Farmlets as learning platforms for the Australian dairy industry

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ABSTRACT

The Australian dairy industry has a farmgate value of AU$3 billion and employs over 40,000 people across the supply chain. Without doubt, the success of the industry is based on a strong foundation of competitiveness, created through a long history of research, development and extension (RD&E). Understanding how the research and extension continuum works and learns together is a fundamental issue implicating the effectiveness of innovation development along with deployment of industry funding.

Farmlets have been a key tool for Australian dairy RD&E, and are small scale dairy farms used to research farming system management issues. Within most of these projects is a team of researchers and extension practitioners working together with their regional farming community to improve management systems, and increase the profitability and sustainability. However, little is known as to what the requirements and possibilities for learning from these farmlet projects are. Anecdotal evidence suggested that farmlet stakeholders consider farmlets to be a learning platform for the dairy industry. But just how do farmlets act as a learning platform for the Australian dairy industry?

Cultural Historical Activity Theory (CHAT) was used as the theoretical framework for underpinning this research. A qualitative, constructionist approach to the research methodology utilised four case studies of regional farmlet project activities which were supported by two national dairy project case studies, for analysing learning platforms. Evidence was sourced through interviews, participant observation and secondary data. Strassaurian Grounded Theory method was employed for data analysis, using Nvivo qualitative data analysis software and thematic analysis techniques. Critical to the approach was for the student to work within the programs both as a contributor to the teams activities and as an observer.

This research concluded that farmlets do act as learning platforms for the Australian dairy industry which is defined as “an intellectual construction that aims to take the process, activities, outputs and outcomes that the dairy RD&E continuum use to set joint objectives and share physical and intellectual resources to manage adaptation”. What underpins this construction is fundamentally a series of processes and contradictions that challenge cultural norms and adequacy of practice. It commands embracement and management of contradictions as a fundamental part to practice, rather than an inconvenience or interfering event.

Overall, the research seeks to encourage broader questioning of not just on what we do in terms of dairy farming systems RD&E using farmlets, but how we work, learn and share knowledge throughout the process of implementing a project. It seeks to make a contribution to the domain of farming systems RD&E, along with stimulating greater dialogue and thinking and subsequent practices that will better capture and utilise transformation processes across the continuum. The new age of current competitiveness and accountability against the deployment of industry funds commands this, as a narrow focus on just providing industry with technical on-farm knowledge outputs is no longer adequate.

Acknowledgements

This research would not have been possible without the support from Dairy Australia. I am incredibly grateful for their generosity and leadership in investing in what was at the time, a largely unknown area for investigation.

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Preface

I was fortunate to be able to undertake this project in an unexpected turn of events. My original desire was to conduct a scientific PhD study on anthelmintic resistance in dairy calves – a proposal that was rejected by industry funders due to the issue being deemed insignificant at the time. Dairy Australia (then called Dairy Research and Development Corporation) at the time was moving to invest in a new initiative called the National Dairy Farming Systems program, part of which involved broadening R&D capacity into areas of rural social research. My supervisor, Dr Mark Paine was appointed to lead the charge, along with him was the first PhD project in this area studying farmlets as learning platforms for the Australian dairy industry.

Both delighted and nervously hesitant, I accepted the challenge of the alternative project, despite the fact I was very much of a post positivist agricultural scientist bent who likes the clear cut, black and white world of fact, rigor and scientific assessment. Instead of plants and animals, I was to study human activity. How hard could it be to do a project that is based on qualitative assessment, interviews and interpretation? Little did I know at the time just how much I liked the security and prescription of rules, boundaries and clear instructions on how to get from a to b that science had always provided. With the project I was to embark on the rules were completely different, the boundaries were to be set by me, and the course of action generated from my own set of criteria. Needless to say I was extremely naïve to what I was signing up for, which as for most things had both good and bad elements to it.

Despite the epistemological challenges I had to grapple with, the project focus and my career path have remained in parallel, along with growth in my thought processes and analytical capacity. This project, was positioned within the continuum of research, development and extension in the dairy industry, while my employment opportunities have spanned graduate research assistant, to extension officer (both in the public and private sector), to my current position of working for a research and development corporation (RDC). This experience has meant I have had the privilege and opportunity to work from each of these perspectives, and test to see whether my assumptions and conclusions hold up outside of my research domain (farmlets and the dairy industry). This process has enriched the research process considerably, and enabled the concepts presented in the case studies to evolve and mature over time.

It wasn't until I commenced my role as a government extension employee, that the real relevance and value of my study became apparent and much more exciting. What became very clear over time, was that in the realms of RD&E, technology and emergent innovation always seemed to reign supreme. We seek to analyse and understand the technical elements of farming systems, production interventions and new management practices that will improve industry performance. Of course this is the imperative of all RD&E investment. However, this is where the analysis and innovation tends to stop. What we don't do is analyse and understand how we, as professional human beings, work, learn and interact together to achieve a joint outcome.

Fundamentally, I have dedicated this thesis to strive to identify what is driving learning across an RD&E continuum – how physical and intellectual resources are shared – to enable a learning platform to emerge. It has been an extraordinary expedition of discovery in human behaviour – both mine and the extensive list of those involved. What I found is that it takes patience and requires time for a story to unfold, and that you really don't know what you are looking for until you have found it. The once black and white view of the world has now turned to various shades of grey, an approach to life where there is never one size that fits all and the old way of doing anything should always be questioned with the rigor of an informed mind.

Chapter 1

1.0 Introduction

This study aims to provide an understanding of the purposeful and emergent learning processes that result from significant industry investment into Australian dairy farmlets. To research issues within a local dairy production context, resources located within dairy research stations are allocated to 'farmlets', or miniature grazing units to simulate a 'real', fully operational dairy system. Primarily, farmlets provide a vehicle for studying questions at a farming systems level, seeking to provide the knowledge and confidence for producers to implement new improved management systems that help the industry to grow and remain competitive. Providing such support structures for the industry is critical, given the dynamic nature of - and climate within which - dairy production operates and the imperative for the whole of industry to have an adaptive capacity to manage change.

Economically, the dairy industry in Australia is of profound importance, contributing approximately AUD$3.9 billion annually to the national economy. Combined, Australia and New Zealand produce 5% of the world's milk with the other major producers being the European Union (24%) the USA, (16%) and Russia (7%) (Dairy Australia, 2011).

Australia's ability to maintain international export market share is due to a domestic farming system with low cost, seasonally-based pasture and a favourable climate that does not require winter housing of animals. This is in contrast to European conditions, where extreme climates makes it necessary to shelter cattle for extended periods, thus requiring the provision of high cost supplementary feeds to maintain production.

