced (post)positivist ontology and epistemologies with controlled scientific experiments to establish cause-and-effect relationships and highlight principles. OFR tested and demonstrated these to develop farmers’ understanding and overcome practical constraints. If new practices could be managed on this larger scale, they may be applied across the property. Team members commonly described OFR as testing and refining principles in farmers’ own situations and identifying issues for other more detailed research. Participation was consultative or sometimes functional as a ‘means’ to encourage farmers’ adoption of ‘best’ practices.

OFR as a complete RDE process. This perspective suggested OFR can identify issues of concern and develop peoples’ knowledge to solve them. It aimed to do research with adequate rigour to understand issues of substantive interest to farmers and scientists. OFR was therefore not a ‘demonstration’ but a process to support farmers and scientists’ learning on the same or different issues. Echoing more relativist ontology and epistemologies, participation was considered an ‘end’ in itself, representing equity and equality of knowledge in interactions, and the development of mutually beneficial insights. However, OFR was an imperative for some advocates, that is, the only type of research needed.

OFR as part of a wider multi-method approach. This view considered OFR to be an important focus of mutual interest to researchers, extensionists and farmers, but only part of a wider RDE effort that embraced the various RDE methods and their underlying paradigms. Interestingly, this view may accommodate either of the predominating views of OFR. It recognised the inherent benefits and costs of each individual RDE method.
Finally, a small minority (two people) proposed an inclusive view - that OFR was critical, but only part of the suite of RDE processes used in Farming Systems RDE. Indeed, they considered the highly constrained experimental research, large commercial-scale trials, and simulation modelling to make valuable contributions to a better understanding of modern farming systems.

The analysis of interview data suggests that team members’ views of on-farm research reflected their preferred RDE paradigms. However, this also highlighted their different ontological and epistemological positions. For example, the apparent need for highly constrained and replicated small-plot experiments was to ensure objective measures and understand the ‘true’ biophysical processes and relationships that could then be extended to others. In contrast, other team members believed OFR was a focus for discussion and investigations that together could support informed decisions on what was best for individual’s situations. They proposed high levels of participation to engage and learn from each other’s experiences. Paradoxically, traditional researchers were sometimes considered to undermine this process and were actively excluded. As some team members confessed, ‘I didn’t want them mucking it up’ and ‘next time I’ll lock the “back-door” (so they cannot attend).’ OFR became an imperative for individuals who then limited participation to control activities. As such, these views of OFR and the ways they are enacted also highlighted different team member’s rationale for participation in research.

**Participatory intent**

All team members publicly supported the notion that more farmer participation is better. However, their understandings of participation were qualitatively different. Their descriptions of how they used participation ranged from consultation to interactive participation (Pretty 1995). As already discussed, many team members wanted to encourage participation to help farmers understand and implement practices they had predetermined to be both sustainable and profitable. Within this ToT paradigm, they viewed participation as market research to better understand farmers, and develop more effective appeals and training to encourage farmers to use these practices. As also discussed earlier, far fewer team members’ descriptions of their own projects included support for understanding and co-learning that may change their fundamental understandings of problems and lead to new solutions, not just the presentation and promotion of their predetermined practices. These two views of participation reflect Pretty’s (1995) claim that there are two basic conceptions and practices of participation within agricultural RDE:

- **Participation as a means to increase efficiency** – the basic notion is that people are more likely to support new developments or services if they are involved; and

- **Participation as a fundamental right** - where the main aim is to initiate mobilisation for collective action, empowerment and institution building.
Individuals’ ‘participatory intent’ may consequently explain the apparent differences between the projects’ specifications and their members’ perceptions and action that were discussed in Section 5.1.1. When a third of team members asserted the projects’ methodology was ‘not new at all’, were they simply continuing their traditional RDE methods with periodic consultation under the banner of Farming Systems RDE? The alternative, that they had always viewed participation as a fundamental right is inconsistent with calls for greater farmer involvement in grains RDE processes (Henzell & Daniels 1995), assessments that ToT remains predominant in Australian RDE (Guerin & Guerin 1994), and the initial observations of this thesis. Similarly, the associated perception that these projects were simply formalising existing practices may reflect the team’s comfort with the ToT paradigm and a denial of any need to change. Indeed, few team members recognised the attempts through the projects to merge RDE processes, integrate all stakeholders’ perspectives, or make co-learning with farmers and scientists explicit as ‘new’. This may have arisen from their limited awareness or understanding of the potential for co-learning in the projects because few team members used, or even acknowledged, the literature that discussed participation and learning in agricultural RDE. Alternatively, they may have rejected the notion of participation for learning and collective action.

In summary, these interviews confirmed the demographic, organisational and informational diversity that shaped team members’ participatory intent. Each team recognised their geographic, age and gender spread; their different organisations; and the predominance of agronomists and soil scientists with different technical specialties. Yet, these interventions identified the teams’ values diversity of aims, expectations, and passions for participatory processes. They also highlighted individual’s preferred RDE methods, their associated RDE paradigms, and underlying worldviews. Team members raised this values diversity in semi-structured interviews but it was not addressed publicly. Their RDE paradigms and their worldview diversity remained similarly latent. For example, the Western project modules that were based around people with specific skills, developed into relatively homogeneous methodological homes for their respective proponents in the project. Their conflicts were not resolved and the modules operated independently. Nor was the extent of other participants’ values diversity and associated worldview and paradigm diversity clear. Consequently, this values, paradigm and worldview diversity of RDE agency managers, industry funders, and farmers is investigated in the next section. The major differences to team members are described, rather than rehearsing the many similar aspects of diversity across these participants.

5.2 RDE agency and industry fund managers

Effective teams require organisational support for their operation and for collaboration across their wider institutions (Kasl, Marsick & Dechant 1997). Consequently, the ongoing support,
understanding and funding from RDE agency and industry managers are likely to play important roles in establishing and enacting collaborative RDE processes. The project teams must therefore understand their values and expectations. Focus groups and semi-structured interviews were subsequently conducted as part of the evaluation project to help understand their expectations, values, RDE paradigms and worldviews.

5.2.1 Values diversity

Table 12 depicts data from these focus groups and interviews with RDE agency and industry fund (GRDC) managers. The left-hand column shows summaries of their expectations of the projects. This range of unprompted responses was similar to the teams but placed more emphasis on improved RDE processes. As one industry manager summarised, ‘this is an experiment...about alternative approaches to RDE...and coordinating RDE. It must produce a model that we might apply elsewhere’. Yet, these managers all declared their faith in participatory RDE from a ‘general belief from the heart that a team approach will be better than a component one’ and focused on how to manage teams to improve their impact on practices. This confirmed their desire for wider organisational learning across the grains industry, in contrast to most team members who valued farmers’ and peers’ recognition of individual activities more than RDE process developments (Lawrence et al. 2001). Their consequent need to demonstrate industry impact and evaluation outcomes (Table 12) was primarily to support the supremacy of participatory RDE over traditional RDE and to improve participatory processes in the projects. These managers believed in participatory processes and wanted evidence to demonstrate it to both government and levy-paying farmers.

Table 12. Managers’ expected outcomes of Farming Systems RDE

<table>
<thead>
<tr>
<th>Expected outcomes of the Farming Systems projects</th>
<th>Unprompted responses (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry impacts - farmer learning and better farming practices for improved profitability and sustainability</td>
<td>18</td>
</tr>
<tr>
<td>RDE process impacts - RDE understanding and improved RDE practices for increased participation and community development</td>
<td>54</td>
</tr>
<tr>
<td>Scientific knowledge – improved scientific understanding of technical principles for grains production</td>
<td>7</td>
</tr>
<tr>
<td>Evaluation data– evidence of industry impact, improved RDE process understanding and stakeholder acknowledgement of this progress</td>
<td>22</td>
</tr>
</tbody>
</table>

Finally, quotes from the focus groups illustrate managers’ expectations that farmers and scientists will both learn and improve their practices: (i) ‘(this is) more development and extension than our other investments...there’s no point doing this stuff if farmers aren’t going to adopt it; and (ii) ‘there are two learners in the partnership. The researcher is learning so there should be a research outcome, advances in knowledge...(otherwise) we’ve failed’. However, as the unprompted responses in Table 12 show, group members emphasised farmers’ learning and
adoption of profitable and sustainable practices more than scientific knowledge. An emphasis of technical learning for farmers and scientists RDE process learning to achieve it provided insights into why they valued participation. These notions of participation and their RDE paradigms and underlying worldviews are elaborated in the next section.

5.2.2 Worldview and paradigm diversity
While these managers believed participatory RDE would lead to more sustainable and profitable farming systems, their perceptions of sustainability, participation, and the impacts of merging RDE processes on participants including themselves were diverse. This was most apparent in their perceptions of their organisational differences and of collaboration between each agency. The industry fund managers believed collaboration was a way to reduce duplication between the state Departments of Primary Industries. However, some Queensland managers believed the NSW Department was a more traditional RDE agency that would constrain their progress toward participatory processes, a belief that data in Section 5.1.1 confirmed. These Queensland managers recognised their greater commitment to, and experienced in, participatory processes and suggested that ‘cross-border’ collaboration was failing. They believed they would get more recognition by collaborating and reporting across projects in Queensland, and only persisted with collaboration because it was a condition of GRDC funding. For example;

GRDC (wants) cross-border projects. (But), it’s failing and doesn’t work well due to the cultures of the organisations. NSW are very much, driven by a traditional transfer-of-technology approach. It’s no less pre-eminent up here, but extension certainly has a different relationship with research

The focus groups confirmed managers’ primary aim of progressing their organisations’ goals and reaffirmed that shared goals are critical for effective teams (Johnson & Johnson 1997). Yet, this quote reveals the tensions that revolved around the managers’ different RDE paradigms, worldviews and subsequent participatory intents. Indeed, excerpts from these focus groups (Box 1) illustrate three distinct views on participation in RDE:

- Firstly, that increased participation and merging RDE will help farmers better understand and see the relevance of their research, or make research more relevant by influencing the issues addressed. This dichotomy reflected each manager’s belief that either research or extension constrained the farming systems. Yet, without direct farmer influence over RDE process decisions, both positions reflect consultative and functional levels of participation (Pretty 1995). This common perspective on participation dominated each agency and may substantially maintain farmers ‘dependence’ on scientists to demonstrate principles and help farmers to understand them ;
A second view was that increased participation and merged RDE provided opportunities for participants to influence the content and processes of RDE. More relevant issues and processes were expected to support learning and more informed decision-making for all participants. This perspective was most evident within Queensland where proponents argued that participation created opportunities for all participants to understand each others’ experiences and insights. Echoing Model II behaviour and double-loop learning (Argyris & Schön 1996), this view was consistent with interactive participation (Pretty 1994). Indeed, one industry fund manager suggested that this learning may, ‘progress towards self-funding of local and regional Farming Systems RDE…grower groups to solve their own problems’. His vision of ‘independent’ farmers who conducted their RDE without institutional support seemed attractive to the industry managers;

Finally, one Queensland manager suggested increased participation and merged RDE provided a ‘team approach to learning and participation to integrate knowledge and use individual diversity in local groups…farmers less dependent on experts…more interdependent’. This provides the catalyst to appreciate each other’s perspectives and move towards a constructivist RDE approach. Essentially, farmers and agencies may remain in an interactive partnership that develops new solutions for individuals’ unique contexts from the ‘melting pot’ of their collective ideas. Such interactive participation may also help participants to understand the nature of their knowledge and assumptions and support deutero-learning, that is, ‘learning how to learn’ (Argyris & Schön 1996).

These contrasting notions of participation confirmed the managers’ different expectations for the relationship between farmers and scientists. This values diversity reflected the managers’ paradigms and worldviews as they typically defined their farming systems in biophysical terms. Like the teams, few managers explicitly included people within the farming system. There were several dimensions of values diversity between the managers and teams. Firstly, all managers expressed support for participatory RDE. Some team members did not, and believed Farming Systems RDE only meant they had to report their work differently. Secondly, managers wanted evidence to demonstrate the projects’ impacts and unlike the teams were not content with informal feedback and a belief their work was valuable. They wanted evaluation to provide convincing impact reports for others, and strategic insights for future projects. However, the managers also recognised the historical lack of reporting demands on staff would make the task of impact and process evaluation difficult. These factors highlight the salience of antecedent conditions for programs seeking innovative practices. Importantly, the pre-mediate experiences – those coming earlier – of many stakeholders in grains RDE provides a strong institutional and personal legacy that confronts the development of effective participatory processes.
There was as much diversity within, as between, the managers and teams. Both comprised mostly middle aged men with training in agronomy. The industry managers included farmers, but whether they were typical farmers was unclear. Consequently, there was also a need to clarify the diversity of participating farmers’ values, that is, their goals, beliefs and perceptions of a more collaborative approach to agricultural RDE and the Farming Systems projects.

Box 1. Focus group discussions with RDE agency and GRDC industry managers

**Focus group with GRDC managers:**

*facilitator*: if people didn’t adopt a practice but understood it, and knew why they didn’t adopt it, is the project a success or not?

*facilitator*: it wouldn’t be a success if its a sustainability issue leading to long-term problems

No, its not good enough… not to adopt. (Sustainability’s) too big an issue…to accept that farmers aren’t going to do anything

*facilitator*: So processes that would come up with more skilled more knowledgeable farmers who didn’t adopt what we saw as sustainable practices would be a failure

That’s assuming we know what’s sustainable practices…. (laughter)

**Focus group with QDPI&F managers:**

It’s really about paradigm change among scientists. This is about moving from a positivist perspective to a constructivist perspective. And that is a very difficult.

tell me in words that you’d tell a group of producers

It’s about working with people and having a whole range of perspective’s in the boiling pot and ending up with a whole range of outcomes. Each outcome’s unique to the person who needs it. It’s not coming up with a scientific “right” answer. You don’t pre-determine what’s going to be adopted.

What you’re really saying is, give us the money and we’ll deliver something good.

No, I’m saying we’ve got a track record…in terms of adoption of principles, like stubble management and nitrogen use. They’re the two big bangs we’ve had over the past five years. The process we’ve used has been this process. We’ve sped adoption. So we didn’t sell zero till, we sold learning processes, which resulted in zero till or high stubble management.

5.3 Values diversity of farmers

The numerous interviews, focus groups and observations of farmers that were conducted in this research were detailed in Chapter Four. That individuals bring different perspectives to agricultural RDE is not further rehearsed in this section. Rather, three salient aspects of participating farmers’ values diversity are introduced and analysed through their perceptions of the projects as: (i) an opportunity to learn and improve farming practices; (ii) an opportunity for better communication; and (iii) an opportunity to participate in RDE. The achievement of these expectations is subsequently described and analysed in Chapter Eight.
5.3.1 An opportunity to learn and improve their farming

Firstly, farmers saw these projects as a strategic opportunity to access RDE resources and make their local RDE more relevant to their individual farming systems. They were more interested in local outcomes than developing new RDE approaches for the grains industry. Farmers supported the projects’ emphasis on understanding basic agronomic principles because it helped them make practical decisions. For example, farmers in the Western project in Queensland suggested, ‘we’ve always known what happened, but now we know why. These same farmers did not initially like the RDE agencies’ policy move away from traditional advisory services, but now recognised that agribusiness still provided these services, ‘you go to (agribusiness) with specific problems. But for the understanding, say soil nitrogen…how that all works, you go to the DPI workshops…they’ve all got their different roles’. The Farming Systems approach was generally considered to be more valuable than traditional RDE that provided answers and advice to operational difficulties as they arose.

In contrast to scientific team members, farmers predominantly took a managerial approach to understanding their farming systems. They used research trials and group meetings to better understand issues of immediate interest to them. However, they typically focused on trial outcomes rather than the underlying cause-and-effect relationships, and only wanted to understand issues well enough to make reliable decisions for their farms, not advance scientific knowledge. This notion of research to test possible management options meant negative results were often seen as failures, ‘if you don’t get a result it is wasted time and resources’. In summary, few farmers were concerned whether a trial advanced science or simply quantified established principles locally…if it helped with their decisions. Consequently, several farmer groups conducted no formal research and simply met to share their ideas and experiences with practices they were trying at home.

5.3.2 Opportunities for better communication

This opportunity to share experiences and understandings with others who faced similar challenges was a key outcome of Farming Systems RDE for most farmers. However, farmers in each project also recognised the input of farmers and scientists with different experiences. This view can be summarised by three quotes from farmers in the Central project:

(i)  *I come away with ideas (but) I’m not good at bringing them back to reality. Others in the group help do that. It’s broader than any one person can come up with;*

(ii)  *it took (a new farmer) from a different background to find the real problems; and*

(iii)  *groups are a good way to integrate information between scientists and farmers.*
These data emphasise farmers’ expectation and the achievement of opportunities for better communication with other farmers and scientists. However, observations also highlighted communication difficulties due to their differing educational levels, terminology and language barriers, some scientists’ poor interpersonal skills, and their tendency to overestimate farmers’ knowledge of technical issues. However, these difficulties may be expected to be overcome by the farmers’ third major expectation of the projects, that is, ongoing participation in the projects.

5.3.3 Participation in RDE

The projects’ approach was considered to have increased participation and made their RDE more relevant. However, the farmers’ notions, expectations and perceptions of participation also varied. Farmers in the previously neglected areas of the Western project declared, ‘it’s unique because it is out here…we’ve never had it before. It’s pretty healthy, ten years ago it was more like looking at something under the microscope, you know, 10 minutes from Toowoomba where you can educate the kids’. Having local research was a major advance, and enough for some farmers who did not want to be directly involved in its analysis.

Ultimately, most farmers sought more than this passive participation and appreciated the ‘grass roots’ consultation and functional participation that allowed them to influence what was done in their groups, the research questions they addressed, and discuss what the results meant. According to these farmers, ‘it looks like somebody in head office is saying “get out there and ask the farmers what they want and lets identify their problems and work on them”’. Indeed, some farmers wanted more than consultation or functional participation with input into the content focus of activities. These farmers were typically disappointed and stated that, ‘everyone needs to contribute and the “wizards” have to listen to what we are saying. They hear what I say, but they do not listen!’ and ‘we supposedly decided what we were going to do…but the facilitators decided…(not us)’. They expected interactive participation with equality in decision-making on strategic project directions and the process decisions of specific activities. However, most farmers wanted the teams’ continued support of their group’s activities. Even self-mobilised groups that existed before the project did not want to become independent and effectively accessed the Farming Systems projects and other resources as much as the projects accessed them. This contrasts with some team members, RDE agency and industry managers who sought self-sufficient and independent farmer groups that conducted their own RDE.

In conclusion, farmers brought a range of different experiences to the projects, namely those of managing commercial farming enterprises. This had a major impact on the focus of activities. They were interested in accessing resources and people to become better informed and make better decisions for their farms. Unlike the salaried participants, the farmers’ decisions had risks with immediate impacts on their livelihood. However farmers, like the project teams, funders
and agency managers showed considerable values diversity. Effective participatory processes must therefore utilise this diversity for better outcomes and avoid the damaging conflict that often arises from such values diversity (Jehn & Mannix 2001). The nature of diversity across all project participants is discussed in the next section to identify the implications for the project teams as they attempt to integrate and utilise these different perspectives.

5.4 Reflections on diversity

The research reported in this thesis established the dominant use of demographics in diversity research as indicators of the dimensions of diversity that actually impact on group performance (Thompson & Gooler 1996). This ‘black box’ approach of relating organisational performance to the demographics of its work teams (Lawrence 1997b) has been avoided in this chapter, and the focus is on the substantive organisational, informational, and values diversity of stakeholders (Jehn, Northercaft & Neale 1999). Indeed, significant demographic, organisational, and informational diversity within and between the projects, their RDE agency and industry fund managers, and farmers has been identified. This diverse technical knowledge and process understanding and the resources available through each organisation provide the project teams with great potential for innovation to improve the farming systems in the region. But, diversity does not always lead to improved performance (Williams & O’Reilly 1998). Actual performance is the result of potential for improvement and the process losses that occur. As summarised in Figure 9, the project teams may have great potential to improve the effectiveness of their RDE by integrating and fully utilising their diverse knowledge, experience and resources. However, the actual improvements in RDE will depend on this potential and the extent of process losses from any damaging conflict that may arise.

\[
\text{ACTUAL EFFECTIVENESS} = \text{Potential effectiveness from utilising diversity} - \text{Process losses from damaging conflict}
\]

Figure 9. A model of workgroup productivity
(source: adapted from Steiner 1972)

Conflict is inevitable in diverse work teams. Their interdependence is grounded in the need for team members with different perspectives to learn to integrate their differences to work effectively (Thompson & Gooler 1996). But this is not always easy and utilising diversity as a source of creativity, productivity and energy remains one of the major challenges facing the field of group dynamics (Johnson & Johnson 1997). The alternative is to remain independent or dependent with no guarantee against competitive behaviour. Consequently, the apparent demographic, organisational, informational, value and RDE paradigm and worldview diversity in the projects presents both opportunities and risks for their performance.
A model of diversity and its impacts on group processes and performance RDE is presented in Figure 10 to help understand these opportunities and risks. It is adapted from Williams and O’Reilly’s (1998) ‘integrated model’ that was introduced in Chapter Two, and summarises the analysis and discussion of the implications of such diversity in this chapter. Thompson and Gooler’s (1996) conclusion that demographic diversity has direct impacts, but is typically used as an indicator of more substantive diversity in recognised in Figure 10. Consequently, the demographic and organisational diversity of the projects and their informational diversity are presented in the left-hand column. As described in Chapter Two, the underlying theories of diversity research are then used to explain the potential impacts on group processes in the project, and the potential moderators of these processes that result in the ultimate group performance. Again, the positive (+) and negative (-) impacts of each transformation are represented on each ‘arrow’. For example, organisational diversity was explicit and the organisations had different emphases on collaboration as a ‘means’ to achieve more sustainable farming systems, or as an outcome in its own right. Similarly, each organisation’s culture and the outcomes they sought were already creating conflict and influencing the nature of participation and learning in the projects. However, participants’ interests, expertise, and understandings of Farming Systems RDE were explored in this chapter to identify the diversity in their information, values, RDE paradigms, and worldviews. These are now discussed.

5.4.1 Informational diversity
Despite lacking the disciplines expected by some stakeholders, there was considerable informational diversity within and between each group of participants. Diverse perspectives, along with participants’ technical and process expertise provided increased information availability and problem-solving perspectives, in line with the model presented in Figure 10 (Williams & O’Reilly 1998). This presents opportunities to draw together and integrate the expertise and resources of the different team members, RDE agency and industry managers and farmers into more useful RDE processes and sophisticated understandings to critically analyse problems and generate more creative solutions (Thompson & Gooler 1996). If the group processes are effective and avoid the negative process effects of conflict from the social categorisation illustrated in Figure 10, the project could develop more integrated RDE to better appreciate the practicalities and sociology of farming, and more informed decision-making on farms. However, if the projects cannot overcome the potentially negative impacts of their diversity on group processes, Figure 10 also suggests conflict from social categorisation and stereotyping may reduce the actual effectiveness of grains RDE through reduced commitment, collective problem-solving and their ability to implement the projects (Cox, Lobel & McLeod 1991; Thornburg 1991).
### Figure 10. A model of diversity and its impacts on group processes and performance in Farming Systems RDE
(source: adapted from Williams & O’Reilly 1998)
Consequently, the project teams must develop group processes to reduce the destructive conflict, communication problems and factionalism that may result from social categorisation theories’ cognitive biases, ingroup/outgroup biases and stereotyping (Williams & O’Reilly 1998). This will require an awareness of the informational diversity at their disposal and sufficient participation to utilise it effectively. Interactive participation with its joint analysis and action plans that employ inter-disciplinary methodologies and seek multiple perspectives may be required (Pretty 1995). However, it will also require an understanding of participants’ differing values and processes to draw them together constructively.

5.4.2 Values diversity
The participants’ aims and expected outcomes of Farming Systems RDE varied within and between the projects. Everyone supported more sustainable and profitable farming practices. Yet, different notions of sustainability, definitions of farming systems, and the role of participation led to quite different expectations of the projects. For example, some participants focussed on better technical understandings which they believed would diffuse through the community, while others focussed on human capital and institution building to develop sustainable systems for ongoing learning and change. Other expectations that establish the potential for task and process conflict included the different goals of each participating agency and the extent of organisational collaboration they each sought, the differing participatory intentions of stakeholders, and the structuring of activities for extension or research aims.

Participants’ visions and aims were not uniform, but were they partially aligned, working in different directions, or working in direct competition with each other? Need they be competitive, or could they be complementary? In systems terms, they were not unitary in purpose (Flood & Jackson 1991a). But, were they pluralistic or conflicted? Conflict may be reduced by selecting new staff with similar expectations. Yet, an imperative of the participatory projects was to involve diverse stakeholders in developing new farming systems. Consequently, it is important to understand whether these diverse expectations could be aligned by participants’ reframing the issues, or redefining their systems boundaries to ensure their pluralism (Schön 1983)? Indeed, could people learn to appreciate others’ perspectives, develop shared goals and ‘align’ their activities? Otherwise individual participants could work extraordinarily hard without their efforts translating into an effective team effort (Senge 1990).

As illustrated in Figure 11, the consequences of developing such ‘alignment’ may be critical in participatory projects that also empower individuals (Christodoulou 2000; Grundy 1982). Figure 11 presents three diagrams of teams: (i) a typical team with individual members and some of their personal goals at cross-purposes with limited alignment to a supposed team goal in the direction of the ‘arrow’; (ii) an empowered but unaligned team that results in chaos as individual team members efforts cancel each other out; and (iii) an aligned team where
individuals’ goals are largely aligned to a shared team goal with little competition. While complete alignment may equate to unitary systems, the aim for the Farming Systems projects with their diversity is to avoid the chaos of conflicted systems, and develop shared goals to encourage more pluralistic systems that meet the needs profitability and sustainability needs of individual farmers, the grains industry, and the wider community through government (Flood & Jackson 1991b). The success of the projects and the extent of the resulting conflict remain to be seen. In Section 5.1.3, attention has already been drawn to individual team members trying to prevent peers with different views from attending activities. Similarly, the teams and their RDE agency managers must align their goals to ensure management decisions do not undermine project commitments to participants. Failure to deliver promises may be costly. For example, continuing management support is needed to avoid potential problems, such as staff changes or maintaining vacant positions that subsequently disrupt the longer-term relationships and trust that underpin participatory processes (Christodoulou 2000). However, it may be that the participatory intent to develop this level of alignment itself depends on participants’ paradigms and worldviews, which have also been shown to be diverse across the projects.

Figure 11. The impact of alignment and empowerment in diverse teams
(source: Senge 1990)

5.4.3 Worldview and paradigm diversity
Developing a participatory paradigm within RDE agencies that have always operated within a positivistic ToT paradigm may be difficult. It is asserted in this chapter that the projects contain the ontological and epistemological diversity that has fuelled conflict throughout social research (Denzin & Lincoln 2000). Indeed, the projects may be microcosms of these conflicts between positivist, post-positivist, constructivist and post-modernist positions. Understanding this RDE paradigm and worldview diversity is critical to develop effective multi-disciplinary RDE teams. Participants’ perceptions of on-farm research and its relationship to other RDE activities highlighted these positivist and constructivist perspectives within the projects. Despite these more collaborative approaches to develop greater participation and move beyond the ToT paradigm, a significant number of participants and stakeholders exemplified the positivist position. Perhaps the majority held a post-positivist perspective. Certainly, their understandings of key Farming Systems concepts and their consequent expectations of the projects suggested many continued to operate firmly within the ToT paradigm.
The implications for reconciling participants’ informational and values diversity in the projects were unclear. To what extent could participants’ different knowledge systems be understood, let alone appreciated and used constructively? While there was little mention of the participants’ ontology and epistemology, some team members used terms such as ‘soft’ systems and qualitative data to embrace relativist notions of social interactions. However, others commonly discounted the knowledge of others unless it could be supported by ‘hard’ data. Indeed, even team members’ desires to integrate their different technical and process expertise and align their expectations appeared to be initially mixed. Some simply believed their perspectives were right. For example, some individuals in the Western project believed highly constrained, small-plot experiments were the best approach for all issues. There were others in each project that felt the same way about on-farm research, action learning groups and crop simulation.

When the results from small-plot research, simulation studies and on-farm research were in apparent conflict, most farmers followed the on-farm research results. Not surprisingly, farmers trusted tangible results from trials that were closest to their own conditions. They apparently valued site-specific outcomes above the generalisation of principles. In contrast, agribusiness typically placed most trust in the internal validity of the more constrained small-plot research. Faced with differing results from nitrogen research, several farmers suggested that the apparent differences from each RDE approach needed further analysis to see if there really was any conflict, and then understand any differences. This situation presented an ideal opportunity to use their diversity of experiences and maximise their learning. However, most farmers, and team members for that matter, simply supported the outcomes of their preferred RDE approach. Their apparent interest in discussing alternatives was rather to convince others through competition and advocacy. If anything, they were avoiding scrutiny of their own research approaches and its implicit weaknesses. This surprisingly included advocates of participatory on-farm research approaches with farmers, who then used positivistic transfer-of-method approaches (King 2000) with peers in their projects.

5.5 Conclusion

In conclusion, the initial interventions reported in this chapter clarified the existence of substantive diversity within grains RDE teams. Despite being comprised of largely tertiary trained male agricultural scientists, these ‘teams’ contained enough diversity to make teamwork challenging. The increased participation of Farming Systems RDE may be expected to make this diversity more explicit. This was already occurring and relationship, task and process conflict were evident. For instance, there were senior team members who viewed each other as competitors and had refused to sit together, let alone communicate, conflicts over the focus of activities, and frustration when concurrent activities were considered competitive rather than
complementary. Could the projects manage this emerging diversity to gain the benefits of information and decision-making theories without excessive factionalism and loss of communication from social categorisation and stereotyping? Would their apparent differences be accepted, appreciated, or ignored over time? Would they result in destructive conflict, or could the teams understand and reconcile their different expectations, paradigms and worldviews? Tomorrow’s effective groups will be those that learn to be productive with diverse memberships (Johnson & Johnson 1997). So, how could the Farming Systems project teams participate effectively? This question is addressed in the next chapter.
Chapter 6. Initiating participation in teams

The perceived need for Farming Systems approaches implicitly recognises diversity amongst participants in grains RDE that broadens the potential to learn and enhance local farming systems. Yet, how this diversity will impact on participation of the Farming Systems project teams and their stakeholders remains unclear. Can the participants in these projects initiate effective participation and work as teams to appreciate and capture this potential under a unifying desire to improve the sustainability and profitability of their farming systems? Given this diversity, participation emerged as the next focus of this thesis with the research question,

*How can the Farming Systems RDE teams participate effectively?*

This question confirms the primary focus of this thesis on the project ‘teams’. Consequently, the nature and extent of participation within each project team are firstly assessed in this Chapter. This assessment prompted modifications to extend Pretty’s (1995) typology of participation for use in these projects. Moreover, the demographic, organisational, informational, values, and paradigm and worldview factors that shape this participation were identified. Understanding these factors provides opportunities to improve participation and progress towards the full potential of Farming Systems approaches in grains RDE. This progress towards greater participation, and the learning that is achieved within the teams and in their interactions with farmers, are subsequently explored in Chapters Seven and Eight.

### 6.1 Initial observations of participation

The three Farming Systems projects had been operating for varying periods when the evaluation project began in July 1997. The ‘Eastern’ project had just commenced, the ‘Central’ Queensland project had begun five months earlier, and the Western project had been operating for two years. Each project developed its own structure to match the perceived needs of the region and their team’s expertise. However, participant observation of team meetings and semi-structured interviews with team members over the subsequent year suggested the reality of participation within each project was failing to meet the expectations of staff.

#### 6.1.1 The Western Farming Systems project

The Western project was a partnership between the New South Wales (NSW) and Queensland Departments of Primary Industries. They initially held full project meetings and developed strategic plans, but after two years they no longer met as a team. Separate sub-projects then operated in Queensland and NSW with little direct contact between them. Indeed, there was little effort to inform each other of planned activities and their progress. Invitations to each other’s meetings were rare and acceptances rarer. Occasional meetings of activity leaders from
each sub-project were passive and consultative, with little joint planning and coordination of activities. Their on-farm research was unrelated and not collated, and this lack of communication resulted in three large small-plot research trials on similar soils without any integration of results. Team members reinforced these observations. They said they had not even met many staff ‘across the border’, complained phone calls were not returned, and even alleged that trial data were withheld. RDE funding for each agency was secured through the project. Yet, team members almost unanimously concluded there was ‘very little collaboration at all. Despite the project’s promotional stuff, we do our own thing’. They suggested separate annual reports were ‘simply stapled together’ for funders. Interstate collaboration was failing as the States pursued their separate aims within their own RDE paradigms.

**NSW sub-project** - The NSW extension service was restructured in the first year of the project and most extension staff took redundancies. They were replaced 12 months later, but in the interim, their salary savings were used to establish an additional major research trial. The sub-project then comprised two small-plot research sites (Module 1) and three ‘satellite’ on-farm research sites (Module 2). However, the sub-project did not utilise Queensland staff to support extension activities. Commitments to structured learning activities (Module 3) were nominal and modelling (Module 4) was non-functional with little trial data provided for analysis by the modellers in Queensland. Staff confirmed, ‘everyone works on the trial sites...(there’s) little resources elsewhere’. The sub-project concentrated on its traditional research. The challenge of combining ‘hard’ and ‘soft’ systems thinking remained and as a NSW team member trained in ‘systems agriculture’ concluded ‘NSW are not trying…it’s a hard systems project. The Western project in NSW exemplified a hard systems approach to study biophysical relationships.

Semi-structured interviews with team members after three years confirmed their continuing emphasis on traditional small-plot research trials. After 12 months on the project, the ‘new’ extension officers remained unclear about Modules 3 & 4 and who worked on the project in Queensland, ‘I don’t know what Module 3 is, (and)I feel pretty terrible not knowing about Module 4’. In team meetings, the project leader and senior researcher announced the project’s processes and content after consulting farmers and funders. Other team members were asked to provide the required support but believed they had little influence on the centralised decision-making of the sub-project where the ‘power base resides in too few (two) people…I don’t have any involvement into setting the strategic picture, it was already decided.’ Consequently, participation was typically passive, or at best, consultative. For example, technical officers maintained research trials and extension staff organised meetings for researchers to present and discuss results with farmers. However, they completed tasks set by their supervisors. Some questioned key decisions but concluded their role was to follow instructions. They became disillusioned with this lack of participation and several subsequently resigned.
Qld sub-project - Queensland state policies also changed early in the project and staff was reallocated into the Departments of Primary Industries (QDPI&F) and Natural Resources (QNRM). Yet, staff retained active roles in the project and the project maintained its methodological diversity. Participation was greater within modules than between them and their methodological differences. Participation within modules ranged from individuals passively informing others of their activities and consulting others for their opinions, to the joint planning, action and analysis of interactive participation. This participation ‘fluxed’ with the different issues and personnel involved. The overall approach of each module was jointly planned but individuals typically then consulted and later informed others what they had actually done in their own activities. Indeed, participation within modules was limited to the passive and consultative in several situations. Firstly, technical officers typically did what research officers told them. Most showed little interest in overall module or project decisions and did not contribute. Secondly, the ‘management committee’ of the small-plot research trial remained an advisory group with consultative participation and researchers making final decisions. At best, researchers provided functional participation for the committee to select some additional treatments of local interest. Finally, the facilitators of on-farm research used passive and sometimes consultative participation with their peers. Individuals with ‘hard’ or ‘soft’ views of systems consequently conducted most trials with little involvement of team members with opposing views. Indeed, others’ involvement was discouraged and information sometimes withheld. Despite these limitations, participation within modules provided many team members with equity and equality in their general planning and in developing their theories-of-action.

In contrast, there was less participation between participants in those modules which operated as largely independent and competitive mini-projects with their own budgets. For instance, team meetings typically reported each module’s progress, results and future plans before other team members asked questions and voiced opinions. Input from those in other modules working on the same technical issues was rarely sought, and decisions were made within each module, not by the project team. Consequently, people were aware of each other’s work but not actively involved, and integration of issues across the project and its modules was largely ignored. Strong tensions between participants in different modules appeared to make people uncomfortable and preclude open discussion of project strategy and the integration of results across the project. The appropriateness of plans for each module was not decided by the team and links to other activities were not developed. Indeed, people privately criticised members of other modules and even suggested other project activities undermined their work. As team members said, differences of opinion, theories and approaches is good, but there’s mistrust all the time...its “us” and “them”. I only thought about my module’s responsibilities, not “the project” across the board...we were all very narrow, thinking within modules’. This tension was strongest between participants in Module One which emphasised scientific rigour and
telling farmers what practices to use, and those involved in Modules Two and Three, which emphasised farmer participation to understand their farming systems and develop their own solutions. Meanwhile, staff in Module Four worked independently and accessed any trial data that interested it. Staff in each module worked to increase farmer participation but appeared to lack the desire or processes to participate effectively with others in the project.

In summary, those involved in the Western project and its state sub-projects were not effective teams. Project members appeared unable or unwilling to harness their diversity for an agreed outcome, and were consequently likely to learn little from each other. They resembled ‘pseudo-teams’ and may achieve less than smaller homogenous work groups if they cannot overcome their conflicts. Without improved teamwork, it may have been better to fund the Western project as discreet activities without the pretence of a shared approach and mutual accountability. It remained to be seen if members of the project could overcome these problems and begin to work together. It also remained to be seen how participation evolved in the other projects.

6.1.2 Central Queensland Sustainable Farming Systems project

The ‘Central’ project was initiated by a steering committee of representatives from several collaborating agencies: Queensland’s Departments of Primary Industries (QDPI&F) and Natural Resources (QNRМ); CSIRO; Central Queensland University and industry. The project leader and an agricultural consultant developed a detailed operational plan to implement the steering committee’s strategy. Their suggested project methodology, tasks, activities and methods were then presented to prospective project staff that discussed these plans and contributed suggestions. Yet, people with alternative views felt they were ignored and some said people were asked to leave discussions, ‘actually told to leave when they tried to make their point. In other words, this is the way it will be done, no matter what you come up with’. This direction with low influence from prospective team members (Strauss 1998a) was akin to Pretty’s (1995) manipulation, and only disillusioned people who disagreed, and recognised their lack of influence. Despite their affinity to the notion of participatory RDE, some prospective staff subsequently avoided the project as they felt the process was inflexible and not participatory.