Responsiveness to change and significant adaptive capacity are fundamental skills required at all dimensions of the industry to manage the many factors that cast uncertainty over the profitability and sustainability of the industry in the future. Over the last 25 years, significant structural shifts have occurred with farm numbers rationalised from 22,000 in 1980 to just over 11,000 in 2000 (ADC 2000). During 1980 to 2011, the average herd size increased from 85 to an estimated 230 head, and average annual yield per cow increased from 2850 litres to 5700 litre (Dairy Australia, 2011). The catch cry of 'get big or get out' was reinforced with the implementation of deregulation of the sector, placing considerable pressure on dairy farmers to become economically and environmentally more efficient producers of clean, high quality milk (ABARE, 2001). Prior to deregulation, Australian State governments were responsible for regulating year-round supplies of fresh, high quality milk to consumers (ADC 2000). There was greater certainty for farmers as they received a weekly pay cheque due to regulatory tools such as pooling or quota systems which controlled prices and distribution from the farm-gate to the consumer. Post farm-gate controls were phased out in the 1990s by all dairy producing States, until only farm pricing and sourcing regulations remained (*ibid*).

Constant economic pressure on all agricultural commodities in Australia requires a relentless focus on improving farm productivity, with intensification and efficiencies paramount for business survival. At the start of the decade, the Federal Government stated the need to understand and manage the triple bottom line (economic, social and environmental impacts) of industry change. The environmental impact, in particular, is now at the forefront of consideration for policy makers and causing considerable uncertainty at the farm-gate level. Farming, generally, has been suggested as the cause of much environmental degradation in Australia (Vanclay and Lawrence 1995) but the global movement to address climate change has created an even bigger imperative for industries to be proactive and accountable for impacts on the environment.

Climate variability is represented largely through long periods of dry conditions without even average annual rainfalls occurring. Although significant differences in the effect of drought exist across the various dairying regions and different production systems, drought in most recent times has adversely affected 75% of dairy farmers in some way (Dairy Australia, 2008). Drought impacts significantly on profitability with feed input costs including grain, energy and fertiliser increasing, as well as affecting the confidence of producers to maintain viable businesses.

Dairy farming is a complex natural system managed through localised decision rules, which in the majority of businesses have been developed over generations of farm managers. Dealing with the added complexities of today’s dairying environment requires a continuously supported adaptation processes, supported by innovative knowledge, information and learning to lift industry capacity to cope and survive. Adoption of new technologies and farm management practices has led to appreciable gains in farm labour productivity and increases in milk yields per cow and per hectare (Dairy Australia, 2005b: 3). Industry growth, however, suggests a slow annual increase in total factor productivity of 1% and declining terms of trade at -2.3% per annum continue today (Dairy Australia, 2011). This indicates overall productivity of the industry is in steady decline, putting current innovation capacity of the industry under the spotlight and in need of greater attention in the area of strategy, focus and evaluation around the deployment of resources.

The uncertainty surrounding the industry created by climate variability and what it means for current farming systems, access to water, input costs (e.g. feed) and future profitability is undermining the capacity for growth in the dairy sector, despite generally strongly positive attitude towards the industry's future (Dairy Australia, 2011). The responsibility for scoping out and providing a response for the industry to the pressures within the national and global market sits largely with the dairy research, development and extension (RD&E) continuum in Australia.

RD&E is managed through Dairy Australia (DA), a research and development corporation responsible for managing the sector's farmer-paid research levy and the matching Federal government funds provided for industry R&D. Dairy Australia arranges RD&E through Regional Development Programs (RDPs) which aim to drive innovation in research and extension throughout Australia's dairy sector through the use of regional knowledge and skills (Dairy Australia, 2005:1). Involved in setting strategic industry priorities and maintaining relationships with industry stakeholders, each RDP is managed by a board of dairy farmers and representatives from other local industry stakeholders to manage investment into local research, development and extension. Development of RDPs was based on the philosophy that the outputs of research and development will most likely be adopted, and hence productivity improved, if they are incorporated into regional dairy farming systems and if the local industry has had input in setting research and development priorities and project development.

Each of the RDPs has been involved with funding farming systems research, development and extension programs within their regions using farmlets. Conducted on dairy research stations, farmlets emerged as a vehicle to study changes in farm management relevant to particular regions. New Zealand has led the way with farmlet research, stemming from the work of McMeekan *et al.* (1964) at the Ruakura Agricultural Research Station located near Hamilton on the north island.

Farmlets are a resource (human and financial) hungry approach to RD&E, incorporating teams of research scientists, extension practitioners and, in most cases, an advisory board of farmers to direct activities (in addition and separate to the RDP). Farmlets have been positioned in each major dairying region to ensure outcomes are locally relevant. Each operates in isolation from the other, and is operationally (in the majority of cases) managed by State Government Departments of Agriculture.

A national dairy industry workshop (Paine, 1999 unpublished) in 1998 questioned the role of dairy farmlet research and extension in Australia with specific questions about whether farmlets were still the most appropriate method for dairy farming systems research and extension. These questions were not aimed at creating negativity towards the farmlet approach or in some way depreciating the value of preceding project outcomes. Rather, they arose at what was seen as an opportune time to explore the approach in comparison to other farming systems RD&E approaches, to extend project capacity and to facilitate more purposeful learning. Farmlet stakeholders recognised that there was an opportunity to improve outcomes through a nationally coordinated programme, as opposed to the then isolated and uncoordinated regional approach. The result of a subsequent study examining a coordinated national approach to farmlet research and extension was that the 'learning platform' theme emerged.

The 'learning platform' is a construct that assumes agreement that farmlets are a place for dairy industry learning despite there being no substantive exploration to validate such a broad claim. It was hypothesised that, if the intellectual and physical resources were shared around a common objective, then a learning platform would emerge. Hence a PhD study was commissioned for the very purpose of establishing the principles and environment under which this can be assumed to occur. It is now pertinent to clarify the problem statement and outlay the roadmap by which the problem has been studied, analysed and resolutions established.

1.1 Problem domain

The forgoing discussion identified considerable industry uncertainty brought about by the price cost squeeze, global competition and climate variability. There is an associated imperative to ensure that industry RD&E structures, designed to inform and support industry learning and adaptation, are delivering this capacity. This is a significant challenge to the dairy RD&E continuum around farmlets, and demands a study that will deconstruct the various elements of farmlet projects in order to study adaptation and learning at the research, extension and farm-gate levels. A reconstruction of the individual parts is proposed to generate a thorough understanding of how farmlets act as learning platforms for the Australian dairy industry.

Directing the research in this thesis is the question:

> How do farmlets act as learning platforms for the Australian dairy industry RD&E continuum?

1.2 Empirical framework

To address the question, this thesis explores farmlet activities using regional case studies, incorporating data generated from the experiences of farmlet researchers, extension practitioners and dairy farmers.

Regionally focussed farmlets, Vasse Research Station (Western Australia), Elliott Research Station (Tasmania), Macalister Research Farm (Victoria) and Flaxley Agricultural Centre (South Australia) provided different institutional contexts for farmlet research and extension practice. Case studies of these farmlets sought to discover concepts impacting on learning and adaptation around farmlets through the various significant events and activities that the teams were involved in.

An additional case study that is appended to the regional case studies examined specific national issues, relevant across all regions. The National Dairy Farming Systems (NDFS) project formed the basis to the national case study and was instigated as a result of the DA dairy industry workshop (Paine, 1998), noted earlier. The project aimed to develop a coordinated approach to farming systems RD&E across Australian dairy farmlet projects. National activities that brought farmlet players together were studied with a key objective being to track learning and adaptation processes that emerged from implementation of the NDFS project. One such activity was the implementation of a new biophysical model called 'DairyMod' into farmlet projects. Integrating DairyMod into farmlet practice is a significant focus of the national case study.