The first full team meeting was held after 12 months. By then, most strategic project decisions had been made and key project activities were under way. Team members had been passively informed, sometimes consulted, and asked to help with activities. Most subsequently suggested they had little influence on major decisions, ‘staff’s not involved in the strategic development of the project...that’s left to others’. Continued consultative participation saw the project leader making final decisions politely, but firmly, in subsequent meetings. However, the varying influence of individuals became evident in who was consulted between meetings and the extent to which individual’s suggestions were recognised at meetings. People with similar perspectives
were attracted and formed coalitions (Byrne 1971), and relationship conflict (Jehn & Mannix 2001) emerged between the leadership group and other team members who advocated more participation in both team decisions and the RDE with farmer groups. Social categorisation led to stereotyping and disparaging comments between these groups. For example, when two people at one team meeting made the same criticism of project activities, they were subsequently labelled as ‘challenging’ or ‘undermining’ depending on their relationship with the leadership group. Reflecting the dominance of the ToT paradigm in the team’s view of on-farm research as a development and extension process, it was the advocates of more participation that were being marginalised in a project dominated by consultative participation. The project was failing to develop the mutual respect and trust needed to utilise the potential of its diversity.

Subsequent project activities were structured around on-farm research sites across the region. The aim was for facilitators to develop this participatory research with local farmers and the project’s technical experts. However, participation in these early activities also remained passive and consultative. Guidelines were provided for the location of each group, steps to form them, and suggested issues to investigate (Doughton & Spackman 1997). Nominated facilitators organised the initial farmer meetings. These facilitators introduced the project’s leader and agricultural consultant who clarified the project’s eight themes for profitability and sustainability and ran processes to identify relevant issues for trials from each group to address. Facilitators’ participation was subsequently functional as they only influenced the specific research topics, initial treatments and trial management once the general themes were decided. Some team members agreed with the outcomes and were happy with their level of input. Yet, others resented their lack of influence and claimed their participation to be superficial…that they were simply doing what others decided. Indeed, some facilitators suggested they were ‘just organisers of tea and bickies to get experts on to talk’ while other technical experts felt totally excluded. Their frustration and disillusionment with the project’s espoused participatory approach grew. This was exacerbated when most group facilitators provided team members with only passive and consultative participation opportunities with their ongoing group activities. Technical experts claimed they were promised opportunities to contribute to research planning with the farmer groups, but this did not eventuate. Their frustration turned to bitterness. They typically felt isolated and reliant on ‘gate-keeping’ facilitators for access to farmer group activities. Some suggested they were actively excluded while facilitators pushed their personal agendas with farmers, ‘if (facilitators) are not interested in what the farmers are saying, it’s not going to come back (to the rest of the team)...I don’t have any input into what goes on. (I’ve) had to ask people for everything’. Yet, these technical specialists provided only passive and consultative participation to the facilitators and the wider team when they established their own activities. This ‘Pedagogy of the oppressed’ (Freire 1970) reinforced the individualistic culture of the project as it developed into a series of parallel activities.
Participation across these parallel activities varied. It was typically passive and consultative as people concentrated on their own activities with farmers. They typically discussed their ideas with team members they respected, and then reported their plans and progress at meetings every six to 12 months. Questions were asked but major decisions were not shared. Most team members were consequently aware of the general nature of each other’s work, but were not actively involved in its planning, conduct, or interpretation. Participation with other team members appeared to be a low priority for many people. For example, facilitators were so busy, or absorbed, in their activities with farmers that they often did not inform other team members of opportunities to participate. Indeed, there were occasions when information such as meeting details was deliberately withheld to ensure other team members could not attend. This ‘kept numbers down’ but also precluded people with different views from contributing.

In summary, the Central project contained less organisational, informational and values diversity than the Western project. Yet, it created conflict - task conflict over the priority issues to address, and process conflict about how to address them. The project leader made decisions on what would be done, but the underlying conflicts were unresolved and participation remained passive and consultative. Team members consequently made most ongoing decisions for their activities and reported their progress in team meetings with little integration of activities. This resulted in potentially complementary, but typically independent and parallel activities in which like minds worked together. Conflict in the Central project was not as debilitating as the Western project, but it produced a series working groups rather than an effective team. The Central project may therefore have been efficient for routine activities and incremental learning but was unlikely to utilise team members’ diversity for the breakthrough thinking of synergistic team learning (Dechant, Marsick & Kasl 1993). Any development of such participation and the consequent learning and behaviour of participants remained to be seen, as did the development of participation in the Eastern project.

6.1.3 Eastern Farming Systems project

The Eastern project was a collaboration of the CSIRO, Queensland’s Departments of Primary Industries (Q DPI&F) and Natural Resources (QNRM), and the NSW Department of Primary Industries (NSWDPI). A management committee representing each RDE agency developed a project strategy and conceptual description of proposed methodologies of participatory on-farm research and action learning with farmer groups. Specific methods were not prescribed, but a working definition of participatory on-farm research and priority setting criteria developed to help team members progress their own project activities. These methodologies, definitions and criteria for assessing possible activities were explained at regional meetings with team members and industry. Feedback was encouraged for consideration by the management committee.
Consequently, the management committee provided passive and then consultative participation to other stakeholders. Subsequent team meetings provided functional participation for other team members to discuss and refine these general concepts and processes to their activities. However, it was eight months before the first project meeting was convened and many team members remained unclear of their roles and responsibilities. Conflicting views of the project’s aims from management committee members resulted in team members asking that ‘someone tell everyone their time allocations, the project aim, and what everyone’s role is, and how we can contribute to the project…I get different perspectives (from each leader) of where it’s coming from and where it’s heading’. Despite their frustration with the project structure and the management committee, most team members remained positive about the project and simply wanted to get involved.

Several ‘pilot activities’ were initiated by individual members of the management committee to develop the project’s methodologies. However, these activities typically involved staff from their own agency working with interested farmers and agribusiness. This alignment to RDE agencies concerned team members who knew the Western project had developed organisational barriers and wanted to work across these boundaries. They believed the Eastern project’s leaders would encourage collaboration, but suspected it would be difficult because while ‘four organisations is an excellent idea, it’s difficult to manage and to get cooperation. They’re not working as a team and don’t think they will work as a team. I don’t think they are trying and it goes both ways…the other crews doing their own thing all the time…but if you talk to them, they probably think we’re doing our own thing…’ and ‘I suspect (the project) will run as separate projects…I think it’s happening now’. Indeed, each organisation’s initiatives evolved into a series of relatively independently activities within the project’s broad guiding principles. The agency-based management structure was developing passive participation across activities as people utilised their existing organisational networks before their peers in the project. Project meetings ensured that team members were informed, but the processes did not extend beyond consultative participation. For example, the progress of pilot activities and plans for proposed new activities were presented and people raised questions for each activity to consider. The team did not assess activities or integrate them. Ongoing decisions for each activity were left to those people directly involved. Private criticisms of activities were made, but public discussion of individual activities value was rare. Project meetings were venues for reporting rather than planning or interpretation. In contrast, participation was much greater within each activity. Interactive participation was evident in the joint content and process decisions of the small teams conducting each activity, showing that participation between these key researchers and extension officers had increased.
In summary, this project also resembled a series of working groups conducting independent on-farm research activities with farmer groups. These working groups functioned as small teams with sufficient interactive participation to develop new insights. However, the diversity within these groups was limited and they had low levels of participation across the range of the wider team. Indeed, they simply reported their progress to any team members that may have been interested. This subsequent lack of integration may have restricted the extent of learning across the wider team and limited the wider impact of the project. Again, there were few apparent advantages over funding a series of smaller independent research activities, and participation in the project would have to increase to fully utilise the diversity of its team members.

Overall, members of the Farming System projects had emphasised participation within, not between their sub-groups and activities. They all focused on farmer participation and operated as independent working groups within each project. Periodic meetings to update other project staff and consider their questions led to more consultation than in some past RDE. Yet, team members’ criticisms suggested such participation failed to meet many team members’ expectations of participatory RDE. The projects echoed past failures to achieve a fully participative organisation (Heller 1998) and confirmed the difficulty of applying espoused theories of citizen participation in practice (Arnstein 1969; Cooke & Kothari 2001). Participatory processes with mutual accountability, interactive participation, and dialogue for team learning were yet to eventuate across any of the projects. This suggests that to better utilise their diversity, the members of each project must recognise the level of their participation, consider its appropriateness, and address any constraints to its effectiveness.

6.2 Reflections on participation

Each project drew together staff from a range of technical expertise and RDE disciplines. This encouraged and even forced interaction during team meetings. Simply having people in the same projects created more awareness of each others’ work and broadened their professional support networks. This support was usually obtained through consultation, and while functional participation emerged in some activities, the interactive participation that underpins modern Farming Systems approaches and sustainable development (Pretty 1995) was rare. This concerned few team members. They had funds to investigate issues that interested them and could provide farmers with more opportunities for input. Nevertheless, this culture of consultation did frustrate some team members who recognised their lack of influence in major project decisions (Pateman 1970). The consequent development of homogeneous and like-minded groups confirmed the difficulties of managing diversity in groups, and helped identify major constraints to participation in grains RDE. However, the investigation of these teams-within-teams also provides insight into the significance of team members’ participatory intent,
understanding of the dynamic nature of participation, and adaptations of Pretty’s (1995) typology of participation to assess participation in grains RDE.

6.2.1 Teams within teams
The projects comprised ‘teams-within-teams’. These included the working groups described in each project proposal, and the smaller homogenous activity teams that developed around people with similar interests (Byrne 1970). New communities-of-practice emerged around specific technical issues, geographic locations, organisations or preferred RDE paradigms. These demarcations differed in each project as teams-within-teams emerged in response to the projects’ initial structures and the ‘participatory intent’ of each project’s leadership group:

- The Western project split into sub-projects. The Queensland sub-project’s subsequent modules emerged as a range of RDE methodologies, each working to increase farmer participation in their activities. Cooperation and synergy were evident within each module, but competition and conflict were evident between them. Meanwhile, the NSW sub-project emphasised a traditional small-plot RDE methodology. Greater farmer participation was encouraged, but the other approaches outlined in the project proposal were not aggressively pursued. These subsequent sub-projects reflected the interests of their respective leaders and lead agencies, and failed to integrate and fully utilise their diversity.

- The Central project team employed a uniform on-farm research approach with large plots and commercial farm machinery to help farmers integrate new technology into their farming systems. The passive and consultative participation used to develop this approach produced considerable conflict. This isolated the supporting technical specialists who subsequently developed their own relatively independent activities. However, relatively independent ‘teams’ also developed around each of the farmer groups and their development sites across the region. They reported their activities at annual team meetings but did not integrate them across the project. Again, the project failed to fully utilise their diversity; and

- The Eastern project focused on testing the practicality of doing rigorous and relevant participatory research with farmers and agribusiness. Each participating agency developed activities of interest to a local farmer groups. However, regional significance of these technical issues was not emphasised and few activities held great interest for others in the project. Relatively independent activity teams consequently developed within each agency and most interaction between activities and their agencies was in annual team meetings and reviews that informed others of progress and invited comments and questions.
These communities of practice had two obvious consequences for participation within each project. They minimised the explicit task, process and relationship conflict in people’s everyday work (Jehn & Mannix 2001) and accentuated the diversity and potential conflict between each group. Participation within these less diverse and more focused teams was easier and often extended to the joint planning, action and analysis of interactive participation. Their relatively homogenous RDE paradigms minimised process conflict as the RDE methodology was assumed. This effectively removed the key distinction between functional and interactive participation. In contrast, there was obvious conflict between communities of practice. Their mutual unease, social categorisation, avoidance, competition and criticisms were reflected in the conflicts that emerged from team members’ differing values, worldviews and paradigms. This conflict was typically between people with ToT paradigms and those advocating capacity building and support for participants making more informed decisions for their own situations. Both task and process conflicts were evident.

However, relationship conflict subsequently developed from individuals’ unwillingness or inability to appreciate and reconcile their competing views. Most project members recognised these conflicts. Their concern varied with their understandings and expectations of Farming Systems approaches and their consequent desire to participate in an effective team. Some wanted to pursue their individual interests and were content for team members to encourage farmer participation as they saw fit. Yet, others wanted more. Participants with previous experience in participatory RDE theory typically sought greater participation and communication across technical disciplines and the RDE paradigms. This latter group was most sensitive to the failings of the projects. They simply expected more and were frustrated by the ‘participatory intent’ of others. However, in sum, the project teams were not discrete entities - there were teams-within-teams that developed and played a significant role in the nature and extent of participation.

6.2.2 Participatory intent

Each project team struggled to align and integrate their individual activities. Indeed, the teams’ divergent views on how to conduct each activity were typically discounted as most team members focused on encouraging greater farmer input into their traditional methodologies and activities. Within this culture of consultation, individuals’ contribution and influence consequently reflected their alignment with the paradigms and worldviews of each activity leader (Strauss 1998a). Some activity leaders manipulated activities and went through the pretence of participation with other team members to camouflage their pre-determined choices (Crouch 1983). Yet, most team members simply considered participation to be letting others know what they were doing, and listening to their opinions on it. In good faith, they consulted other team members to help them make the best decisions for their own activities. Their
participatory intent was increased efficiency and support for individual activities, not mobilisation for collective action, empowerment and institution building (Pretty 1995). Indeed, few team members sought participation within their team to appreciate and integrate their different methodologies to develop a shared understanding of how to conduct participatory grains RDE.

Team members’ participatory intent was a major determinant of participation in each project. Most critical was the participatory intent of each project leader. These leaders could limit, and even prevent, people’s participation in key decisions and activities. And, while they could not guarantee interactive participation by forcing everyone to contribute equally, leaders could use processes to encourage participation and ongoing opportunities for all team members to help make decisions. It seems therefore that project leaders’ understanding of participation and their participatory intent created a ‘ceiling’ for teams’ participation (Freire 1970). Consequently, it is critical to appoint project leaders that understand and believe in participatory approaches if ‘Farming Systems’ projects are to achieve the interactive participation needed for sustainable development.

Each project leader’s initial focus on passive participation, consultation and some functional participation resulted in the project teams reciting the virtues of multi-disciplinary teams, but applying their expertise in parallel or competitive activities. Teams’ diverse experiences and knowledge systems were rarely integrated. Their RDE paradigms and associated worldviews and values were not reconciled because it was not the priority, not the prime participatory intent of the project team. Consequently, the projects became ‘multi-disciplinary’, not ‘interdisciplinary’ as envisaged in soft systems thinking and modern Farming Systems approaches (King 2000). Higher levels of participation and transparent processes to facilitate appropriate levels of participation across the communities-of-practice in each project are required to become interdisciplinary and confront and appreciate the teams’ differing values, paradigms, and worldviews. Projects participants needed to understand and believe in participatory approaches if they were to progress toward sustainable development. Yet, the data reported in Chapter Five shows that this was not the case. In sum, the evidence suggests that progress towards sustainable development depends on the authenticity of team members’ desire to understand their participation, assess its appropriateness, and overcome any emerging constraints to participation in their projects.

6.2.3 Understanding and assessing participation: towards a new typology of participation

Pretty’s (1995) typology depicts a progression from low to high levels of participation and describes these generic levels in development projects. These descriptions provide a solid framework to explore participation and appreciate the difficulties of understanding effective and
efficient participation across the farming system projects (Christodoulou 2000). Indeed, this exploration quickly confirmed that labelling a project ‘participatory’ without clarifying the nature of participation is meaningless (Pretty 1995). Participation is not an ‘on-off’ switch and all human activity involves some level of participation and social practice (Cadzen 1993). It is therefore critical to clarify the desired outcomes of projects and decide the most appropriate types of participation to achieve them. This requires teams to appreciate participation and its outcomes, and develop their ability to assess the participation achieved in practice.

The starting point to consider the extent of participation in the project teams and to understand how they can effectively participate was Pretty’s (1995) typology (Table 2). This typology helped identify the limits to participation in many project activities and highlighted differences in team members’ influence in decisions and the power relationships that sustained this influence. For example, the emphasis on passive and consultative participation meant the influence of individuals depended largely on the alignment of their views with the ultimate decision-maker’s perspective. However, while its description helped understand the continuum of participation in each project, assessing the level of participation in specific activities remained relatively subjective. Three reasons that often made it difficult to reach consensus with others and differentiate between different levels of participation using this typology alone are discussed below.

Firstly, the boundaries of the phenomenon being investigated needed to be clear. Was the focus of attention the whole project, the major sub-projects, or specific on-ground activities and communities-of-practice within the projects? Secondly, the types of participation varied over time. Indeed, participation fluxed with different participants and different stages of most activities. Consequently, participation was typically characterised by the highest level of participation achieved in the interaction of interest. Thirdly, the key distinguishing features of each type of participation were not always obvious in the descriptions provided. For example, consultative participation was differentiated from passive participation when people were asked their opinions. However, the differences to manipulative participation were unclear, and there was overlap between these three forms of non-participation and tokenism (Arnstein 1969) and participation by material incentive. This typology was subsequently reviewed to reflect the emerging experiences of the Farming Systems projects and efforts to assess their participation.

A new typology of participation in Farming Systems RDE

The new typology of participation in Farming Systems RDE extends that offered by Pretty (1995) and comprises both substantive and presentational modifications (Table 13). The left-hand column of Table 13 depicts the typology’s proposed ‘modes of participation’ and provides a brief description of each mode, an exemplar, and its implications for the practices of Farming
Systems RDE. Most importantly, the ‘characteristics’ of each type of participation were reviewed to identify the ‘discriminating attributes’ needed to avoid any overlap and develop an explicit and consistent progression. Pretty’s descriptions were resonant, but the discriminating factors that separated each level were often implicit rather than explicit. For example, descriptions of the information shared was explicit in passive participation, as was the nature of learning in interactive participation, but they were only inferred for the others. Consequently, ‘benchmarks’ for an explicit series of ‘discriminating attributes’ for each level of participation are listed in the right-hand column of the table. This series of discriminating attributes was proposed to understand and assess the equity and equality of involvement in initiating activities, communication between participants, overall decision-making, defining the initial content issues, defining the initial process, content reflection, and process reflection. Finally, these discriminating factors were developed into a ‘Checklist for assessing levels of participation in Farming Systems RDE’ that provides a series of prompts aligned to the discriminating attributes for each level of participation in this typology (Appendix 5). This extended typology does not represent a wholly new perspective of participation. Rather, it advances the existing typology by removing the overlap of Pretty’s (1995) typology and extends his underlying notions to the context of these Australian projects. Firstly, it contains the notion of ‘Isolation’ in which team members neglected to passively inform others of their activities. This completes a progression of the quality of communication and opportunities to influence content and process decisions:

1. Isolation - not informing people;
2. Passive - informing people;
3. Consultation – informing and consulting people but maintaining decision-making control;
4. Functional – sharing content decisions within pre-determined processes and major strategies;
5. Interactive – sharing decision-making for both content and process; and
6. Self-mobilisation – traditional ‘power-yielder’ initiates activities but embraces shared decision-making with stakeholders (including the traditional ‘power-wielding’ agencies).

Secondly, the new typology includes three other types of participation as variants within this central progression. The first two, intimidation and manipulation were evident within the teams’ interactions, while material incentive was most obvious in the interactions between the teams and farmers which are explored in Chapter Eight;

- Intimidation – an anti-participatory variant of isolation in which information is intentionally withheld to preclude specific participants’ input and influence,
- Manipulation – a disingenuous variant of consultation in which interest in other opinions is ‘simply a pretence’ (Pretty 1995), and
Material incentive – people contribute resources in return for incentives (e.g. inputs and money (Pretty 1995). This may occur at any level of participation. These incentives may indicate participants’ real interest and support activities with little lasting impact.

Finally, this new typology includes a distinction between participants’ learning about the ‘content’ (i.e. technical focus) and the ‘processes’ of project activities. This distinction is suggested in Chapters Seven and Eight to differentiate between functional participation with its content learning, and interactive participation with its content and process learning outcomes from equality in both content and process decisions. These different learning outcomes are inferred but not explicit in Pretty’s (1995) typology. However, they are included as important discriminating attributes in the new typology.

In sum, the development of this ‘Typology of participation in Farming Systems RDE’ was a catalyst and means to a better understanding of participation in the projects. The apparent overlap in Pretty’s (1995) typology was overcome by identifying discriminating attributes for each type of participation and the relative influence of participants in each stage of the RDE process. However, these attributes also highlight the consequent potential for single and double-loop learning (Argyris & Schön 1996) that arise from opportunities to share in the respective content and process decisions of investigations. Indeed, the importance of this distinction between functional and interactive participation emerged as a critical trigger to effective participation throughout the research in this thesis. Equality in both content and process decisions was to prove critical to capturing the potential of the informational diversity of the projects because of their accompanying paradigm and worldview diversity.

In conclusion, this new typology and accompanying checklist to assess participation (Appendix 5) provides a framework to explore, understand, and encourage dialogue on participation and its role in grains RDE. Notwithstanding the imperative to develop interactive participation for inter-disciplinary teams, sustainable development and the capacity for ongoing change, this typology includes the range of constraints discussed in the following section that will continue to determine the limits to participation in practice. It consequently provides a structure to consider the learning and behaviour that may emerge from the range of participation that may be expected in farming system projects. While this current analysis has emphasised participation within the project teams of scientists, the new typology also draws upon the subsequent chapters and their changing emphasis from overcoming the constraints to participation in these teams, to their development of participation and learning between the project teams and farmers.
<table>
<thead>
<tr>
<th>Modes of Participation</th>
<th>Benchmarks for discriminating attributes</th>
</tr>
</thead>
</table>
| **Isolation**          | 1. Little, if any, effort is made to provide information to stakeholders  
2. Agencies initiate and direct the activities  
3. Agencies determine a set process to address their own perceived issues/problems/needs/goals  
4. Agencies make or has already made decisions on what will happen/is happening |
| **Description:** No effort is made to raise stakeholders’ awareness of activities or decisions. Awareness results from stakeholders’ own initiatives or by chance  
**Exemplars:** Reviewing activities and decisions to pursue specific project activities, such as trials, with no direct consultation or publicity  
**Implications:** Most stakeholders are unaware of activities and have no opportunity to influence decisions. |
| **Passive**            | 1. One-way communication to provide information (from agencies to stakeholders)  
2. Agencies initiate and direct the activities for stakeholders  
3. Agencies determine set processes to address their own perceived issues/problems/needs/goals  
4. Agencies make or has already made decisions on what will happen/is happening  
5. Agencies provide information and may allow clarification of content/detail by stakeholders  
6. Stakeholders given no opportunity to influence decisions |
| **Description:** The prime focus is building stakeholders’ awareness of activities or decisions already made. Stakeholders are given information on what is happening, but their responses are not sought or considered.  
**Exemplars:** Seminars, lectures, mass communication and media events, field days, and demonstrations that may include questions for clarification, but not discussion.  
**Implications:** The relevance of content depends on how well people understand stakeholders and their needs. Announcements must be made widely to reach the intended audience. Passive participation provides stakeholders with a perspective that they ignore, reject or accept it. Any modification is the responsibility of individual stakeholders. |
| **Consultation**       | 1. Communication is one-way to collect information  
2. Agencies initiate and direct the activities for the stakeholders  
3. Agencies define issues, problems and needs  
4. Agencies define a set process to address their own issues/problems/needs/goals  
5. Agencies make final decisions on what happens/is happening  
6. Stakeholders have some opportunity to indirectly influence decisions by volunteering information/ideas/views/feedback  
7. Competition for time constrains the access to individual’s information/ideas/views |
| **Description:** Information, ideas, and views, including feedback sought from stakeholders so agencies can make better decisions.  
**Exemplars:** market research surveys, interviews, focus groups, working papers, reports or reviews for governing bodies, field days with open discussion sessions, and informal discussion at field days. At the ‘whole-of-project’ and strategic level, this covers many Farming Systems projects, where stakeholders are consulted (informally or by consultative committees), but not directly involved in decisions.  
**Implications:** Value to stakeholders depends on the skill of the consulting agencies to understand feedback, and their sincerity to honour and include it, or ignore it in decisions. Consultation can be used very well or widely abused. Decisions remain firmly with the agencies |
Table 13 (continued). A typology of participation in Farming Systems RDE

<table>
<thead>
<tr>
<th>Mode of Participation</th>
<th>Benchmarks for discriminating attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional</strong></td>
<td>1. Agencies define a known or tangible end-point. Alignment with stakeholders needs may be achieved by their involvement by self-selection</td>
</tr>
<tr>
<td><strong>Description:</strong> Agencies initiate stakeholder involvement to achieve their pre-determined end-point. This may be a greater stakeholder understanding of something the agencies already ‘understand’. Participation is a means to increase the efficiency of development and extension, by helping stakeholders to understand and adopt the agencies’ ideas (e.g. ‘I know the answer, here’s a way for you to figure it out for yourself’).</td>
<td></td>
</tr>
<tr>
<td><strong>Exemplars:</strong> demonstration sites, on-farm research trials in which agencies can predict outcomes, training and teaching events that have set processes with limited stakeholder influence on process decisions, such as most nitrogen workshops and action learning activities. At the ‘whole-of-project’ and strategic level, this covers many Farming Systems projects, where stakeholders decide the content issues of interest, but have little or no influence over how those issues are addressed.</td>
<td></td>
</tr>
<tr>
<td><strong>Implications:</strong> Functional participation can lead to great learning about content issues and improved stakeholder decision-making. However, it often results in the same RDE process being applied, rather than multi-method approaches where the context decides the most appropriate process. If agencies and stakeholders have different values and assumptions, functional participation may not address the stakeholders underlying needs. Lack of consideration of assumptions and values, and the influence on RDE processes separates functional from interactive participation and double-loop co-learning.</td>
<td></td>
</tr>
<tr>
<td>2. Agencies initiate and define the processes to address their own issues/problems/needs/goals, in this case, for stakeholders to reach the known or tangible end-point defined by the agencies. This may or may not be consistent with the stakeholders own issues/problems/needs/goals</td>
<td></td>
</tr>
<tr>
<td>3. Agencies facilitate structured processes which may allow stakeholders to customise it to their own situation</td>
<td></td>
</tr>
<tr>
<td>4. Structured learning processes with customisation allows partially integration of knowledge systems...ie propositional/local knowledge are combined to help stakeholders learn and develop their own situation specific answers. Stakeholders may contribute information and ideas that affect outcomes and decisions for actions</td>
<td></td>
</tr>
<tr>
<td>5. This customisation reflects the presence of some shared decision-making (e.g. how to apply to specific situation) but typically only after agencies have made any major decisions</td>
<td></td>
</tr>
<tr>
<td>6. Agencies do not develop new learning from stakeholders about the substantive issue/end-point</td>
<td></td>
</tr>
<tr>
<td>7. There is no explicit stakeholder reflection on the framework of the structured learning process itself</td>
<td></td>
</tr>
<tr>
<td>8. Communication is in the form of debate (i.e. a systematic contest of speakers in which opposing views are advanced)</td>
<td></td>
</tr>
<tr>
<td>9. Higher order inquiry into process and underlying assumptions may lead to defensive routines and reasoning.</td>
<td></td>
</tr>
<tr>
<td>10. There is no explicit stakeholder reflection on the framework of the structured learning process itself</td>
<td></td>
</tr>
<tr>
<td><strong>Interactive</strong></td>
<td>1. End-points are emergent and negotiated</td>
</tr>
<tr>
<td><strong>Description:</strong> Systemic and structured learning process in which agencies initiate co-working/learning opportunities to draw mutual benefit from the collective knowledge, perceptions and resources of the stakeholders. This includes joint planning and analysis of the content and processes of activities.</td>
<td></td>
</tr>
<tr>
<td><strong>Exemplars:</strong> Farmer groups that have planned and decided to pursue a range of different approaches to their issues. For example, some groups use of on-farm research and action learning activities for nitrogen have arisen from joint planning and analysis of activities.</td>
<td></td>
</tr>
<tr>
<td><strong>Implications:</strong> Farmers and Farming Systems project teams will learn about the content and processes used, and gain an appreciation of each other’s expertise, values and assumptions. At the whole-of-project and strategic levels, this may include representative stakeholders as full participants of management groups rather than consultative committees, and groups having opportunities for direct influence over strategic project decisions. Multi-method approaches are likely and indicate matching of processes to the situations encountered.</td>
<td></td>
</tr>
<tr>
<td>2. Agencies initiate the activity</td>
<td></td>
</tr>
<tr>
<td>3. Not dependent on agencies to continue</td>
<td></td>
</tr>
<tr>
<td>4. Joint definition of the issues, problems and needs</td>
<td></td>
</tr>
<tr>
<td>5. Tangible end-points emerge and specific answers are unknown to the agencies or stakeholders</td>
<td></td>
</tr>
<tr>
<td>6. Process jointly designed to achieve agencies’ and each stakeholders issues/problems/needs/goals</td>
<td></td>
</tr>
<tr>
<td>7. Involvement in definition of issues, processes, interpretation and decision-making are considered a right</td>
<td></td>
</tr>
<tr>
<td>8. Embraces multiple perspectives and shares experiences/knowledge as a source of understanding and learning</td>
<td></td>
</tr>
<tr>
<td>9. Agencies and stakeholders both develop new learning from each other about the substantive issue/end-point</td>
<td></td>
</tr>
<tr>
<td>10. Explicit stakeholder and agency reflection on the framework of the structured learning process itself</td>
<td></td>
</tr>
<tr>
<td>11. Communication develops dialogue with inquiry into values, assumptions, knowledge systems and inferences</td>
<td></td>
</tr>
<tr>
<td>12. May involve interdependent multi-method approaches with appreciation of individual contributions</td>
<td></td>
</tr>
<tr>
<td>13. High levels of ownership over activities</td>
<td></td>
</tr>
</tbody>
</table>
### Table 13 (continued). A typology of participation in Farming Systems RDE

<table>
<thead>
<tr>
<th>Mode of Participation</th>
<th>Benchmarks for discriminating attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-mobilisation</strong></td>
<td>1. End-point is emergent and negotiated</td>
</tr>
<tr>
<td><strong>Description:</strong> Systemic and structured learning process in which Stakeholders (may become the ‘power-wielders’ but/and) initiate co-working/learning to draw mutual benefit from the collective knowledge, perceptions and resources of other stakeholders which may include the agencies (traditional ‘power-wielders’)</td>
<td></td>
</tr>
<tr>
<td><strong>Exemplars:</strong> Local groups initiating their own RDE activities. Local farmer groups initiating market collectives with the support of agencies.</td>
<td></td>
</tr>
<tr>
<td><strong>Implications:</strong> The benchmarks described here are for a self-mobilised group that continues to foster interactive participation with its stakeholders. The most compelling implication is that self-mobilised groups (in which for example, farmers become the new power-wielders) face the same challenges as the previous agency power-wielders. Consequently, self-mobilised groups can mirror all levels of participation already described in this typology.</td>
<td></td>
</tr>
<tr>
<td><strong>1.</strong></td>
<td>End-point is emergent and negotiated</td>
</tr>
<tr>
<td><strong>2.</strong></td>
<td>Stakeholders initiate the activity independently from agencies</td>
</tr>
<tr>
<td><strong>3.</strong></td>
<td>Not dependent on traditional power-wielding agencies (or any single external resource/organisation) to continue</td>
</tr>
<tr>
<td><strong>4.</strong></td>
<td>Joint definition of the issues, problems and needs</td>
</tr>
<tr>
<td><strong>5.</strong></td>
<td>Tangible end-points are emergent (i.e. specific answers are unknown to stakeholders and the traditional power-wielder)</td>
</tr>
<tr>
<td><strong>6.</strong></td>
<td>Process jointly designed to achieve power-wielders and each stakeholders issues/problems/needs/goals</td>
</tr>
<tr>
<td><strong>7.</strong></td>
<td>Involvement in definition of issues, processes, interpretation and decision-making are considered a right</td>
</tr>
<tr>
<td><strong>8.</strong></td>
<td>Embraces multiple perspectives and shares experiences/knowledge as a source of understanding and learning</td>
</tr>
<tr>
<td><strong>9.</strong></td>
<td>Power-wielders and stakeholders both develop new learning from each other about the substantive issue/end-point</td>
</tr>
<tr>
<td><strong>10.</strong></td>
<td>Empty stakeholder and power-wielder reflection on the framework of the structured learning process itself</td>
</tr>
<tr>
<td><strong>11.</strong></td>
<td>Communication develops dialogue (i.e. disclosure and inquiry into values, assumptions, knowledge systems and inferences)</td>
</tr>
<tr>
<td><strong>12.</strong></td>
<td>May involve interdependent multi-method approaches with appreciation of individual contributions</td>
</tr>
<tr>
<td><strong>13.</strong></td>
<td>High levels of ownership over activities</td>
</tr>
<tr>
<td>*discriminating factor between ‘self-mobilisation’ and ‘interactive’ participation</td>
<td></td>
</tr>
</tbody>
</table>

**Additional levels of participation are:**

**Intimidation** - a variant of isolation. Where isolation may be unintentional due to the agencies’ ignorance of who stakeholders are, or potential impacts on them. In contrast, Intimidation is the intentional withholding of information. Examples in farming system projects include team members acting as gatekeepers. Desiring a particular outcome and knowing others have a different view, they withhold information to avoid the risk of others altering the course of action. This has seen people not informed of activities, or given too short a notice to become involved.

**Manipulation** - After Pretty (1995), a variant of consultation in which participation is ‘simply a pretence.’

**Material incentive** – as per Pretty (1995), where people contribute resources such as labour and land in return for incentives, typically inputs and money. For example, trials in the Farming Systems projects that only occur because free operational inputs such as fertiliser, seed, and soil tests are offered to participants. The incentives required may indicate the real level of participants’ interests in the activity which may have little lasting impact.
6.3 The emerging factors that shaped participation

Five sets of factors that shaped effective participation within the projects were identified through participant observation at team meetings and semi-structured interviews with individual team members: (i) demographics factors; (ii) organisational factors; (iii) informational factors; (iv) value related factors; and (v) worldview factors. These factors aligned closely to the domains of diversity identified in Chapter Five and inform the practice of participation in each project team as they work towards sustainable development.

6.3.1 Demographic factors

Each project comprised approximately 10 fulltime staff equivalents across 20 people, and annual funding of $500 000 from industry and up to $1 500 000 from government. Considerable demographic diversity was inevitable. However, team members identified the project size, location of staff, and gender as the significant constraints to participation in the project teams.

Project size and location – Interactive participation in large projects requires much more communication than smaller, less participatory projects. The effort to maintain communication increases exponentially with staff numbers and underscores Schumpeter’s (1943) rationale for representative democracy. As team members noted, the ‘project is so big, it’s been hard for roles and responsibilities...(especially) having people so far (400 km) from project activities’. Geographic diversity was intended. Yet, these distances constrained ongoing communication and the incidental understandings that develop with proximity within organisations (Marsick & Watkins 1990). Having many staff in large centres isolated from authentic project activities only exacerbated the problem. Without regular team meetings to help people established relationships and understand local officers’ needs and capabilities, many team members simply continued to work within their existing organisational networks. It was easy for people to simply avoid team members with alternative views. Consequently, it appears that the number and location of project staff can influence the nature of participatory practices.

Gender relations – The projects were male dominant and several female officers in one projects believed they were ‘taken less seriously’ because they were women. This lack of influence was observed in several project meetings when their suggestions were ignored, but strongly endorsed when later raised by others. The cause appeared to be their philosophical views which differed to those of the project leader and several ‘trusted’ people of influence. In each case, the female officers advocated higher levels of participation with farmers and less directive action by the project team. Yet, the women involved believed it was not about different views of process, but were adamant it was gender based. They believed this was unintentional and simply reflected some older males discomfort in dealing with women. So, it seems factors associated with age and gender shaped the participatory processes of the projects.
In sum, demographic factors stood as important variables in understanding how participatory practices within RDE projects proceeded. They might have been managed by locating as many staff as possible in key project centres, not 400 km away. While experienced specialists may be reluctant to move to isolated region centres, participatory projects need a presence in their communities to develop authentic activities that involve other team members. They also need regular team meetings so people can get to know each other. People cannot be expected to engage to any significant degree with people they have not met, or see once a year. Finally, when teams do meet, they need internal processes that ensure all participants have the opportunity to contribute. Indeed, there are many other factors, including organisational factors that must then be considered to develop effective participation in Farming Systems projects.

6.3.2 Organisational factors
The projects were created to build cooperation between the RDE agencies and reduce perceived duplication of their efforts. Yet organisational factors associated with staff, their visions and organisational structure were identified as shaping the development and continuity of their partnership. Many of the teams-within-teams in each project were aligned along organisational lines, and involving several organisations only amplified the other organisational constraints to effective participation that loomed large for many team members.

Staff time and continuity – Staff time commitment was a major constraint to participation. Each project typically had three or four full-time members, while people’s commitment ranged between five and 50%. Indeed, opportunities to participate often depended on the competing interests and dispositions of these team members who had limited time to be involved or involve others in their activities. As team members observed, ‘it’s hard to get commitment if people have small time allocations’, especially if their involvement was not negotiated, and distracted them from their primary technical interests. This constraint is easily overcome. Indeed, there was consensus that a majority of staff should have at least 30% to 50% time commitments to the projects with essential specialists brought in as required.

There was also consensus that effective project leadership was a full-time job. Yet, project leaders’ commitments varied from 10% to 100%. As one leader confessed his 40% commitment was not enough, ‘I’ve come to realise…admit, these projects need a leader able to commit 100% of their time.’ Anything less limited the team leaders’ participation and the opportunities they provided for others to participate in major decisions. Indeed, the leaders’ time commitments and management styles interacted to shape participation in each project. Limited time for the more inclusive leaders reduced the alignment of activities to the projects vision and resulted in people pursuing their own interests. However, for consultative leaders with largely
predetermined agenda, low time commitments simply precluded wide consultation and resulted in passive participation. Team members in one project lamented that, ‘it would only take 10 minutes each week to ring up and see what’s going on’. However, a 10% commitment was insufficient to avoid a complete breakdown of communication and ensure that the most obvious problems were addressed in one of the projects. Team members later said, ‘something should have been done earlier about teamwork, communication and management problems, (and) people knew of problems and didn’t do anything.’ However, the resulting staff turnover and delays in filling vacancies led to a breakdown of relations within the teams and encouraged people to ‘do their own thing.’ Such poor management promoted independent activities, not the participation and interdependence expected in real teams (Katzenbach & Smith 1993). In this way, staff time and continuity influence the development of RDE projects.

**Project structure** – structuring the projects around organisational groups and RDE methodologies constrained participation between the resulting communities-of-practice. As members of the Western project almost unanimously declared, ‘communication, the module structure and geographic problems leave any others for dead.’ Indeed, these original structures were reinforced in each project as the emerging communities-of-practice identified problems they could address with their existing skills. Overcoming these structures then depended on the projects members’ ability to identify problems of mutual interest that required cooperation. While steering groups and management committees were formed in two projects, team members’ participation in them was passive and consultative for strategic decisions. Both steering groups became dysfunctional and project leaders subsequently relied on informal groups within each project for advice. These groups again tended to include people with similar views and reduced the participation of others until major decision had been made. Team members in one project believed the ‘power-base’ resided in ‘two people, (and) allows people to hold onto their paradigms’. The original project structure and the leader’s lack of participatory intent precluded greater participation. Critically, future project leaders must understand and support interactive participation. They must also structure projects around the shared problems and outcomes required by industry, not their organisational groups or RDE methodologies, so staff with the required skills can be matched to the problems, not vice versa. Hence, project structure shapes the operation and success of participatory processes.

**Visions, roles and responsibilities** – Only one project team had a vision more specific than improving the sustainability and profitability of farming systems. Consequently, many team members were unsure how their different activities aligned and contributed to the ‘big picture’. As one team member put it, ‘I’d like to know where I stand and what’s expected of me.’ Without a shared vision, each project team developed a ‘distributed responsibility’ with little accountability for the overall project outcomes. Consequently, people worked on their own
activities to improve sustainability and profitability as they thought best. Participation across activities was not emphasised and individual achievements were rewarded. Indeed, participation across the projects was constrained by the lack of collective recognition and reward systems. The host agencies’ system of rewarding individuals and their achievements was not encouraging team effort and participation. Despite the rhetoric of each agency, host agency feedback to team members’ applications for promotion included advice to ‘do less work in teams and focus on individual achievements’. Each project needed a shared vision and agreed roles and responsibilities for all team members. Team members needed to understand how their activities aligned and contributed to this vision and a reward system with collective accountability and recognition for the team, not just individual achievements, to encourage rather than constrain their participation (Johnson & Johnson 1997; Katzenbach & Smith 1993). Therefore, clear goals and the degree to which they were shared across the projects were major determinants of effective participatory engagement in these projects.

**Organisational multiplicity**

The projects represented an unprecedented, but under-utilised opportunity to access skills in other agencies. Indeed, the failure to participate effectively across RDE agencies was identified by 19% to 50% of each project team. Participation across the agency-centred teams-within-teams was typically passive or consultative, and involving multiple organisations may have simply amplified other constraints to participation. Faced with these constraints, it appeared that many team members simply defaulted to their existing intra-agency networks rather than develop new networks across the rest of their projects. Their empathy and understanding from existing relationships made these networks easier and more efficient to use. Indeed, team members suggested that new networks and relationships could be difficult to establish due to, ‘some pretty difficult barriers to break down...demarcations put in place over the last 10-15 years for competitive reasons...because its been a competitive approach between organisations for funding. But those became professional barriers (and) I am personally not going to try and break them down.’ It would be difficult to cross these boundaries established from many years of agencies using different RDE approaches to compete for scarce industry funding. A significant number of staff recognised these agencies differences and believed it was not worth the effort, especially with a lack of two-way communication in some projects,

> people on either side have divergent philosophies and both think they are right...(Its) not being discussed and that’s not collaboration

> (you) need to know what each other’s doing, but pushing (four institutions) into one project is naïve. Its laboursome...it doesn’t make sense
This ambivalence in team members’ dispositions to participate across agencies was accentuated by the priorities, hierarchies and reporting structures of each agency that further constrained participation within each project. Firstly, as noted above, most organisations rewarded their staff’s individual achievements within each project, and the profile of their agencies more than overall project achievements. Secondly, with these individual reward structures based in each organisations, their internal decisions and demands for people’s time often took precedence. This was exemplified by organisations managers regularly maintaining staff vacancies that improved their internal budgets but severely compromised the Farming Systems projects. The external funder’s decision to contract the individual agencies within each project reduced the project leader’s capacity to call other agencies to account. Requests by senior project staff to fill vacancies were rejected and individuals were pressured to ‘toe the agency line’. Finally, each agency had small teams working on existing issues at the start of the projects. Some simply used the projects as convenient funding to conduct this work. They already knew what they wanted to do and how to do it with little participation from the wider project team.

It is concluded from the evidence gathered through observing and questioning participants, that participatory RDE relies on effective relationships and quality communication between team members and stakeholders. Organisational factors shaped participation in each project and subsequent opportunities to utilise team members’ diversity to improve the projects. Project structures and organisational arrangements must consequently foster participation and provide opportunities for people to contribute their ideas across activities. For example:

1. Most staff should be co-located in the project area with time commitments approaching 50% to ensure sufficient time to establish and maintain their relationships with teammates and stakeholders;

2. Project leaders should be full-time to avoid competing interests;

3. Projects should be structured around the shared problems and outcomes required by industry, staff’s organisational groups or preferred RDE methodologies;

4. Steering committees and all project staff should develop a shared vision and be explicit in how proposed activities integrate to contribute to the vision, not just their contribution in isolation. The use of log-frames to link proposed project activities, their contributions to aims, and their key assumptions may be useful (Dart 2005);

5. The steering committees and all project staff should review and decide the projects portfolio of activities before work begins. Critical viewpoints and linkages can then be incorporated, not treated as comments for each of the ‘teams within teams’ to consider;

6. Only involve staff who are interested in working across agencies and have not built up barriers over many years. New staff, or mid-career officers who are established in their fields and looking for new challenges may be ideal;
7. Reward overall project achievement and ensure project outcomes meet individual agencies’ aims to avoid conflicts of interest for staff; and
8. Hold agencies accountable for their contracted staff commitments - for example, suspending funds for positions left vacant for over 3 months.

Organisational factors are therefore crucial to prospects for effective participatory RDE projects. In particular, projects must be structured to meet their goals and involve appropriately skilled and interested staff with sufficient time to make a significant contribution. In sum, organisational imperatives cannot guarantee interactive participation, but may minimise organisational constraints or excuses for not taking the opportunities to participate that are envisaged in modern farming system approaches. Consequently, they will help utilise the project teams’ informational diversity that also constrained participation in the projects.

6.3.3 Information factors

Industry’s imperative for the projects was to better integrate RDE activities and reduce their duplication of effort. Farming system approaches explicitly aim to capture and integrate the technical knowledge and process understandings of the teams and their stakeholders (Gibbon 2003). However, participation across the projects was paradoxically constrained by two aspects of this informational diversity and its management.

**Technical expertise and skills** - technical expertise presented no apparent constraint to participation in the projects. The teams’ collective interest in science and agronomy to improve regional farming systems was a unifying force and overcame the specific language differences of their technical specialties. However, the duplication of skills reduced the need for people to meaningfully participate with staff from other organisations. Indeed, people sought participation from people with specific skills when they recognised they were needed. For example, the wide involvement of key people with modelling, simulation and evaluation expertise was attributed to activities needing them to achieve their objectives. Consequently, participation in Farming Systems projects should involve removing unnecessary duplication of skills and negotiating complementary skills with clear roles and responsibilities. This may overcome many apparent organisational constraints that some team members suggested were simply excuses for individuals’ lack of interest in participating with others. It follows that technical expertise and skills are important factors in shaping the likely success of participatory processes in RDE.

**Processes for facilitating participation** - Each project contained diverse RDE process skills but little direct experience in Farming Systems RDE (Table 7). Indeed, team members had little theoretical understanding of knowledge construction and learning. There was an apparent lack of considered processes to facilitate participation and integrate participants’ knowledge.
Discussion was ubiquitous and typically ended in advocacy about ‘what are we going to do,’ without inquiry to first understand issues and frame agreed problems. Consequently, people often felt they lacked influence in decisions as others used their specific knowledge as a source of power in team decisions. The language of advocacy, such as ‘as we all know,’ ‘no we’ve tried that and it doesn’t work,’ and ‘you’re wrong, wrong, wrong’ intimidated some team members who then ‘opted-out’ without contributing their ideas or clarifying other’s views. Some intimidation may have been unintended. However, without clear protocols and processes to ensure opportunities for participation, many deliberate ‘power-plays’ developed. For example:

- Stopping people attending key planning meetings - Supervisors directed technical staff not to attend some activities, saying ‘(it’s) a waste of time...nothing will come of it.’ Yet, others used less professional methods to prevent people with alternative views attending critical planning meetings. Indeed, prefaced with the proclamation ‘not that I don’t want you stay,’ a senior officer said he had spoken to the owner of their transport and there was not enough room for the person to get home if they stayed for the meeting. This was surprising because transport had already been arranged with the car owner who still had spare seats;

- Ignoring other team members’ plans - A senior member of one project was impatient to establish research trials, but the local officer first wanted to establish rapport with farmers and determine their priorities. The senior officer suggested to a trusted colleague that they simply establish the trials they wanted anyway, ‘he wanted me to go straight over the top of him...said that bloke’s never going to come around. If you’re going to do on-farm research, you’ll have to do it yourself. I said I’m not...he’s coming with me or I’m not going at all...and I don’t mind if it takes me 2-3 years’. Fortunately, the trusted colleague subsequently acted as an intermediary to resolve the situation.

These instances were attempts to preclude people’s opportunities to participate. Indeed, people do not always yield to such ‘power-plays’ but they may undermine trust and lead to relationship conflict that damages performance in teams. The project teams needed clear processes to avoid these situations and ensure key project decisions were transparent with the opportunity for all team members to participate. Yet, a final example demonstrates that such processes cannot guarantee participation. For example, an officer in a remote district lacked confidence and was uncomfortable with other team members attending activities. Indeed, the officer consistently used a passive-aggressive approach to constrain team members’ participation in activities. Meetings with farmers were typically organised for Friday afternoons with short notice to discourage other team members attending, and agency staff external to the project canvassed beforehand to avoid needing team members with the necessary expertise. Despite offers of assistance and ongoing support, this officer’s avoidance of teamwork and closer relationships...
with other team members led to further isolation over time. The experience reaffirmed that participation is a two-way process (Billett 2002) and even the best processes can only provide people with the opportunities to participate. People must want to participate and be able to accept the help and support of others. Participation cannot be forced.

It is concluded from this analysis that the dominating informational influence on participation was project members’ experience with processes to facilitate participation. Most had difficulty achieving high levels of participation with their diverse technical knowledge, values, RDE paradigms and worldviews. One officer with formal training in participatory RDE concluded, ‘we’re having trouble understanding and using the interaction of different knowledge systems...we need processes to help.’ The move towards participatory RDE had been made with a limited understanding of how these approaches work (Vanclay 1994). Participation was constrained by this limited understanding and the teams’ lack of processes to overcome their defensive routines, develop dialogue and shared visions, and encourage equity and equality in decisions. While (Day 1997) suggests all planners should be acquainted with the notion of participation, these project teams and their leaders needed a broader understanding of Farming Systems theories. The projects were always expected to be a learning exercise for participants. However, the greatest need to learn was in developing processes that supported participation and knowledge construction amongst diverse participants. This need was reinforced by the different visions and goals that emerged in each project. In sum, informational factors were confirmed as important to develop and sustain participatory RDE with productive outcomes.

6.3.4 Value factors

The informational diversity of participants had always been explicit as their content and process expertise was a key selection criterion for the initial team composition. Yet, the accompanying values diversity of these team members was highlighted in Chapter Five. It may not have been as explicit, but this values diversity precipitated both task and process conflict. Indeed, these conflicts became intertwined with team members’ dual foci on improving farming systems and improving the RDE process. Team members had different goals and pursued them with others who shared them. As one project leader observed, ‘we all had goals, but they all differed…the challenge is to be on the same wavelength and going for the same goals.’

Differing goals and visions – the ‘teams-within-teams’ in each project illustrate how people pursuing their own goals constrained participation across the projects. Lacking a shared vision for each project, these ‘teams-within-teams’ pursued their own interests. Nobody can tell an individual what their vision should be. Nevertheless, some ‘alignment’ of visions is needed for the synergy and potential for learning that make teams attractive (Johnson & Johnson 1997). Otherwise, anarchy and competition of individuals pursuing their independent goals may result...
A shared vision could help overcome project members’ demographic, organisational and informational constraints to participation by providing a reason to integrate activities and value-add to each other’s activities (Senge et al. 1994).

However, developing this shared vision and maintaining an alignment of goals may have become burdensome for the activists who dominated all teams. Silence was sometimes taken as agreement, and people’s reluctance to engage in real dialogue before acting resulted in miscommunication and failures to participate. However, acceptance of passive-aggressive ‘non-participation’ by some team members challenged the basis of participatory approaches, and not managing ‘difficult’ people who preferred to do their own thing is ultimately an unacceptable constraint to participation. In one case, people meant to be working together in critical positions failed to have a single ‘work discussion’ over three years. As one of them admitted, ‘I still have some communication problems with some staff in the team and we’ve never sorted them out properly, but gone and done our own things. So underlying tensions are there, and it’s not just me feeling it…its two-way.’ In another case, people did not even know who was working in major parts of their project. The lack of consequences for not participating or undertaking key job tasks was a constraint to wider team participation in some areas of the projects.

Projects need staff committed to their vision and aims to be effective. This is critical for innovations, in which participants’ passion is a key to such success (Shadish, Cook & Leviton 1991). Yet, the individuals appointed to these projects had commitments to Farming Systems RDE and participation that varied from a driving passion to make it work, through mild interest in its feasibility, to a conviction that participatory projects were a waste of time. The impacts on participation were obvious. Indeed, all projects needed the momentum of having most team members committed to the cause. Even ambivalence is a constraint. Effective participation cannot be forced, so recruiting staff with an interest in participatory RDE is essential.

6.3.5 Paradigm and worldview factors

Participation continued to be lower across RDE disciplines than across different technical specialties. Scientific knowledge from all team members was easily shared. However, integrating their scientific biophysical principles and sociological perspectives on farming systems development remained difficult. As one researcher asked, ‘How can we underpin farming systems with strong scientific principles, yet be well integrated with sociological principles? It’s incomplete unless you have both. We are still grappling with this…we’ve made substantial progress…slowly, but it’s a change of culture to accept that we need both.’ Progress was being made, but it was difficult and frustrated people. Constraints to participation emerged from RDE methodologies becoming individuals’ paradigms for all RDE, and positivist worldviews that struggled to appreciate others’ paradigms.
**Differing RDE paradigms** - the consistent development of smaller homogeneous communities-of-practice illustrates the attraction of people to similar perspectives. However, this methodological and paradigm monism within groups constrained their participation across each project. People used their own paradigms and standards to judge other activities, and were far less willing to try to understand other paradigms. As team members of the Western project observed, their inevitable task and process conflicts often developed into relationship conflicts with a loss of trust between members in each of the project’s modules, ‘we were all very “modulated” and thought about our own modules (RDE paradigms). Differences in opinions, theories and approaches are good, but there’s mistrust all the time...(its) “us” and “them”.

Whilst oversimplified, the most apparent distinction was between quantitative research inquiry seeking internal validity and truth, and more qualitative extension perspectives emphasising external validity and sense-making with farmer participation and farmer experience. Most individuals consequently retreated to activities in their own comfort zones and privately criticised the operation of other activities. The projects subsequently operated as parallel multi-disciplinary activities, not inter-disciplinary teams. This analysis shows that paradigms play a significant role in the likely success of participatory processes. Indeed, teams containing different RDE paradigms may help participants see their own and others’ paradigms. However, developing individual’s fundamental appreciation of their own and others’ paradigms may require more inclusive or participatory worldviews (Vickers 1984).

**Worldviews** – The different RDE paradigms reduced participation. The apparent underlying constraint was individuals’ unwillingness, or inability, to try and appreciate alternative paradigms. As team members observed, ‘the FSR paradigm doesn’t suit everyone and really grates some people...its not real research, but we’re being told to do it. (Indeed), there’s an old fashioned element in the project...people who don’t agree with new methods.’ The lack of transparent processes to facilitate an appreciation of other paradigms surely contributed. But, little effort can be expected without a real disposition to learn. The predominant positivist worldviews present dilemmas for the projects. Firstly, some staff complained they undermined more participatory efforts with farmers, ‘we want to help people learn and go through some options...help them gain self-sufficiency. (But other team members) just give answers!’ Secondly, modern farming system approaches developed in direct response to the ToT approach and positivistic worldviews. Early positivist farming system researchers used participation to gain adoption of their own technical solutions, but constructivist thinking of soft systems approaches and the use Participatory Action Research helped to integrate all types of inquiry (Petheram & Clark 1998). Yet, most team members and leaders of the current projects were grounded within positivist perspectives and this makes progress beyond a positivist ToT approach difficult. The inevitable participation to improve adoption may improve the projects’
effectiveness and efficiency, but is unlikely to develop beyond functional participation to interactive participation and sustainable development. From this analysis, it appears that participants’ worldviews underpin the likely outcomes of ‘participatory’ projects. It is consequently proposed that constructivist perspectives are ideal for effective Farming Systems RDE and may be almost mandatory for project leaders.

6.4 Conclusion: participation for better ‘adoption’

The current projects were intended to develop participation and learning between scientists, and between these scientists and farmers. The diversity identified in Chapter Five provides huge opportunities for learning in these projects and understanding how participatory processes may proceed. Paradoxically, it has been shown that this same diversity shaped their prospects for effective participatory practices through factors associated with demographics, organisation, information, values, paradigms and worldviews. Participation between scientists consequently broadened as individuals became part of a larger network, gained awareness of others’ activities, consulted specialists in other agencies, and were exposed to different ideas on how to conduct RDE. Yet, the practice of participation in each project failed to meet the expectations of some staff and fell well short of the ideals espoused in modern Farming Systems approaches.

Participation was observed to progress from the past isolation and passive approaches towards more consultation and functional involvement. However, there remained little joint analysis across the projects. The projects have largely employed ‘hard’ systems analysis in a series of parallel multi-disciplinary activities for farmers. They had not become inter-disciplinary teams that sought multiple perspectives and reframing of problems through structured learning processes (Pretty 1995). Some teams-within-teams in each project developed interactive participation. However, these communities-of-practice typically attracted participants from existing organisational structures, with similar values and RDE paradigms. Indeed, their mostly positivist perspectives apparently constrained participation between these communities as each applied the ‘best’ methodology, their own, and passively informed others of their progress.

Pretty’s (1995) typology helped investigate the participation that developed across the projects. However, the research findings suggests that it is necessary to advance this existing typology by removing apparent overlaps and extending its underlying notions to the context of participatory RDE in Australia’s developed agriculture. Thus, a new ‘Typology of participation in Farming Systems RDE’ is proposed.

Identifying the factors that shaped participation provides a better understanding of opportunities to develop participatory RDE processes. This understanding may be valuable to developing new projects by recruiting key staff with constructivist perspectives and a belief in participatory
processes, developing a shared vision with clear roles and responsibilities for each organisation and its individual staff, co-locating staff with major time commitments in the project area, and developing structured processes to support participation and learning opportunities for all staff. However, the extent to which the current project teams could address these constraints and participate more effectively remained to be seen as peoples’ values, paradigms and worldviews are notoriously resilient and unlikely to change in the short-term (Dick & Dalmau 1999). Progress required the development of better processes to understand and facilitate participation between team members. However, the development of interactive participation will ultimately depend on individuals’ ability to break free of Freire’s (1970) ‘pedagogy of the oppressed’ and provide other team members with opportunities for greater participation. It is also likely that people’s management of the participation of team members will be reflected in the opportunities they provide for farmers’ participation in their activities. This development of ongoing participation within each team, and between the teams, farmers and others is the focus of Chapters Seven and Eight respectively.
Chapter 7. Participation for learning in teams

The initial levels and factors that shaped participation in the Farming Systems project teams were clarified in Chapter Six. Participation between agencies and RDE disciplines had increased as individuals were often consulted and had some equity in their projects. They were no longer passive recipients of information provided by others in articles and conferences. However, this consultation was failing to meet some team members’ expectations of equality in project decision-making, and interactive participation to learn from each other. Indeed, these multi-disciplinary projects operated as a series of diverse, but parallel activities that did not necessarily enhance participatory practices across their projects. The teams’ participation subsequently focused on increasing farmer adoption with their existing methodologies, but participation for collective action, empowerment and institution building was not apparent (Pretty 1995). Whether this interactive participation could be developed over time remained to be determined. Research into how teams can develop effective participation was continued through the final research sub-question of this thesis:

What is the consequent learning and behaviour of participants in Farming Systems RDE?

Three interventions, or case studies, are reported in this chapter to further develop, explore, and provide some understanding of the ongoing participation and learning within the RDE project teams. In the first case study, an evaluation framework that highlights opportunities for all participants to help plan, manage and evaluate the projects is described. Secondly, the nature of team learning in each project, that is, the extent to which they operate as fragmented, pooled or synergistic teams (Kasl, Marsick & Dechant 1997) is then reported. Trouble reconciling the observed behaviour and the teams’ self-assessments of their learning processes was the catalyst for the final case study presented in this chapter. A series of semi-structured interviews was subsequently used to clarify the teams’ participation, the learning that arose from it, and changes in their behaviour towards the end of each project.

The conclusion drawn in this chapter is that the teams’ learning and behaviour was a function of their diversity and participation: that is, the level of learning in teams was the product of the nature of their diversity, and the levels of participation achieved to utilise this diversity. These levels of participation in diverse groups determined the subsequent levels of their learning. For example, consultative participation in teams with diversity in values and RDE paradigms created damaging conflict; interactive participation with dialogue and equality in process decisions was required to support participants to understand each other and coordinate their actions to meet their respective aims (Habermas 1971). However, it is concluded from the investigation of the projects’ impacts, that learning through participants’ existing meaning schemes and extending them to new contexts (Mezirow 1991) may meet many of the projects’
aims. For instance, farmers and scientists sharing their existing experiences led to major practice changes. Consequently, planners must address the outcomes desired by stakeholders to develop projects with the appropriate diversity to achieve these outcomes without unnecessary conflict.

7.1 Evaluation as a catalyst for participation

The establishment of an evaluation project (from which the data in this thesis was drawn) recognised that evaluation and reflection on projects’ impacts and processes were critical to improving Farming Systems approaches (Gibbon 2003; Packham 2003). Consequently, evaluation principles and tools for Farming Systems RDE were developed, the processes of the projects evaluated, and their impact on practices were assessed to help understand how participatory RDE should be enacted in Australia’s grain industries (Lawrence 1997a). In this section, several key evaluation interventions are analysed to develop insights into the contribution of evaluation to participation within the project teams. Elements of participatory practices were revealed to team members through the resulting evaluation framework which became a catalyst for participation and encouraged additional opportunities for them to influence decisions in their projects.

7.1.1 Establishing the evaluation context

The initial evaluation interventions were based on team meetings, focus groups and semi-structured interviews to establish the evaluation experience, information needs, and evaluation process requirements of team members, their managers and funders. These interventions confirmed the inherent diversity of participants’ experience, perspectives and values as identified in Chapter Five. As indicated in Section 5.1.2, all participants wanted to improve farming practices. However, their emphases of the ecological and economic impacts of these practice changes, farmer and scientific learning, and the social impacts of participation in RDE processes varied. Also, while few people had first-hand evaluation experience, most asserted it was important to improve their activities and communicate the benefits to their stakeholders. Consequently, focus groups were used to discuss ‘what the evaluation process must and must not do’ and negotiate five guiding principles for evaluating the projects:

1. To be a simple and natural part of each project…not an adjunct or burden on staff;
2. Cover the projects’ life with regular feedback…not be continually deferred and late;
3. Be participatory and involve all stakeholders…not exclude groups or individuals;
4. Develop a reflective learning culture for improvement…but not become negative;
5. Consider the projects’ processes…but not ignore outputs and outcomes; and
6. Maintain a balanced perspective and respect others’ views…not sit in judgement or impose ideas.
These principles emphasised an iterative participatory approach for reflection and the ongoing development of Farming Systems RDE. Yet, the practice of evaluation was different. While most individuals asserted that evaluation be incorporated into each activity, they typically avoided it when developing their own activity plans and even described it as ‘scary’. Consequently, evaluation was almost non-existent, and despite proposing Participatory Action Research as their core methodology, there was little apparent observation or reflection to inform each cycle of planning and acting in the projects’ first year. Indeed, few teams conducting on-farm research established baselines of participants’ knowledge of research issues, the specific information sought, or their current management practices. Few team members were able to clarify what they, other team members, or farmers wanted to learn from their research. These symptoms of limited participation questioned the teams’ ability to integrate their knowledge systems and challenged their espoused theories-of-action for participatory RDE.

The challenge for the author (the evaluation project leader) was consequently broader than developing evaluation processes to fit the projects’ existing ‘participatory’ methods. It was an opportunity to encourage more participatory processes and a more evaluative culture for learning across the projects. This is not always easy as ‘evaluation’ may fail to support team learning by creating information overload, or reinforcing single-loop learning and defensive routines to save ‘face’ (Turner 1998). As Feldman (1986, cited in Hitchener et al. 2001) observed, everyone wants to learn but nobody wants to be wrong. Indeed, successful professionals often avoid evaluation or fall into doom-loops rather than learn from the results (Argyris 1991). It was concluded that participatory evaluation processes would be of little value without first developing a real and shared desire to evaluate activities. The evaluation project leader subsequently began activities to encourage people to reflect on and evaluate their work, and contribute to developing evaluation processes for Farming Systems RDE. It was hoped that iterative reflection and development would progress this initial functional participation in evaluation towards the interactive participation desired in modern Farming Systems approaches. These processes were deliberately introduced and monitored in the projects.

7.1.2 Early evaluation experiences

The semi-structured interviews discussed in Chapter Six established team members’ initial, or ‘baseline’, understandings of Farming Systems RDE and their current practices. Activities also evaluated the projects’ impact on farmers’ knowledge and behaviour. These early interventions were developed with team members to ‘evaluate’ their priority activities and encourage their interest in evaluation. The relative success of these interventions shaped the participation and subsequent evaluation activities in each project. For instance, evaluation was widely accepted in action learning activities after the initial soil water and nitrogen evaluations demonstrated their impact and support from farmers (Christodoulou 2000). However, successive iterations of these
Interventions also informed the development of an ‘Evaluation framework to support ongoing participation and learning in Farming Systems RDE’ that was used to plan and evaluate on-farm research activities across the projects, and develop the quantitative evaluations of farmer learning and behaviour that are reported in Chapter Eight. These early interventions, which are discussed below, included customised impact surveys for discrete project activities, major evaluations to establish baselines for on-farm research activities, and qualitative whole-of-project evaluations with collective interpretation of results with the teams.

**Impact surveys for discrete project activities** – The early evaluations were developed and conducted with team members who had little evaluation experience but wanted to ‘evaluate’ their activities. Functional participation was subsequently used to develop ‘exit surveys’ that assessed participants’ motives for attending workshops, field days, and bus trips; their assessments of these activities; and the impact on participants’ learning and behaviour. Essentially, the evaluation project was used to provide basic evaluation processes and rating scales, but facilitate team members’ decisions of the key issues to evaluate and wording of questions. Individuals sometimes consulted other team members who then contributed to the design and interpretation of the evaluation results. However, evaluation results were managed like other project information and typically distributed to the whole team after the event. Team members appeared most interested in whether participants believed their activities were ‘useful’ and were relieved if they could report that evaluations had been conducted. Their lower interest in, and subsequent failure to establish participants’ knowledge and practices at the start of activities became a priority because increased understanding and informed decision-making is critical to Farming Systems approaches (Christodoulou 2000).

**Establishing participants’ initial knowledge and practices** - Semi-structured interviews with team members highlighted the lack of information about participants’ knowledge and practices across the projects. Indeed, many on-farm research activities had established trials without clarifying each group’s initial understanding of their research issues, or their current management of these issues. For instance, the Central project team recognised this deficiency and approximately half the team took the opportunity for interactive participation to develop an evaluation template to establish the understandings and management of the research issues within each grower group. This template (Appendix 6) comprised a modified ‘Strengths, Weaknesses, Opportunities and Threats (SWOT)’ analysis to engage farmers and document their knowledge, attitudes, skills, aspirations and practices in relation to their research issues (Kelly et al. 1999). It was proposed that this approach could help document the farmers’ current and initial perspectives in line with Bennett’s (1976) Hierarchy, the dominant evaluation framework in agricultural RDE. While team members initially believed that farmers were not interested in evaluating their progress, observations indicated that farmers enjoyed sharing their
knowledge of research issues. Indeed, several farmer groups suggested the meetings were amongst their best in the project because the process facilitated input to the ‘strategic’ direction of their activities. For example, farmers’ rationales for each research activity, their initial understandings of the research issue, and their qualitative assessments of the project so far were clarified for each group. However, the meetings also confirmed concerns that had previously been dismissed as individual team members ‘white-anting’ the project. For example, concerns about the project’s scientific rigour were subsequently addressed by a ‘peer review’ in which team members and participating farmers assessed each other’s research programs. Research designs without appropriate randomisation and replication were subsequently rectified.

These evaluation meetings achieved more than to establish belated ‘baselines’ of participants’ initial knowledge and practices (Lawrence & Kuskie 2002). They achieved three other purposes. Firstly, they catalysed greater participation and critical reflection within the team as individuals accepted the opportunity for interactive participation to develop, conduct and interpret the evaluation. Group facilitators adapted this general process to match their group’s research issues and invited other team members to help conduct the evaluation. This helped team members understand the project’s activities and provided them with a ‘voice’ and greater influence in project decisions. Secondly, the evaluation template provided a process to help other project teams draw out and clarify their participants’ knowledge and practices during on-farm research activities. These initial questions then became prompts within the evaluation framework to clarify participants’ initial understanding of research issues. Thirdly, the evaluation activity set a precedent for participation in other project activities and highlighted the contribution that participatory evaluation could subsequently make throughout the projects. A similar approach was subsequently used to develop and conduct an ‘interim’ evaluation of the Western project.

**Collective interpretation of evaluation results** - This interim qualitative evaluation was conducted in preparation for the mid-term review of the Western project by its industry funders. Some of the discrete activities had been evaluated as described above, but the project ‘as-a-whole’ had not. The project leader consequently decreed that an evaluation would be done. The initial process was suggested by the evaluation project, while the specific questions and logistics were decided by the team, exemplifying functional participation. The team supported the decision to conduct a qualitative evaluation that identified their major impacts prior to their review, and the need to quantify these impacts with detailed surveys towards the end of the project. Details of the survey process were described in Section 4.3.6. However, it began with a brainstorming session that provided all team members with input to the bases for evaluating the project, and reviewed their information needs to develop consensus on the general themes to evaluate. The team endorsed the subsequent proposal to use focus groups and semi-structured interviews with participating farmers, and selected dates to conduct the evaluation. They then
collectively developed the interview schedule and logistics for two focus groups and 20 semi-structured interviews with their stakeholders. The fieldwork was conducted by team members, the evaluation project leader, and invitees from other RDE projects. All team members had the opportunity to participate in the evaluation to the extent they wished. The few that elected not to participate said they regretted it, and were heavily involved in subsequent surveys to quantify the project’s impact on farmer learning and behaviour.

The focus groups and interviews were conducted in pairs over two days, with a further two days also being used for several stages of data interpretation by the team. This iterative interpretation ensured everyone’s input and developed a collective understanding of the project, and stakeholders’ perceptions of its impacts. Firstly, the interview notes and a backup audiotape from each interview were collated in a one-page summary for each of the major themes of the evaluation, and the interviewers’ general impressions and observations. Each team member then summarised the data across all interviews for each theme. Essentially, they read everyone’s interview summaries for each theme to summarise what the interviews said as a whole. This ensured they honoured others’ interpretations and did not just draw conclusions on their own direct interview experiences. These summaries for each theme were subsequently discussed by the whole team before pairs compiled a ‘team interpretation’ for each theme. Finally, a half-day dialogue session drew upon these collective understandings to explore the implications of stakeholders’ perceptions of the project and develop draft recommendations for an evaluation report that was published several weeks later (Cawley & Lawrence 1998).

Despite some team members’ anxiety about evaluation and wanting to ‘keep putting it off’, the activity drew out farmers’ and the team’s diverse views of the project. Team members recognised the tensions between their different modules and their past criticism of others’ activities. It emerged that farmers had similar criticisms, including that the project’s small-plot research site was ‘irrelevant’ and provided few insights as the soil was ‘unrepresentative.’ This collective conclusion from the iterative interpretation sessions was undeniable and motivated the whole team to take remedial action and better integrate their activities. The process developed empathy and ownership of both the problem and solutions by the team. It began with functional participation, but established the potential for future interactive participation by reviewing both the content outcomes and the evaluation process itself as a team. Critically, the team’s recommendations for greater farmer participation and better integration of their activities across the project improved future evaluation, and the transition from functional towards interactive participation in strategic project decisions had a lasting impact on teamwork across the project. As the following comments from three team members suggest, the evaluation was later recognised as a major event in the life of the project: (i) ‘It was a major event that brought out into open (the team’s) perceptions of the core site, of evaluations, and the need for full participation
across the project”; (ii) ‘It was useful for all involved, an opportunity for the project to work together on something and focus on what we were really doing…(with) feedback to improve’; (iii) ‘I didn’t like that the core trial didn’t come out too well. I found it a bit traumatic at the time, but that was what we were there to do, (so) it gave me a wider appreciation of the project and the people and farmers involved.’ These comments reinforce the importance of participation and structured processes to appreciate others’ perceptions and understandings in team-based RDE activities.

Each of these early evaluation experiences was critical to developing the evaluation framework for the projects. The teams’ lack of attention to participants’ learning and consequent behaviour was evident in the first evaluations of discrete activities. Yet, Farming Systems RDE is grounded in the notion of participation and the opportunity it provides to learn with others. It was apparent that the teams needed more than evaluation support. They needed a structure to better understand participatory approaches and processes to plan, conduct, and evaluate their activities. Consequently, questions to clarify participants’ initial knowledge, expectations and practices in their research and to support their collective interpretation were developed through other early evaluation activities. These questions provided some initial prompts to help ‘plan’ and ‘reflect’ on the action research in each project. This was the first step towards developing the evaluation framework to support participation and learning in the projects.

7.1.3 Developing an evaluation framework for ongoing participation and learning
The evaluation framework was developed because Farming Systems RDE was new in Australia, and as already noted, the project teams needed support to better understand and improve their projects. RDE agencies and industry funders also wanted evidence of the projects’ efficacy. A reference group of project leaders, and agency and industry managers was consequently established to support the activities of the evaluation project. This group expected the projects to improve industry practices, farmers’ and scientific knowledge, and RDE processes, and demonstrate their contribution to the triple-bottom-line of environmental, economic and social impacts. As scientists, they developed a basic reporting structure that reflected scientific research in terms of its (i) rationale, (ii) process, (iii) results, and (iv) interpretation and implications, along with its (v) evaluation and impacts, and (vi) future directions. This impact matrix and reporting framework established their expectations as project leaders, agency managers and project funders. The challenge was to integrate these expectations and the early evaluation experiences into an ongoing evaluation process to support participation and learning.

Scientific training was the common heritage for the RDE project teams and their managers, who all related to scientific notions of systematic research based on deduction, inferences, and quantitative hypothesis testing with reproducible observations (Uvarov & Isaacs 1986). Indeed, interviews confirmed that many team members equated quality research with quantification, statistical rigour and repeatability. Far fewer members emphasised the qualitative aspects of
rigour, that is, trustworthiness, authenticity, sense-making, and the consequent implications for practice (Denzin & Lincoln 2000). Many members therefore dismissed the initial proposal to structure evaluations around the action research cycle, despite participatory action research (PAR) and action learning comprising the central processes of their projects’ specifications. Others members, typically those with an interest in extension processes were similarly uncomfortable with evaluation processes focused strictly on the steps of scientific research and a universal objective ‘truth’. They believed that the provision in PAR for explicit reflection on methods and the encouragement of alternative viewpoints were ideal for the project. Indeed, PAR is consistent with action learning and using people’s different experiences to question, interpret, and learn from others’ initiatives in the workplace (Revans 1997). Ultimately, the scientific and participatory action research approaches were merged in a framework to avoid alienating either sub-group (Figure 12).

**Plan**

1. what are we trying to do, learn or achieve?
2. why is it important?
3. what is our baseline for assessing our impact?

**Act**

4. What methods were used?

**Observe**

5. What were the results?

**Reflect**

6. what are the interpretations & implications?
7. what was the impact of the work?
8. what did we learn about how we did the work?
9. what future developments are needed?
10. what products have resulted?

**Figure 12. A framework to support participation and learning in Farming Systems RDE**

This framework emerged through iterative cycles of input from team members, project leaders, managers, and industry funders. It reflects the ongoing Plan, Act, Observe, and Reflect stages of action research, while posing questions aligned with accepted scientific processes. Evaluative questions in Step 3, 7 and 8 were added to establish initial baselines and ongoing benchmarks of participants’ knowledge and practices. Specific prompts for farmers, the team and others were similarly added to encourage the participation and input from these key stakeholders who the analysis in Chapter Six showed to be missing at key stages of some RDE activities (Box 2).
## Plan

**Step 1. What are we trying to do, learn or achieve?**

**Step 2. Why is it important?**
- Why is it an issue for (i) farmers, (ii) the team, (iii) others?
- What do (i) farmers, (ii) the team, (iii) others (including literature) already know about it?
- What’s the gap between what we want to find out and what we know?

(Revisit Step 1)
- Is it a research issue? If so, what is the question?
- Is it an extension issue? If so, what is the learning need?
- What tangible products are planned?

**Step 3. What is our baseline for assessing impact?**
- Summarise (i) farmers, (ii) the team, (iii) others (including literature) already know about it from Step 2
- What are the likely changes in knowledge, attitudes, skills, aspirations, and practice (KASAP) as a result of the activity?
- How can we measure these changes?
- What are the measures of these things now?

## Act

**Step 4. What methods were used?**
- What did you do?
- What did you measure? (wrt the underlying systems and/or components)
- How will you know if you have achieved what you set out to do?

## Observe

**Step 5. What were the results?**
- What were the results?
- What else happened? Were there any unexpected outcomes?
- How did the season unfold? Was there anything unusual to influence the results?

## Reflect

**Step 6. What are the interpretations and implications of the results?**
- What do the results mean to you? Why?
- What do the results mean to farmers (their ideas, not yours!) Why?
- What do the results mean to the rest of the team?
- What do the results mean to other interested group?
- What will (i) you, (ii) the team, (iii) farmers, and (iv) others do differently as a result?
- What else have we learnt?