1.3 Organisation of the thesis

Figure 1.0 below is a diagrammatical representation of the organisation of chapters. In the next chapter, an elaboration of the contextual setting for this thesis is provided. The Australian dairy industry is reviewed to highlight the nature of the dairy farming, and where Australia is positioned in the international dairy market. The key challenges faced by the industry are discussed prior to discussing how the industry responds to the challenges using research, development and extension for the dairy industry. The chapter finishes by summarising the fundamental attributes of the RD&E continuum that need to be accounted for to construct and determine the theoretical foundations that can guide this research.

Chapter 3 then explores the concepts and theory informing the research process. In the first instance, the key concepts within the problem domain are explored and defined namely learning, learning platforms, and farming systems research, development and extension. Learning theories including social learning (Wenger, 1998; Woodhill and Roling, 1998; Roling, 2002) and experiential learning (Kolb, 1984) are briefly reviewed, leading to a more in depth review of activity theory (Leont'ev, 1978; Engeström and Miettenin, 1999). Given the breadth and applicability of activity theory to enable analysis of learning across a social system, providing focus on the relationships between tasks, tools, and rules around an object, the theory was found to have matured to a level that provided considerable utility for guiding the research. Elements of transgressive and transformative learning, accounting for the influence of historical experience on learning, reinforced the theory's applicability to understanding adaptive processes associated with farmlets. Core principles arrived at through critiquing activity theory provide a framework on which to proceed in the construction of the research methodology.

Chapter 4 critiques and justifies the methodology and methods employed for the research approach. This proved a trying task given a number of tensions in typical epistemological debate, compared with my unique position as a student who has shifted from agricultural science to rural social research or from the respective post positivist to constructivist world view. The struggle to be in either one or the other camps has resulted in this thesis being constructed to cross the boundaries of both. The way in which this thesis has been formatted in the linear progression of chapters to address a hypothesis demonstrates a clear linkage to the post positivist roots of my education. However the nature of research around the problem domain warranted a qualitative constructivist approach to enable in depth exploration in real time. Participatory action research principles guided the qualitative interviews and observations with farmlet actors. A Straussurian approach to grounded theory with the constant comparative approach was employed to guide data collection and analysis. Chapters 5, 6, 7 and 8 present the results of the case studies that utilised this method.

In Chapter 9, the discussion consolidates and arranges the emergent principles from the regional case studies in an a cross case analysis framework that addresses the research questions. The research approach, including activity theory, is re-evaluated and incorporated into the framework, which collectively makes a contribution to both the discipline of farming systems research and extension as well as activity theory.

Chapter 10 presents the final conclusions and critiques the methods used for this project. The authors' role in the research process is analysed and finally recommendations are provided for enhancing learning and adaptive processes in future farming systems research, development and extension projects.

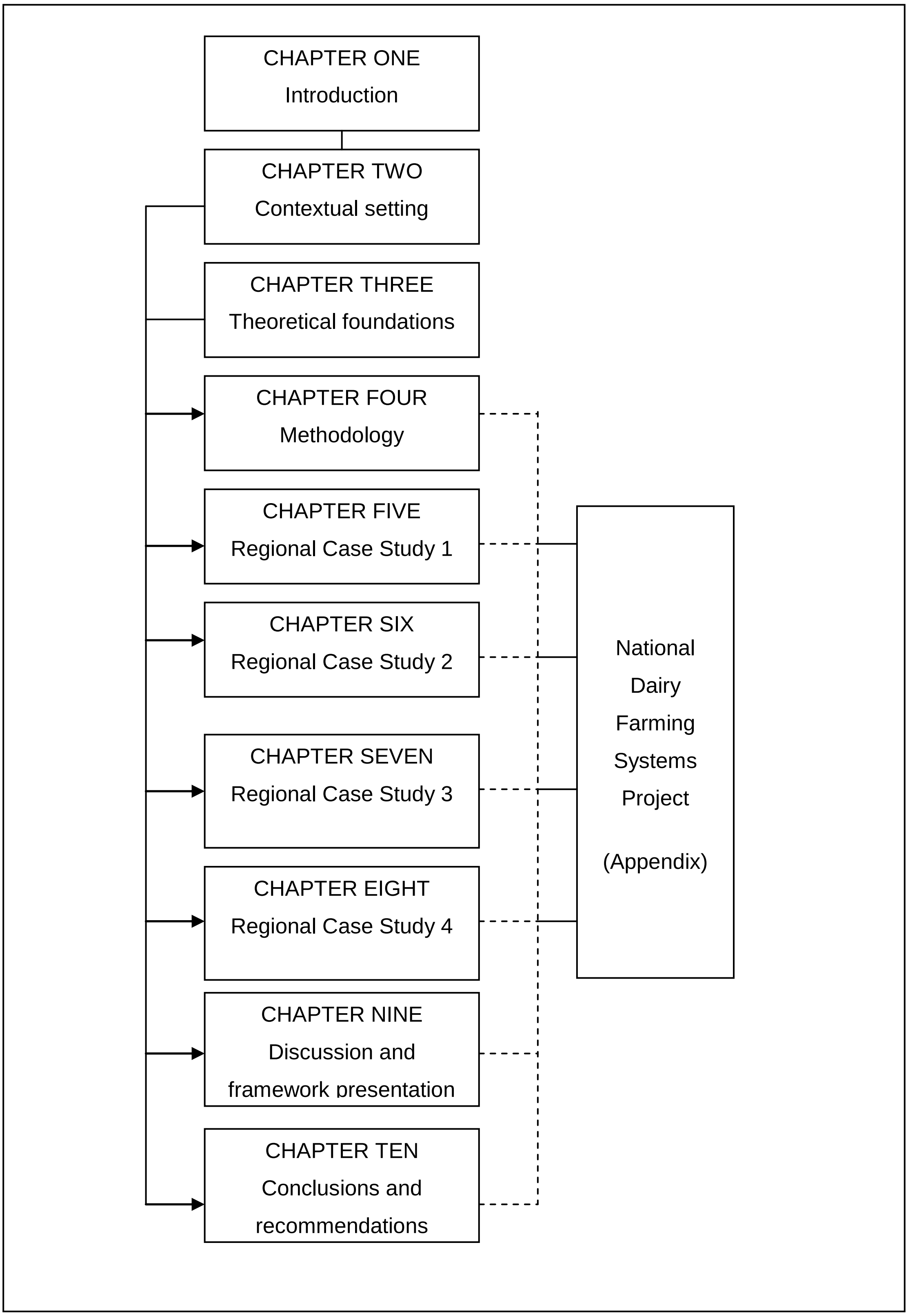


Figure 1.0 Organisation of chapters

Chapter 2 The Australian dairy industry

2.0 Introduction

This chapter contextualises the research and positions it within the dynamic Australian dairy industry. While outlining the critical factors that shape the industry, this chapter seeks to demonstrate the complex interrelationships between global and domestic markets, on-farm production and the need for an effective research, development and extension continuum. This sets the platform for understanding the key elements of the problem context prior to embarking on the description of the research process.