**Step 7. What was the impact of the work?**
- What was the impact on industry (KASAP)?
- What was the impact on scientific knowledge?

**Step 8. What did we learn about doing this work and our RDE processes?**
- Did the activity achieve its aim? Why/why not?
- Did the activity achieve other things?
- What did we learn about how to do this type of work?
- What would you do differently if you had your time again?

**Step 9. What future developments are needed?**
- What other work needs to be done now?

**Step 10. What products have resulted from the work?**
- What are the tangible products or outputs from the activity?
The supporting prompts in Box 2 were developed to encourage input from participating farmers and the teams-within-teams that developed across each project. The framework and its associated questions are normative generalisations of the questions and formats used across the projects. They were grounded in the on-farm research of each project across several seasons. However, they were also used to develop and evaluate other project activities, guide project management and review the overall logic of the projects themselves. They were also supported by a workshop process, a workbook of suggested evaluation methods for the questions in each step, and a series of worksheets to help team members develop quantitative surveys for their own group activities. These same materials were used to develop the major qualitative and quantitative surveys reported in this thesis. In summary, the framework provided a checklist of key considerations for best practice in Farming Systems RDE. This provided a rich learning experience for those team members who used it. However, its use and team members’ subsequent participation in evaluation varied.

7.1.4 Teams’ subsequent participation in evaluation
Most team members had little evaluation experience and used the evaluation project and its resources to evaluate their main project activities. A small minority of individuals considered evaluation ‘a passing fad’ and avoided it as a distraction from their work. However, the materials developed were used to evaluate on-farm research trials, training workshops, field days, bus trips and overall projects as requested. Team members’ participation in these evaluations was typically functional, that is, they applied the methods suggested by the evaluation project to develop the content focus and wording of specific questions for their own situations. Despite this, each project team’s involvement in evaluation fluctuated from isolation and passive participation, through consultative, to fully developed interactive participation. While the cause-and-effect relationships may be confounded, the subsequent levels of participation observed within each project team closely aligned with their participation in these evaluation activities.

The Western project in NSW
The evaluation project leader’s involvement with the Western project in New South Wales (NSW) ceased when the team’s collective interpretation of their semi-structured interviews confirmed the lack of participation and communication described in Chapter Six. This was exemplified by a senior researcher revealing in a facilitated dialogue session that he was presenting trial results to farmers the next day, but had not distributed them to the team or the local extension officer sitting next to him who had been requesting the results for weeks. Team members subsequently proposed new roles and responsibilities in the project and asked the evaluation project leader to again facilitate their discussions with management. However, the outgoing leader of the Western project in NSW had ‘severe reservations of having an outsider
(see) how badly we’ve managed the project’. And his replacement confirmed he ‘didn’t need (evaluation) to tell him what was wrong in the project.’ Senior NSW Department managers subsequently excluded the evaluation project team and no further evaluations were conducted. The perceived failings of the Western project in NSW prompted the funding of a local farmer consortium to conduct the project’s on-farm research. The NSW Department continued to conduct small-plot research. However, conflict between the two groups continued until funding was cut three years later. Agency managers’ ability to control activities reaffirms that their support and participation is essential for organisational change (Argyris & Schön 1996). Yet, this experience also confirmed organisations resistance to change and the potential of evaluation to promote defensive routines that preclude learning and improvement (Turner 1998). This outcome was avoided in the other projects.

**The Western project in Queensland**

‘Exit’ surveys continued to be used to evaluate workshops and field days in the Western project in Queensland, and the teams’ development of the evaluation framework to clarify and review their on-farm research with farmer groups is highlighted in Chapter Eight. However, this project team also consolidated the interactive participation of their interim evaluation described above to collectively develop, conduct, interpret and report their quantitative study of the project’s impact on farmer learning and behaviour. The evaluation project leader contributed many ideas and facilitated the development of this evaluation. Yet, it was initiated by the Western project team which negotiated the final process and content decisions, sometimes after much dialogue and debate to understand why others thought something was important. For example, a question of what rate of fertiliser farmers used led to a lengthy debate on whether the project should promote specific rates in a traditional behaviourist approach, or whether the evaluation should emphasise farmer understanding of nitrogen processes and the methods they used to make nitrogen decisions. The project team ultimately collected data on both. This opportunity for interactive participation was taken by most team members. However, their participation throughout these qualitative and quantitative impact evaluations typically fluctuated between functional and interactive levels. In sum, these evaluations were a catalyst for the subsequent integration of the different modules and paradigms during the last two years of the project.

**The Central Queensland project**

Evaluations in the Central project continued to focus on the team’s on-farm research and group work with ten farmer groups. Each group continued to reflect on their progress in line with the evaluation framework. However, they also repeated a series of focus groups across the project (Lawrence & Kuskie 2002a), and as a team developed, conducted, interpreted and reported a subsequent quantitative study of the project’s impact on farmer learning and behaviour (Lawrence & Kuskie 2002b). This study was again based on a self-administered mail
questionnaire (Appendix 4) for participating farmers and then modified to assess impacts on the wider farming community and the team itself. Both the interview schedule for the focus groups and the subsequent quantitative questionnaire were developed from the evaluation framework and its accompanying evaluation workbooks (Lawrence & Kuskie 2003). Indeed, team members first completed these workbooks for each on-farm research activity to document the team’s learning. The evaluation consequently encouraged wider team participation and drew together the team’s and growers’ perceptions of the project, its impact on their learning, and the implications for their practices.

The subsequent survey of the team confirmed that the evaluation provided more participation and influence than other activities in the project. It also encouraged more participation in the overall project by reviewing evaluation data and suggesting improvements. Indeed, interpreting evaluation results and identifying opportunities to improve the project was the focus of a two-day team dialogue session towards the end of the project’s first phase. This dialogue addressed communication problems between some staff, suggested processes to ensure greater participation of team members in major project decisions, explored alternative structures for the project, and finally compiled draft recommendations for improving the second phase of the project. Together these evaluations provided all team members with the opportunity for interactive participation. Their varying dispositions resulted in participation fluctuating between consultation, functional and interactive. However, this precedent with evaluation subsequently encouraged greater participation across the rest of the project

The Eastern project

Evaluations in the Eastern project followed the team’s emphasis of individual activities, and on-farm research in particular. Most on-farm research activities were evaluated in line with the structure of the evaluation framework. Consequently, participants in each on-farm research activity were able to document the activity’s impact on farmers’ knowledge and practices, new scientific knowledge, and the development of RDE processes. Team members’ participation in these evaluations was typically functional as they applied the evaluation framework to their content issues. However, individuals’ participation varied with their interest in participatory RDE and evaluation. While some were self-mobilised and modified the evaluation framework to initiate, conduct and report evaluations for their activities, others were only willing to accept consultative participation, and effectively had evaluations of their work done for them. Again, other team members’ participation was limited in most evaluations that were planned, conducted and interpreted by those directly involved, their institutional leaders and the evaluation project. These evaluation plans and results were included in the project’s annual progress reports and presentations. Other team members were consequently aware of progress and asked questions, but were not directly involved in decisions. This focus on discrete
activities was reinforced by the relatively independence of each RDE agency and ‘overall project’ evaluations were confined to a mid-term review by funders, and a contracted qualitative evaluation by a private consultant.

In summary, evaluation encouraged participation within individual Eastern project activities, but the process was limited by the structure of the project and the emphasis of individual activities. Consequently, the team members’ experiences were not integrated across the project as they were in the Western and Central projects in Queensland.

7.1.5 The potential for evaluation to integrate Farming Systems RDE

The prospect of evaluating their activities was daunting for some participants, but involving people with different and sometimes challenging perspectives was simply ‘scary’ for others. However, after ‘wanting to keep putting it off’, considering it ‘too hard’ and even putting their ‘head in the sand…hoping it might go away’, most team members evaluated their activities. Indeed, each project team’s ability to document their impacts on participants’ learning and practices must be ‘applauded’ in this area that agriculturalists generally do poorly (Hitchener et al. 2001). Consequently, research utilising the evaluation framework and its associated resources has contributed to a better understanding of how Farming Systems RDE can impact on the learning and behaviour of its participants in the Australian grains industry. Yet, developing and using these materials also led to the conclusion that evaluation can be a powerful catalyst for participation and rich and productive learning when there is a genuine desire to work together. Indeed, the evaluation framework provided the structure and processes for team members of the Western project in Queensland to contribute and integrate their ideas across the project. This occurred to a less extent in the Eastern project with its emphasis on individual activities and the Central project where questioning the level of participation in activities was considered ‘negative’ by the leaders, but was absent in the Western project in NSW project where evaluation was viewed with suspicion for highlighting its poor management. From these experiences it seems that evaluation is a management function that needs the support of project leaders to avoid becoming, or at least being seen to become, subversive to their interests. Ultimately, project leaders and agency managers must be responsible for ensuring projects are evaluated and their direct support and involvement in participatory evaluation must be encouraged at all times.

Finally, evaluation was a catalyst for discovering the diversity of teams. Clarifying individual’s preferred evaluation criteria highlighted their content and process knowledge, values, and inferred their underlying worldviews and paradigms. This diversity and its consequent task and process conflict cannot be removed by simply imposing a view and dismissing alternative perspectives as ‘white-anting.’ Rather, these substantive conflicts may simply fester and
develop into the damaging relationship conflict observed between some project participants (Jehn & Mannix 2001). The pedagogy of oppression, and the reciprocal ‘tit-for-tat’ denial of meaningful participation observed in some project activities, is likely to continue unless there is meaningful dialogue to appreciate and reconcile team members’ views. Participatory evaluations provided sufficient focus and motivation for team members to resolve some substantive differences. After hearing farmers repeatedly express concerns about the relevance of the small-plot research site, the Western project team in Queensland made greater efforts to integrate their activities. They reframed the project to develop a ‘real’ team that integrated multiple methods rather than continue with their parallel and competitive RDE methodologies (Christodoulou 2000). This had the potential to broaden the project’s focus from the learning of individuals within the projects towards new shared understandings of farming systems such as those envisaged in Marsick and Kasl’s (1993) model of team learning (Figure 5).

7.2 Understanding the practice of team learning

The process of team learning may develop shared new understandings. However, it also develops knowledge for individuals and their wider organisations (Kasl, Marsick & Dechant 1997). Consequently, the projects teams’ efforts to better integrate their experiences will not preclude divergent views amongst individuals or the apparent teams-within-teams (van Offenbeek 2001). And nor should it, as that diversity provides the enhanced capacity for problem-solving and learning highlighted in Chapters Two and Three. Indeed, conflict from this diversity may be necessary to improve RDE because the alternative to conflict is rarely harmony and agreement, but apathy and disengagement (Eisenhardt, Kahwajy & Bourgeois 1997b). The project teams must therefore avoid the potential limitations of ‘Groupthink’ (Janis 1983) and manage their diversity for learning and better farming systems. While learning will always occur (Jarvis, Holford & Griffin 1998), the teams’ capacity to develop processes to frame and reframe problems, cross boundaries and experiment, and finally integrate their perspectives will determine whether this learning is fragmented and individually focussed, pooled for others interest, or actively integrated for shared understandings of how to improve farming systems (Kasl, Marsick & Dechant 1997).

7.2.1 Assessing team learning in the Farming Systems projects

A range of factors that have shaped participation in the teams was identified in Chapter Six, and the evaluation framework’s potential to facilitate stakeholder participation across RDE activities was highlighted in the current chapter. Indeed, by clarifying the current knowledge and importance of the research issues for all participants, and establishing a shared research question, the prompts in Step Two of the evaluation framework (Box 2) provide a process for participants to frame and reframe issues and cross existing boundaries to negotiate experiments of mutual benefit. Similarly, Step Six encourages all participants to provide their interpretations.
and rationale as a catalyst for the dialogue and inquiry needed to appreciate and integrate others’ perspectives (Ellinor & Gerard 1998). This framework extends beyond evaluation alone to provide a structure to develop best practice in participatory RDE and progress towards the team learning processes implicit in modern Farming Systems approaches.

Dechant and Marsick’s (1993) *Team Learning Survey* was used to investigate the extent of team learning in each Farming Systems project. The aims of this survey are to diagnose teams’ learning abilities, explore the impacts of these abilities on learning, and provide a basis for future development of their learning processes and outcomes. It was developed from factor analysis of surveys with large corporations and MBA students in North America. However, the underlying model of team learning (Dechant, Marsick & Kasl 1993) helped conceptualise team members’ observed participation and behaviour and to construe distinct modes of learning within each project. For example: the Western project in NSW appeared badly ‘fragmented’ as most people continued their traditional activities with little interest in others’ ideas; the Eastern project was ‘pooled’ as activities groups typically reported their progress for the wider team’s information; the Central project appeared to have been ‘fragmented’ but then ‘pooled’ as individuals shared their experiences as required in team meetings; and the Western project team in Queensland appeared to be moving from their initial fragmentation towards ‘synergistic’ learning as they collectively planned, conducted and evaluated activities.

Two key indicators from completing Team Learning Surveys for each project confirmed these perceptions. The first column in Table 14 outlines the measures of team learning outcomes and team learning processes developed in the survey. These measures are composite scores of questions from the survey. For example, the team learning process rating is the aggregate score of 16 individual questions related to the projects’ ability to frame and reframe problems, cross boundaries and experiment, and ultimately integrate team members’ perspectives (Dechant & Marsick 1993). Consequently, team learning outcomes are scored across a continuum of unfavourable, neutral and favourable results and the team learning processes across the fragmented, pooled and synergistic modes of learning described in Chapter Three. The remaining columns show that the author’s survey scores for each project generally agree with the constructions of their learning modes based on previous observations. Fragmentation in the Western project in NSW was reflected in a team learning score of 38, much lower than the other projects and firmly classified as fragmented by the survey. The unfavourable score for team learning outcomes (i.e. the performance improvements and products (Dechant & Marsick 1993)) from this project team was similarly predictable. The scores for the remaining three project teams reflected the relativities already described. That is, the Western project team in Queensland that was construed to be developing synergistic learning scored more favourably than the Central and Eastern project teams which appeared to use a pooled learning mode.
While the survey classified the learning processes of these three teams as pooled, the Western project team in Queensland’s score of 76 was approaching the synergistic team learning score of 81. This broad agreement of the survey and the conceptualisations of observations using this model of team learning built confidence in using the survey with each team.

Table 14. **The team learning survey assessments of each project by the author**

<table>
<thead>
<tr>
<th>Team learning outcomes, processes and conditions</th>
<th>The author’s scores for each team</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CQSFSP</td>
</tr>
<tr>
<td>Team learning outcomes (7 – unfavourable – 24 – neutral – 32 – favourable – 49 )</td>
<td>29</td>
</tr>
<tr>
<td>Team learning processes (16 – fragmented – 68 – pooled – 80 – synergistic – 112)</td>
<td>69</td>
</tr>
</tbody>
</table>

However, the mean survey scores of the Eastern, Central and Western project teams in Queensland were higher and suggested favourable team learning outcomes and improved end products had resulted from each project (Table 15). This claim is substantiated in Chapter Eight that describes participants’ perception that the projects have improved RDE process and led to better outcomes on farms. Yet, the results for team learning processes were at odds with the detailed observations of participation and conflict in the projects to date. The classification of the Western project team in Queensland as synergistic may have reflected their recent emphasis of teamwork, but classifying the Eastern project team as synergistic and the Central project team at the cut-off between pooled and synergistic was surprising. Observations and semi-structured interviews confirmed these last two teams did not commonly seek out challenging views, freely provide their views, or regularly engage in dialogue (Kasl, Marsick & Dechant 1997). Indeed, the Eastern and Central teams seldom met as teams, and communications were typically passive or consultative to inform the wider team what had occurred in each sub-project activity and to field any questions. However, the mean score for the Western project team in NSW at the cut off between fragmented and pooled was of most concern as that team was widely considered dysfunctional with continuing poor communication and staff losses. This apparent disconfirming data required further scrutiny.

Table 15. **Team members’ assessments of their projects using the team learning survey**

<table>
<thead>
<tr>
<th>Team learning outcomes, processes and conditions</th>
<th>Mean scores for each project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CQSFSP</td>
</tr>
<tr>
<td>Number of respondents</td>
<td>16</td>
</tr>
<tr>
<td>Team learning outcomes (7 – unfavourable – 24 – neutral – 32 – favourable – 49 )</td>
<td>36</td>
</tr>
<tr>
<td>Team learning processes (16 – fragmented – 68 – pooled – 80 – synergistic – 112)</td>
<td>80</td>
</tr>
</tbody>
</table>

The distribution of scores for each project team’s learning processes revealed considerable variation in team members’ assessments (Table 16). Table 16 shows that for each project in column one, there was a percentage of team members that suggested their project had a
fragments, pooled or synergistic mode of learning. The Western project in NSW was again considered the poorest in term of team learning with a third of team members perceiving the project to be fragmented and over half considering it pooled. In contrast, a majority of each other team scored their project as synergistic. Fragmentation was least in the Western project in Queensland with over 90% of the team considering the project to at least pool their knowledge and share their experiences (Kasl, Marsick & Dechant 1997). However, synergistic learning to actively create new knowledge and alter individual team members’ assumptions and beliefs and achieve their collective goals was not observed in practice across the projects. The Western project in Queensland was indeed moving towards this outcome as members attempted to synthesise their different RDE methodologies and overcome their apparent conflicts through dialogue rather than majority rule (Kasl, Marsick & Dechant 1997). While evaluation activities in the Central project were conducted in a similar vein, the typical operations of the project were based on majority rule, and the Eastern project remained strongly focused on individual activities and discrete learning for their direct participants. With individual views offered but typically defended rather than integrated, the two projects exemplified pooled team learning with incremental rather than innovative outcomes (Kasl, Marsick & Dechant 1997). This does not mean the projects were ineffective (Chapter Eight); rather that individuals and discrete activities were a higher priority than the team. The author’s team learning survey results and observations demand reconciliation with those from the members of each project.

Table 16. Frequency of team members’ assessments of the projects’ modes of learning

<table>
<thead>
<tr>
<th>Project team</th>
<th>Number of respondents</th>
<th>Team members’ assessments of their teams’ mode of learning (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fragmented learning</td>
</tr>
<tr>
<td>CQSFSP</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>WFSQld</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>WFSNSW</td>
<td>9</td>
<td>33</td>
</tr>
<tr>
<td>EFS</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td>All projects</td>
<td>62</td>
<td>18</td>
</tr>
</tbody>
</table>

7.2.2 Reconciling the varying assessments of team learning

The author’s survey results confirmed the observations and interpretations presented earlier in this thesis, but were at odds with team members’ own results. The relativities of scores were consistent, but the teams’ perceptions were more favourable. Five possible explanations for this difference are proposed. Firstly, the author’s survey responses may be inaccurate. Yet, they confirmed the constructions of learning in each project from participant observation and semi-structured interviews with team members. This explanation is thus possible but unlikely. Secondly, the project teams may have been optimistic because they proposed to introduce new participatory approaches. It may have been hard not to agree with ‘Item 15: members try out new approaches to their jobs as a result of the teams work’, despite only 29% of the team
members interviewed believing the approach was really new (Chapter Five). Thirdly, debriefs with members of the Eastern project suggested some individuals assessed their discrete activities rather than ‘the project’ as requested. For them, these discrete activities were the project. More positive responses could be expected from some of these teams-within-teams’ who could agree with statements such as ‘Item 30: we listen to the perspectives of every member in the team’ without having any input from the wider project team.

A fourth explanation for the more favourable responses in the Eastern and Central projects is grounded in socio-cultural learning theory and the appropriation of other team members’ experiences through their social practice of reviewing activities (Rogoff 1995). These passive and consultative activity reviews focused on the learning of individuals directly involved in each activity. Yet, periodic questioning and criticism from other teams-within-teams may contribute to team learning through increased congruence and consensus over time (Newman, Griffin & Cole 1989). Survey Item 34 suggests ‘members change their behaviour as a result of seeing other team members change.’ Many of these discrete activity groups employed similar processes, so vicarious experiences may have provided a rich source from which to appropriate knowledge for their own situations (Billett 2003). Such learning may be more difficult to observe than in the progress of the teams-within-teams in the Western project of Queensland, which initially held explicitly antagonistic views and were not disposed to integrate them (Goodnow & Warton 1991; Leonteyev 1981). This reinforces the largely unrecognised view that learning is ubiquitous in ongoing activity (Lave 1993), but the nature of this learning varies with its context (Argyris & Schön 1996; Bateson 1972; Habermas 1971; Mezirow 1991).

The varying nature of learning in the projects provides a final explanation of the unexpectedly favourable assessments of team learning. The survey assesses learning processes, but only two items infer any sense of the nature of this learning: ‘Item 9, we change our perspectives about ourselves and others’; and ‘Item 37, we challenge our basic beliefs and assumptions about issues under consideration.’ The survey measures the extent of learning based on individuals’ expectations and past experiences. Yet, neither this survey nor its underlying team learning model is explicit about the ‘levels of learning’ developed. The high scores of members of the Eastern and Central projects reflect greater opportunities for participation and learning than participants experienced in other projects. However, the emphasis of participation within their less diverse activity groups appeared to encourage less reframing and reflection on individual’s basic beliefs and assumptions than the Western project in Queensland. Consequently, the author scored the Western project in Queensland as it was beginning to use interactive participation spontaneously, and learning to integrate different RDE methodologies across the project. The apparent extent of reframing, crossing boundaries and integrating different perspectives was therefore higher. This does not mean the Eastern and Central project teams were not learning or
effective. They simply emphasised individuals’ learning and team learning was not spontaneous. Rather, team learning typically emerged in evaluations and major reviews when processes were imposed by the project leaders (Kasl, Marsick & Dechant 1997)

In conclusion, the team learning survey reinforced the observed performance of the Farming Systems projects. It confirmed the fragmentation of the Western project team in NSW and the other project members’ development of processes to at least pool and share their individual experiences. Indeed, the teams’ perception that their participation and learning processes improved their performance and consequent impact on farms is supported by farmers, as discussed in Chapter Eight. The extent to which the teams developed their team learning processes and how they utilised their diversity remains unclear. In essence, each project team’s learning surveys suggested that they worked as interdisciplinary projects and spontaneously sought challenging views in order to better integrate their diverse experiences. Yet the observations, semi-structured interviews and the author’s team survey responses concluded that the projects were multi-disciplinary and that members pooled their experiences through passive, consultative and functional participation so individuals could do their own jobs better. Further semi-structured interviews with team members were then initiated to re-assess participation and learning as each project concluded. These interviews, along with continuing participant observation and surveys of team members, clarified the extent of participation that developed over the life of each project, their teams’ learning processes, and consequent learning outcomes.

7.3 Subsequent participation and learning in Farming Systems teams
The extent of participation in the early stages of each project and the factors that shaped it were identified in Chapter Six. It was concluded that participation was failing to meet the expectations of some team members who perceived the projects’ fragmented and pooled learning processes, not the synergistic processes of team learning and participatory RDE. In this chapter an evaluation framework designed to support and assess the teams’ progress towards effective participation is described. First, each project is interrogated to highlight the generally increasing participation of the teams, and the range of learning outcomes produced from participating within the diversity of each project.

7.3.1 The Eastern project
The collaboration of staff from all RDE agencies was maintained in the Eastern project. Yet, their participation was shaped by the management committee’s own inability, or unwillingness, to overcome the task and process conflict born of the diversity of their values, worldviews and paradigms. There was no funding imperative for agencies to resolve these conflicts as the industry funding was negotiated directly with each agency. As the project leader confessed, ‘the management committee is non-functional. The institutions have done what they would have
done anyway. It needed an honest broker like a farmer…but its too late. So let’s get to the end, admit mistakes and fix it.’ The leader’s lack of funding authority or industry presentation on the management committee contributed to each activity ‘team’ pursuing independent activities with little accountability to other team members. The consultative participation of the early project was now mostly passive. Indeed, team members confirmed there was ‘no big picture…(and we) haven’t even tried to integrate things. It’s just a lot of disjointed separate projects.’ Annual team meetings provided opportunities to participate in others’ activities, but most team members concluded that they simply, ‘presented results, without cross-project participation…(and) could have been a separate project and got the same result.’ Others believed these meetings provided ‘some cross-fertilisation and (people) could take away bits of others’ work.’ Participation across activities was apparently considered nice, but not essential. While team members criticised their limited participation in others’ activities, they provided few opportunities for participation in their own work. Members of the Eastern project functioned as a working group, not a team (Johnson & Johnson 1997). However, this working group comprised many smaller teams that used their information diversity and technical specialities to jointly plan, interpret and evaluate their work. They typically formed around pre-existing staff relationships and attracted others with similar values, worldviews and RDE paradigms (Byrne 1971). Task and process conflict were consequently minimised and their ‘interactive’ participation resembled functional participation within their assumed RDE methodologies.

The three main learning outcomes from the Eastern project were; improved technical understandings, improved process understandings, and an appreciation of evaluation (Lawrence 2001). Firstly, most technical insights emerged from team members’ own activities. Their assessment of technical learning from other activities varied from ‘picking things up’ to ‘I don’t really get much out of it’. Secondly, team members learned how to make on-farm research more relevant or rigorous. They suggested insights in ‘setting up, laying out, working with farmers, and getting components into research’ helped them ‘achieve rigour and be practical.’ Again this learning was focused within activities with no consensus on how to on-farm research and when to use different approaches. Finally, evaluation was recognised as an issue team members learned about, but was also a key source of learning. For example, ‘I certainly learned a lot from (evaluation). Helped me learn about evaluation, but also to teach me to look back, to examine and reflect on things. I have to say that’s the activity I’ve learned the most from.’ Using the evaluation framework to assess the impact of most activities prompted the project leader’s observation that ‘one of the big outcomes of these projects is the mind shift about evaluation. It’s like a light has come on to see that evaluation is essential.’ Team members consequently learned about a range of technical issues, RDE process and evaluation. However, these insights were mostly individual or shared within their specific activity groups. They were
made available for others, but not integrated into a collective team understanding as the project focused on individuals’ development within a mode of pooled learning.

In conclusion, members of the Eastern project operated as a working group of discrete activity teams pursuing participatory RDE with farmers. The evaluation framework was used within many of these activities. However, most team members were ambivalent towards the project’s proposed focus of developing participatory RDE and mainly used the wider team as a ‘sounding-board’ to make sense of the outcomes. The wider team were not co-researchers and the local nature of most research topics failed to engage the interest of other team members. Indeed, this final series of interviews and surveys confirmed the project’s pooled learning processes, its emphasis on individual’s learning within the diverse team, but the team’s higher levels of engagement in their less diverse RDE activities. This passive and sometimes consultative participation resulted in instrumental learning on the cause-and-effect relationships of each content issues (Habermas 1971), and single-loop learning to improve each group’s initial approach to on-farm research (Argyris & Schön 1996). In this way higher level learning on the appropriateness of different methodologies was not addressed in the Eastern project.

7.3.2 The Central Queensland project

Participation in the Central project was variable. Each project activity continued to be jointly planned, interpreted, and evaluated by its three or four key staff. However, the project came to be dominated by Queensland Department of Primary Industries. The CSIRO conducted some research independently and was not observed at any subsequent meetings, the University of Central Queensland was isolated after its research approach failed to interest other team members, and policy changes in the Department of Natural Resources reduced their staff commitment as they began new projects of their own. Ironically, this failure to participate reduced the projects diversity and encouraged more participation among the remaining staff.

Participation between project activities increased from the passive participation and isolation of the early project to become consultative as team members asked for feedback from others at meetings. However, team members’ comments reflect the limits to this participation; for example, ‘we’ve changed a bit…but still act as individuals in that this is “my group” and if I need help I’ll ask for it. But working under the project umbrella, we tend now to offer ideas, whereas in the past probably didn’t unless asked.’ So while team members ‘have input at occasional meetings...or if asked,’ they recognised the lack of spontaneous and continuous participation, ‘(Outside meetings) I don't know what (he’s) doing and (he) doesn't know what I'm doing. Even in this office we can't communicate with each other... and we're all friends. It's just unbelievable,’ and, ‘that email the other day (asking for feedback)...People don't do that.’ The facilitators of on-farm activities maintained their control of decisions. Surveys confirmed
this low level of participation across activities. Indeed, 44% of team members believed they had ‘no influence at all’ over the content of on-farm research. Only 19%, about the number directly involved in each activity, believed they had a ‘large influence’. This consultative participation dominated most other project activities, that is, economics, modelling and weeds research.

However, one activity offered more participation - work to develop practical management options for a new pasture called butterfly pea gained the broad participation of the team and farmers across the region. For example, the agronomy of this new species was established in large-scale participatory trials with farmers, weed control options assessed with targeted traditional small-plot research, and nitrogen contributions quantified in development trials. Long-term economics were subsequently established by modelling, and the collective interpretations for management of new farming systems with butterfly pea published. The informational, values, worldview and paradigm diversity was utilised without damaging conflict. Several team members attributed this success to the accepted need for a new legume, and an activity leader who realised he didn’t have all the answers and sought others help,

‘we had to find a legume. Previous work was done in isolation and if it continued, we would be no closer. Most of work we did was done before project. But for butterfly pea we needed it all together…the project facilitated it. I could sing til my hearts content, “this is how you control weeds in butterfly pea” but that wasn’t going to sell butterfly pea. We needed all the other information/knowledge as well…fertility and feed etc. It got going when (the activity leader) got involved and was not narrow minded enough to think he knew it all…he canvassed others for input. I learned we can work together with different disciplines and different RDE styles…we should be doing it with everything!’

The potential to draw people together and integrate their different technical expertise and RDE methodologies in the project was identified through this collective activity. This was achieved through functional participation as the coordinator of the activity sought individuals and workgroups in the project to overcome specific problems as they arose. These workgroups subsequently developed the processes and experiments to address their specific problem. These outcomes and experiences were ultimately pooled for publication in the Butterfly book (Collins & Grundy 2005). Indeed, the coordinator successfully employed functional participation to gain the support of others and share the technical understandings that arose. Yet, reflection on his processes, the contributions of each activity and RDE methodology, and the transition to interactive participation were not pursued and only surfaced publicly during evaluation meetings late in the project. The project had provided an opportunity for the team to understand their common experience and learn how to coordinate their actions in future (Habermas 1971). However, the team missed the opportunity for this double-loop learning (Argyris & Schön
1996) about the most appropriate methodologies and how to integrate them. This style of activity was not repeated, and most activities continued in relative independence with consultative participation.

The project team’s consultative participation produced a similar range of technical and processes learning outcomes to those from the Eastern project. Again, the focus of learning was the individual, or each specific activity group’s understandings of technical issues, how to conduct more participatory on-farm research with farmers, or evaluation processes (Lawrence 2002). However, these pooled learning processes were used to integrate individuals’ activities across the technical themes of the project. These themes were criticised for being passively imposed with little consultation at the start of the project, but they ultimately helped integrate individuals’ technical understandings, resulting in instrumental learning across the project (Habermas 1971). Finally, the project helped people better understand their own RDE processes. However, even in the butterfly pea example, team dialogue and double-loop learning to appreciate and subsequently use their methodological diversity was not apparent. Team members were more interested in their individual activities than in the team. In conclusion, the Central project was characterised by the consultative participation that dominated most on-farm research activities. The team’s interaction fluctuated towards functional and interactive in the evaluation and butterfly pea activities, but returned to being consultative with little opportunity for double-loop learning once the external encouragement was removed.

7.3.3 The Western project in Queensland

The Western project team in Queensland exhibited a wide and explicit range of technical disciplines and RDE paradigms but made the most progress towards becoming ‘interdisciplinary’. Structuring the project around its different RDE methodologies created extensive early conflict and competition. Yet, undertaking the qualitative evaluation described earlier in this chapter forced team members to deal with their diversity. The emphases on participation and on the team’s collective interpretation of results in this evaluation helped individual’s appreciate each other and the contributions of their activities to the project. Joint development of the subsequent quantitative evaluation developed this understanding by encouraging dialogue, discussion and outright debate on what was important to evaluate in the project. Using the evaluation framework to develop these project surveys clarified team members’ understanding and expectations of Farming Systems RDE better than any other process reported in this thesis. Having a supportive team leader was critical to this use of evaluation to develop a team culture. Team members subsequently acknowledged he was simply ‘the right person at the right time’ to develop participation across the project.
This new culture of participation was used and consolidated through a series of full team meetings to develop a proposal for renewed funding of the project. These meetings developed team insights from the first phase of the project and a vision for the new project. Most people were surprised by the consistency of their personal visions, and how easily they combined into a collective vision for the project. In essence, they reframed the project. It was no longer a series of discrete activities to boost ecological and economic sustainability that just happened to be in one project. Rather it was a way to combine their expertise and develop a partnership for prosperity with growers, RDE staff and agribusiness in the region. The focus was now on combining their efforts to help growers understand and manage their systems. The strengths, weaknesses and major contributions of their small-plot research, on-farm research, action learning and modelling approaches to RDE to their vision were subsequently identified. Indeed, the team concluded that project modules were not useful and they were eliminated. Instead, industry priorities were used to focus and integrate the teams technical and process perspectives. Decisions subsequently emerged from the teams’ reflection and dialogue about their past performance, their hopes, and expectations for the future. Indeed, as the following quotes from team members suggest, they began to work as a true team.

*(the project) actively encourages a range of approaches to problems...to identify and prioritise, and deal with key issues...team as a whole gets on and works well together.*

*There’s team spirit and people consider themselves part of the team*

*The project tries to participate across the disciplines and I think it does it best of any of the projects. It tries hard to integrate approaches and not come up with one (answer), but to understand their strengths and weaknesses...and how to decide which to use*

*It took two years before we ever got to talk the same language. We both changed and I had to learn his language. It’s about mutual respect of people’s skills...and getting one’s hands dirty.’*

These comments reflect the team’s developing interactive participation. As the team leader suggested, ‘people are more appreciative of other approaches’ from their dialogue on both content and process decisions. Indeed, this participation in strategic planning extended to the ongoing process and content decisions of the project and its subsequent activities. Not everyone participated fully or provided this interactive participation. However, the following quote exemplifies the effort of most team members to provide genuine opportunities for the team’s input and scrutiny of their activities; for example, ‘I try very hard and give people opportunities to give their interpretations of what’s happening and why. So, this is their expertise...what can I learn from them? And I hope they learn from me.’ Indeed, this reflects the team’s new norms.
and ways of working. Emails now addressed the whole team, and there were open invitations for all team members to plan project activities. These were small but telling indicators of the changes in the project. As a result, seasonal reviews of on-farm research with farmer groups now involved team members from across the project as full participants in the dialogue to interpret results, relate them to other work, and plan future activities. Interactive participation with equality in both process and content decisions was now frequent for major decisions in the project. Functional, consultative and passive participation still occurred, but the team appeared to have more influence, perhaps because their views were better understood. Veiled attacks and underlying tensions remained between specific individuals. However, participation was regularly interactive and the team used synergistic learning processes to utilise its diversity.

The Western project in Queensland was reframed to develop a ‘multi-method approach’ that valued each of the project’s RDE approaches. This attempt to develop a pluralistic system from a prevailing coercive context (Flood & Jackson 1991a) was not always easy, or successful. Yet, continuing dialogue developed their collective appreciation of each RDE approach to inform their future process decisions (Appendix 7). This understanding subsequently supported more integration to address technical issues. For example, one team member suggested that they resembled ‘used cars salesmen’ promoting different RDE approaches and subsequent nitrogen decision-making processes to farmers. Dialogue sessions subsequently helped the team understand the strengths and weaknesses of each approach, their underlying assumptions, and their main contributions to better nitrogen management. This culminated in the ‘Sustainable soil nitrogen decisions’ workshops described in Chapter Eight, to help agronomists and farmers better understand the available nitrogen management approaches, compare them, and develop the most appropriate nitrogen management methods for their own situations (Christodoulou & Lawrence 2005). Consequently, there was team learning about nitrogen, about the various processes to understand nitrogen management, and new processes to integrate their knowledge across the team and with other stakeholders. Team members recognised this progress from purely technical cognition and instrumental learning to the practical cognition and communicative learning required to understand others (Habermas 1971),

‘I was trying to get it going and learning...but wasn’t drawing researchers in to learn with me. It was “us” and “them”. To a large extent it has been overcome...at a huge cost, but its part of the project objectives to change people’s thinking and improve RDE processes. It’s a good project overall in that it has at least achieved better connectedness between approaches...but we’ve got a long way to go before we really appreciate each others’ views of the world.’
The team was becoming interdisciplinary by reflecting on the strengths and limitations of each RDE methodology and integrating them as appropriate. In sum, they were now ‘learning how to learn’ as they participated to help individuals clarify their aims for nitrogen management and develop an appreciation of their approach to building knowledge (Graziano & Raulin 1993). This is the level of participation required within teams, and subsequently with farmers, to achieve the potential of modern Farming Systems approaches for sustainable development (Dixon 2003; Pretty 1995). The experience clarified the potential learning outcomes of high levels of participation within diverse teams. Yet, team members’ comments suggest the journey towards emancipatory cognition and learning had only just begun. The experience also reinforced the dynamic nature of participation RDE and the importance of effective processes to support team members’ participatory intent to develop effective participation across teams.

Having reviewed participation and learning across the projects, it is now timely to draw out key findings about the changing nature of participation and its contribution to participants’ learning.

### 7.3.4 The dynamic nature of participation

The level of participation generally increased over the life of the projects, but still varied across each project. Although it ranged from isolation to interactive, functional and interactive participation were now typical within activities. Most team members now expected, and had opportunities for, democratic participation and equality for content decisions (Pateman 1970), which commonly extended to process decisions of activities they were directly involved in. Participation across project activities also increased but remained qualitatively different for each project. The Eastern project developed as a series of relatively independent activities with common project funding and passive to consultative participation. Meanwhile, the Central project utilised functional and interactive participation in project evaluations and their Butterfly pea activities. These opportunities for participation were externally imposed or, in the case of Butterfly pea, catalysed by an individual. This participation was not spontaneous and individual on-farm research activities still provided only passive and consultative participation for most team members. In contrast, the Western project in Queensland came to provide all team members with opportunities for functional and interactive participation in its activities and strategic decisions. This was a major advance from the initially fractured and competitive project. Notwithstanding their failure to participate across States, effective teamwork with interactive participation was achieved across the sub-project. The project contained wide informational, values, RDE paradigm and worldview diversity, yet team members participated effectively to the interactive level. Effective participation is a process that emerges and changes over time (Christodoulou 2000), and three main insights into the nature of participation in the farming system teams are provided in this chapter.
Firstly, the findings confirm that participation is not a unitary construct and means many things to different individuals. Participation is not an ‘on-off’ switch. Participation occurs along a continuum, and even the most apparently solitary tasks are embedded in social practice and have some level of participation (Cazden 1993). Consequently, the new typology of participation in Farming Systems RDE that was introduced in Chapter Six (Table 13) does not dictate that ‘more participation is better’. Rather, it was developed to help understand and explore the appropriate modes of participation for planned activities, consider their consequences, and recognise that modes of participation may overlap, interact and flux over the life of a project. It was also apparent that different levels of participation may produce different learning outcomes and behaviours. This new typology was subsequently modified to include additional discriminating attributes that clarify the different learning outcomes that are implicit in Pretty’s (1995) identification of structured learning processes, use of interdisciplinary methodologies, and decisions on how resources are used. For example, passive participation may result in simple recipes and behavioural learning, while the functional participation of guided learning may support cognitive development on the content issues being investigated. However, process learning may also be expected from interactive participation and its equality in methodological decisions and joint analysis. Consequently, planners and practitioners must clarify their own participatory intent, and understand these levels of participation and their potential outcomes to make informed decisions on appropriate modes of participation in ‘participatory’ Farming Systems RDE projects in Australia (Pretty 1995).

Secondly, the findings confirm the dynamic nature of participation by highlighting how participation fluctuates across the levels described in Pretty’s (1995) typology, that it occurs within concurrent and even nested social relations, and depends on people accepting opportunities to participate. For instance, the emerging interactive participation in the Western project in Queensland did not preclude other levels of participation. Passive, consultative and functional participation were apparent at different times and in different aspects of the project. Indeed, the fluctuations and the range of concurrent activities in each project meant different levels of participation co-existed within most relationships in the teams. This fluidity of participation, and the power relationships between individuals that it represents, is consistent with Foucault’s (1980) concept of individuals as vehicles of power. Power is therefore inevitable in relationships and must be analysed as something that circulates, or functions in the form of a chain (Foucault 1980). Consequently, participation and power are perhaps best analysed through the social norms that develop (Kothari 2001). Indeed, they may be best described by the highest level of participation achieved, or at least, by the opportunities provided within the system being studied.
Thirdly, it was apparent that opportunities to participate were not taken by everyone. Some individuals may have avoided participation in activities that they believed may have highlighted their lack of knowledge (Billett 1994) because, as several team members noted, teamwork ‘really exposes everyone’s weaknesses.’ Alternatively, individuals’ dispositions to participate in specific activities and provide opportunities for others to participate may simply reflect their priorities (Perkins, Jay & Tishman 1993a, 1993b), that is, their judgements of whether it is worthwhile. While Pateman (1970) argues for full participation with equality in decision-making, and Pretty (1995) and Arnstein (1969) imply that ‘more participation is better’, individuals have limited time to invest in different aspects of their lives. Nobody can ‘fully’ participate in all activities and team members may not want decision-making equality in all facets and stages of their projects. As such, participation and learning within teams fluctuates with individuals’ interest in specific activities and their time available. The nature of teams’ diversity also affected how they participate. It stands to reason that the learning outcomes for individuals and teams depend on the nature of their diversity and the level of their participation.

7.4 Learning as a function of participation within diversity

The need to introduce a participatory approach to grains RDE implicitly recognises the diversity of its participants and the opportunities to learn from each other. Indeed, one aim of the projects was to encourage participation and learning within the project teams, and between each team’s scientists and farmers. The discussion in this chapter has highlighted each team’s response to this diversity and how they participated as result. However, it has also highlighted the different learning outcomes produced in each project and showed that learning in each team was a function of its members’ diversity and participation. More specifically, the level of learning (L) in teams is the product of the nature of their diversity (D) and the level of participation achieved within this diversity (P), that is;

\[ L = D \times P \]

It is suggested in experiential learning theory that ‘unexpected’ observations, the differences that create dissonance with people’s existing experiences and cognitive structures, are the catalyst for learning (Kolb 1984). People solve these cognitive problems and construct new knowledge by (re)-organising or modifying their existing cognitive structures to integrate and comprehend the new experiences (Ormrod 1999). However, learning is socially mediated, and while individual project members may initially rely on their existing meaning schemes, or extend them to understand new observations, they also interact with other team members to clarify and develop their cognitive processes and their meanings (Lave 1993; Matlin 2002). The diversity in the Farming Systems projects provides alternative and
potentially quite different meaning schemes to explain the phenomena encountered. So this diversity provides the potential for higher level learning. However, exposure to new meaning schemes will be reduced by participating in groups that hold similar understandings.

Team members participating in each project’s small activity groups, with informational diversity but little values diversity or RDE paradigm and worldview diversity, may have developed new technical insights and refined their learning schemes for RDE processes. However, transformation of these learning schemes or perspectives to integrate the projects’ different RDE methodologies was unlikely (Mezirow 1991), as this research showed. For example, testing and quantifying existing theories in local conditions with farmers in the Eastern project produced Level 1 learning in line with the notions of instrumental learning (Habermas 1971), single-loop learning (Argyris & Schön 1996), and learning through meaning schemes and extending them as needed (Mezirow 1991). The overall project contained considerable diversity. However, participants responded to this diversity by developing functional and interactive participation within their smaller, more homogeneous, and relatively independent activity teams. In practice, their interactive participation resembled functional participation as their methodological monism meant processes were largely assumed, with some refinement or extension of the basic learning scheme, but little apparent reflection on their appropriateness. Such developments in the Central project and early stages of the Western project have already been highlighted in this chapter.

The research findings also indicate that participation in diverse teams does not guarantee Level 2 learning and the transformation of learning schemes. Rather, it is the nature of teams’ participation, that is, the levels of participation that they develop in Farming Systems RDE (Table 13) to utilise this diversity, which transforms their learning schemes and perspectives. The isolation, passive and consultative participation between these teams-within-teams in the early stages of each project failed to develop higher level learning. The fragmented team learning processes whereby these smaller teams used their prevailing RDE methodologies to conduct different styles of on-farm research produced the refinement of mainly technical knowledge described above. They did not challenge or reflect on each other’s assumptions, learn to understand others, or integrate their perspectives. Despite the teams’ diversity, these low levels of participation did not develop Level 2 kinds of learning, and the outcomes may have been more efficiently achieved in smaller, independent projects.

Even the periodic functional participation that developed across the Central project did not develop into sustained interactive participation or support Level 2 learning to understand their common experiences and learn to coordinate their future actions (Habermas 1971). For example, the functional participation of the Butterfly pea activity focused on technical
outcomes and Level 1 learning. Similarly, pooled learning processes in the project integrated technical findings for each priority content issue. However, the process contributions of participants’ RDE methodologies: on-farm research, small-plot research, economic modelling, crop simulation, and experiential knowledge, were not reconciled. Indeed, crop simulation and economic analyses that disputed the value of the wide-row sorghum strategy proposed by the project’s on-farm research activities were not the catalyst for team members to develop their team learning processes. They did not reframe the problem, jointly develop experiments to resolve the apparent conflict, or subsequently integrate their perspectives (Dechant, Marsick & Kasl 1993). Rather, the economic data were ignored, and opportunities for interactive participation and Level 2 learning were lost. This was not an isolated case, and the activity group continued to pursue increased productivity and yield reliability and ignored other team members’ concerns about the potential of its lower ground cover levels to increase soil erosion and chemical pollution. The conclusion is that diversity alone does not provide higher levels of learning - interactive participation with dialogue and reflection on the underlying assumptions and values of processes and people is required.

Yet, diverse teams need the disposition to participate at this level. They need the interdependence of a collective vision to which they all want, and perhaps need, to contribute to for success. For example, the Western project in Queensland drifted apart from its NSW partner and faced a review by funders. Furthermore, an evaluation demonstrated that the different RDE methodologies (i.e. the modules) in the sub-project were not integrated. The sub-project was subsequently reframed so that team members would work better as a team and integrate their diversity for better farming systems. In their words, this ‘multi-method approach’ valued each RDE methodology and used them to develop different insights into the technical issues they addressed. Their subsequent development of interactive participation and dialogue was chronicled above, showing how these helped to reconcile team members’ values and so utilise their informational, RDE paradigm and worldview diversity effectively. This transformation of their learning schemes (Mezirow 1991), double-loop learning from reflecting on the appropriateness of each methodology (Argyris & Schön 1996), and communicative learning to better understand others and share ideas (Habermas 1971), confirmed their Level 2 learning. The Western project in Queensland provided the best example in this research of a team becoming interdisciplinary and ‘learning how to learn’ with their diversity.

In this chapter, the notion that learning in Farming Systems RDE is the product of participants’ diversity and their subsequent participation has been rehearsed and illustrated in data from each project. People continue to learn from ongoing participation in any project. Yet, the interaction of diversity and participation is major determinant of the nature of their
learning. In sum, Level 1 learning predominated from any participation in situations of low diversity, while the level of participation determined the nature of learning in contexts with diverse values, RDE paradigms, and worldviews. In these latter contexts, participation essentially becomes learning (Lave 1993). This interaction of diversity and participation on learning may explain the conflicting observations of team learning in the projects. Many project members reported favourable team learning processes. They continued to develop useful learning outcomes despite an apparent lack of participation. These may have been predominantly Level 1 learning outcomes, not the Level 2 outcomes inferred by the team learning processes of framing/reframing, experimenting, crossing boundaries and integrating perspectives (Kasl, Marsick & Dechant 1997). These varying levels of learning are not explicit in the outputs of Dechant, Marsick and Kasl’s (1993) model of team learning and the Team Learning Survey. Consequently, modifications to this model are proposed in Chapter Nine (‘Conclusions and implications’). However, overall impact of the Farming Systems RDE projects on farmers’ participation, learning and practices is assessed in Chapter Eight, before these findings and those of the earlier chapters are brought together in the final chapter of this thesis.
Participation and learning with farmers

As discussed in earlier chapters, farmer participation in RDE was proposed in order to improve the balance between understanding science and better farm management, and to facilitate learning between RDE project teams and farmers to improve farming practices (Henzell & Daniels 1995). This participation was expected to increase the relevance and impact of RDE, not simply provide participatory ‘therapy’ to help farmers see the relevance of current RDE (Arnstein 1969). Consequently, the development and role of participation between the project teams and farmers, and their subsequent learning and behaviour are explored in this chapter through the final sub-questions of this thesis:

How can the Farming Systems RDE teams participate effectively?

What is the consequent learning and behaviour of participants in Farming Systems RDE?

The overall impact of the RDE projects on farmers’ participation, learning and practices is assessed first. It is concluded that the projects improved farmers’ participation and had major impacts on regional farming systems. Nevertheless, limits to farmers’ participation in strategic project decisions and varying levels of participation were identified in specific project activities. Farmers’ participation was typically consultative before functional and interactive participation developed in some activities. This suggests that the majority of activities remained firmly within the Transfer-of-technology (ToT) paradigm and will not support the sustainable development sought in modern Farming Systems approaches.

The development of farmers’ participation, learning and behaviour in the structured action learning activities and on-farm research of the projects is then explored. This exploration reiterates the dynamic and differentiated nature of participation and highlights the difficulties in assessing participation through each stage of RDE activities. It also confirms that farmers’ participation, like team members’ participation, was constrained by the participatory intent and opportunities developed with the coordinators of each activity. Ultimately, the adequacy of participation will be determined by individuals’ participatory intent and the learning and behavioural outcomes they seek. However, it is asserted in the conclusion to this chapter that these learning outcomes and behaviours depend on the diversity of participants and the extent to which they participate. To this end, three key kinds of participation were synthesised from the empirical work: (i) consultative participation; (ii) functional participation; and (iii) interactive participation. Each of these has different characteristics and contributions to RDE practices as their subsequent outcomes.
Participation improves RDE

The Farming Systems projects provided participating farmers with better access to RDE resources and greater opportunities to influence local RDE decisions. Many farmers took this opportunity and appreciated their increased participation. For example, evaluation data indicates that 70% of farmers in the Western project in Queensland believed it ‘increased farmer involvement in decisions’ and 66% believed it ‘provided opportunities to influence research issues.’ Similarly, 95% of farmers in the Central project believed they ‘developed a strong partnership between farmers and project staff.’ Further, with more than 90% of the project teams agreeing, there was consensus that farming system projects increased farmers’ participation in RDE. Yet, farmers’ understandings, expectations and perceptions of the adequacy of their participation varied. Some did not want to be directly involved and simply wanted increased local research funding. Having local research to draw upon with any opportunity to influence it was a major advance for some farmers, ‘(its) unique...we’ve never had it before.’ Indeed, one group of farmers from the Western project in NSW only wanted a ‘two-sentence take home message...and a copy of the results for their local agronomist to interpret.’ However, most farmers sought more than this passive participation and particularly acknowledged each project team’s attempts to identify their local RDE priorities. Indeed, consultation was evident in the major activities in each project, and functional participation emerged as scientists and farmers discussed and decided the content focus of specific activities.

Most farmers appreciated the ‘grass roots’ consultation and functional participation to influence what was done in their groups and the issues they addressed. It appeared to them that the RDE agencies were being told to ‘get out there and ask the farmers what they want and let’s identify their problems and work on them.’ Such activities to improve the relevance of research were considered ‘pretty healthy’ and a major change. Yet, some farmers wanted more than consultation or input to refine the focus of activities already decided by the RDE agencies. For example, farmers on the management committee of the major research site of the Western project in Queensland helped select ‘opportunity cropping’ options to compare with the underlying nutrient treatments established by scientists. Scientists still decided the farming systems to compare and selected the trial sites and soil types which left farmers without any influence in the decision-making process and completely unaware of how these important initial decisions were made. Indeed, some farmers wanted more influence in the conduct of the project. They sought interactive participation with equality in the strategic project directions and process decisions of specific activities. As they put it, ‘everyone needs to contribute...the “wizards” have to listen to what we are saying. They hear what I say... but they do not listen!’ This lack of farmer participation in strategic decisions was conspicuous in each project as the RDE agencies continued to initiate and control each project and their activities. Consequently, the expectation of developing independent farmer groups that could conduct their own RDE remained largely
unfulfilled and many farmers still believed the project teams were ‘driving the group’. Some also believed their groups would collapse without the teams continued support and suggested that ‘we probably have to grow up one day and do our own thing’. However, some existing farmer groups recognised this participation as an opportunity to ‘capture RDE resources.’ These groups accessed the projects’ resources as much as the project teams accessed their groups. They represented the self-mobilisation of participants described in Pretty’s typology (1995). Yet, such groups remained an exception rather than the norm. This is contrasted with southern Australia where independent farmer groups have formed through a perceived lack of service by their state RDE agencies (McClelland, Gartmann & van Rees 2004). Perhaps RDE agency services and the increased participation through the Farming Systems projects were sufficient to preclude independent community action in Queensland. In sum, the projects provided increased opportunities for farmers to participate in the RDE processes but were yet to achieve the levels of participation envisaged for sustainable development.

Evaluation data from surveys of the 200 farmers participating in the Central and Western projects in Queensland (e.g. Appendix 4) established that most farmers felt the projects had improved their RDE despite the limitations to their participation. Over 90% of the 120 farmers that responded (62% response rate) to these surveys believed the projects ‘improved how research and extension was done’, and over 70% suggested there had been a moderate to large improvement in their RDE. Much of this improvement was attributed to the project teams’ increased participation and the subsequent learning that helped farmers understand key agronomic principles and make more informed management decisions. Indeed, farmers were supported to apply this understanding to integrate existing technology on their farms. The evaluation data confirms this as 49% of farmers categorised the projects’ impact on their knowledge on key technical issues as moderate, while 23% categorised this impact as large. Increased technical understanding and the project teams’ support to apply this knowledge to authentic decisions had a major impact on participants’ farming practices. Most project participants (80%) believed they had improved their farming practices and that their farming had become more sustainable (77%) and more profitable (74%) as a result. From these data it is concluded that the projects’ emphasis on increased participation to support learning was successful. Indeed, evaluations show the projects impacted on the management of the following four key issues that have eluded traditional RDE:

1. **Minimising soil erosion with the use of zero tillage and controlled traffic** – In Central Queensland, the proportion of participating farmers’ land under zero tillage (i.e. using herbicides rather than ploughing to control weeds) rose from 24% in 1996 to 77% in 2001, and is anticipated to reach 88% in 2006. These figures equate with 48%, 95% and 96% of these farmers using zero tillage over these same periods. The increased proportion of land under
controlled traffic has been equally impressive, rising from 7% in 1996, to 53% in 2001, and anticipated to reach 75% in 2006. Again, this equates to 17%, 66% and 80% of participating farmers using controlled traffic farming practices.

2. **Nitrogen management** - The proportion of farmers in the Western project in Queensland using nitrogen fertilisers also rose from 28% in 1995, to 72% in 2000, and their average rate of nitrogen rose from 23 to 38 kg N/ha over this same period. These dramatic changes were pivotal in ensuring farmers matched their soil nutrients supply to those demanded by the crops.

3. **Ley pasture management** – The proportion of participating farmers in the Western project in Queensland using legume ley pastures to improve soil fertility also increased from 20% in 1995 to 33% in 2000. Again, the surveys suggested these impacts would continue as 60% of these farmers intended using leys in 2005. The mean proportion of crop land under leys was consequently expected to double from 11% to 22% by 2006. There had been no suitable legume species available in central Queensland until their project team developed butterfly pea which 21% of participating farmers’ used in 2001 and 35% intend using by 2006. This has been a huge advance for managing soil fertility in the region.

4. **New crops and rotations** - Surveys also showed that the area of traditional crops grown by farmers in the Western project in Queensland - wheat, barley and sorghum - increased by 25% between 1995 and 2000. Yet, the area of other crops, such as canola, chickpea and mungbean increased by 560%! This diversification, especially the increase in people growing legume crops from 28% in 1995 to 48% in 2000, is a major achievement that has long been sought.

These four issues are important for sustainable grain production and illustrate the impacts of the projects on farming practices. It can be concluded from these data that RDE was improved by replacing passive participation and informal consultation with explicit farmer consultation to influence decision-making, reporting and hence learning. While the project teams remained the ultimate decision-makers in most activities, participating farmers recognised substantive increases in participation and considered the subsequent RDE more relevant and effective. The increased farmer learning and improved farm management illustrate how a market research approach to participation (Dennis 1972) can improve RDE if decision-makers are sincere and allow farmers considerable ‘subordinate influence’ (Strauss 1998a). Such consultation does not however ensure farmers’ opinions are taken into account and this frustrated some farmers when they felt their opinions were discounted in significant decisions (Armstein 1969). For example, many farmers were unhappy with the Queensland site of the small-plot experiment in the Western project and described it as ‘irrelevant…show pony country, one extreme end of the soil types in the district.’ These farmers wanted this major research activity conducted on a more
typical soil for wider relevance to farmers. They resented some team members using consultation to manipulate their on-farm research trials. At times, such manipulation to meet team members’ personal interest was not even ‘camouflaged’ (Crouch 1983). Indeed, an influential team member suggested at one Central Queensland project meeting that groups were now addressing all the team’s priorities, so they could let the ‘two new groups identify their own issues…(and) go down the ‘proper’ approach of talking, talking, talking…let me know when the snow falls (lots of laughter).’ In summary, and despite such cynicism, each project provided increased opportunities for farmers to engage in substantive planning and decision-making of specific activities. These levels of participation and the ways they enacted participatory processes differed in each project. Yet, farmers’ general endorsement of impacts of these processes on farming practices attested to the success of the projects. Moreover, functional participation developed to characterise most action learning and on-farm activities, and interactive participation began to emerge within and between some activities.

**Action learning and training activities**

The underlying ToT paradigm of the RDE agencies is evident in Martin’s (1996) emphasis of the Farming Systems projects teams’ role in testing treatments that major research sites identified as valuable. Indeed, action learning and training activities aimed to extend the principles developed in the research activities of the projects, and support a wider number of farmers to improve their skills and confidence to manage complex agricultural systems (Carberry 1997). Team members subsequently developed numerous activities to help farmers understand and better manage key aspects of their farming systems, such as; soil nitrogen, soil water, crop rotation, legume management, controlled traffic systems, and economic performance. However, over time, the potential to facilitate higher levels of participation and encourage learning amongst all participants and not just farmers became apparent. These activities subsequently became more flexible, allowed emergent themes, and encouraged learning and more informed decisions through collaboration and dialogue between different participants (Christodoulou 2000). The Nitrogen in ‘95-99 project (Lawrence et al. 1996) was proposed as the initial model for these action learning activities (Martin, Cornish & Verrell 1996). It was subsequently used in each project and provides a useful case study of these activities and the teams’ participation with farmers, their subsequent learning and behaviour. The learning potential of this project is discussed in the next section.

**Guided learning to navigate existing knowledge for real-time decisions**

The Nitrogen in ‘95-99 project was developed and initiated to go beyond merely advancing farmers’ awareness of nitrogen budgeting. It aimed to help farmers understand the basic principles and apply them effectively to their own situations. Specific learning outcomes included a propositional understanding of soil nitrogen processes, the rationale for agronomists’
nitrogen recommendations, and sufficient skills to develop nitrogen strategies for a real crop and interpret their nitrogen responses. This was achieved by developing an initial framework for participants to share their nitrogen experiences, and support their ‘real-time’ application and review of their nitrogen budgets. The developmental approach was strongly influenced by Revan’s (1985) notion of using groups to question and interpret authentic experiences. Revan’s (1997) learning equation, \( L = P + Q \) provided a framework to combine participants’ existing knowledge and questions to develop new understandings of nitrogen, especially at the post-harvest workshops to reconcile expectations and actual outcomes (Lawrence & Cawley 1999). Consequently, the *Nitrogen in '95-99* project and subsequent group-based learning activities in the Farming Systems projects became known as ‘action learning modules’.

The four major steps of the *Nitrogen in '95-99* development process are summarised in Box 3. The first step was pre-plant soil sampling in which a 90 cm soil sample was taken from one paddock on each participant’s farm to ensure an authentic problem to work on. This also clarified participants’ expectations and emphasised that the activity was an interactive workshop that could help them to understand nitrogen and calculate their own nitrogen requirements. It was not a seminar with hypothetical examples. The second step was a participatory pre-planting workshop to generate and share participants’ nitrogen experiences, introduce scientific understandings of nitrogen, and guide participants through five simple step-by-step mathematical worksheets to estimate their nitrogen fertiliser requirements for themselves. In the third step, farmers were encouraged to apply this rate of fertiliser and record their crop outcomes, before reconciling their results and expectations in the fourth step at a post-harvest workshop. The process proved popular and workshops were conducted by the development team, the Farming Systems teams, and other agronomists. By the end of 1996, 44 workshops with 400 farmers and 50 agronomists were conducted to support the potentially rich learning through a participatory process that involved farmers investigating nitrogen on their own farms and sharing the results (Lawrence & Cawley 1999; Lawrence, Cawley & Hayman 2000a).

Each facilitator of these workshops placed varying emphasis on participation and on either independent or shared learning processes (Lawrence & Cawley 1999). Commercial agronomists were used to providing advice, and typically used a seminar approach with passive participation to guide people through the worksheets for a fertiliser ‘answer’ with little background understanding. In contrast, team members were encouraged towards a more participatory approach to develop participants’ understanding and application of nitrogen decision-making processes (Lawrence & Cawley 1999). The facilitators got all participants to first describe their recent nitrogen practices and plans for this season. A guided discussion was then used to help them navigate basic propositional knowledge about nitrogen, and to use the worksheets and personal experiences to transform it into practical knowledge for their farms (Lawrence, Cawley
This structured process integrated propositional and experiential knowledge through participants’ expectations and their modification of some content (Christodoulou 2000). Finally, participants explored the likely reasons for any discrepancies between the expected results from the workshops and their actual outcomes. As such, the process used in the Nitrogen in ’95-99 project provided many opportunities for increased farmer participation. It was successful, but was still pre-determined by scientists and dependent on them to function. This exemplifies Pretty’s functional participation.

**Box 3. The Nitrogen in ’95-99 development process**

<table>
<thead>
<tr>
<th>PRE-PLANT SOIL SAMPLING</th>
<th>SOIL SAMPLING AND ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Growers look at their soil profile, moisture levels, plant roots etc</td>
</tr>
<tr>
<td></td>
<td>• Clarify expectations and current understanding</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRE-PLANT WORKSHOP</th>
<th>DISCUSS AND DOCUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Paddock histories</td>
</tr>
<tr>
<td></td>
<td>• Yields and protein expectations</td>
</tr>
<tr>
<td></td>
<td>• Intended nutrient strategy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INDEPENDENT FARMER PROCESS</th>
<th>DISCUSS FUNDAMENTALS OF THE NITROGEN CYCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DETERMINE NITROGEN REQUIREMENT FOR THE YIELDS AND PROTEINS PARTICIPANTS EXPECT ON THEIR OWN PADDOCS</td>
</tr>
<tr>
<td></td>
<td>DETERMINE AVAILABLE SOIL NITROGEN FROM OWN SOIL TEST</td>
</tr>
<tr>
<td></td>
<td>RECONCILE NITROGEN REQUIRED AND NITROGEN AVAILABLE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>POST-HARVEST WORKSHOP</th>
<th>OTHER INFLUENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Finances</td>
</tr>
<tr>
<td></td>
<td>• Market prices</td>
</tr>
<tr>
<td></td>
<td>• Fertiliser costs</td>
</tr>
<tr>
<td></td>
<td>• Weather</td>
</tr>
</tbody>
</table>

|                       | FARMERS DECISION |
|                       | FARMERS ACTION |
|                       | CROP GROWN |
|                       | CROP HARVESTED |

|                       | COMPARE EXPECTATIONS WITH ACTUAL RESULTS |
|                       | REVIEW VALUE OF THE PROCESS FOR DECISION MAKING |

190
Evaluations confirmed the value of this approach as participants overwhelmingly believed the process was effective, relevant, and had a major impact on their farming practices (Cawley & Lawrence 1998; Christodoulou 2000; Lawrence, Cawley & Hayman 2000a). The data from a case study of 114 workshop participants is depicted in Table 17. Perceptual statements from the evaluation survey are listed in the left-hand column, and the proportion of participants that variously agreed or disagreed with them is listed in the other columns. The impact of this structured learning approach is obvious in the participants’ responses. Over 90% agreed that the Nitrogen in ’95-99 project was very useful (98%) and relevant (91%). Most also agreed that the process was an effective way to look at nitrogen (94%), which helped them understand it (98%) and helped with nutrient decisions (86%). Indeed, 94% disagreed that this workshop on one of the most researched issues in agriculture was too complex. As a result most participants were confident that they could interpret soil tests (88%) and use past crop performance to check their soil’s nitrogen status (77%). The project was a success based on this data. This assessment was reinforced by data on the impact on the workshops on participants’ practices.

Table 17. Participants’ perceptions of the Nitrogen in ’95-99 workshops

<table>
<thead>
<tr>
<th>Perceptions of the Nitrogen in ’95-99 workshops</th>
<th>Percentage of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall perceptions and content</td>
<td>strongly disagree</td>
</tr>
<tr>
<td>The workshops were very useful</td>
<td>0</td>
</tr>
<tr>
<td>The workshop was very relevant to my farming system</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Perceptions of the process</th>
<th>Percentage of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>The workshop was an effective way to look at nitrogen</td>
<td>0</td>
</tr>
<tr>
<td>The workshop really helped with my nutrition decisions</td>
<td>1</td>
</tr>
<tr>
<td>The workshop was too complex</td>
<td>30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Perceptions of understanding and skills gained</th>
<th>Percentage of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>The workshops really helped me understand soil nitrogen</td>
<td>0</td>
</tr>
<tr>
<td>I can now make much more sense of nitrogen soil tests</td>
<td>0</td>
</tr>
<tr>
<td>I can now confidently use crop yield &amp; protein to check soil nitrogen status</td>
<td>0</td>
</tr>
</tbody>
</table>

An analysis of this evaluation data is summarised in Table 18 to show how participants responded to the workshop results. The left-hand column shows the classification of participants into three groups based on whether their workshop ‘recommendation’ was to maintain their intended rate (Group 1), increase their intended rate (Group 2), or reduce their intended rate (Group 3). Finally, the left-hand column shows the extent to which participants’ actual nitrogen rates reflected these recommendations and pre-workshop intentions. The right-hand column presents the proportion of people within each group that match these final descriptions. Table 18 shows that participating farmers changed their nitrogen fertiliser rates in line with their workshop suggestions. Few changed fertiliser rates when their workshop suggestions were within 10 kgN/ha of their pre-workshop intentions. However, 76% of participants reported
increased rates when higher rates were suggested, and 71% reduced them when lower rates were suggested. Changes in participants’ mean fertiliser rates towards the suggestions from the workshops are summarised in Table 19. The classifications of participants with recommendations to maintain, increase, or reduce their intended fertiliser rates are again listed in the left-hand column. The mean nitrogen rates of each group’s pre-workshop intention, workshop recommendation, and their actual applied rates are presented in the other columns. Again these rates moved strongly towards the recommendations from the workshops and showed participants had developed confidence in the *Nitrogen in '95-99* processes. The worksheets were re-used by 53% of participants and 22% subsequently reported tested more paddocks before planting. It appeared that participants understood the processes and learned how to apply them to their own situations. Supporting people to use their own real-time data in a simple and transparent model of reality brought nitrogen budgeting to life. That is, it helped people understand and adapt new practices for better management which is the prime, but sometimes elusive, goal of RDE.

Table 18. The impact of the *Nitrogen in '95-99* workshop participants’ fertiliser rates

<table>
<thead>
<tr>
<th>Classification of participating farmers based on their pre-workshop intentions, workshop recommendations and actual fertiliser rates used</th>
<th>Proportion of people in each group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP 1. RECOMMEND TO MAINTAIN INTENDED NITROGEN RATE (30 PEOPLE) (workshop recommendation within 10 kgN/ha of the pre-workshop fertiliser intention)</td>
<td></td>
</tr>
<tr>
<td>Actual nitrogen rate within 10 kgN/ha of participants’ workshop recommendation</td>
<td>87</td>
</tr>
<tr>
<td>Actual nitrogen rate not within 10 kgN/ha of participants’ workshop recommendation</td>
<td>13</td>
</tr>
<tr>
<td>GROUP 2. RECOMMEND TO INCREASE INTENDED NITROGEN RATE (46 PEOPLE) (workshop recommendation &gt;10 kgN/ha above the pre-workshop fertiliser intention)</td>
<td></td>
</tr>
<tr>
<td>Actual nitrogen rate within 10 kgN/ha of participants’ workshop recommendation</td>
<td>50</td>
</tr>
<tr>
<td>Actual nitrogen rate above participants’ pre-workshop intention, but not within 10 kgN/ha of the workshop recommendation</td>
<td>26</td>
</tr>
<tr>
<td>Actual nitrogen rate the same or lower than participants’ pre-workshop intention</td>
<td>24</td>
</tr>
<tr>
<td>GROUP 3. RECOMMEND TO REDUCE INTENDED NITROGEN RATE (38 PEOPLE) (workshop recommendation &gt;10 kgN/ha below the pre-workshop fertiliser intention)</td>
<td></td>
</tr>
<tr>
<td>Actual nitrogen rate within 10 kgN/ha of participants’ workshop recommendation</td>
<td>53</td>
</tr>
<tr>
<td>Actual nitrogen rate below participants’ pre-workshop intention, but not within 10 kgN/ha of the workshop recommendation</td>
<td>18</td>
</tr>
<tr>
<td>Actual nitrogen rate the same or above workshop recommendation</td>
<td>29</td>
</tr>
</tbody>
</table>

A 10 kgN/ha increment was used to account for the rounding of recommendations to the nearest 5 kgN/ha, the accuracy of budgeting approaches, the need for significant differences for people will change their intent.

Table 19. The mean fertiliser rates of *Nitrogen in '95-99* workshop participants

<table>
<thead>
<tr>
<th>Classification of participating farmers into three groups (N=114)</th>
<th>Mean nitrogen rates (kgN/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-workshop intent</td>
</tr>
<tr>
<td>Group 1. Recommend maintain intended nitrogen rate</td>
<td>22</td>
</tr>
<tr>
<td>Group 2. Recommend to increase intended nitrogen rate</td>
<td>37</td>
</tr>
<tr>
<td>Group 3. Recommend to reduce intended nitrogen rate</td>
<td>49</td>
</tr>
<tr>
<td>Total of all participants</td>
<td>37</td>
</tr>
</tbody>
</table>
Most participants supported this focus on understanding rather than just providing recommendations (Cawley & Lawrence 1998), as one farmers suggested, ‘we’ve always known what happened, but now we know why.’ Developing this basic knowledge of nitrogen processes helped overcome farmers’ confusion from the mixture of success and failure after following past fertiliser recommendations. As another farmer said, ‘I gave (nitrogen) up 40 years ago as too hard to understand and now I’ve got a lot better handle on it.’ Commercial agronomists also recognised farmers greater understanding, as exemplified by the comment that, ‘(Farmers) have always known they needed nitrogen, but they now know why and that it can be managed... (now) it’s not just a number plucked out of the air. (They can now) come back, disagree, and discuss things that affect nitrogen’ (Lawrence et al. 1997). In sum, these testimonials and practice data confirm the potential for active participation to support learning and the integration of different stakeholders’ knowledge.

**Learning through active participation**

Applying an expert’s model to an authentic problem in the Nitrogen in ’95-99 workshops was effective and deeply informative (Brown, Collins & Duguid 1989). Using this simple and transparent model of reality within farmers’ zone of proximal development (Vygotsky 1978, 1987) supported them to use their own data to make better decisions. Functional participation was sufficient for farmers to understand the rationale for their answers and better equip them for future decision-making (Lawrence, Cawley & Hayman 2000a). Farmers appreciated this ‘guided learning’ approach because it gave them the opportunity to influence outcomes and not simply be passive recipients of information, ‘I enjoyed having the opportunity to listen and discuss with other farmers our experiences and problems, the group activities have helped us in formalising this and to pool our experiences’ (Christodoulou 2000). The project teams also benefited from these experiences as they developed the skills to move from an instructor or teacher, to a facilitator of learning, and in some cases to co-learner (Christodoulou 2000). Some team members encouraged explicit reflection on both the workshop process and the rationale of nitrogen budgeting. For example, the Western project team in Queensland provided opportunities for farmers to influence the content and process of the activity. Technical gaps were then identified and better local information sought. Participants wanted local data and concluded that on-farm research was most appropriate as ‘it’s relevant to our situation... and includes scientists’ and farmers’ needs and views.’ Farmers and scientists jointly decided to use on-farm research, not further action learning activities to determine local soil water holding capacities and nitrogen mineralisation rates. The interactive participation envisaged in modern Farming Systems approaches was emerging.

Through interactive participation, participants ultimately raised questions about the rationale of budgeting processes, comparisons with other nitrogen decision processes, and dialogue on
participants’ nitrogen management aims. Differences between people’s espoused theories and their actual practices, their theories-in-use (Argyris & Schön 1996), were highlighted by this dialogue. For example, farmers typically insisted that they needed to produce ‘prime hard’ quality wheat of at least 13% protein to be viable. Yet, when high nitrogen rates were required, participants often reduced their expected yields in an attempt to lower their fertiliser rates to what their cash-flow would allow (Lawrence, Cawley & Hayman 2000a). This action severely limited their ability to achieve the prime hard quality that they espoused as essential. Dialogue amongst farmers was then used to explore the economics of these decisions and review their theories-in-use for nitrogen management. In sum, the Nitrogen in ’95-99’s process was a major success that helped farmers understand nitrogen and make better nitrogen decisions on their farms. It also provided a process for project teams to encourage interactive participation. The transparent framework was also a catalyst for participants to review alternative nitrogen strategies and reflect of their own aims, constraints and assumptions about nitrogen management. This ultimately led to the development of the Sustainable nitrogen decisions workshops that used higher levels of participation to encourage double-loop learning about the most appropriate nitrogen decision-making process (Christodoulou & Lawrence 2004). The potential of this later workshop to support participants’ learning is discussed in the next section.

Facilitating higher learning for nitrogen management

Although the Nitrogen in ’95-99 workshops helped people understand basic nitrogen processes and use nitrogen budgets to determine their crop nitrogen needs for the season, other processes for making nitrogen decisions had been developed and were being actively promoted to farmers (Lawrence & Christodoulou 2005). These competing methods led to both public and private criticisms of these different methods. Even within the Farming Systems projects, there was competition and debate between individuals who promoted each method to participants. Yet, the assumptions and limitations of each method were rarely made public. As an individual in the Western project of Queensland observed, team members resembled ‘used car salesmen’ promoting different products. Their failure to reconcile the methods developed by each of the methodology-based modules of the project had already been identified as a lost learning opportunity (Cawley & Lawrence 1998). Moreover, the team provided no support for farmers and agronomists to decide the most appropriate methods for their own situations. The Sustainable nitrogen decisions workshops were then developed and staff reframed the problem from ‘which method is the best to tell farmers?’ towards one of helping farmers assess the most appropriate method for themselves.

The Sustainable nitrogen decisions workshops (Christodoulou & Lawrence 2004) emerged from a series of meetings in the Western project in Queensland to reconcile an increasingly bitter internal email debate on the value of these nitrogen decision-making methods (circa
January 2000). The team subsequently reviewed each method and compiled a summary of their key assumptions, strengths and weaknesses. The workshops drew upon this experience to help farmers review their nitrogen management aims, assess these common methods, and make an informed decisions about the most appropriate approach for their own situation (Lawrence & Christodoulou 2005). These dialogue based workshops consequently began by discussing participants’ aims for managing nitrogen, their constraints and what they had learned about nitrogen and its management over recent years. Participants then described their past fertiliser use, intentions for the coming season, and discussed how they currently made nitrogen decisions. Each participant then used a soil test from their own farm to calculate the nitrogen requirements for the season using each of the common nitrogen decision-making methods. These were subsequently rated for ‘ease of use’ and ‘help for making decisions’ before a group discussion of their strengths and weaknesses. Finally, each participant explained their planned nitrogen rate and what they now believed was the most appropriate approach for them in future (Christodoulou & Lawrence 2004). The ensuing dialogue focussed heavily on the participants’ aims with nitrogen management and the assumptions of each decision-making method. In this way, the process focused heavily on interactive participation.