2.1 Australian dairy farming systems

Like all agricultural industries, dairying is dependant on a myriad of natural resources that vary across regions. In Australia, the dairy industry is one of the leading agricultural industries, with an annual farm gate value of approximately AU$3.9 billion (Dairy Australia, 2011). The production system is predominantly based on improved pastures, containing mainly ryegrass cultivars (*Lolium* spp.) and white clover cultivars *(Trifolium* spp.) in the temperate, mediterranean climates and Kikuyu cultivars (*Pennisetium* spp.) and Paspalum cultivars (*Paspalum* spp.) in the northern tropical dairy regions. Supplementary feeding with cereal grains such as barley and wheat or other supplements (e.g. silage) is common to extend the milking season and increase milk production.

Australian dairy farming systems have undergone a continuing process of intensification, with farms becoming larger and more efficient in response to competitive pressures from the international market. Figure 2 highlights how these changes have occurred. Farm numbers have rationalised from 22,000 in 1980 to just over 8055 (Dairy Australia, 2007). During 1980 to 2011, the average herd size increased from 85 to an estimated 230 head, and average annual yield per cow increased from 2850 litres to 5700 litre (Dairy Australia, 2011).

Milk production has steadily increased, with an average annual yield per cow increase from 2850 litres to 5700 litre (Dairy Australia, 2011) over the last two decades.

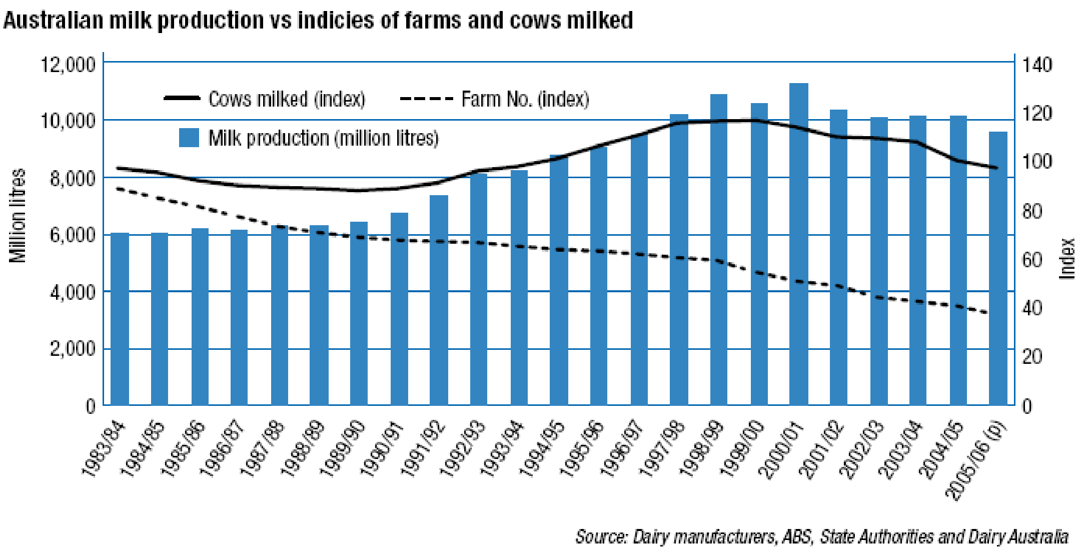


Figure 2. Australian milk production versus farm numbers and the number of cows milked. Source: Dairy Australia, 2007:17.

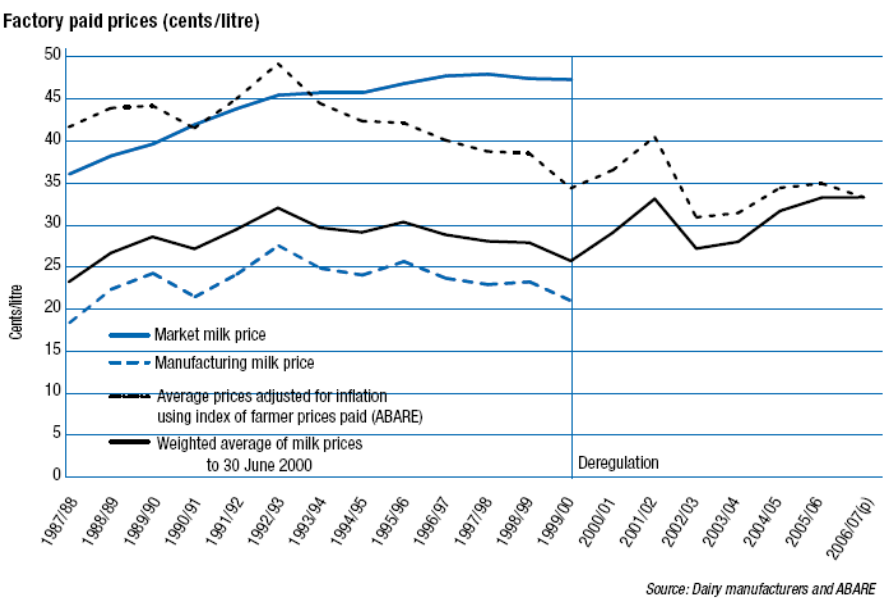


Figure 3. Milk price volatility in the Australian market
Source: Dairy Australia, 2007: 15.

Milk price received is highly variable and volatile as demonstrated in Figure 3. The prices Australian dairy producers receive for milk are dependent on the world market and there are no formal controls over the price for milk used in manufactured dairy products (ADC, 2002). Farm-gate prices can vary between manufacturers, with individual company returns being affected by product mix, marketing strategies and processing efficiencies. Most manufacturing prices are also based on both the milk fat and solid non-fat content of fresh milk at the factory. Payments from processors to individual farmers can vary as processors operate a range of incentive/penalty payments relating to milk quality, volume and out-of-season supply (*ibid.*).

In addition to farm system intensification, the industry has been completely deregulated since 1999. In the past, State governments generally used pooling or quota systems to regulate year round supplies of fresh milk to consumers (ADC, 2000). Price and distribution were also regulated. During the 1990s, the dairying states phased-out post-farm-gate controls, until only pricing and sourcing regulations remained (*ibid.*).

Geographic diversity, particularly associated with a wide range of climatic regions, creates much variation between farming systems across the country (see figure 4). Climates range from high rainfall, in cool temperate Victoria and northern Tasmania, and sub-tropical northern New South Wales and coastal Queensland to Mediterranean low summer rainfall and cool, relatively wet winters in Western Australia and South Australia.

Figure 4. Major dairy regions of Australia (Adapted from Dairy Australia, 2007:38).

Davidson and Schwarzweller (2009) argue that differences in farming systems can be regarded as a geographical expression of the extent to which regions are able to participate effectively in the global economy. Some regions become marginalised as they become remote from economic centres and the authors suggest that the concentration of production in certain regions is associated with differentials in scale and productivity. Berrevoets (2000) also found varying scale effects, with a predominance of small farms in marginal regions whilst regions at the economic core of the development were characterised by large scale, highly productive and efficient systems with high returns.

Regional differentiation is market linked (Berrevoets, 2000) with, for example, Victoria having a stronger focus on export compared with the New South Wales' focus on manufacturing for the local fresh market.

The historical development of the dairy industry in each State has played a role in the scale of production of different regional farming systems (Berrevoets, 2000). The size of farms in States where dairy farming was established relatively early (Vic and NSW) appears smaller than in areas where the industry was established later (WA). Western Australian farms were established in areas with lower rainfall that, because of the pasture-based nature of dairying in Australia, require larger farm areas (*ibid.)* to allow for greater grazing area.

The number of dairy farms, as a proportion of the total number of farms, varies substantially between States with less than 4% of farms in Western Australia used for dairying compared with 22% in Victoria and 17% in Tasmania. States such as Victoria also have a more developed dairy products manufacturing sector (i.e. cheese, milk powder etc.) than States such as Queensland and Tasmania (ABARE, 2001). The more important agriculture is in a State economy, and the relative importance of dairy farming can affect the political influence of dairy farmers on government policies. This then determine levels of public expenditure on outreach services, extension and support to the industry (Berrevoets, 2000).

Despite the regional differentiation in production and target markets, State governments in Australia have significant expectations for dairy production to increase. Statements of expectation (see below) have been written with the assumption that there is human capacity and infrastructure within the regional industries to enable the increases to occur.

Box 1. Extracts from State dairy strategic plans

"The dairy industry aims to double production by 2010 to 800 million litres"

Department of Agriculture, Western Australia (2002)

"Research predicts that Australia and New Zealand will produce over 50% of the world's dairy exports within three years"

Department of Natural Resources and Environment, Victoria (2003)

"Growing the dairy industry to 1.5 billion litres (from 700 million) annually by 2010 – achieving the highest added value per litre of milk in the Australasian region – and earning $1 billion."

Dairy Industry Development Board, South Australia (2002)

Indeed, while research predictions for Australia and New Zealand delivering 50% of world dairy exports have been realised (see Section 2.2), stretch targets for doubling production are perhaps idealistic given the significant uncontrollable barriers at the farm level to the achievement of this. The impact of drought, otherwise defined as extended abnormally dry periods when there is not enough water for users' normal needs (BOM, 2008), is an inevitable factor that impacts on all of Australian agriculture. Australia is the driest inhabited continent on the planet, and managing climate variability requires considerable skill and management foresight. The effects of drought continue to adversely affect more than 75% of dairy farmers in some way, including large increases in the cost of inputs of grain, fertiliser and energy (Dairy Australia, 2008:4). There are significant differences in the effect of these costs on cash margins between regions and production systems (*ibid.*).

Rising fuel prices and the competition for water and irrigation rights are two other major shocks to farming businesses that increase the cost of production for many dairy farmers. An example of how the most recent season was affected is provided in northern Victoria water, where allocations started low and water prices rose quickly to around $AU900 per mega litre (ML) in Spring, well above the peak price of $AU660 in 2006/07 (Dairy Australia, 2008:64). Such costs are limiting the productivity growth of the industry that is currently at a rate of 1% per year (Dairy Australia, 2011). For farm incomes to be maintained, annual growth needs to exceed the rates of decline in the terms of trade that is currently at a rate of 2.3% per annum (*ibid*.). In economic terms, the 'cost price squeeze' is forcing the industry to seek greater efficiencies and skills to survive. However, given that the Australian dairy industry is dependent on exports, milk price is largely determined by the international market place. This impact of this on industry operation is now explored.

2.3 The Australian dairy industry in an international market

Although Australia exports around 50% of its annual milk production, drought conditions have limited Australia's global dairy trade capacity to 11% of total international market share, down from a peak of 17% in 2002 (Dairy Australia, 2008:21). Main markets are in Asia, with Japan and south-east Asia accounting for more than half by value. This pattern reflects both a geographic advantage with respect to these current markets, and restricted access to other major markets either directly by trade restrictions or indirectly because of export subsidy programs of major competitors (ADC, 2000).

In terms of the international dairy market, Australia is a relatively small player with the major international competitors (in terms of milk production) being the European Union (24%), the

USA (16%) and Russia (7%), compared with Australia/NZ comprising 5% of the total world production (ADC, 2002).

Compared with most other countries, Australia, New Zealand and Uruguay have efficient production systems due to low cost and seasonally based pasture feeding techniques. Argentina uses a mixture of pasture-based and grain feeding techniques due to a much less seasonally influenced pattern of milk production (ADC, 2002). Climatic factors in much of the northern hemisphere require herds to be sheltered indoors for extended periods with considerable supplementary feeding needed to maintain output. This reliance on grains creates milk production averages well above pasture-based producers, but production costs are much higher.

Intensification of dairy farming systems is occurring worldwide. For example, the numbers of dairy cattle in traditional dairying regions in Germany have reduced slightly (Vonderach, 2000), however dairy farm numbers have also decreased with a concomitant increase in numbers. This is a result of restructuring causing smaller farms to cease operation due to high production costs and low prices received (Vonderach, 2000). In some areas, this has led to manure management problems, pollution of ground water, and consequent destruction of regional vegetation and bird habitat (*ibid*.).

Compared with Australia, where agricultural policy is focussed on production, Europe has moved beyond a purely production orientated system. Quality of produce, environmental considerations and quality of life has become the focus for improvement (Becattini and Zorini, 2002). This different focus requires the strengthening of agricultural linkages between urban populations, and farmers, other land users and regional planners (ibid.). Maintaining and valuing local identity of the region to market and better position products are also key policy areas for production. This is illustrated by the case in Box 2 below, an example from Ireland, which is indicative of a trend throughout Europe.

The Irish story in Box 2 demonstrates that there is a change in focus from production to an ability to provide greater services to the regional community. Multifunctional farming systems have become a major focus for agriculture across Europe, capitalising on regional culture and history as a way of marketing agricultural products and services (Hubert *et.al*., 2002). This distinct mission of the dairy industry is not one fostered by the Australian dairy industry. In the Australian regions where the industry is relatively small, such as Western Australia and Queensland, farms are seeking alternative marketing opportunities by developing ‘value added’ products such as specialty cheeses, to remain in the industry.

Box 2. Change in focus for European dairying

"Rural Ireland is being transformed from 'rural society' (based on the reproduction of family farming) into 'rural space' (available for conservation, urban consumption and regulated entrepreneurs). In Ireland, dairy farming systems have transformed from an agrarian to an industrial form. Among the contemporary successful dairy farmers, the family farm is losing its master-status as the definer of family identity and becoming one among a portfolio of family business activities. Urbanization has brought about the reordering of social and political priorities to emphasise urban needs and values. One dimension of this is a transformation in the meaning of rural resources, from resources for production to resources for consumption. Rural society is being shaped from a producer society into a location for tourism, environmental conservation, wildlife and leisure appreciation. Those landholders that remain in agriculture, such as successful dairy farmers, find their operations constrained and regulated in new ways by concerns about food safety and quality or about the effects of their activities on water quality or wildlife. In Ireland this has been described as a process of 'de-moralisation', the collapse of a collective culture and identity which once promised to be transformative, not just for farmers, but for Irish society as a whole" (Tovey, 2000:70).