The huge variation in nitrogen rates recommended by the individual methods for each paddock is illustrated in Table 20. Participants’ expected grain yields and proteins, and their targets for deciding the appropriate fertiliser rates are presented in the left-hand column. Their initial fertiliser plan for each paddock is in the second column. The remaining columns depict the rates of fertiliser suggested for the common methods assessed in the workshop, that is, the annual replacement of nitrogen removed in the last crop, nitrogen budgeting using past crop performance, nitrogen budgets using soil tests, and a rule of thumb based on a given ratio of ‘soil water’ to ‘soil nitrogen’ at planting. One person’s initial intention was to apply no nitrogen for an expected yield 2 t/ha at 12 % protein, as the shaded row in Table 20 shows. However, the suggested rates varied from 84 kgN/ha (annual replacement) and 69 kgN/ha (pre-plant ratio) to zero, with surpluses of 30 kgN/ha using soil tests and 48 kgN/ha for budgets using past yields and protein. This reinforced the danger of using an inappropriate method for their farms. At approximately $1/kg, applying too much nitrogen to thousands of hectares of crop is very costly. Yet applying too little can result in big yield losses, low grain quality and poor returns. Participants recognised it was critical to understand the assumptions and limitations of each method. For example, simply replacing the nitrogen removed by the last crop would be too costly on new soils that could support crops for another 20 years without fertiliser. Similarly, this would never overcome problems on deficient soils where past crop failures had removed little nitrogen. Ultimately, most participants developed an approach of combining two different methods. They typically used nitrogen budgets based on soil tests and one other method to complement their own experiences.
Participating farmers’ and agronomists’ ability to understand and explain the reasons for these different outcomes was confirmed in workshop discussion and evaluations. They strongly supported the focus on understanding the different methods and reconciling them with their own constraints. This provided a more nuanced and situation-specific understanding. ‘Learning-wise’, this is a more complex outcome than generally applicable measures because it introduces situational variables that are richer, yet reflects the actualities of practice within farms as individual units rather than collectives with uniform factors. A survey of 30 participants showed they overwhelmingly believed it helped to ‘understand each method’ (n=26), ‘clarify my aims and constraints for using nitrogen’ (n=26), and ‘decide the best approach for my farm’ (n=27). These responses again emphasise understanding, but also conceptual development and a capacity to account for situational factors that are important to farmers.

Yet, the resilience of the ToT paradigm and behaviourism was highlighted in discussions of the workshop results with regional agronomists. Most agronomists just wanted the ‘best’ method to promote to their clients. One leader of a Farming Systems project even described the workshop as ‘rubbish’ because it failed to identify this ‘best’ method. He was not interested in helping people understand the methods and develop their own solutions. Indeed, after working in the projects for seven years, including three years as a project leader, he remained ‘unsure what the Farming Systems projects are trying to achieve’ and confessed to ‘little understanding of the theories.’ It follows that without the effort to understand participation and system thinking; many activities will remain firmly within the ToT paradigm and rely on passive, consultative, and sometimes functional participation to encourage adoption and behavioural learning.

Participation in Sustainable nitrogen decisions workshops, as with Nitrogen in ’95-99, could be described as functional. Participants modified the content and influenced the direction of the
workshops, but the basic process was predetermined by the facilitators. Both workshops extended beyond ToT and the adoption of standard fertiliser recommendations. Yet, their learning outcomes were qualitatively different. The Nitrogen in ‘95-99 workshops focused on Level 1 learning to develop participants’ understanding of nitrogen processes and their skills to conduct their own nitrogen budgets. Its impact was huge, and nitrogen budgeting rapidly became industry standard practice. In contrast, the Sustainable nitrogen decisions workshop emphasised understanding the appropriateness of nitrogen budgeting and other methods. It focused on the Level 2 learning outcomes of double-loop learning, practical cognition and communicative action to transform participants’ learning schemes (Table 6). It used a flexible structure and developed dialogue between participants to share their experiences with nitrogen decision-making methods. This dialogue deepened participants’ learning. It highlighted inconsistencies between participants’ stated aims (i.e. espoused theories) and their actions (i.e. theories-in-use), and identified gaps in the propositional understandings that people accepted as complete. As such, the process evolved towards interactive participation and learning how to reframe problems to integrate different perspectives. It echoed the interactive participation of jointly planned on-farm research that emerged from the Nitrogen in ‘95-99 workshops. Both farmers and Farming Systems team members modified their traditional learning systems to incorporate some of each other’s traditional experiential and propositional knowledge.

In summary, traditional passive and consultative participation supported behavioural learning with district fertiliser recommendations that, if successful, were repeated. These ‘rules-of-thumb’ were useful but failed in unusual or changing circumstances (Lawrence, Cawley & Hayman 2000a). In contrast, the functional participation of the Nitrogen in ‘95-99 project promoted single-loop learning (Argyris & Schön 1996) to help participants understand nitrogen and apply worksheets to their own situations. Yet, interactive participation provided equality in both process and content decisions in the Sustainable nitrogen decisions workshops where there were opportunities for double-loop learning (Argyris & Schön 1996) to understand when a budgeting approach was appropriate. Reflection of participants’ aims, their rationale, and conflicts between their espoused and actual theories and practices were encouraged by the emerging dialogue on the appropriateness of budgeting approaches. However, these opportunities for deutero-learning (Argyris & Schön 1996) and participants’ reflection on their learning systems were the exception rather than the rule within the projects. Team members employed functional participation and focused on Level 1 learning goals to increase the adoption of current best practice in most action learning and training activities. Such activities alone are unlikely to build the ongoing capacity to support a sustainable agriculture with interactive participation to integrate the diversity of participants and their different knowledge systems (Pretty 1999). Yet, success in progressing further towards Level 3 learning from processes such as those developed in the Sustainable nitrogen decisions workshops remains to
be fully evaluated. The challenge is developing processes that encourage and support interactive participation and integrate the diversity of knowledge and experiences involved in grains RDE. Christodoulou (2000) concluded that a Participatory Action Research approach to on-farm research provides the ideal opportunity for this co-learning and integration of propositional and indigenous knowledge. Indeed, the evaluation focus groups and interviews confirmed that on-farm research is the aspect of the farming system projects that interests everyone: the researchers, extension officers and farmers. Consequently, the extent of participation and the nature of learning in on-farm research stand as being critical to the impact of the projects.

**On-farm research activities**

Research is a natural and instinctive part of being human (Hunter & Hayes 1996), perhaps no more so than when uncertainty surrounds a decision that may impact on issues of salience to the individual. Farmers and agronomists continually engage in ‘research’ (i.e. testing propositions through practice) as they try to improve their farming. While scientists have traditionally undertaken experiments on research stations or cooperating farmers’ paddocks, the notion of participatory on-farm research was introduced through the Farming Systems projects. Such research was to be valued by all participants, located on farms, initiated with farmers, and would maintain the participation of farmers, advisers and researchers throughout (Carberry 1997). This charter was the catalyst for numerous on-farm research trials and some team members had conducted over 90 on-farm trials since 1995. Most early on-farm research was initiated by scientists, but by 2000 over half were farmer initiated, or jointly initiated by farmers and scientists (Christodoulou 2000). Again, there were different levels of participation in individual research activities, each activity over time, and the issues addressed in each project. Most farmers recognised their increased participation. Yet, just as the project teams had to learn how to participate effectively with each other, so too did the teams and farmers.

**Participation in on-farm research**

While farmers’ participation in overall project decisions remained at the consultative level, the constraints to wider participation in on-farm research activities were targeted to encourage more equal and effective participation through the key stages of on-farm research. These key stages of (i) developing the research focus of on-farm research, (ii) designing and conducting the research, and (iii) interpreting the results, are discussed in the next section.

**Developing the research focus**

Developing the research focus and establishing participants’ understanding of the issues is a key step in rigorous research. Ensuring farmers and scientists participation in this stage of research will be critical to ensure research is relevant. Yet, each project team’s urgency to establish on-farm research constrained participation between farmers and the teams in three ways:
1. **Team members controlling decisions.** Each project team was accused of imposing its views on the topics to address. Criticism was strongest from farmers when teams tried to camouflage their own priorities rather than discuss them. As some farmers complained, ‘we supposedy decided what we were going to do. (But we didn’t)...the facilitators decided’. Others suggested some team members were ‘doing what they are interested in and tagging it onto a group...making a token attempt of involving farmers.’ This manipulation reflected most team members’ enculturation from their ToT backgrounds. Yet, it did not upset all farmers. Some groups were interested in several issues and were happy while their priorities were discussed and one of their issues was addressed. For example, farmers in the Central project happily addressed their second priority issue when research on their top priority was already being undertaken by other groups;

2. **Defaulting to ‘farmer-driven’ research.** Some activities were initiated on issues the teams understood very well. Yet, they did not always contribute this knowledge in the design of the ‘research.’ For example, research on farmers ‘best-bet’ treatments to improve soil organic matter contained options that scientists knew would have little impact. This was not discussed when the research issue was developed, as farmers later lamented in evaluation meetings. Such willingness to conduct ‘farmer driven’ research is reminiscent of the ‘Farmer first’ movement (Chambers, Pacey & Thrupp 1989) and undervalues the teams’ knowledge. It may also reflect the limited exposure of the teams to Farming Systems theory that was identified in Chapter Five and their prevailing view that farming system RDE is primarily extension with participation to increase farmer ‘adoption’. In this view, the focus was on farmers participating in research to test established agronomic principles in local contexts, not the integration of all participants’ perspectives and experiences as proposed in ‘Beyond farmer first’ (Scoones & Thompson 1994) and participatory action research; and

3. **Unclear aims.** The urgency to establish activities resulted in much early on-farm research addressing general issues without consensus on the aims, or clear research questions. Indeed, many team members were unable to clarify what information they, or farmers, really wanted to gain. This failure to clarify participants’ initial understandings of issues, the information they sought, and their specific research questions was obvious in evaluation meetings. This made participants’ learning difficult to evaluate and seriously questioned the quality of participation in these activities. This approach allowed individual participants to pursue their different research questions. For example, farmers could answer their specific technical questions, while scientists learned how to conduct more participatory on-farm research. Yet, it may also have encouraged parallel activities with limited participation and contributions to each others’ research.
In sum, the limited sharing of participants’ experiences and understanding in this initial on-farm research seriously limited opportunities for team learning (Dechant, Marsick & Kasl 1993). Focussing on individual learning may produce valuable outcomes. However, the likely learning outcomes will be ‘fragmented’, or perhaps ‘pooled’ if overlaps of interest develop, but they will not be ‘synergistic’ (Kasl, Marsick & Dechant 1997). This consequently represents lost opportunities to integrate participants’ different perspectives and develop the collective framing and understanding of local issues and farming systems.

Impact on team members

Many team members sought to develop more equal participation in their activities. They wanted real issues from the ground up because ‘if the issues are from the top down they die because they are irrelevant (to farmers).’ They needed issues of genuine interest to all participants. The Eastern project team highlighted the value of clear and shared research questions for their activities. Insisting that each activity have an explicit research question encouraged participation and was a critical step to conducting both rigorous and relevant research with stakeholders (Carberry 2001). Developing a shared research question encouraged participants to consider their existing knowledge and ‘reframe’ their individual questions to ensure the research was of genuine interest to all. The wider team did not always agree on the value of the subsequent research questions, but these questions supported a collective focus for the learning of team members and farmers directly involved. Clear research questions subsequently became an imperative across most on-farm research activities in each project.

Because team members were criticised for developing their research questions and then finding a group to conduct the research with, a process was sought to ensure greater participation and questions of genuine interest to all participants. This comprised key questions from the evaluation framework which had recently been used to ‘recapture’ participants’ initial knowledge of their research issues (Chapter Seven). This emerging framework provided more than just evaluation. It represented a normative process for planning, conducting and evaluating participatory on-farm research. For example, the framework explicitly asks why the research issue is important to each stakeholder group, what they already know about the issue, and what they really want to find out or learn? That is, what is their key research question? Team members’ ability to provide this level of information quickly confirmed that they were participating at high levels with their stakeholders.

In sum, the framework provided a checklist of key questions that supported best practice in participatory research and encouraged each project to ensure greater input into on-farm research activities and clarify all participants’ knowledge of the issues (Chapter Seven). Team members learned how to explore participants’ understandings and aims for their proposed research and to
initiate deeper and more challenging dialogue with farmers. So the framework became a catalyst for learning. For example, farmers and scientists were both concerned about how the new controlled traffic farming practices would affect the runoff of rain and soil erosion. Controlled traffic means farm equipment travels on permanent ‘tramlines’ for greater efficiency of operations and to reduce soil compaction and crop damage. However, the impact of planting crops up-and-down slopes for greater efficiency rather than the traditional across slopes designs was unknown to all parties. Reviewing their existing knowledge and experiences to develop a research question helped all stakeholders learn. For example, scientists learned how farmers improved their operational efficiency by 15% though reduced overlap, and farmers learned about the underlying soil and water processes that drove soil erosion. They collectively considered the likely outcomes from their existing understandings and developed their research question to test their hypotheses. This exemplified how team learning led to crossing of boundaries and experimentation to resolve differences and create new knowledge for all participants (Dechant, Marsick & Kasl 1993), in this case, whether any differences in soil erosion were sufficient to modify the most efficient ‘longest runs’ that were currently used. It can therefore be concluded that reviewing participants’ understandings of priority issues and agreeing on the information required, is critical to effective participatory research. Documenting such reviews helps encourage engagement and learning with other stakeholders who can contribute because it is clear what is already known and is trying to be achieved. Just as importantly, a clear question provides a basis for deciding the most appropriate research design and methods for the investigation, which are critical in ensuring appropriate data is gathered to adequately answer the research problem.

**Designing and conducting the research**

The early difficulties in establishing effective participation carried through designing the on-farm research methods. Most early on-farm research was apparently designed by either the scientists or the farmers with passive or consultative participation. The research treatments emerged from farmers’ and scientists’ discussions. Yet, the lack of shared aims meant farmers typically focused on the treatments as outcomes to apply in their management, while scientists used treatments to understand underlying agronomic principles. For instance, a treatment containing a new crop and a zinc fertiliser pleased farmers who wanted an economic return. However, scientists wondered if the gains were due to the variety or the fertiliser and complained ‘we are not measuring the causes so we cannot understand and fix it…we’re just measuring outcomes’. The farmers’ focus was on which treatment was best, or gave the best return on their investment, while scientists wanted to know why this occurred and became frustrated with confounded variables in some initial farmer-designed treatments. This example confirms the values diversity of participants and the need to develop a shared question before deciding the research design.
These comments illustrate farmer’s input to treatments. Yet, their influence on research designs was not obvious. Most initial research designs reflected the preference of the coordinating project members and what they believed farmers would accept. The project teams typically took over once the research issue was established. Consequently, trials coordinated by individual team members tended to use fairly similar designs regardless of the research questions, or the quantification and confidence levels sought by participants. Replication and randomisation were evident when traditional researchers were involved, and conspicuously absent in most trials coordinated by extension officers. Some researchers had complete trial designs ready before meetings with participating farmers had decided their specific research questions. Scientists are trained in research, so they can be expected to contribute strongly to the research designs. Yet, there was limited evidence of farmers’ input into these designs because the scientists’ knowledge was privileged in this matter. This lack of participation continued in some activities that became ‘disconnected from participating farmers’ and saw scientists simply conduct their own research once priority topics had been decided. In extreme cases farmers did little more than plant the crop and receive a summary of results after harvest. However, this passive participation was the exception rather than the rule. Through consultation, team members began to discuss alternative designs with farmers and test their assumptions about what was practical for farmers. In this way, the practices of both scientists and farmers were extended and developed in keeping with more participatory processes.

For example, scientists used simple comparisons between treatments applied side-by-side within farmers’ paddocks in many initial trials because they were easy to establish with commercial equipment (Christodoulou 2000). Replication was rare until all parties became frustrated with unclear results and began to review their research designs. Comments from a researcher in the Central project exemplified this frustration with the emphasis on demonstrating new practices with little or no replication or randomisation to account for trends in paddock variability,

‘the statistical side’s a weakness...the sites have poor replication and badly randomised treatments which may jeopardise the credibility of our research. When I started I thought on-farm research was grower-initiated, group-based, fuzzy research that they’d use as a stepping stone for their aims. I still see it as farmer-initiated, (but) now I see it as more rigorous...it can be demonstrations, but there’s also space for rigour and credibility’.

This concern for scientific rigour as well as farm relevance led to a review of on-farm research in the Central project. This review concluded that farmers would use replication and randomisation if it was ‘hard to prove anything’ without them. Farmers wanted to avoid results that wasted their time. The on-farm research in each project subsequently spanned a wider range
of designs to account for farmers’ and scientists’ needs. This included non-replicated side-by-side comparisons, strip comparisons with multiple controls, and the traditional completely random and randomised complete block designs with several replications that are widely used in agricultural research (Lawrence, Christodoulou & Whish 2004). Designs were still typically decided by scientists before farmers helped decide treatments, select trial sites, establish them and monitor their progress. And, while most activities were conducted with farmers’ equipment to ensure its practicality, farmers’ involvement in monitoring the research varied. For example, the Central project had dedicated technical officers to maintain sites, monitor them and record results. However, farmers in the Western project in Queensland typically shared these duties by keeping a diary of farm operations, recording weather for each site, and actively participating in the site characterisation, soil sampling and measuring of crop performance (Christodoulou 2000). Activities in the Eastern project spanned this continuum and reflected the participatory intent of each coordinating team member. Farmers had very little involvement in some sites, but were equal participants in each stage of the field activities in others. In sum, farmer participation in the design and conduct the research remained largely consultative and functional. Such involvement is more likely to support learning about the technical issue being researched than the research process itself. Consequently, farmers’ participation in the interpretation of the results will be critical.

**Interpreting research results**

The limitations to participation from the early stages of on-farm research were perhaps stronger in the interpretation of research results. Team members typically assumed what farmers wanted to learn from their on-farm research activities, analysed the results, and presented conclusions back to farmers after each season. Questions and discussion were encouraged and farmers’ participation was typically passive or consultative. Most team members remained unsure what the results meant to farmers, and there were few records of how farmers interpreted the data or how these interpretations differed from those of team members. The project teams needed processes to help clarify farmers’ interpretations and learning.

It also became obvious that experimentation to resolve differences and support team learning by crossing boundaries and integrating perspectives (Dechant, Marsick & Kasl 1993) needs clear, specific and agreed research questions for participants. Unclear research questions and designs led to unclear results and confusion rather than collective understanding. For example, scientists became frustrated trying to attribute cause-and-effect relationships from ‘confounded’ treatments containing multiple contrasts, and farmers remained happy to consider them as complete management options to compare. Encouraging farmers’ interpretation of results and inquiring into their rationale made team members uncomfortable. They found it hard not to interpret all the results for participants because as one young scientist confided, ‘I can’t help it.”
If I sit there and don’t tell them what it means...they’ll think I don’t know’. By tradition, team members were familiar with providing solutions to farmers’ immediate technical problems. However, 40% of farmers in the Central project agreed in their major quantitative survey (Appendix 4) that the project ‘would be better if project staff challenged farmers’ ideas more’. It was found that team members had great technical understanding but limited process experience to inquire into farmers’ understanding of issues. They needed support.

Team members remained reluctant to facilitate participants’ explicit interpretation of their results. Indeed, few on-farm research groups collectively interpreted results. When they did, the focus was on content learning with little reflection on the research process and whether the research questions had been adequately answered. Most activities simply continued until interest waned enough for team members to suggest finishing them. For example, there was a collective ‘sigh-of-relief’ from one farmer group when asked at an evaluation meeting whether their nitrogen trial had already answered their initial question and could be discontinued (Lawrence & Kuskie 2002a). Within minutes they concluded the trial was no longer required. There was little self-critique or the explicit process reflection that underpins participatory action research (Lewin 1948) and capacity building in modern Farming Systems approaches (Dixon 2003).

Indeed, farmers’ participation in interpreting results remained so poor that additional evaluation meetings were required at the completion of many on-farm research activities to document farmer learning. The evaluation framework was again used to support this inquiry and assess participants’ learning and understanding of their research issues. It was also integrated into some later on-farm research to provide ongoing reflection. For example, groups in the St George district of western Queensland used a modification of the evaluation framework to facilitate the collective interpretation of results. Box 4 describes this process. Essentially, participating farmers explained the rationale, methods, results and their initial interpretation of research being done on their farms. All participants subsequently noted their own interpretations before participating in facilitated dialogue to reflect on the results and the on-farm research process.

These meetings encouraged greater participation between farmers and scientists. The activity exemplified interactive participation with open dialogue and reflection on the content issues and the on-farm research process. It appeared that everyone contributed and was keen to interpret the results of their individual trials. Participants gained from discussing each others trials. As an observer noted, ‘very few people have sat there like “stunned mullets”. They are participating. Some had written notes... (you) can see the change in people.’ Difficulty interpreting some trials led to assessments of the strengths and weaknesses of the on-farm research process itself and what could be learned from it. Some farmers learned not to dismiss research that ‘did not make any sense’ initially and came to appreciate that research could be useful even if treatments produced ‘no response.’ For example, fertiliser trials with no response were initially considered
a ‘waste of time’ because they did not improve production. However, the valuable learning was that these soils did not currently need fertiliser. Such outcomes show that some farmers were learning to understand research from this participatory approach that explicitly reflected on the content and process of their on-farm research.

Box 4. Basic process to guide reflection and dialogue in on-farm research activities

| 1. Rationale – the farmer’s reasons/aims for the trial |
| 2. Process – how the farmer went about it |
| 3. Observations – what the farmer saw, how the season went, what the treatments looked like |
| 4. Results – present charts (prepared with assistance of team members) |
| 5. Interpretation/learning of results – what the farmer thought the results meant |
| Facilitated group dialogue session |
| 6. Group interpretation/learning of results – what other people think the results mean and the implications for farming practices |
| 7. Group reflection on objectives and the OFR process – were the aims achieved? Should it be done differently next time? |
| 8. Future directions – whether to continue, what needs to be done? |

(Source: Lawrence & Christodoulou 1999)

Participants in subsequent debriefs concluded that these meetings were valuable, but hard work. As a farmer said, ‘it’s been a good meeting...you’ve drawn out a lot more at this meeting than some others...(but) it’s been hard and draining.’ The nature of the meetings discouraged scientists from answering everyone’s questions and encouraged farmers to think more deeply. Farmers recognised the progress from debate to dialogue, ‘as long as we agree to disagree and don’t get annoyed with one another...We’re trying to teach you, get what’s in my head into (scientists’) head. No point us just each doing what we are. (So) keep doing what you’re doing (with) discussion groups...its marvellous.’ As team members observed, ‘(we’ve) come a long way over the last few years with people. Its more open, can highlight opinions and differences between them...discuss them constructively.’ The leader of the Western project in Queensland subsequently described the meetings as ‘the closest we have come to what I think farming systems work is about’, i.e. that they reinforced the value of developing dialogue with all participants. In this way, the team was developing the interactive participation that underpins modern Farming Systems approaches.

The subsequent impact of participation

The evaluation framework and its reflective questions were subsequently used to encourage participants’ ongoing interpretation of on-farm research. For example, the second phase of the Eastern project required each on-farm activity to clearly define participants’ research questions and review results with farmers, because a lack of farmer interpretation has been used to
identify activities that have not maintained participation with farmers. Farmer participation consequently increased and achieved interactive participation and ongoing dialogue between all participants and their different knowledge systems in some activities. For example, on-farm research to assess the extent of deep drainage and salinity in different farming systems arose from a direct clash of the knowledge systems and values of farmers, scientists and policy makers (French et al. 2005). While land-clearing policies have threatened future cropping development in order to reduce deep drainage and salinity, farmers have been sceptical that there was any drainage at all. Indeed, farmers’ disbelief and denial of scientists’ drainage estimates from simulation models were the catalysts for this research. The farmers and scientists subsequently clarified their initial understanding of drainage, jointly planned and conducted research to compare drainage under several farming systems. There were iterative collective reviews of the results with open dialogue used to understand the data and learn from each other. Different approaches to estimating the extent of drainage were reconciled and a new collective understanding of drainage and its consequences developed between experimental scientists, simulation modellers and farmers. Participants subsequently reframed the research away from ‘estimating the extent of deep drainage’ towards understanding to what depth the drainage occurs and where it goes. Yet, this example of interactive participation represented another exception, rather than the rule. The emphasis of most activities remained on the research content with far less reflection on the appropriateness of the research methods used. Consequently, the participation of most on-farm research remained typically functional and achieving the interactive participation required for sustainable development (Dixon 2003; Pretty 1995) remains a major challenge for Farming Systems RDE.

In conclusion, processes to support high levels of participation are required in both farmer and scientist initiated research. RDE agencies do not initiate and control all on-farm research, and most farmers are ‘fiddling about with something on their place’ with little input from others. The full continuum of participation between scientists and farmers therefore ranges from scientists encouraging only isolation and passive participation for farmers, to farmers offering only isolation and passive participation for scientists. Opportunities for RDE teams to participate effectively extend beyond increasing farmers’ participation in agency initiated activities, and include scientists’ participation in other farmer and industry initiated research. As noted in Chapter Six, people disillusioned with opportunities for participation may subsequently limit others participation in ‘their’ activities. Neither outcome will achieve the balance nor the effective use of diversity sought within the grains industries. Therefore, whoever is funded to do participatory RDE requires sufficient understanding of participation and its processes to use it effectively. More participation may not always be best, and RDE coordinators will need to facilitate dialogue and informed decisions about the appropriate types of participation in
Farming Systems RDE. This will require an understanding of the consequent learning and behaviour of different types of participation in on-farm research and Farming Systems RDE.

Reconciling farmers participation and their learning

On-farm research helped participants improve their agronomic knowledge and improve their practices. Farmers generally attributed this impact to the projects’ emphasis on participation and the improved understanding of technical issues they subsequently developed. The value of this improved understanding across a wide range of topics (Appendix 8) was their most consistent message from the projects. Consequently, many participants believed the projects’ impact on their understanding of technical issues was moderate or large. For example, participating farmers’ assessments of the impact of the Central project on their technical understandings is summarised in Table 21. The technical issues addressed in the project are listed in the left-hand column. The results from an evaluation survey (Appendix 4) in which respondents rated the projects impact on their understanding to be each topic are presented in the remaining columns.

Table 21. Farmers’ assessment of the Central projects’ impact on their understanding of issues

<table>
<thead>
<tr>
<th>On-farm research topics of the CQSFSP</th>
<th>Impact of participants understanding (% respondents)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>moderate/large</td>
</tr>
<tr>
<td>Soil nitrogen management</td>
<td>75</td>
</tr>
<tr>
<td>Soil water management</td>
<td>75</td>
</tr>
<tr>
<td>Zero tillage systems</td>
<td>73</td>
</tr>
<tr>
<td>Controlled traffic systems</td>
<td>67</td>
</tr>
<tr>
<td>Opportunity cropping</td>
<td>71</td>
</tr>
<tr>
<td>Weed management</td>
<td>78</td>
</tr>
<tr>
<td>Grain legumes</td>
<td>43</td>
</tr>
<tr>
<td>Grazing legumes</td>
<td>43</td>
</tr>
<tr>
<td>Sorghum planting populations</td>
<td>64</td>
</tr>
<tr>
<td>Sorghum row spacing</td>
<td>68</td>
</tr>
<tr>
<td>Soil sodicity and salinity</td>
<td>48</td>
</tr>
<tr>
<td>Nutrients other than nitrogen</td>
<td>55</td>
</tr>
<tr>
<td>Water use efficiency</td>
<td>65</td>
</tr>
<tr>
<td>Comparing different farming systems</td>
<td>67</td>
</tr>
<tr>
<td>Costs and benefits of grazing stubble</td>
<td>29</td>
</tr>
<tr>
<td>Soil organic matter</td>
<td>62</td>
</tr>
</tbody>
</table>

Because most groups conducted research on several issues only, there was a significant number of people who had limited exposure, or none at all (not applicable), to some research issues. However, that up to 78% of respondents rated the projects impact on their understanding of key issues as ‘moderate to large’, goes a long way to explaining the major impacts that have already been highlighted for each of the projects. These more sophisticated understandings and the procedures to apply them emerged with farmers and scientists sharing their experiential and propositional knowledge of each issue. Indeed, functional participation and joint development of mutually important research questions led more interactive participation and collective interpretation to develop new and shared understandings of local farming systems. For example, the responses and outcomes to new fertiliser treatments, crops, and tillage practices under local conditions contributed to the knowledge of both farmers and scientists. Consequently, scientists
refined their understanding of how accepted propositions and principles were locally expressed. For example, they may have predicted that mineralisation of nitrogen on most soils would be between 20 and 100 kg/ha/year but undertook local trials to quantify these site-specific outcomes. However from a socio-cultural perspective, this functional participation aligns with the notion of guided learning (e.g. Billett 2001). Indeed, scientists acted as ‘expert others’ providing the scaffolding and proximal guidance to help farmers with both the specific outcomes and an understanding of the general principles. Farmers equally appreciated the general interaction with scientists that came with a trial because it also developed their understanding of general agronomy and scientific tools and language - ‘you’d never ever get a group like this together without a trial to provide a focus. (So) while we may not be about to use this (research) information now, we’ve still learned heaps...about it and other things. We have different expectations now, because we measure water and nitrogen...and our expectations and averages have definitely increased. Being in this group has made us better farmers. Overall farm performance has improved...our recording, improved management, and better planning’s due to better understanding.’ These comments suggest that the general understandings and appreciation of scientists’ perspectives are as important as the specific research questions. In this way, participants of the projects came to better appreciate each other and utilise the outcomes of their RDE processes.

Farmers’ and scientists’ understandings of each other developed in these emerging communities-of-practice. Farmers learned about their technical issue and the scientists’ analytical processes; similarly, scientists developed their understanding of technical issues and better appreciated the practical constraints to farmers’ management of these issues. Over time, participants in these communities-of-practice developed their own approaches to doing on-farm research and learning to better manage their farming systems. However, the varying nature and extent of this learning reflected the outcomes of participation that emerged within the project teams. That is, the extent to which farmers and scientists shared their understandings of these approaches appeared to vary in line with the extent of their participation in the activity. This is discussed in the next section.

Kinds of participatory practice
Three key kinds of participatory practice can be identified throughout this analysis: (i) consultative participation; (ii) functional participation; and (iii) interactive participation.

Consultative participation. Farmers’ participation in many early activities was consultative. The issues had been discussed but the team members controlled the research process and its key decisions including the selection of treatments. Of course, research using treatments farmers did not understand could only lead to behavioural learning outcomes and to simple recipes such as
‘grow crop A to boost organic matter’. Such limited cognitive understanding is exemplified by this farmer’s assessment that, ‘it lifts organic matter for the soil and mineralisation…I don’t understand…but (team member) tells me you need it’. The advance over previous RDE was that formal consultation increased efficiency by encouraging research on issues known to be important to farmers. However, farmers would have to make their own sense of why treatments worked. Without subsequent cognitive development this may provide little adaptive capacity, or higher order procedures, to abstract the meaning of these lessons to problem-solving in other contexts (Gott 1989);

- **Functional participation.** The contribution of participants’ content knowledge and joint decision-making on the focus of research activities led to greater understanding of underlying principles and propositions as to why the measured outcomes may have occurred. For example, trials to assess the extent of deep drainage under different farming systems, and the quantification of local nitrogen mineralisation rates. Indeed, processes that support proximal development to share existing understandings may best help participants develop and apply higher order cognitive procedures and propositional knowledge to solve drainage and nitrogen problems in new contexts. For example, the Level 1 understanding of the underlying drainage and nitrogen processes, and the Level 2 understanding to make informed decisions about the most appropriate methods for their assessment may ensure results can be extrapolated to new farming systems and site specific conditions. As such, functional participation that focuses on higher order learning may facilitate participants’ capacity for continued development and transformation of their learning schemes; and

- **Interactive participation.** Participants developed shared understandings of their research issues and how to conduct on-farm research by jointly defining their issues of interest, deciding the process of investigation and interpreting the outcomes. This interactive participation supported both Level 1 and Level 2 learning as participants crossed their initial methodological boundaries to use more appropriate processes for their needs. Indeed, several on-farm research groups developed from action learning activities on soil nitrogen or soil water. These groups also drew upon insights from modelling and small-plot trials for a greater appreciation of the scientific notions of replication and randomisation. Yet, interactive participation and dialogue also enhanced scientists’ appreciation of farmers’ knowledge of their farming systems. Indeed, the farmers in the communities-of-practice that developed around some on-farm research activities considered this dialogue to be as valuable as the insights into their specific research questions. For them, research was ‘a way of getting researchers and farmers together…a good way to integrate information between scientists and farmers.’ They recognised they could draw upon the diversity of these communities-of-practice, and that people with different experiences and understandings could challenge things they took for granted, ‘I’m not good at bringing...
(ideas) back to reality and others in the group can help do that. It’s a broader scope than one person can come up with...for us it took (someone) from a different background to find the real problems.’ Indeed, some groups progressed towards Level 3 learning with a growing appreciation of others’ insights and the limits of their own worldviews. They were learning how to participate across the domains of informational, values and worldview diversity. However, this interactive participation was not apparent in all on-farm research activities. Most continued with consultative and functional participation in which major process decisions and the explicit interpretation of results remained firmly within the control of the scientists.

In sum, the learning outcomes of the projects’ action learning and on-farm research activities depend on participants’ exposure and consideration of new experiences. New experiences will always emerge and learning will continue through the dialectic between ‘intra’ and ‘inter’ psychological processes (Vygotsky 1978). Yet, the action learning and on-farm research activities discussed above confirm that the nature of this learning was shaped by the diversity of participants and their levels of participation. Consequently, three key kinds of participatory practice have been identified and their contributions outlined.

**Conclusion**

Evidence of the projects’ impacts on farming practices has been provided in this chapter. The research data shows that the projects teams’ emphases of increased participation and understanding basic agronomic principles developed more effective RDE processes that helped progress several long-running management problems. This increased participation in action learning and on-farm research activities provided learning opportunities that extended beyond passive behaviourism. Conceptually, functional participation encouraged cognitive development by helping participants relate and reconcile their own experiences and data to existing propositional knowledge. Guided learning that engaged the diverse expertise of stakeholders provided the proximal development opportunities for farmers to navigate important existing information and make more informed decisions on their farms. This resulted in more effective Level 1 learning about each group’s topics and the processes they used to investigate them. The content focus of this learning was most obvious. For example, participants developed an understanding of nitrogen in their farming systems and learned about nitrogen budgeting as a way to make nitrogen fertiliser decisions. However, functional participation in many action learning and on-farm research activities began to support some initial reflection on the learning strategy being used but did not provide input to major decisions about the process. Participants’ learning consequently remained focused on Level 1 outcomes regardless of their informational, values and worldviews diversity. The conclusion is that interactive participation is required to achieve the potential learning opportunities that such diversity provides.
However, initiating interactive activities was perhaps too much for most team members and farmers. Most project staff and activities were grounded in the Transfer-of-technology (ToT) paradigm and emphasised passive and consultative participation for the adoption of externally developed practices (Henzell & Daniels 1995). Consequently, ‘evolution not revolution’ proved most effective in increasing participation, that is, activities offering functional participation were critical to developing more interactive activities with farmers. Some team members transcended the boundary between functional and interactive participation when they encouraged serious reviews of the processes in their initially functional activities. Their participatory intent to encourage learning rather than ‘teach’ participants to adopt the ‘best’ practices encouraged input to process decisions. This subsequently supported Level 2 learning about the appropriateness of processes including the learning strategy itself.

For example, Nitrogen in ’95-99 workshops evolved into subsequent on-farm research activities that integrated other aspects of the Western project in Queensland’s replicated small-plot trial and crop simulations. Farmers and scientists began to recognise they could learn more with a multi-method approach that integrated farmers’ experiential knowledge and that of the scientists from each module of the project and their RDE methodologies (Christodoulou 2000). Indeed, the different ‘answers’ from each approach provided opportunities to understand both nitrogen management and RDE processes in the project. This was perhaps the clearest example of the projects developing a modern Farming Systems approach with interactive participation and collective learning at Level 1 and 2. It precipitated the Sustainable nitrogen decisions workshops that facilitated double-loop learning about nitrogen decision-making processes. Such interactive participation made explicit the informational diversity of participants’ process knowledge and their underlying values and aims for nitrogen management. This was the catalyst for Level 2 learning. However, by also making the limitations of each approach more explicit, participants began to appreciate the limitations of their experience and assumptions. While not the initial focus of the activity, this appreciation may provide opportunities for Level 3 learning in future by supporting self-reflection on how people come to understand what they ‘know’ and the distorting assumptions that underpin most meaning perspectives (Mezirow 1991).

In conclusion, it can be seen that developing interactive participation remained a major challenge for each project team. Explicit processes such as the evaluation framework encouraged opportunities for interactive participation. However, participation was still limited by the participatory intent of project staff, project leaders and their managers. Consequently, more inclusive worldviews of staff, and especially leaders, will be required to develop beyond the ToT paradigm and fully utilise the diversity of experiences in the grains industries for sustainable development (Pretty 1999). These findings and those of earlier chapters are now brought together in the final chapter of this thesis.
Chapter 8. Conclusions and implications for Farming Systems research, development and extension

8.1 Introduction

This thesis is grounded in the introduction of Farming Systems research, development and extension (RDE) to Australian agriculture, and three major Farming Systems projects in the northern grains region. Indeed, the introduction of such RDE is problematic as there is only a limited understanding of how participatory processes may work in Australia’s developed agriculture. The research reported in this thesis contributes to an understanding of these participatory processes through its support of the Farming Systems project teams to evaluate and learn about Farming Systems RDE, and by investigating the central research question and its constituent sub-questions:

How can participatory Farming Systems RDE impact on the learning and behaviour of its participants in the Australian grains industry?

1. What is the diversity of participants’ experiences, understandings and expectations of Farming Systems RDE?

2. How can the Farming Systems RDE teams participate effectively?

3. What is the consequent learning and behaviour of participants in Farming Systems RDE?

These research sub-questions on diversity, participation and learning provide a structure for the thesis. In this final chapter, the findings of these investigations are summarised and, drawing upon the literature discussed in Chapters Two and Three, conclusions are presented for each sub-question and their contribution to the central research question. Conceptual contributions of this research and the implications for new and ongoing participatory projects are also clarified. Finally, some future research and development opportunities to support the ongoing understanding and development of participatory Farming Systems RDE in Australia are identified in the conclusion to the chapter.

8.2 Understanding Farming Systems RDE processes

The findings of the research questions from earlier chapters are now reviewed to better understand how participatory Farming Systems RDE can impact on the learning and behaviour of its participants. This is done by reviewing: (i) the nature and extent of diversity amongst participants that was clarified through the first question; (ii) the behaviour of participants that
was explored by investigating the nature and extent of participation that developed within the teams, and between the teams and their stakeholders; and (iii) the consequences of this participation that were examined through participants’ learning and behaviour. Together, the findings and analysis of the three sub-questions address the central research question directly, and culminate in an understanding of the impacts of a Farming Systems approach on participants within the Australian grains industry.

8.2.1 The diversity of participants
Table 22 summarises the diversity identified across the participants of the projects. The demographic, organisational, informational, and values domains of diversity reviewed in Chapter Two, and the paradigm and worldview diversity that was identified in Chapter Five are introduced in the left-hand column. The dimensions of diversity that were identified in the exploration of participants’ experiences, understandings and expectations of Farming Systems RDE are summarised in the right-hand column. Different organisations and diverse technical and process skills are no surprise as the projects were developed as multi-disciplinary teams across several agencies to reduce duplication in their efforts. Similarly, the observed demographic diversity could be expected in any major RDE program. Implicitly, encouraging the participation of farmers and different scientists in RDE processes will increase diversity.

The review of literature in Chapter Two establishes that diversity creates opportunities to improve groups’ performance. Yet, it concludes that the actual impacts on performance are mixed because the potential for better decision-making from informational diversity is counterbalanced by the conflict that often develops. It appears that projects require a similar interest, a collective focus, as an incentive to avoid damaging conflict and use their diversity effectively for success. However, significantly different visions and aims within and between the project teams, their managers, funders, and participating farmers are identified in Chapter Five. The research shows that this values diversity constrained the development of the shared focus needed to reconcile the teams’ task and process conflicts for improved performance. For example, the dual aims of developing ‘new’ participatory RDE processes and making farming systems more sustainable and profitable confounded and exacerbated these conflicts. Team members variously saw new RDE processes as the primary task, believed they were nothing new, or even a waste of time. Sceptical team members and some who believed existing RDE processes were effective, opposed the philosophy of the projects, and were obvious sources of process conflict. Indeed, a dominance of Transfer-of-technology (ToT) paradigms and positivist worldviews in the teams is also identified in Chapter Five. Consequently, many team members continued to define farming systems in biophysical terms only, despite modern Farming Systems approaches proposing people be included within the systems boundaries (Packham 2003). For those members, ‘participation’ may remain a tool to ensure farmers understand and
adopt ‘best’ practices. It appears that the diversity of RDE paradigms and the dominance of positivist worldviews diluted team members’ disposition to use participation to appreciate others’ perspectives and to collectively develop new systems. Task and process conflicts were often unresolved and potentially damaging relationship conflicts emerged across the projects.

Table 22. Dimensions of diversity observed in the Farming Systems projects

<table>
<thead>
<tr>
<th>Categories of diversity</th>
<th>Dimensions of diversity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic domain</strong></td>
<td></td>
</tr>
<tr>
<td>Project size</td>
<td>number of people; up to 10 full time equivalents in each project</td>
</tr>
<tr>
<td>Locations</td>
<td>numerous locations, with up to 600 km between them</td>
</tr>
<tr>
<td>Personal</td>
<td>mostly males, but some females; from 20-60 years of age</td>
</tr>
<tr>
<td><strong>Organisational domain</strong></td>
<td></td>
</tr>
<tr>
<td>Employer</td>
<td>self-employed farmers; GRDC; QDPI&amp;F; QNRM; CSIRO; NSWDPI; universities; private consultants</td>
</tr>
<tr>
<td>Time commitment</td>
<td>5-100%</td>
</tr>
<tr>
<td>Tenure</td>
<td>casual; term of the project contracts; permanent staff</td>
</tr>
<tr>
<td>Classification (seniority)</td>
<td>new graduates to experienced scientists and middle managers</td>
</tr>
<tr>
<td><strong>Informational domain</strong></td>
<td></td>
</tr>
<tr>
<td>Technical expertise</td>
<td>crop agronomy; pastures; soil science; economics; farming operations</td>
</tr>
<tr>
<td>Process expertise</td>
<td>research; extension; agency management; farming</td>
</tr>
<tr>
<td>Understandings of Farming Systems RDE</td>
<td>definitions of Farming Systems RDE; sustainability; farming systems; participation; research; learning; evaluation</td>
</tr>
<tr>
<td><strong>Values domain</strong></td>
<td></td>
</tr>
<tr>
<td>Expected outcomes</td>
<td>industry impact; RDE process insights; scientific knowledge; primarily research, primarily extension, or both</td>
</tr>
<tr>
<td>Learning and practices</td>
<td>passively adopt; manage outcomes; detailed understanding</td>
</tr>
<tr>
<td>Participatory intent</td>
<td>participation as a ‘means’ or an ‘end’</td>
</tr>
<tr>
<td>Community development</td>
<td>dependence; independence; interdependence</td>
</tr>
<tr>
<td>Organisational collaboration</td>
<td>teams work across organisations; work independently</td>
</tr>
<tr>
<td>Evaluation</td>
<td>summative judgements; formative insights</td>
</tr>
<tr>
<td><strong>RDE paradigm and worldview domain</strong></td>
<td></td>
</tr>
<tr>
<td>RDE methodologies</td>
<td>small-plot experiments; large on-farm trials; action learning groups; crop simulation &amp; modelling</td>
</tr>
<tr>
<td>Underlying RDE paradigm</td>
<td>transfer-of-technology; participatory co-learning</td>
</tr>
<tr>
<td>Interpretative perspectives</td>
<td>positivist, post-positivist and constructivist ontology &amp; epistemologies</td>
</tr>
</tbody>
</table>

In conclusion, the research demonstrates that directives from RDE funders to work together, cooperate and be a team are insufficient to create productive cooperative efforts within Farming Systems projects (Johnson & Johnson 1997). While diversity is to be prized, it must be understood and managed. These projects contained considerable demographic, organisational, and informational diversity, and the resulting task and process conflict provided potential to integrate, learn and improve their performance. Yet, the inherent values, RDE paradigm and worldviews diversity in each team made this difficult. Management of the resulting task, process and relationship conflict and the levels of participation that developed in each project are discussed in the rest of this chapter. However, future participatory projects must consider the appropriateness and balance of team members’ values, RDE paradigms and worldviews, and support them with project leaders and processes that encourage the levels of participation needed to utilise this diversity effectively.
8.2.2 The participation of Farming Systems RDE teams

The paradox of diversity is elaborated throughout this thesis, that is, diversity increases the potential for learning but also constrains the levels of participation needed to realise it. A perceived genuine need for high levels of participation by participants is required to break this ‘reinforcing loop’ of diversity and participation (Senge 1990). A detailed analysis of the levels of participation within each project team is provided in Chapters Six and Seven, and with farmers in Chapter Eight. This analysis shows that despite initially failing to meet some team members’ expectations, participation within the projects generally increased. Interactive participation provided equality in the content and process decisions of most activities in which each team member was directly involved, but participation across project activities was variable.

The Eastern project comprised a series of relatively independent activities with passive and consultative participation. The Central Queensland project team progressed towards functional and interactive participation in their evaluation and Butterfly pea activities, but otherwise provided only passive and consultative participation for individuals. Finally, the Western project in Queensland developed to provide team members with opportunities for functional and interactive participation in most project decisions, a major advance from their initially fractured and competitive conduct in the project. Farmers’ participation in each project was similarly variable but provided increased opportunities to influence RDE activities. Consultation became widespread, and functional participation in which farmers jointly decided the technical focus of activities and contributed their content knowledge was common. Indeed, interactive participation also emerged as farmers and team members jointly defined their issues of interest, decided the most appropriate processes to investigate them, and interpreted the results of some activities. Overall, participation in the projects was variable.

The nuances in the question ‘How can the Farming Systems RDE teams participate effectively?’ are highlighted in Chapters Six, Seven and Eight. Effectiveness may include changed farming practices, informed understandings of these practices, or sustainable development with its ecological, economic and social imperatives. This polemic reflects the diversity of behaviourist, cognitive and socio-cultural learning perspectives and values that are described in Chapter Two. Yet, within the ongoing convergence of cognitive and socio-cultural theories, it is concluded that to participate effectively, teams must: (i) understand the notion of participation; (ii) believe in it and see sufficient benefit to participate at high levels; and (iii) develop processes to encourage and support opportunities to participate. Each of these is now discussed.

Firstly, participation is not a unitary construct. All human relations reflect some level of participation and practitioners of participatory RDE must understand these constructs. Chapter Two, reviews of the literature of democratic theory, organisational participation, and citizen
participation, and identifies two broad ‘participatory intents’: (i) a ‘means’ to enhance the efficient adoption of predetermined outcomes, or (ii) an ‘end’ where equality in decision-making and empowerment for collective action is a right (Pretty 1995). The use of functional and interactive participation in the Farming Systems projects reflects this dichotomy. However, the levels of participation between members of each project, across the wider projects, in projects’ activities with farmers, and in the activities of other stakeholders all fluctuated. Consequently, practitioners must recognise that participation is a dynamic reciprocal relationship based on the exercise of power between people. To that end, a new Typology of participation in Farming Systems RDE is proposed in this thesis to help practitioners better understand participation, assess it, and reflect on the appropriate levels of participation for their purposes (Chapter Six).

Secondly, people are intentional and only accept opportunities to participate when they recognise sufficient benefits. Participation must help them to achieve a shared interest, a collective focus (van der Vegt & Bunderson 2005), before they will actively integrate their efforts. Further, effective Farming Systems RDE requires people with paradigms and individual worldviews that at least sympathise with participatory processes, to develop interactive participation and integrate their informational, organisational and demographic diversity. Otherwise the factors identified as shaping participation in Chapter Six become constraints, or perhaps excuses for individuals’ lack of intent to participate, which produce conflict and the teams-within-teams and parallel independent activities that developed in each project.

Thirdly, explicit processes are needed to encourage understanding of participation and support pre-disposed individuals to participate at higher levels. Team members’ limited informed understanding of participation, knowledge construction and learning, and their subsequent lack of participatory processes to integrate participants’ knowledge are highlighted in Chapter Six. For example, they ‘discussed’ most issues, but this typically resulted in advocacy about ‘what to do’, not inquiry to first understand issues and frame agreed problems to solve. Consequently, Chapter Seven develops and proposes an ‘evaluation framework’ as a structure to encourage interactive participation, that is, for team members to seek participants’ initial knowledge of issues, involve them in framing the research questions and methodologies to address them, and encourage their contributions to interpret the results. This framework comprises a checklist of key consideraitons for best practice in participatory RDE. Importantly, it reflects the principles of participatory RDE, and challenges team members to seek higher levels of participation with their projects’ participants. As such, it may be a catalyst to develop equality in the content and process decisions of project activities. Other frameworks may be better suited to future projects, but it is likely that effective participation will require explicit structured processes to encourage and support the contribution and utilisation of participants’ diversity.
Processes to support high levels of participation are required in both farmer and scientist initiated Farming Systems research. Critically, participation is a two-way and reciprocal process (Billett 2002). The subsequent full continuum of participation between scientists and farmers is depicted in Figure 13. This ‘co-participation’ ranges from agency-initiated activities in which scientists encourage only isolation and passive participation of farmers (on the left-hand side of the figure); through to farmer-initiated activities that offer similarly limited participation to scientists (on the right-hand side). The dynamic nature of this participation is represented by the shaded double-headed arrow for the fluctuating of participation across each level in the continuum. This two-way and reciprocal notion may seem obvious, but it impacts on the understanding of participation and the current typologies that infer more farmer or citizen participation is better (e.g. Arnstein 1969; Pretty 1995). The proposed ‘Typology of participation in Farming Systems RDE’ (Table 13) includes Pretty’s (1995) ultimate level of participation as self-mobilisation. Yet, the discriminating features of self-mobilisation from interactive participation are that it is initiated by stakeholders (e.g. farmers), and does not depend on the traditional power-wielders (e.g. RDE agencies) to continue. Within the broader continuum of participation in Figure 13, self-mobilisation may become redundant and be replaced by interactive participation initiated by the traditional stakeholders (e.g. farmers). This recognises that State agencies in developed democracies, perhaps in contrast to international development agencies, have a continuing legitimate role as representatives of wider community interests. Interactive participation, in which the content and process decisions of RDE are made collectively and participants use dialogue to embrace and integrate multiple perspectives, becomes the desired level of participation for sustainable development - regardless of who initiates it. In essence, this kind of engagement develops participatory democracy and equality between groups that may have developed via representative democracy.

Furthermore, this broader continuum of participation in RDE highlights the risk that, in response to RDE agencies’ perceived failure to participate effectively with farmers, ‘farmer-driven’ research (Scoones & Thompson 1994) may develop to mirror the same ToT practices (Freire 1970). As noted in Chapter Six, people denied opportunities to participate often respond by limiting others’ participation in ‘their’ own activities. Neither of these outcomes will achieve the balance and effective use of diversity sought within the grains industries. More participation may not always be better, and RDE coordinators will need to facilitate dialogue and informed decisions about the appropriate types of participation. Ultimately, whoever is funded to conduct participatory RDE will require sufficient understanding of participation and its processes to use it effectively. This also requires an understanding of the consequent learning and behaviour from different types of participation in Farming Systems RDE.
8.2.3 Participants’ learning and behaviour

The view that people are always learning through their interactions with others (Billett 2004) is upheld here. Evidence of participants’ learning and subsequent changes in behaviour from their participation is promoted throughout. In particular, team members’ increased understandings of technical issues, Farming Systems approaches, participation, the need for evaluation, how to improve their RDE methods, and in some cases how to integrate these different RDE methods are identified in Chapters Six and Seven. This learning is identified as an outcome of participation in the conduct of RDE activities. Further, as the research in Chapter Eight shows, farmers’ increased understanding of technical issues, the research process, and consequent management options are potent and relevant learning outcomes. For example, improved understanding culminated in major progress towards more profitable and sustainable farming systems. Indeed, widespread zero tillage and controlled traffic systems to control soil erosion, common use of nitrogen fertilisers to match crop requirements, ley pastures to address soil fertility in grain and grazing systems, and new crops to diversify grain systems away from monocultures are being instituted as a result of this participation and learning. The conclusion here is that the increased participation in the Farming Systems projects can be effective and can help participants develop solutions to problems that have long plagued traditional RDE.

As communities-of-practice (Lave & Wenger 1991), the Farming Systems project teams provide opportunities for scientists and farmers to participate and deepen their knowledge and expertise
(Wenger, McDermott & Snyder 2002). It is proposed here that these interactions resulted in different levels of knowledge development over their respective time frames. In other words, team members’ microgenetic development, or moment-by-moment learning (Rogoff 1990) through ongoing everyday activities, led to greater changes in their thinking about local farming systems and how to conduct participatory RDE. This ontogenetic development, their changing mental models and behaviour, also appears to have produced socio-cultural developments of knowledge, such as, accepted new farming practices and ways to conduct participatory RDE within these communities-of-practice (Scribner 1985). These new farming practices address protracted problems, and project teams now typically use farmer consultation and evaluation in ongoing activities. Consequently, it is concluded here that participation in the projects was effective and led to significant learning and changes in behaviour.

In addition, there is evidence of different levels of cognitive development in each project. Following the analysis in Chapters Seven and Eight, it is held that learning in each project was a function of team members’ diversity and participation. Indeed, it is proposed that the level of learning (L) in teams is the product of the nature of their diversity (D) and the level of participation achieved within this diversity (P), that is; \( L = D \times P \). This notion of learning as the product of diversity and subsequent participation in each project is elaborated in Chapters Seven and Eight. While people will always learn from their ongoing participation in such projects, their diversity and levels of participation are major determinants of the quality of this learning. The findings from this study indicate that Level 1 learning through existing meaning schemes (Mezirow 1991) predominates from any level of participation in situations of low diversity in the values, RDE paradigm and worldview domains. Interactive participation then provides fewer ‘unexpected’ observations and subsequent cognitive problems that require the re-conceptualisation of participants’ learning schemes (Level 2) or underlying perspectives (Level 3). However, the level of participation in contexts with diverse values, RDE paradigms, and worldviews determines the nature of learning. If functional participation only addresses the content issues, then learning is again restricted to Level 1 outcomes, but interactive participation with dialogue and reflection on process assumptions may facilitate higher levels of learning. In these contexts, participation equates to learning through practice (Lave 1993).

While observable within the activities of the project teams, these different levels of learning were not reflected in the team learning survey results of each project. Kasl, Marsick and Dechant’s (1997) model of team learning focuses on the internal learning processes of the team, and the learning outcomes for the team and the wider organisation. Yet, the levels of the teams’ learning are not explicit. Modifications to the operation these team learning processes for diverse Farming Systems teams with low and high levels of participation are proposed in this thesis. Learning in synergistic teams that develop interactive participation (e.g. the Western
project in Queensland) is depicted in Figure 14. The original model (Figure 5) remains unchanged as the learning conditions for the team support their thinking and action processes to produce learning outcomes. However, in Figure 14, the integration of perspectives explicitly supports the potential for Level 1, 2 & 3 learning as interactive participation across diverse teams ensures their multiple perspectives are considered (cross boundaries) and tested (experiment) to integrate these perspectives and reframe their problems situations. The dialogue of interactive participation supports the potential transformation of learning schemes and perspectives for Level 1, 2 & 3 learning outcomes.

Figure 14. A model of synergistic team learning processes in diverse RDE teams

The research findings in this thesis confirm that not all diverse teams develop the interactive participation to support synergistic learning processes. Indeed, this model of merging ‘thinking’ and ‘action’ for team learning requires modification for teams with fragmented learning from isolation or passive participation (i.e. simply telling others what has been decided), pooled learning from consultation (i.e. asking opinions without ceding decision-making control), or functional participation in which people share content decisions but not those on processes. The experiences in the Farming Systems projects, that is, a diversity of values and RDE paradigms may lead to more homogeneous teams-within-teams (i.e. Group 1 and Group 2) that maintain their divergent views (van Offenbeek 2001), is depicted in Figure 15. Divergent views establish great potential for learning, but without subsequent integration and convergence, they may defeat the purpose of establishing diverse teams to learn from each other. This research shows that teams-within-teams evolve from the limited team learning processes and participation of project groups that maintain their initial problem frames, experiment within them, and so learn through extended or similar meaning schemes, rather than integrating their perspectives to transform their learning schemes or wider perspectives. Consequently, Level 1 rather than Level 2 or 3 learning will result. The extent of pooled learning is represented by a ‘dotted line’ in Figure 15 because it depends on the development of a common focus for participants to share their divergent experiences.
Finally, it appears that introducing process reflection to activities with functional participation was consistently a catalyst for higher level learning in these projects. For example, reflecting on the processes and assumptions of the early on-farm research in the Western project in Queensland, and the Nitrogen in '95-99 project led to higher level learning with multi-method investigations and the Sustainable nitrogen decisions workshops (Chapter Eight). Similarly, the evaluation processes and evaluation framework were based on functional participation with subsequent reflection on the processes. These experiences suggest guided learning that uses functional participation for participants’ proximal development can be very effective for developing interactive participation for sustainable development. Such processes help participants navigate the existing information of specific phenomena and make more informed contributions to subsequent reflection on the process and its assumptions. This approach also avoids the frustration of starting with a ‘blank sheet’ and struggling to find the common focus to integrate different participants’ contributions on every aspect of projects. Functional participation may therefore be an efficient starting point to integrate activities in diverse settings. With subsequent reflection on processes and assumptions for interactive participation, functional participation may represent ‘legitimate peripheral participation’ towards sustainable development (Lave 1991).

Figure 15. A model of fragmented and pooled team learning processes in diverse RDE teams
8.2.4 The impact of Farming Systems RDE on participants

In conclusion, this review of the research sub-questions has clarified how Farming Systems RDE can impact on the learning and behaviour of participants in the Australian grains industry. It can help support greater participation in order to more effectively utilise the diversity in the knowledge and resources of grains industry farmers and scientists. In the projects reviewed, participation within each team and between the teams and participating farmers was increased. This helped farmers and scientists improve their understanding of technical issues, their own research processes, and each other’s perceptions and priorities. Their RDE was subsequently more relevant and rigorous, and helped participants make more informed decisions for their own situations. There was a wide consensus amongst participants that a Farming Systems approach had improved grains RDE, and improved the profitability and sustainability of farming systems.

However, participants’ diversity has constrained their progress towards the levels of participation and learning proposed for sustainable development. A legacy of prevailing RDE paradigms, worldviews and subsequent values from the traditional ToT approach makes a pervasive interactive participation in grains RDE difficult to envisage. While the learning literature concludes that cognitive processes mediate peoples’ responses to stimuli, most RDE agency staff’s understanding of learning is grounded in behaviourist perspectives. For example, few team members had training or an interest in developing the theoretical understanding of learning to develop processes that explicitly support participants’ knowledge construction. Team members recited the project aims to increase participation and help people learn about their farming system, but few could explain how an emphasis on learning changed their RDE processes. Structured processes were used to evaluate the projects, support participation and reflection in on-farm research, and provide proximal development for participants on key technical issues. Yet, these processes were developed by a minority of staff and were not used spontaneously across the projects. Team members’ typical participatory intent remained for more efficient ‘adoption’ which they assessed in the behavioural terms of how many people ‘adopted’ what they believed were the ‘best’ practices. Knowledge construction remained largely informal and grounded in participants’ everyday interactions. However, progress toward sustainable development has been made. The projects have achieved a more sophisticated braiding of the ‘technical innovation’ and ‘human resource development’ approaches to overcome some of the limitations of ToT alone (Russell et al. 1989).

In conclusion, an overarching participatory RDE methodology that utilises ToT and other approaches as appropriate may be desirable. However, highly participatory approaches are unlikely to replace the traditional ToT approach in the foreseeable future. The apparent challenge remains to encourage RDE staff to better understand participatory processes, and develop their ability to determine the most appropriate processes and levels of participation to
support learning for the situations they encounter (Ellis et al. 2005). This is the challenge to which the conceptual contributions of this thesis, and their implications for policy and practice, contribute directly.

8.3 New understandings of participation and learning within diversity
Addressing the research questions provides an understanding of how Farming Systems RDE can impact on the learning and behaviour of participants in the Australian grains industry. However, the analysis in this thesis makes a significant contribution to agricultural RDE by integrating the current theories and models of diversity, participation and learning. More specifically, it contributes to a better understanding the dynamics of diversity in teams, current concepts of participation, the development participatory RDE and the interaction between participation and learning in diverse contexts.

8.3.1 Contributions to understanding diversity
Firstly, applying concepts from diversity research to the Farming Systems projects contributes to the understanding and management of diversity in participatory RDE in Australia. It also extends the diversity typologies to reflect the challenges of different paradigms and worldviews. Recent arguments for innovation in agricultural RDE in Australia embrace the notions of farmer participation, multi-disciplinary projects, soft systems thinking, organisational collaboration, and teamwork, that all infer greater diversity (Chapters Two and Three). Consequently, the theories and typologies of diversity research are introduced in this thesis to help understand and manage these innovations. The subsequent integration of diversity theories and participatory RDE in this thesis is, in itself, a valuable contribution. Adding the RDE paradigm and worldview diversity observed in these projects to classifications of diversity from Jackson and Ruderman (1996) and Jehn, Norcross and Griffin (1999) results in a ‘Typology of diversity in Farming Systems RDE’ that spans the demographic, organisational, informational, values, RDE paradigm and worldview domains. As such, this new typology provides a grounded structure to consider the nature of diversity when developing RDE activities, and to understand the extent and impact of diversity across ongoing activities. The conclusions about diversity in this thesis may be limited to the context of the Farming Systems projects in the northern grains region. Yet, this may be the first explicit application of diversity research in Australian agriculture and provides a reference for future analysis. It presents planners and practitioners with a structure to understand and manage diversity, participation and conflict in participatory RDE. This is a valuable contribution with the continuing emphasis of participatory processes in agriculture and RDE more generally.
8.3.2 Contributions to understanding participation

Secondly, the research in this thesis makes an original and significant contribution to current knowledge of participation and the practice of Farming Systems RDE in developed agriculture. It contributes an understanding of factors that shape participation within professional RDE teams and their interactions with farmers. However, these factors largely reflect participants’ diversity. This ‘reinforcing loop’ may be broken by developing a shared focus and an authentic need for high levels of participations to utilise others potential contributions. Otherwise, self-perpetuating conflict and low levels of participation between the inevitable teams-within-teams may emerge (Freire 1970). This research also contributes an understanding that evaluation is a powerful catalyst to make teams’ diversity explicit, to encourage dialogue to develop a collective vision, and to understand each others’ contributions to this vision. To that end, the proposed evaluation framework and checklist can be used to support participation and learning in Farming Systems RDE. They highlight the decisions faced for effective participatory RDE and represent a major contribution to understanding how to facilitate interactive participation in settings with values, paradigm and worldview diversity. Indeed, evaluations will require informed decisions about the most appropriate levels of participation and progress towards achieving them. The ‘Typology of participation in Farming Systems RDE’ similarly contributes to current understandings of participation in developed agriculture. It does not represent a wholly new perspective of participation. Rather, it advances Pretty’s (1995) existing typology by removing its apparent overlap in some levels, extends its notions to the Australian context, and makes the dichotomy of content and process learning more explicit. This new typology and its associated checklist (Appendix 5), together with the evaluation framework and supporting prompts, are artefacts of the Farming Systems projects and the contributions of this research to understanding participation. They represent the socio-cultural development of these projects.

The research in this thesis makes a final original contribution to current understandings of participation. Drawing upon the experiences of participation across the projects, participation is recognised as a reciprocal and dynamic relationship based on the exercise of power between individuals (Foucault 1980). Participation in Farming Systems RDE is re-conceptualised on a broader continuum between RDE agencies and farmers (Figure 13), which reflects this thesis’ contributions to understanding that participation: is a two-way process; is reciprocal and dynamic; occurs in concurrent systems that may be nested and confounded; that more participation may not always be better, or desired by participants so the extent of opportunities to participate may be most critical; and that participation may consequently be best described by the highest levels of participatory opportunities. However, it should also be understood that the direct negotiation of participation with stakeholders – who may not want to participate at a high level in the project – may somewhat paradoxically exemplify a highly participatory approach. Because participatory processes deal with multiple goals and issues, understanding the
appropriate levels of participation and recognising when to improve the quality of participation in practice, remains a major challenge to utilise the diversity of teams effectively and efficiently (Christodoulou 2000; Senge 1990). Collectively, the contributions described in this thesis represent further development towards such a grounded understanding of participation.

8.3.3 Contributions to understanding learning

Thirdly, the research in this thesis contributes to a deeper understanding of learning in participatory RDE in Australian agriculture. Case studies of each project confirm the proposition that participatory RDE can develop the conceptual and the procedural knowledge of scientists and farmers to develop innovation in regional farming systems. Advances in farming systems, such as the widespread use of zero tillage and controlled traffic systems to control soil erosion, nitrogen fertilisers to match crop requirements, ley pastures to address soil fertility in grain and grazing systems, and new crops to diversify grain systems away from monocultures provide evidence of the subsequent changes in participants’ behaviour.

However, this investigation of participants’ learning and behaviour contributes new knowledge to better understand the interaction between diversity, participation and learning. It proposes the simple equation, $L = D \times P$ to represent the proposition that learning is a function of the diversity and participation within specific communities-of-practice. More specifically, that the level of this learning ($L$) in teams is the product of the nature of their diversity ($D$) and the level of participation ($P$) achieved to utilise this diversity. The learning theorists that propose different levels of learning either infer (Argyris & Schön 1996; Bateson 1972; Mezirow 1991), or are explicit (Habermas 1971, 1974), that Level 2 and Level 3 learning is catalysed by interaction with alternative meaning schemes (see Chapter Three). However, they do not relate this learning directly to the nature of diversity, or the levels of participation with people who hold these alternative learning schemes or perspectives. The equation $L = D \times P$ proposed here is an original contribution to knowledge that makes this relationship explicit. Appropriation as learning through continual inference and correction may occur with lower levels of participation. Yet, sense-making through correspondence and relationship to background material (Greeno 1991) is likely to only extend existing meaning schemes unless new learning schemes are introduced. It is held here that meaningful dialogue to understand any alternative meaning schemes is the catalyst for integrating and transforming these learning schemes and perspectives for Level 2 and Level 3 learning, respectively.

Participation in teams with diverse values, paradigms and worldviews therefore presents a powerful opportunity to learn about different people, their perspectives and how to communicate across these differences (Communicative learning, Level 2). Dialogue and reflection across those differences also provide a unique opportunity for self-awareness and
emancipatory learning to understand the limitations of individuals’ basic assumptions (Habermas 1971, 1974). Yet, it is concluded here that these opportunities are not commonly taken and the level of learning in teams varies. A modified model of team learning is proposed in Section 9.2.3 to account for the varying levels of learning that result from the level of diversity and participation in teams. These modifications and the depiction of learning as a product of diversity and participation make an original and significant contribution to knowledge about learning in teams. This understanding of the interaction of diversity, participation, and learning and its expression in these projects presents significant implications for the practice of Farming Systems RDE in the Australian grains industry.

### 8.4 Implications for the practice of Farming Systems RDE

The experience and insights presented in this thesis have three general implications for the practice of Farming Systems RDE. Firstly, project planners must consider the vision and outcomes of future projects because these determine the extent of participation, diversity and levels of learning outcomes required. For example, sustainable development and the establishment of an ongoing process of reciprocal knowledge building for continued innovation in the grains industries will require high levels of learning to integrate the meaning schemes and knowledge systems of participants. Such an outcome may require wide participation and negotiation of this very project vision from the start. Secondly, a more modest outcome of gaining widespread adoption of what planners consider ‘best’ practice may require the skills to develop guided learning activities that employ functional participation. The technical skills of the project teams would then simply match the priority issues for industry. Thirdly, funders and RDE agencies must reconcile their ToT paradigms and positivist worldviews and the sustainable development they espouse, because without an informed understanding of the concepts of diversity, participation, and learning, their day-to-day management decisions may continue to undermine progress towards sustainable development. Processes to help project staff, RDE agency managers and funders to better understand the key principles of Farming Systems RDE are needed. These three general implications have subsequent repercussions for: (i) new projects; and (ii) the development of guided learning processes for higher level learning.

#### 8.4.1 Implications for new projects

RDE agencies must support project leaders with these understandings and constructivist perspectives if new projects are to achieve sustainable development. This may require recruitment of new staff and the proximal development of existing personnel to understand these concepts. Furthermore, a range of operational principles to encourage subsequent participation in new RDE teams is proposed from the insights reported in this thesis:
1. Ensure project leaders are full-time appointees to minimise competing agency interests;
2. Establish management groups that represent existing industry and agency structures, and encourage interactive participation (i.e. participatory democracy) in their decisions;
3. Ensure project staff are genuinely interested in participatory processes and working across organisational, discipline, and methodological boundaries;
4. Avoid unnecessary duplication of expertise, and develop clear roles that recognise participating agencies’ unique contributions.
5. Seek staff time commitments approaching 50% and co-locate them in the project area to establish relationships within other teams and participants;
6. Develop a shared vision that addresses an authentic need for participation and the integration of participants knowledge and resources;
7. Structure projects around the subsequent shared problems and outcomes that are desired by industry, staff and agencies;
8. Ensure staff and management committees collectively plan, interpret and review all activities in terms of their contributions to overall project aims;
9. Ensure research questions reflect all participants’ existing knowledge;
10. Encourage pluralistic activities that meet individual agencies aims, but develop rewards for overall project achievement (This may prove difficult within the RDE agencies that currently recognise and reward individual achievement); and
11. Emphasise action learning activities that support proximal development (i.e. guided learning) and interactive participation.

These principles may support the general operation of participatory RDE projects and help develop effective participation. However, the final suggestion in this list reflects the value that this thesis establishes for guided learning approaches that use functional participation for proximal development, yet encourage interactive participation to integrate participants’ contributions. For example, the Doing successful on-farm research activity, a culmination of the ideas developed here, uses workshops to develop research of genuine value to all participants.

### 8.4.2 Guided learning processes for high levels of learning

The Doing successful on-farm research workshops are valuable because they address three deficiencies in the Farming Systems projects: (i) the participation of the team and farmers in on-farm research is variable; (ii) on-farm research comprises the central process of each project, but there are no guidelines for its conduct apart from the evaluation framework that acts as a prompt for effective participatory practice; and (iii) there is a need to support on-farm research beyond the typically intensive investigations conducted in the projects (Whish, Lawrence & Christodoulou 2003). Indeed, many farmer groups and agronomists are seeking support to find an appropriate balance between scientific rigour and relevance in their research (Carberry
The *Doing successful on-farm research* project consequently addresses this need by supporting participants to better understand on-farm research approaches, answer a research question of their own, and develop the skills to use on-farm research (Lawrence, Christodoulou & Whish 2004). The explicit focus is on learning to participate and conduct better on-farm research. The activity comprises a facilitated process for participation and dialogue about participants’ issues and the most appropriate methods to progress them. Like the *Sustainable nitrogen decisions* workshops described in Chapter Eight, it extends beyond technical issues to encourage reflection on the assumptions and limitations of common research methods for decision-making (Lawrence & Christodoulou 2005).

This workshop approach uses interactive activities to help participants decide and apply the most appropriate on-farm research methods to their own priority issues. Activities typically span a full cropping season with a pre-season planning workshop, a mid-season tour of trial sites, and a post-harvest workshop to interpret any research results. These activities provide opportunities for farmers, agronomists, and the facilitators to share ideas and learn together. Some issues may be resolved from existing information without any trials. However, if adequate information is not available, the process supports participants to plan, conduct and interpret their own on-farm research trials. Ultimately, the structure of the workshops reflects the basic process of scientific research (Appendix 9). However, three key features of the workshop process address the implications of this thesis on practice. Firstly, the process encourages participation at each stage of the research. It is targeted at people who have authentic, not hypothetical, issues to address. The process helps them ‘navigate’ the research process with support from other participants, but decisions remain with those who own the problem issue. Secondly, the transparent process promotes sharing of ideas and problems. For example, participants complete a step-wise workbook, but a summary of all steps for their issue is permanently displayed on the wall to encourage dialogue with the wider group. The iterative process then encourages suggestions from the group for each participant to consider. For example, to clarify participants’ knowledge before developing a research question, each participant is asked to document:

- What is your issue?
- Why is it important to you?
- What do you already know about the issue?
- What else do you want to know?
- What is the most critical information you want to know?

This information is ultimately presented to the wider group for their inquiry in order to understand the problem and volunteer their experiences. Similarly, discussion of likely sources of further information from direct experience to propositional knowledge is encouraged. Each
participant then decides whether they need to conduct on-farm research. Again, the process provides propositional information on the features of a good research question and common descriptive, experimental and quasi-experimental research designs. In each case, groups discuss these features before each participant develops a research question for their issue, or proposes a research design to answer it. However, these proposals are again shared and reviewed with the group to provide each participant with some questions and suggestions to consider. This process is typically repeated two to three times to develop a research question, and twice for the research designs. Ultimately, the process concludes with a structure developed from that used to review on-farm research in the Western project in Queensland (Box 4).

Thirdly, this true workshop process introduces the notion that people have different approaches to pursuing knowledge from tenacity, intuition, and authority, through to rationalism, empiricism and science (Graziano & Raulin 2004). It also encourages dialogue into the relative costs and benefits of descriptive, experimental and quasi-experimental approaches. However, the final decisions remain with each individual who must ultimately decide what quality of answer they need for the question and the resources they have available. As a result, some farmers seek greater scientific rigour through replication and randomisation, while many commercial agronomists opt for quasi-experimental designs with some compromise on establishing cause and effect relationships. Indeed, some commercial agronomists are concluding that qualitative descriptive methods may provide adequate answers to some of their questions, and feel somewhat ‘liberated’ that full experimental designs may not be essential.

The ‘Doing successful on-farm research’ process has been used with 16 groups of farmers, agronomists, Farming Systems project teams, community-based natural resource management groups in the grains, cotton, sugar industries of Australia and the grains industry in China. Evaluations confirm that this guided learning approach can have a large impact, with 89% of participants believing it has helped improve their on-farm research (89%). Most critically, they appreciate their improved ability to develop clear research questions (96%) and make informed decisions on the most appropriate methods to answer those questions (87%). Finally, an analysis of early evaluation data showed that the first 50 participating farmers and agronomists conduct up to 150 on-farm research trials a year. They suggested that the workshops will help them avoid failures in up to half their trials. At $5000 per trial, this translates to a saving of $375 000 on wasted resources alone, without any benefits from the information arising from successful trials. The magnitude of these figures confirms the potential of guided learning activities that utilise higher levels of participation to integrate the diverse expertise of the scientists and farmers in grains RDE. This thesis provides the basis for the design of further guided learning activities that may benefit the grains industries of Australia.
8.5 Reflections on the research methodology

This thesis was conducted within a grains industry funded project to develop and support the use of evaluation processes in the Farming Systems projects. Participatory action research underpinned the evaluation project and this thesis. The challenge of conducting both ‘projects’ was greater than anticipated, but has ultimately been rewarding with a deeper understanding of diversity, participation and learning in the practice of Farming Systems RDE. Personal reflections on this methodology are too numerous to detail. However, it is appropriate to conclude with some reflections on this action research approach, particularly successful aspects of activities and conclusions from self-reflection:

1. The iterative nature of action research helped integrate propositional knowledge from the literature as my interests intensified from a fuzzy notion about evaluation, to the convergence of cognitive and socio-cultural perspectives of learning in the projects. That action research recognises this interaction to inform practice and the wider body of knowledge remains invaluable. Knowing when to stop was my challenge;

2. Diversity can maintain conflict and learning. Multiple goals and issues make participatory research challenging, and at times frustrating. Yet, Participatory Learning and Action Research (PLAR) provides an umbrella to maintain varying levels of participation in line with peoples’ interests and avoid the lowest common denominator of consensus on all activities. These goals and interest create conflict, but when managed this conflict is a valuable catalyst for learning;

3. Disconfirming data is critical for progress. Consistent with the theme of this thesis, my greatest insights emerged from disconfirming data. For example, frustration that projects’ team learning survey results differed to my own finally developed the re-investigation of learning in the projects. This ultimately produced the transformation of my perspective on learning;

4. Evaluation is ideal for surfacing diversity in teams. It is also a strong catalyst for action to reframe projects with a collective vision and effectively use their diversity;

5. Functional participation is a critical ‘stepping stone’ to interactive participation. Not everyone wants interactive participation in all activities, especially initially when they have little inherent understanding. The value of increasing opportunities for reflection on the process and the underlying assumptions of decision-making tools is a key personal learning from this thesis;

6. Participation cannot be forced. Opportunities to participate can be provided, but individuals ultimately decide whether to take these opportunities. Indeed, ‘positivistic moments’ and my attempts to force participation in early evaluation activities confirmed that modelling the
practice of constructivism is difficult and somewhat unnatural for humans (Christodoulou 2000). My subsequent engagement with the literature, most notable with Freire’s (1970) ‘Pedagogy of the oppressed’, has had a lasting impact on my practice to provide opportunities and support people to take them; and finally

7. The support of trusted team-mates who truly appreciate your perspectives is invaluable. Throughout this thesis, the sympathetic ear and critique of a trusted colleague who could highlight the conflict between my own espoused and actual practices was invaluable. Again, the diversity of the team was the catalyst for self-reflection.