Regional differentiation in Australia along with the alternative focus provided by the international scene, provides an opportunity for dairy industries across the developed world to learn from each other. Differentiation offers alternative perspectives on technology implementation and management to deal with the uncertainty that the industry challenges create.

According to Paine (1997:6) "farmers and processors use technology to reduce the uncertainty surrounding the performance of their respective activities towards competitive sector performance. Interventions are used by those who provide technical information to farmers and processors to reduce the uncertainty of human performance in the context of a marketing channel". That is, technology and interventions are used to respond and to develop a capacity to deal with uncertainty and in Australia, technology and interventions have been developed mostly through research and extension programs, funded or part funded from the public sector. More recently, the cost of such programs has been shifted more towards industry with public sector support.

2.4 Research and development for Australian dairy farming systems

An active and relevant RD&E program can provide a basis for ongoing development, and responses to current economic, social and environmental challenges. Dairy Australia (DA) is responsible for managing the dairy sector's farmer-paid research levy and matching government funds. At the time of this study, Dairy Australia invested around AUD$25-30 million each year in research conducted by research providers, such as State Departments of Agriculture, universities and other research institutions (DRDC, 2001). This investment has been suggested by Dairy Australia to deliver benefits of $AUD3.20 for each dollar invested (DRDC, 2002).

Regional Development Programs (RDPs) established by DA in all major dairy regions of Australia, coordinate and manage research designed to improve productivity, prosperity and sustainability (DRDC, 2001). Local dairy communities are involved in setting priorities or determining the research questions to be evaluated. RDPs are also involved in implementing research and development outcomes in their region, through the RDP board. Each RDP reviews all regional research projects submitted for approval, prior to submission to Dairy Australia for further refereeing before funding is approved. DA funded research covers all areas of the dairy sector, from on-farm production to manufacturing, economics, marketing, and innovation and change. Management of these areas of research and extension is by individual portfolio managers, whose role is to work with the RDPs and project teams to ensure the objectives of their portfolios are met by project delivery.

2.5 Research structure for Australian dairy farming systems

In most countries, agricultural research has traditionally been organised on the basis of disciplines or commodities (e.g. dairy) using experimental stations (Petheram, 1996). For the past four decades, production orientated farming systems research and extension has been conducted in Australasia using farmlets (McMeekan, 1966; Fulkerson, 1980; Thomas and Matthews, 1991). A farmlet is a small grazing unit that simulates production conditions on commercial farms. Traditionally, trial designs have arranged these grazing units following conventional experimental protocols according to treatments, control, randomisation and replication requirements.

In New Zealand farmlet based RD&E began in the 1960s, with studies on low cost farming systems at the then Ruakura Agricultural Research Station[1] (McMeekan, 1966; Paine, 1997). In Australia, farmlet based RD&E has generally been undertaken on a State-by-State basis. Farmlet projects are traditionally led by the project leader (usually a scientist), together with other scientists, extension practitioners, technical staff and farm workers. Each project usually has a consultative or reference committee that includes local farmers and consultants, who provide guidance, technical advice, and an industry perspective to the project. Extension practitioners are aligned with the research project to package the learning outputs and deliver to the local industry.

[1] This research station is now part of the New Zealand Dairy Research Corporation
example a dairy farm may have 3 cows per hectare

At the time of this research there were seven farmlet studies spread throughout six states in Australia. Located in the major dairying regions, farmlets operate autonomously and have been established at different times with separate objectives and research questions. The projects that were in operation are detailed below in Table 1. The majority of projects focussed on dairy feedbase (e.g. pasture versus grain or other supplement) and production (e.g. stocking rate) issues, though other areas of the farming system are incorporated into the studies. All projects had some emphasis on extension strategies, learning and communication, though the level is variable between projects.

	Soil & Nutrients	**Nutrient Loss**	**Water**	**Biodiversity**	**Feedbase**	**Animal Production**	**Animal Fertility**	**Animal Health**	**Modelling**	**Economics**	**Learning & Communication**
Vasse Milk Farmlets, WA	x		x		xxx	xx xx	x	x	x	x	xx
Flaxley Farmlets, SA	x		x	X	xx	xx xx	x	x		X	x
Profitable Mgt Strategies Farmlet Trial, Elliott, TAS	x		x		xxxx	xx x	x	x		X	xxx
Phosphorus for Dairy Farms, Ellinbank, VIC*	xxxx	xx	x	X x	xxx	xx x	x	x x x		x x	xxx
Feeding Demonstration Trial, Macalister Research Farm, VIC*	x	xx	xx		xxx	xx xx	x	x		x x	xx
EMAI, NSW	xxxx	xx x	x		xxx	xx	x	x	X	x	xx
Sustainable Dairy Systems for Profit, Peak Crossing, QLD	x		xx x		xxxx	xx	x	x	xx	x	xx

Source: Crawford, 2001 XXXX = primary emphasis
X = taking some measurements
*Projects have been completed in 2002

Table 1. Summary of research focus for each Australian dairy farmlet project

The influence of this research mirrors the profound role played by research in the extraordinary productivity growth that has occurred in agriculture across the globe (Bawden, 1991). A survey conducted by DRDC suggested the following trends in productivity as a result of research investment into production issues from 1991–1998:

- Productivity, measured as litres of milk produced per grazed hectare has increased by 31%;

- Labour productivity, measured as litres of milk produced per week of farm labour has increased by 31%;
- Use of computers for any farm purpose more than doubled from 17% to 38%;
- Computer use increased significantly, for milk production recording, breeding and budgeting;
- The type of milking shed continued to shift toward larger scale production units, such as 90 degree herringbone and rotary sheds;
- The proportion of farms with vats larger than 400L almost doubled every two years to 23%;
- The proportion of farmers who soil test or routinely renovate their pasture increased from 60% to more than 80%; and,
- Use of feeding concentrates or grains has increased (Riley, 1999).

These outcomes may not have resulted solely from the research investment, in that market forces may have led to farmers implementing these changes without the research effort, but as McMeekan argues (1966:2), it has had significant impact:

> "It would not be true to claim that organised scientific research has been the mechanism responsible for all advances made. Much of the progress has been due to the farmers themselves. By trial and error, and to a large degree by using the same reasoning processes and using the same approach through observation and experiment that characterises science, they have done much of the job without organised aid. Yet it is true to say that most of the changes have been based on research".

While dairy production research has advanced the industry and provided options for dealing with challenges and uncertainty, extension has also played a significant role in both the dissemination of new information and management and facilitation of industry change.

2.6 Extension foundations and practice in the Australian dairy industry

Extension has a multitude of definitions focussing on the facilitation of change in agriculture and resource management (APEN, 2005). A widely cited definition is that of van den Ban and Hawkins (1996:24), who state that "extension involves the conscious communication of information to help people form sound opinions and make good decisions". Roling (1988:39) identifies five common elements of extension:

- extension is an intervention;
- extension uses communication as its instrument of change;
- extension can only be effective through voluntary change;
- extension focuses on a number of different target processes and outcomes which distinguish it from other communication interventions; and

- extension is deployed by an institution.