8.6 Further research
This final chapter presents numerous opportunities for future quantification and testing in order to generalise the conclusions. However, this thesis also suggests two further research opportunities to support the development of participatory RDE in Australia:

Research to test the authenticity of collective learning. There remains debate as to whether collective learning is possible. It is commonly held that while individuals are subject to social pressures and can arrive at shared meaning, learning remains an individual process and responsibility, not a collective activity and cannot be shared (King 2000; Novak & Gowin 1984). However, despite such notions that learning is an individual phenomenon, ‘collective learning’ is increasingly accepted as a useful way of analysing organisations and their teams. This thesis suggests that the controversy may simply be a problem of boundary definitions which then pre-determine the findings. If so, can the boundaries for the unit of study be expanded to a collective and be investigated in terms of memory, behaviours and processes etc? Furthermore, if organisations can learn, where does their collective learning, if there is any, reside? Are all the synergies of collective activities lost (forgotten) between interactions, are some captured (learned) by the individuals involved, or are some captured (learned) by the collective itself? For example, in an activity between two people that achieves significant synergies, how is any positive learning (ability to act a certain way in future) captured or lost? Mathematically, if ‘1 + 1’ before an activity equals ‘3’ via synergy during the activity, what happens after the activity? Three possible scenarios include: a return to the original situation (e.g. 1 + 1); sharing of the new learning by the individuals (e.g. 1½ + 1½); and some new learning by individuals plus some collective learning accessible when they are together (e.g. 1¾+ 1¼ + ½). Research into these alternative propositions may help develop better theories of what happens when teams learn, as opposed to individuals in team learning (Senge 1990).
Research to assess tools to clarify potential participants RDE paradigms and worldviews. The worldviews of participants in this thesis were commonly inferred from interviews and observations. However, initial testing of a repertory grid activity (Kelly 1955; Stewart, Stewart & Fonda 1981) to clarify participants’ constructs of the dominant RDE methodologies in the projects and to clarify their underlying worldviews, confirms the potential of the approach. It is suggested in this thesis that constructivist perspectives may be best suited to Farming Systems projects to encourage the integration of their diversity. Consequently, further testing of the repertory grid approach, and other alternative approaches, to clarify participants RDE paradigms and worldviews is suggested.

The research presented in this thesis confirms that the introduction of Farming Systems RDE can positively impact on both the learning and behaviour of participants in the Australian grains industry. However, it is proposed that the nature and extent of this learning depends on the different kinds of participation that develop to utilise the diversity of people in the grains industry. That is, learning is a function of participation and diversity.

-----------------------------

232
Bibliography


138. Hawke, RJL 1989, Our country our future. Department of Prime Minister and Cabinet, QGPS, Canberra, Australia.


265. Reardon, KK 1995, They don’t get it, do they? Communication in the workplace – Closing the gap between men and women, Little Brown, Boston.


322. Uhlmann, V 1994, *Consulting on a consultation protocol: a project where the means were as important as the end*, Action Research Case Study Series, Monograph No. 1, ALARPM, Brisbane.


Appendix 1. Schedule for the first round of semi-structured interviews with team members of the Western project

GENERAL ISSUES

Theme 1. Farming Systems and On-farm research (general)

*Qn: People talk about “Farming Systems RDE”, what does the term mean to you (personally)?*

- what experience have you had with Farming Systems work other than WFS?
- what do you think of the Farming Systems literature, have you used it
- what do you think on-farm research all about? how would you define it?
- do you see the WFS project as a “new” approach? (in what ways?)

Theme 2. Attitudes to the Western Farming Systems project

*Qn: How would you describe the Western Farming Systems Project? what’s it all about?*

- what do you think of the WFS project?
- does the project have any burning issues for you?
- what are its main strengths? (what things have worked really well in the project?)
- what are its main weaknesses? (what’s not gone so well? what would you do differently?)

- how would you describe your involvement in the project? (roles and responsibilities)
- is the project giving you enough support?
- how much input do you have into the overall project? (like more, less, same?)

- is the project helping you and your district? (or is it a burden or an irrelevance?)
- is the project answering relevant questions for your district? (how well is this extended?)
- how well is the project linking with the wider community (cf growers directly involved?)
- with 20/20 hindsight, would you have structured the WFS project differently?
- assuming there is another term of funding, what should the new project should look like?

Theme 3. Expectations and outcomes of the Western farming Systems Project

*Qn: After 5 years, what outcomes do you expect to see as a result of the WFS? (the legacy?)*

- stakeholders (individual farmers, project team, industry in general, state depts, GRDC)
- practice change vs learning & understanding Vs R,D & E models/guidelines
- how do you see the project with respect of Research, Development and Extension
- how would you describe quality research?
- how successful will the project be in doing quality research? (Modules 1/ 2/ 3/ 4?)
- what do you think of having several organisations in the WFS?
- how would you describe the collaboration between organisations?
- what could the Western Farming Systems project do that would most annoy you?

Theme 4. Personal aspirations, expectations and impacts

*Qn: what do you personally want to get out of the WFS Project?*

- are there any specific skills, knowledge you want out of the project
- what about the specific trials/groups you are involved with? what do you want out of them?
- how will you judge your success wrt these aims
Theme 5. Evaluation and values

Qn: How will you decide how valuable the Western Farming Systems project has been?
- what outcomes would make the projects a success/failure?
- what specific information would you need to help you judge the FS projects’ value?
- how will you judge the value of the FS Evaluation project?
- what would you like your role in the evaluation of the project to be?
- what could the evaluation project do that would really annoy you?
- what did you think of the GRDC review?
- what did you think of the interim evaluation from Qld?

QUESTIONS FOR EACH MODULE OF THE PROJECT

Qn: what is the role of module 1/2/3/4 in the project?
- what do you think of the Module?
- what are its strengths? what does it do really well?
- what are the future challenges? what could be done better?
- what impact does it have? (how can you tell/substantiate this?)
- what is being learnt from the module
- what is being learnt that you didn’t know before (apart from quantifying known processes?)
- what are the outputs of the module? how can they be accessed by others?
- what is its contribution to sustainability?
- how does it differ from past efforts to do this type of work?
- how would you like to see it evaluated? what criteria? why are they important?
- what evaluation processes do you have in place to assess progress and learning?

- how did you (the team) get the module going?
- how was the focus of the work, the questions asked, the treatments decided?
- how much participation is there with farmers? how did that occur initially? and now?
- at what stages of the research process does this participation occur?
(what things were changed as a result of this participation?)
Appendix 2. Schedule for the second round of semi-structured interviews with project team members

**Theme 1. Philosophies and perceptions of Farming Systems RDE**
1. What the following terms mean to you and their importance to the project:
   - farming systems RDE
   - systems approach
   - research
   - participation
   - evaluation
   - on-farm research
   - learning
   - action learning

**Theme 2. Attitudes towards the Farming Systems project**
1. what’s your vision for the project?
2. what are its main strengths/weaknesses?
3. when would you suggest using/not using a (participatory) Farming Systems RDE approach?
4. what do you think about multi-institutional projects, compared to smaller projects? why?
5. how does collaboration between the different organisations work? why?
6. what would you do differently in the first phase of the project if you had your time over again?
7. if funding continues, what should the new project be like?
8. is the project helping you to achieve your own goals?
9. how valuable is the coordinating committee

**Theme 3. Outcomes of the farming systems project**
1. what have been the main impacts of the project? can you give me some examples/evidence?
2. what’s been improved? what’s got worse?
3. is impact outside the project’s farmer groups needed?
4. how do you perceive the project with respect to its emphasis of RD&E.
5. are you more/less confident of successful research outcomes than you were at the start? why?
6. what evaluation activities have you been involved in?

**Theme 4. Participation and learning**
1. how would you describe farmers participation in the project and its activities?
2. how do you contribute to the overall team effort
3. how do all the different groups/people in the project work together?
4. what’s been your biggest learning? what do/will you do differently as a result of that?
5. what else have you learnt during your time with the project?
6. what project activities have you learned the most/least from? why?
7. think of the people in the project have you learned the most and the least from? why is that?
8. what have been the critical events that have shaped your thinking?
9. what sort of things have you learned from people in the other organisations in the project?
10. what sort of things have you learned from the other activities in the project?
11. what challenges still exist to ensure we all learn as much as possible from each other?
Appendix 3. The importance and achievement of success factors across the Farming Systems RDE projects

<table>
<thead>
<tr>
<th>Success factors with a mean rating of ‘high’ to ‘very high’ importance</th>
<th>importance(^a) (mean score)</th>
<th>ranked(^b) importance</th>
<th>achievement(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Philosophies of farming systems RDE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>external funders support participatory FS RDE</td>
<td>4.5</td>
<td>6</td>
<td>+</td>
</tr>
<tr>
<td>external funders understand participatory FS RDE</td>
<td>4.0</td>
<td>17</td>
<td>-</td>
</tr>
<tr>
<td>host agency management support participatory FS RDE</td>
<td>4.3</td>
<td>10</td>
<td>+</td>
</tr>
<tr>
<td>team members are committed to participatory RDE</td>
<td>4.3</td>
<td>9</td>
<td>+</td>
</tr>
<tr>
<td>team believe participatory research can be quality research</td>
<td>4.0</td>
<td>18</td>
<td>+</td>
</tr>
<tr>
<td><strong>Project focus and outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a common project vision is developed by team members</td>
<td>4.1</td>
<td>15</td>
<td>+</td>
</tr>
<tr>
<td>the ‘systems’ under investigation are clearly defined</td>
<td>4.1</td>
<td>16</td>
<td>+</td>
</tr>
<tr>
<td>farm practices are clarified/described at the start of the project</td>
<td>4.3</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>project has a clear focus on ‘quality not quantity’</td>
<td>4.3</td>
<td>7</td>
<td>+</td>
</tr>
<tr>
<td><strong>Participation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>project staff have developed trust with grower groups</td>
<td>4.5</td>
<td>2</td>
<td>+</td>
</tr>
<tr>
<td>farmers have opportunity to define and prioritise issues</td>
<td>4.2</td>
<td>7</td>
<td>+</td>
</tr>
<tr>
<td>farmers’ interpretation of trial results are encouraged/discussed</td>
<td>4.4</td>
<td>4</td>
<td>+</td>
</tr>
<tr>
<td>whole team has opportunity to define and prioritise issues</td>
<td>4.3</td>
<td>10</td>
<td>+</td>
</tr>
<tr>
<td>whole teams interpretation of trial results is encouraged/discussed</td>
<td>4.4</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>team members have a good understanding of participation</td>
<td>4.2</td>
<td>13</td>
<td>+</td>
</tr>
<tr>
<td><strong>Evaluation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>project leaders directly support project evaluation</td>
<td>4.1</td>
<td>15</td>
<td>+</td>
</tr>
<tr>
<td>key evaluation activities are included in project milestones</td>
<td>4.2</td>
<td>11</td>
<td>-</td>
</tr>
<tr>
<td>evaluations occur during, not after the project</td>
<td>4.3</td>
<td>10</td>
<td>+</td>
</tr>
<tr>
<td>evaluation addresses practice changes, learning and processes</td>
<td>4.2</td>
<td>12</td>
<td>+</td>
</tr>
<tr>
<td>a ‘reflection’ stage is built into all major activities</td>
<td>4.3</td>
<td>8</td>
<td>-</td>
</tr>
<tr>
<td>peer reviews are used to assess and report on progress</td>
<td>4.0</td>
<td>17</td>
<td>-</td>
</tr>
<tr>
<td><strong>Project leadership</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>the leader is committed to and experienced in participatory RDE</td>
<td>4.4</td>
<td>5</td>
<td>+</td>
</tr>
<tr>
<td>the leader is locally based and directly involved in activities</td>
<td>4.4</td>
<td>5</td>
<td>++</td>
</tr>
<tr>
<td>the leader has a large personal time commitment to the project</td>
<td>4.4</td>
<td>6</td>
<td>+</td>
</tr>
<tr>
<td><strong>Team structure and skills</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>the team has a balanced range of RDE skills</td>
<td>4.4</td>
<td>6</td>
<td>+</td>
</tr>
<tr>
<td>the team has good facilitation skills</td>
<td>4.3</td>
<td>7</td>
<td>+</td>
</tr>
<tr>
<td>the team has good issue identification and prioritisation skills</td>
<td>4.3</td>
<td>7</td>
<td>+</td>
</tr>
<tr>
<td>team members each have a major time commitment to projects</td>
<td>4.3</td>
<td>10</td>
<td>+</td>
</tr>
<tr>
<td>team clearly understand their roles and responsibilities</td>
<td>4.6</td>
<td>1</td>
<td>+</td>
</tr>
<tr>
<td>appropriate RDE processes are used</td>
<td>4.3</td>
<td>8</td>
<td>+</td>
</tr>
<tr>
<td><strong>Organisational factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>projects have negotiated the involvement of staff</td>
<td>4.3</td>
<td>9</td>
<td>+</td>
</tr>
<tr>
<td>projects have good staff continuity</td>
<td>4.3</td>
<td>8</td>
<td>-</td>
</tr>
<tr>
<td>staff are based close to the ‘action’</td>
<td>4.3</td>
<td>8</td>
<td>+</td>
</tr>
<tr>
<td>team members have a real desire to work across organisations</td>
<td>4.1</td>
<td>14</td>
<td>+</td>
</tr>
<tr>
<td><strong>Communication and reporting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>stakeholders recognise communication is critical to FS RDE</td>
<td>4.3</td>
<td>8</td>
<td>+</td>
</tr>
<tr>
<td>specific communications/reporting milestones are developed</td>
<td>4.1</td>
<td>15</td>
<td>+</td>
</tr>
<tr>
<td>frameworks are used to plan/communicate/report</td>
<td>4.1</td>
<td>14</td>
<td>+</td>
</tr>
<tr>
<td>regular team meetings are held</td>
<td>4.2</td>
<td>12</td>
<td>+</td>
</tr>
<tr>
<td>progress is clearly/effectively reported to farmers/industry</td>
<td>4.5</td>
<td>2</td>
<td>+</td>
</tr>
<tr>
<td>progress is clearly/effectively reported to host managers/funders</td>
<td>4.3</td>
<td>9</td>
<td>+</td>
</tr>
<tr>
<td>high levels of trust exist amongst team members</td>
<td>4.5</td>
<td>3</td>
<td>+</td>
</tr>
<tr>
<td>use of dialogue, not arguing</td>
<td>4.3</td>
<td>8</td>
<td>+</td>
</tr>
</tbody>
</table>

\(^a\) mean importance score where 1 = very low; 2 = low; 3 = medium; 4 = high; 5 = very high

\(^b\) some success factors had equal mean importance scores and so were ranked equally

\(^c\) based on mean achievement scores: (-) was less than 3.0; (+) was between 3.01 and 4.0; (++) over (source: Lawrence et al. 2001)
Appendix 4. A questionnaire to quantify the impacts of the Central Farming Systems project on participating farmers

GENERAL INFORMATION

Q1. How would you describe the level of your involvement with the Farming Systems project?
(please tick the most appropriate)
[ ] substantial
[ ] moderate
[ ] occasional
[ ] hardly ever involved

Q2. How would you describe your farming enterprises?
(please tick the most appropriate)
[ ] cropping only
[ ] mainly cropping, with some cattle
[ ] an equal balance of cropping and cattle
[ ] mainly cattle, with some cropping

Q3. What is the total CROPPING AREA that you farm? ........... acres, or ........... hectares

Q4. What percentage of your CROP AREA do you typically plant to sorghum, wheat and other crops?
......... % grain sorghum
......... % wheat
......... % other crops

Q5. Roughly, what percentages of your cropping country are the following soil types?
......... % open downs
......... % brisalow clay
......... % river/creek alluvial
......... % other soils (eg ............. ............. ............. ............. )

THE PROJECT'S IMPACT ON FARMING IN YOUR DISTRICT

Q6. How much IMPACT has the project had on these aspects of farming in your district?
(please circle one number)

<table>
<thead>
<tr>
<th>Impact</th>
<th>no impact</th>
<th>small impact</th>
<th>moderate impact</th>
<th>large impact</th>
<th>unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>helping people improve their farming practices</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>developing farmer knowledge</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>developing new science</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>improving how research and extension is done</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>improving the sustainability of farming</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>improving the profitability of farming</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

256
**THE PROJECT'S IMPACT ON YOUR UNDERSTANDING & KNOWLEDGE**

Q7. How much impact has the project had on YOU in terms of your own UNDERSTANDING of these issues?  
(please circle one number, or "not applicable" for issues you have not worked on with the project)

<table>
<thead>
<tr>
<th>Issue</th>
<th>no impact</th>
<th>small impact</th>
<th>moderate impact</th>
<th>large impact</th>
<th>not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>soil nitrogen management</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>soil water management</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>zero tillage systems</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>controlled traffic farming</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>opportunity cropping</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>weed management</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>grain legumes</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>grazing legumes (e.g. fab lab, butterfly pea)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>sorghum planting populations</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>sorghum row spacing</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>soil sodicity and salinity</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>nutrients other than nitrogen</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>comparisons of different farming systems</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>costs and benefits of stubble grazing</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>soil organic matter</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
</tbody>
</table>

**THE PROJECT'S IMPACT ON YOUR FARMING PRACTICES**

Q8. How much impact has the project had on YOU in terms of your FARMING PRACTICES over recent years?  
(please circle one number, or "not applicable" for issues you have not worked on with the project)

<table>
<thead>
<tr>
<th>Issue</th>
<th>no impact</th>
<th>small impact</th>
<th>moderate impact</th>
<th>large impact</th>
<th>not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>soil nitrogen management</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>soil water management</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>use of zero tillage systems</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>use of controlled traffic farming</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>use of opportunity cropping</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>better weed management</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>use of grain legumes</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>use of grazing legumes (e.g. fab lab, butterfly pea)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>sorghum planting populations</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>sorghum row spacing</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>fertilising for nutrients other than nitrogen</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>grazing of stubble</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>na</td>
</tr>
</tbody>
</table>
### GENERAL IMPRESSIONS OF THE PROJECT

Q9. How strongly do you agree or disagree with these statements about the project and its processes? (please circle one number)

<table>
<thead>
<tr>
<th>Statement</th>
<th>strongly disagree</th>
<th>disagree</th>
<th>unsure</th>
<th>agree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The CQSFSP project:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>has been a good investment of funds and resources</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>is helping improve the sustainability of my farm</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>is helping improve the profitability of my farm</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>puts too much emphasis on production and not enough on sustainability</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>puts too much emphasis on sustainability and not enough on production</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>puts too much emphasis on what the project staff want, not farmers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>puts too much emphasis on what farmers’ want, not the project staff</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>would be better if farmers challenged the project staff’s ideas more</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>would be better if the project staff challenged farmer’s ideas more</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>has developed a strong partnership between farmers and project staff</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>has provided opportunities to discuss my experiences</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>helped me interact and learn from other farmers in the group</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>helped me interact and learn from farmers in the project’s other groups</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>helped me interact and learn from project staff</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>helped the project staff interact and learn from farmers in the group</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>needs to do more for farmers outside the existing farmer groups</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>has helped me better understand how research is done</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>has helped me improve my own on-farm trials</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>has helped identify the strengths and weaknesses of my farming system</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>has helped me get the most out of my farming system</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>has lifted my yield expectations</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>has helped develop new farming systems for Central Queensland</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>has helped me integrate existing technology on my farm</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>has helped me use information from crop simulation models and climate forecasts to look for new options and analyse risk</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>needs to put more emphasis on weed management</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>has made me more inclined to seek advice from agronomists</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Q10. How much influence have FARMERS had on these aspects of your group’s DEVELOPMENT SITES?

<table>
<thead>
<tr>
<th>(please circle one number)</th>
<th>none</th>
<th>small</th>
<th>moderate</th>
<th>large</th>
<th>unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>deciding which issues to work on</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>selecting the relevant treatments</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>management of the development sites</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>monitoring and recording results</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>interpreting the results</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>evaluating progress and future directions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Q11. How useful are the following aspects of your group’s DEVELOPMENT SITES?

<table>
<thead>
<tr>
<th>(please circle one number)</th>
<th>no at all useful</th>
<th>slightly useful</th>
<th>moderately useful</th>
<th>very useful</th>
<th>unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>having development sites as a focus for activities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>having farmers and project staff working together on-farm</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>detailed sampling and measurements at development sites</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>using large scale plots and farmer equipment</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>replicating treatments</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>running trials over several years</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>using an agricultural consultant to advise on site management</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

The usefulness of different project activities

Q12. How useful have the following project ACTIVITIES been to you?

<table>
<thead>
<tr>
<th>(please circle the most appropriate number, or “not applicable” for activities you have not been involved in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>group meetings</td>
</tr>
<tr>
<td>evaluation meetings</td>
</tr>
<tr>
<td>meetings with other farmer groups</td>
</tr>
<tr>
<td>field days</td>
</tr>
<tr>
<td>bus tours</td>
</tr>
<tr>
<td>project update newsletter</td>
</tr>
<tr>
<td>interaction with project staff</td>
</tr>
<tr>
<td>interaction with agricultural consultants</td>
</tr>
<tr>
<td>soil characterisation of development sites</td>
</tr>
<tr>
<td>crop models and economic analysis of farming systems</td>
</tr>
</tbody>
</table>
Farming practices

Q13. How strongly do you agree or disagree with these statements about cropping?

(please circle one number)

<table>
<thead>
<tr>
<th></th>
<th>strongly disagree</th>
<th>disagree</th>
<th>unsure</th>
<th>agree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>the management benefits of controlled traffic under zero tillage</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>outweigh any impact it may have on soil erosion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I know how the returns from grazing legumes and grain compare</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>nitrogen fertiliser is often not the best option on shallow soils</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>butterfly pea is a reliable legume for forage and ley pastures</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>with controlled traffic under zero tillage, running lines up</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>and down the slope will give less runoff than across the slope</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with controlled traffic under zero tillage, running lines up</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>and down the slope will give more erosion than across the slope</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>higher sorghum populations will reduce yields in dry years</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>the project has made me aware that soil sodicity is an issue</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>in CQ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>the project has started me measuring my soil nitrogen levels</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Q14. On what percentage of your crop land would you grow GRAIN LEGUMES, LAB LAB & BUTTERFLY PEA?

<table>
<thead>
<tr>
<th></th>
<th>grain legumes %</th>
<th>lab lab %</th>
<th>butterfly pea %</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) currently (this year/last year)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) in the past (say 5 years ago)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) in future (say 5 years time)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q15. Roughly, on what percentage of your cropping country would you normally use NITROGEN, PHOSPHORUS and ZINC fertilisers?

<table>
<thead>
<tr>
<th></th>
<th>nitrogen %</th>
<th>phosphorus %</th>
<th>zinc %</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) currently (this year/last year)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) in the past (say 5 years ago)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) in future (say 5 years time)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q16. What would be your average rate of NITROGEN fertiliser on wheat and grain sorghum?

Please tell us the rate per acre or per hectare, and the product used (eg. rate = 80 kg/ha, product = urea)

<table>
<thead>
<tr>
<th></th>
<th>wheat rate</th>
<th>wheat product</th>
<th>sorghum rate</th>
<th>sorghum product</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) currently (this year/last year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) in the past (say 5 years ago)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) in future (say 5 years time)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q17. Which of the following methods do you use to decide how much NITROGEN to apply to your crops?
(please tick the main methods you use)

[ ] apply a standard annual rate
[ ] do nitrogen budgets based on soil tests
[ ] follow an agronomists recommendation
[ ] vary rates according to last years response and the paddocks history of grain yield and quality
[ ] vary rates according to the weather outlook (eg SOI), soil moisture, crop type and prices etc
[ ] recommendations from other farmers
[ ] computer models (eg. WHEATMAN, HOW WET? and Whopper Cropper)
[ ] use as much as I can with the cash available
[ ] other ................................................................. %

Q18. Roughly, on what percentage of your cropping land would be under ZERO TILLAGE?

a) currently (this year/last year) ................ %
b) in the past (say 5 years ago) ..................... %
c) in future (say in 5 years time) .................... %

--- If you do not have controlled traffic, please go to Question 21 ---

Q19. Roughly, on what percentage of your cropping land would be under CONTROLLED TRAFFIC?

a) currently (this year/last year) ............... %
b) in the past (say 5 years ago) ................. %
c) in future (say in 5 years time) ............... %

Q20. Roughly, what percentage of your Controlled Traffic runs are mostly up & down the slope? .......... %

Q21. What impact do you think moving from ZERO TILLAGE to a CONTROLLED TRAFFIC/ZERO TILLAGE system has in your district?
(please circle the most appropriate number)

<table>
<thead>
<tr>
<th>Impact</th>
<th>A lot higher</th>
<th>A bit higher</th>
<th>About the same</th>
<th>A bit lower</th>
<th>A lot lower</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runoff will be</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Erosion will be</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Moisture storage will be</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Costs will be</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Yields will be</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Profits will be</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Ease of management will be</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

Q22. Would you normally use a pre-harvest spray for sorghum?

a) currently (this year/last year) .......... [ ] yes [ ] no
b) in future (say in 5 years time) ...... [ ] yes [ ] no [ ] unsure

261
Q23. Would you normally graze your sorghum stubble after harvest?
   a) currently (this year/last year) [ ] yes [ ] no
   b) in the past (say 5 years ago) [ ] yes [ ] no
   c) in future (say in 5 years time) [ ] yes [ ] no [ ] unsure

Q24. Would you use SKIP ROWS or WIDE ROWS (over 1 metre) for grain sorghum on your main cropping soil?
   a) currently [ ] every year [ ] in marginal conditions [ ] never
   b) in future [ ] every year [ ] in marginal conditions [ ] never [ ] unsure

Q25. Do you use a TARGET PLANT POPULATION for grain sorghum?
   [ ] yes ... what population do you aim for? ... per acre or ... per hectare
   [ ] no ... what planting rate do you normally use? ... per acre or ... per hectare

Are there any other comments you would like to make about the Central Queensland Farming Systems project or your farming system? (e.g. other activities you would like to see, other issues you would like to see work on)

(Optinal) Name: ... address: ...

Thanks for your valuable time and effort!
Appendix 5. A checklist for assessing levels of participation in Farming Systems RDE

Please select and tick (✓) the statement that best captures the following attributes of ‘Activity X’:

1. COMMUNICATION CONTEXT – ‘Activity X’

[ ] lets ‘stakeholders’ find out for themselves what is happening
[ ] tells ‘stakeholders’ what is being done and lets them discover how it will affect them
[ ] asks ‘stakeholders’ their perceptions of about issues/events so improved activities can be developed
[ ] encourages ‘stakeholders’ interpretation of events/issues but puts little emphasis on their rationale
[ ] encourages stakeholders to give their interpretation of issues and their rationale

2. DECISION MAKING – In ‘Activity X’

[ ] ‘agencies’ make decisions with no input from ‘stakeholders’
[ ] ‘agencies’ make decisions but ask for ‘stakeholders’ views
[ ] ‘agencies’ make the big (strategic) decisions but share smaller (operational) decisions with ‘stakeholders’
[ ] ‘agencies’ and ‘stakeholders’ share strategic and operational decision making
[ ] ‘traditional stakeholders’ control strategic and operational decision making

3. INITIATION – ‘Activity X’

[ ] was suggested by ‘agencies’ who then decided to develop it
[ ] was suggested by ‘agencies’ before ‘stakeholders’ and ‘agencies’ joint decision to develop it
[ ] was suggested by ‘stakeholders’ before ‘stakeholders’ and ‘agencies’ joint decision to develop it
[ ] was suggested by ‘stakeholders’ who then decided to develop it

4a. DEFINITION OF INITIAL ISSUES/PROBLEMS/GOALS – In ‘Activity X’

[ ] ‘agencies’ defined the initial aims prior to development of the process
[ ] ‘agencies’ and ‘stakeholders’ jointly defined the initial aims prior to development of the process
[ ] ‘stakeholders’ defined the initial aims prior to development of the process

4b. INITIAL PROCESS DEFINITION – In ‘Activity X’

[ ] ‘agencies’ developed the processes used
[ ] ‘agencies’ and ‘stakeholders’ jointly developed the processes used (consensus/multiple perspectives)
[ ] ‘stakeholders’ developed the processes used

5. PROCESS REFLECTION AND DEVELOPMENT – In ‘Activity X’

[ ] ‘stakeholders’ have must comply with processes/ideas as they are
[ ] ‘stakeholders’ are made aware of processes/ideas and may adopt/reject or independently modify them later on
[ ] ‘stakeholders’ are made aware of processes/ideas and may adopt/reject or independently modify them later on
[ ] Feedback is sought to help the ‘developers’ improve the processes/ideas
[ ] ‘stakeholders’ are assisted to use the processes/ideas and assisted to modify existing variables for their own situations
[ ] Underlying assumptions and variables may be transparent, but are not explicitly reviewed/modified by ‘stakeholders’ as part of the activity
[ ] ‘stakeholders’ are assisted to use the processes/ideas and assisted to modify the existing variables, added/deleted variables and develop alternative processes for their own situation
[ ] Underlying assumptions, variables and alternatives are transparent and explicitly reviewed/modified by ‘stakeholders’ as part of the activity

6. ANALYSIS/INTERPRETATION OF EVENTS – In ‘Activity X’

[ ] analysis and interpretations of results are not part of the process
[ ] analysis and interpretations of results are typically those of the ‘agencies’ ‘Stakeholders’ analysis and interpretations are not explicitly sought as part of the process
[ ] ‘stakeholders’ and ‘agencies’ analysis and interpretations of results/events are explicitly part of the process
[ ] ‘stakeholders’ and ‘agencies’ analysis and interpretations of results/events are explicitly part of the process
[ ] Their explanations of those interpretations are also an explicit part of the process

7. ‘AGENCIES’ LEARNING – In ‘Activity X’

[ ] ‘agencies’ typically develop few new insights/knowledge from ‘stakeholders’
[ ] ‘agencies’ typically refine their knowledge from the insights of ‘stakeholders’
[ ] ‘agencies’ typically develop fundamentally new knowledge from the insights of ‘stakeholders’

8. ‘STAKEHOLDERS’ LEARNING – In ‘Activity X’

[ ] ‘stakeholders’ typically develop few new insights/knowledge from ‘agencies’
[ ] ‘stakeholders’ typically refine their knowledge from the insights of ‘agencies’
[ ] ‘stakeholders’ typically develop fundamentally new knowledge from the insights of ‘agencies’

This assessment sheet can be used as a checklist for participant observation, as a survey of participants, or a guide for discussion amongst participants to determine the appropriate mode of participation for specific activities.
Appendix 6. A template of generic questions to establish participants’ knowledge, attitudes, skills, aspirations and practices for their research issues

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Theme</th>
<th>Questions on participants’ knowledge, attitudes, skills, aspirations and practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current practices</td>
<td>Experience and exposure</td>
<td>• Have you had practical experience with ________ prior to the project? • What level of exposure/experience have you previously had with ________? • What would go into a book on ________ if you were writing one? • In your opinion, what is best practice for ________?</td>
</tr>
<tr>
<td>Interpretation</td>
<td></td>
<td>• Can you describe your current knowledge and/or implementation of ________? • How has the project contributed to your current knowledge of ________?</td>
</tr>
<tr>
<td>Strengths</td>
<td>Main benefits</td>
<td>• What do you consider to be the main benefits of getting into ________? • What attracted you towards finding out about ________?</td>
</tr>
<tr>
<td></td>
<td>Measuring these benefits</td>
<td>• How will you decide that ________ is better than your previous practice? • How can you tell there are benefits?</td>
</tr>
<tr>
<td></td>
<td>Systems approach</td>
<td>• How do you see ________ aligning with other practices within your farming system? • What else fits in with ________?</td>
</tr>
<tr>
<td>Weaknesses</td>
<td>Limitations</td>
<td>• What do you consider to be the limitations of ________? • What are your reasons for considering ________ to be a limitation to your farming system? • What sorts of things prevent you from using ________?</td>
</tr>
<tr>
<td></td>
<td>Systems approach</td>
<td>• Do you see any hassles/problems with introducing ________ into your farming system?</td>
</tr>
<tr>
<td>Opportunities</td>
<td>Why?</td>
<td>• What is your reason for considering ________? • What do you want to learn/achieve from this activity?</td>
</tr>
<tr>
<td></td>
<td>How and when?</td>
<td>• How will you know you’ve learned what you wanted to learn? • What work needs to be done to fill in the gaps? • How can we better meet those needs?</td>
</tr>
<tr>
<td>Threats</td>
<td>Preventative issues</td>
<td>• What sorts of things are preventing you from using ________? • What makes you uncertain about going ahead and getting stuck into it?</td>
</tr>
</tbody>
</table>

(source: adapted from Kelly et al. 1999)
Appendix 7. A summary of the collective understanding of the RDE methodologies from the Western project in Queensland

1. Contributions of applied research (a process for establishing small-plot experiments with highly controlled variables to develop scientific cause-and-effect relationships). The main contribution of applied research was considered to be technological awareness and enhanced understanding of scientific cause-and-effect understandings. Applied research was considered appropriate when there was:
   - a primary need for greater scientific understanding;
   - comparing biophysical characteristics across multiple systems over time to obtain a valid comparison of a range of options;
   - a need for high levels of control of variables;
   - a need to establish underlying scientific principles, or the local application of principles in situations where there is minimal understanding; and
   - a need to develop resources for supporting stakeholders to deal with change through better information on principles.

2. Contributions of on-farm research (a process for developing commercial scale experiments to develop people’s understanding of biophysical and socioeconomic issues to improve decision-making for technological adaptation for specific sites). On-farm research was considered to incorporate current management issues and constraints to the investigations. It provided a process for stakeholders to learn to understand the implications for change through testing and adapting technology. On-farm research was considered appropriate when there was:
   - a need to develop communication of experiential knowledge and sharing experiences of site-specific issues;
   - a need to develop problem solving skills by providing opportunities for all stakeholders to participate in process and content decisions;
   - a need to compare fewer options (i.e. biophysical and socioeconomic) on a larger scale at a wider range of locations (i.e. across time and space).

3. Contributions of action learning (a process for integrating people’s existing knowledge with their emergent understandings of a particular issue through group learning). Action learning was considered as a process for sharing and developing participants’ knowledge, skills, and attitudes to better inform their decision-making processes and enhance their problem solving skills. Action learning was considered appropriate when there was:
   - a well established principle relating to the questions or issues at hand;
   - a need for developing new understandings or interpretations of existing information and experiences; and
   - groups of people that are motivated to learn from each others’ experiences and provide confidence to improve their practices.
Appendix 8. Selected examples of farmers’ improved understanding from on-farm research

- Learned there’s more to it than just organic carbon. Lower levels of organic carbon lead to lower levels of nutrients supplied to the crop. The impact is you are going to have potentially much lower mineralisation and so will lead to higher levels of nitrogen applications to the paddock.

- We learned a lot in the last six months. Butterfly pea doesn’t seem suited for shallow, sodic soils. Leucaena’s OK on sodic and harder soils. Caatinga stylo for harder soils and butterfly pea on the better soils.

- What we’ve found is age of cultivation hasn’t made a difference other than nutrition. I always thought it was critical for the physical characteristics of the soil, and we’re tending to disprove that. That declining organic carbon meant declining soil structure.

- Controlled traffic came out well. It had more runoff in some places but less erosion. (and) No matter what direction you run it is still better than conventional tillage.

- In 1997, only a limited amount of nitrogen was put on in the district. We needed to come to terms with the reality of having to put fertiliser on but this trial is probably enough. We now fertilise all crops all years.

- Scientific figures provided us with the proof. We’re not just taking a hunch. We go and measure the important things rather than just observe something.

- I used to farm dirt. I was always in the bank paying bills. (now) I farm moisture. We have different expectations now. Because we measure water and nitrogen we picking up differences, in say areas that were zero tilled and areas grazed. Expectations and averages have definitely increased.

- How’s this for a change of attitude? Dad was saying the other day that his chickpeas were going to “do” mine for water use efficiency. Is that change or not? A 63 year-old bloke talking about doing me for water use efficiency.

- We needed to know what we were missing out on in a good season, now we know that. Plan to use skip rows in spring or when the season is supposed to be dry. SOIL and all that. Whenever we are taking a risk by planting.

- The group has shown us what the soil limitations are. We’re all doing more testing. We found out we have other limiting factors. So we could put on all the nitrogen but it didn’t matter.

- The ley legume rotation has seemed to significantly improve organic matter. If you want to build up organic matter, have to go into ley pasture.

- It’s helped me realise what the limiting factors are. Need the knowledge before you can do anything. What stands out for us is increased soil knowledge. When we started we knew we had some limiting factors but were shooting in the dark. (for example) People outside this room have probably never thought about their subsoil limitations.

(source: Assorted evaluation reports described in this thesis (Lawrence 1988 to 2005))
Appendix 9. The seven steps of the *Doing successful on-farm research* workshops

Step 1. Introduction to clarify all participants' expectations and the process

Step 2. Reflecting on participants experiences with on-farm research
   - What are the key features of on-farm research?
   - What are the advantages/disadvantages of on-farm research?

Step 3. Developing specific research questions
   - What do you already know about your research issue?
   - What are the features of a good research question?

Step 4. Reviewing existing information and past research
   - Can other people, here or outside experts and practitioners, already answer your research question?

Step 5. Selecting an appropriate research method
   - What's important when selecting a research method?
   - What are the common on-farm research methods and trial designs?
   - Which method is best for you and your research question?

Step 6. Developing an action plan for the research
   - What needs to be done, how, when and by who?

Step 7. Interpreting and learning from the research
   - What are the results and what do they mean?
   - Have you answered your original question?
   - How might your farming practices change?
   - What have you learned about doing on-farm research?

(Source: Lawrence, Christodoulou & Whish 2004)