In addition to Roling's common elements, extension can require short or long term learning processes, and is dependent on the development of a network of learning relationships. Such relationships within farmlet projects consist of those between funders, scientists, farmers, extension practitioners and, in some cases, agribusiness and political institutions.

Extension by regional farmlet projects has included conventional methods such as discussion groups, research station farm walks and field days, newsletters and farmer participation in specific development topics like soil fertility or riparian zone management. In most States, it is delivered and managed by State government agricultural agencies with some extension practitioners located at the farmlet while others operate from a remote location. In South Australia, however, farmers are reliant on private extension providers, due to the withdrawal of government support for extension (Paine and Weatherley, 2001).

Trends over the last few decades of extension reflect its historical influences, which may be culturally embedded within institutions (Roling, 1988). Due to State agricultural agencies being the dominant provider of dairy extension in Australia, the foundation for extension practice has stemmed from the transfer of technology (ToT), diffusion of innovations paradigm of the 1960s (Rogers, 1983). This represents the original and predominant approach adopted in less developed countries prior to the 1970s, and traditionally in developed countries such as New Zealand (Reid, 1996) and Australia (Hamilton, 1995).

The starting point in the ToT approach is a new technology developed by a science and technology expert, often separate from either a market opportunity or specific production context. Rogers (1962), who has since changed his views (Arnon, 1989:746), put forward the concept that innovations were first adopted by a small group of the farmer population who were referred to as the innovators. If the innovators proved to be successful then categories of farmers referred to as the early adopters, the early majority, the late majority and the laggards successively followed suit and adopted the innovation (Rogers, 1962: 168-171). This model of innovation diffusion was developed, along with models of farmer decision-making, to provide an idealised explanation of the process used by farmers to adopt a new technology (Rogers, 1962; Rogers and Shoemaker, 1971).

The ToT model of extension is a one-way flow of information (expert to farmer) top down approach (the expert is the font of all knowledge) to communication and has been widely criticised (Chambers *et al*. 1990; Vanclay, 2002 amongst others). Extension principles then moved to ensure that communication was a two way process. The linkage model of communication (Havelock *et al*. 1973) was one example that incorporated bottom up flows of communication, whereby information from the dairy farmer client was considered an important part of research and extension practices. Bottom up flows have increased in the recent past as a result of approaches advocated in publications such as “Farmer First” (Chambers *et al*. 1990).

The emergence of the “Farmer First” (Chambers *et al*. 1990) model led to further development and emergence of the conceptual extension system based on a ‘farmer – led’ model (Ison and Russell, 2000). This system was based on a multi-directional communication process between and among extension staff and farmers, involving the sharing, sourcing and development of knowledge and skills in order to meet farming needs and develop innovative capacity (Farrington & Johnson, 1997). With this model, farmers have the controlling interest and are the protagonists that play a key role in the technology development and delivery (*ibid.*). Group processes were implemented for the delivery of extension around this era, as opposed to the one to one methods traditionally used (Woods *et al.* 1993).

The shift in delivery methods in Australian dairy extension paralleled major institutional changes occurring across State government agricultural agencies. During the last decade there has been a great deal of change in the public provision of extension, including: a shift from the focus on maximising production to sustainable production; the reduction in public funding for extension; the increasing role of private providers; the role of government in extension as new private providers emerge; and, the role of research and development corporations in extension and changes to state government extension systems (Fulton, 1997).

With each shift in extension delivery, extension principles and approaches have come under question and there has been much debate and reflection on the effectiveness of extension programs (Hamilton, 1995). Debate has brought to the surface previous criticism of extension for not doing enough, not doing it well and not being relevant (Fulton, 1997). Much criticism has been directed at the effectiveness of extension due to the lack of adoption of research findings being substantiated through rigorous evaluation (Rivera and Gustafson, 1991; Fulton, 1997; van den Ban and Hawkins, 1996). Key areas where extension has been found to be particularly have been found to be: poor linkages between research and extension; poor planning and implementation of research programs; research outcomes not perceived as relevant; lack of resources allocated to extension; lack of extension skills held by extension providers; internal organisational problems of the extension providers; and lack of necessary technical skills by the extension provider (Fulton, 1997).

The most recent advance in extension in Australia has been focussed on capacity building, described by Macadam *et al.*, (2003) as containing a number of attributes:

> "Capacity building refers to intervention, consequent enhancement of human and social capital plus increased motivation or commitment to act or empowerment to act independently, and the expectation of an outcome in the form of an improvement of some kind. Capacity building is construed as externally or internally initiated processes designed to help individuals and groups associated with rural Australia to appreciate and manage their changing circumstances, with the objective of improving stock of human, social, financial, physical and natural capita in an ethically defensible way".

This definition implies that capacity building involves an intervention and a process for improvement that may start from within an organisation or from external pressures. Capacity building in this sense, then, is about providing people with tools and skills that will improve the capability of individuals or communities to better manage their own situations and challenges.

One of the unique attributes of a capacity building approach to extension is that "the stock of human and social capital is developed through learning" (Macadam *et al*., 2003:20). While extension has previously been linked to learning theories (eg. Knowle's (1990) adult learning, Kolb's (1984) experiential learning, Zuber-Skerritt's (2002) action learning), according to Ison *et al.* (1993) cognitive development is also a foundation learning theory that informs extension practice. As highlighted by Macadam *et al*.:

> "Translating development as a learner into the context of building capacity to managed change takes learning beyond simply learning to undertake tasks that result in technical competence. The effective learner also knows how to learn (Schon, 1990) and how to critically evaluate the assumptions underpinning what is learned and how it is learned (Brookfield, 1987). The learner will be competent in addressing practical tasks, will know how to generalise from past experience to improve problematic situations not previously encountered, and be able to discern and critique strategic assumptions the learner and relevant others hold".

Therefore, capacity building seeks to take the learner beyond the learning task. A capacity building approach develops further competencies within the learner, in terms of increasing the level of questioning that a learner elicits from the task itself. Capacity building encourages the learner to approach a process critically, and take control and be active in the learning activity rather than simply accepting the information provided. A capacity building approach to extension, then, allows for a learning process that enables different levels of learning. For example, if a subject learns about a task as well as how other people act as learners in the same situation, they are better prepared to deal with the next problem that comes along.

Macadam *et al*. (2003) use the conceptual notion of communities of practice (Wenger, 2000) as a way of organising the players involved in the learning process. Communities of practice are defined by intangible boundaries that are created through shared practice and a social learning system (Wenger, 2000). Achieving social learning systems requires something to interact about, some intersection of interest, or some activity (Wenger, 2000). In the present context, an example of a community of practice could be at the level of a dairy discussion group or at an institutional level, depending on the context and purpose of the activity. In terms of capacity building, Macadam *et al.,* (2003:22) refers to "…all members of the relevant communities of practice are potentially responsible for and competent to build capacity". Capacity building is for the co-learning of the provider and the user, by bringing together different skills and attributes, and hence communities of practice are driven by different forces (Macadam *et al*., 2003).

Capacity building has been linked to the concept of the 'triple bottom line' as a way of focussing on the outcomes required from the RD&E sector. In recent years, the Australian Federal Government has emphasized a need to address rural and regional development initiatives in terms of the triple bottom line that accounts for the economic, social and environmental impacts of change (AFFA, 2001). For the Australian dairy industry, this means that the future of the industry will depend on RD&E's ability to develop farming systems that deliver adequate returns on the capital invested, and that also enhance or maintain the natural resource base and provide a rewarding lifestyle for dairy farmers (DRDC, 2002). This is a significant challenge and responsibility for dairy RD&E and has meant that significant reflection, rearrangement of practice and collective action has already occurred and continues to influence dairy farmlet operation and activity.

The changes and demands for new knowledge from RD&E are being felt throughout the world and as a result, different approaches are emerging. As summarised by Hervieu (2000:9):

> "The changes occurring in industrial societies compel us to reconsider the place and role of agricultural activities and turn our attention to the technical and organisational innovation processes underpinning these evolutions. Given the complexity of these issues and the diversity to stakeholders

> involved, we can no longer keep to the linear knowledge models that have been applied over the past half century: they have shown their limitations in the past".

To cope with change and improve farm business productivity, farmers need to learn new practices and enhance managerial competence (Gray, 2002). In light of this recognition, different perspectives on farming systems research and extension have been evolving through the 1990s. These focus on an understanding of the learning processes involved in effective extension and turning learning theory into practice. Learning is seen as central to improvements in agricultural systems and the ability of farmers to cope with change (Hubert *et al.*, 2000). The Australian dairy industry, through DA, over the last five years has sought to build the capacity of farmlets to deliver greater outcomes for the industry, encouraging farmlet teams to coordinate their activities and interact more effectively.

2.7 Changes to investment, infrastructure and resource allocation to dairy RD&E

Expenditure on dairy research development and extension in Australia has been tracked over three separate studies since the year 2000 (Juff and Oates, 2008). In 2008, Juff and Oates found there had been a 20% reduction in expenditure towards dairy RD&E since 1998-99. Total input into professional staffing had also declined to 703.1 full time equivalent (FTE) staff across the country, down from 892.6 FTE over the same time frame.

Significant shifts were also found to have occurred in the levels of funding from particular areas including substantial increases in funding by the larger dairy companies by 40%, particularly in the appointment of dairy company field staff which had increased by 17 FTEs since 1998/99. However, there had been decreases in funding by all State Departments of Agriculture, which is consistent with the decline in human resources for extension. The total number of extension FTEs in 2007 was 77.8 compared to 89.7 in 2002 (Juff and Oates, 2008).

Of the farm based dairy research centres with milking herds, several had ceased to operate since 2002, although some had been upgraded. No new R&D centres with a specific dairy farm focus had been established since 2002 (Juff and Oates, 2008).

The implications of such changes to the investment and resources directed towards dairy RD&E highlight significant issues. As pointed out by Juff and Oates (2008), the decline in State extension staff and the rise in dairy company field staff suggests a shift in the information resource, a change in the nature of relationships between information providers and support, also alternative motivations behind the relationship. Change in dairy research centres also represents a shift in regionalised information, forcing producers to depend on other centres that through regional differentiation may be perceived as less relevant. But overall, the disruption and dynamic nature of investment and resource allocation creates an additional need for adaptive capacity of relationships across researchers, extension practitioners and farmers.

2.8 Restructuring Australian dairy industry RD&E: a learning approach for farmlets

Section 2.7 highlighted changes that have accentuated the need to improve the use of farmlet facilities including: (1) a need to increase return on investment from RD&E; (2) the reduction and restructuring of government funding for extension; and (3) an overall requirement to adopt a triple bottom line perspective to systems (Crawford *et al*., 2002). Since 1999, there has been a targeted effort by DRDC and DA to review resource development and extension and to put in place strategies to improve the effectiveness of extension (McKenzie, 2001; Hayes *et al*., 1999). The outcome, in terms of dairy farming systems RD&E, was a series of workshops that initiated collective action on a national level.

An initial national three-day workshop in February 1999 defined what farmlets represent as an RD&E method and determined the farmlet role in such a program. At this workshop, a number of opportunities were identified for scientists, extension practitioners and funders to more effectively to drive greater outputs from farmlet projects. A second workshop (November, 1999) was then held to progress the opportunity, by developing a nationally coordinated network of farmlet projects (Paine, 1999). Expectations among participants at the workshops revealed that there was considerable ambiguity around the role, value and possibilities for using a farmlet approach. Participants also questioned the potential role of farmlet projects for communication purposes and as “centres of creativity and partnership learning” (Paine, 1999 unpublished).

Results from the workshops included the identification of themes that could link farmlet projects across the nation using a systems-based approach with a focus on learning outcomes. The workshop concluded that farmlets are most appropriate when research questions cannot be answered using lower cost component research studies. Box 3 presents a summary of the role that farmlet projects were fulfilling in Australian dairy RD&E.

Box 3. The role of farmlet projects in Australia as defined by industry stakeholders

The role of farmlets was to:

- provide a final evaluation step for research and a method for integrating research and development;
- develop research models and provide a process for validating decision support systems (DSS);
- be a risk taker for the farming community and demonstrate best practice farming systems;
- provide credibility and professional development for extension and research people; and
- provide a platform for action learning by researchers, extension officers and farmers.

(adapted from DRDC National Farmlets Workshop, Nov. 1999).

The most prominent outcome of the workshops, though, was a shared vision to integrate and coordinate a national effort into dairy farmlets. There was a commitment to maintain cross site linkages and teams that within themselves would ensure the processes of integration and coordination of farmlet activities at a national level. The key areas that required development for achieving these aims were reported by Paine as being (1999):

- Facilitation and coordination across the farmlets;
- Data management including: sharing across sites; database to facilitate sharing; and modelling to increase overall understanding;
- Themes to provide a basis for cross-site discussion; and
- Learning: within farmlets sites and teams: across the farmlets network and; from farmlets to the dairy industry.

The second prominent outcome from the workshops was the development of a concept of farmlets as “learning platforms” representing the emergence of a new focus on farmlets and the way they contribute to ongoing growth of the industry. This highlighted how little exploration or knowledge existed with regards to the learning processes and behaviour that occurs around farmlet RD&E projects. Anecdotally, RD&E players recognised that farmlets provide numerous learning opportunities across the continuum, beyond just the final outputs of the research project (Paine, 1997). As the industry relies on farmlet projects to deliver continuous innovations and management intervention, knowledge and understanding of how learning occurs around farmlets will give legitimacy and meaning to the concept.

2.9 Conclusion

It is important to consider the dynamic nature of the Australian dairy industry and the impact that volatile international market creates for individuals and activities operating to create the whole market system. Australia has considerable relative advantage in milk production, and an industry of players with the capacity to capitalise on this and make a living from the benefits despite the on-going cost price squeeze occurring.

However the dynamism and volatility created by the market place means that the goal posts are constantly on the move, uncertainty is a way of life for not only producers, but those organisations such as DA that are dependent on income from the industry to maintain their core activity. Dependency on a biological system creates further uncertainty, with inevitable shocks to the system such as drought becoming a primary focus for managing and staying in the game.

Learning and adaptation, then, and a capacity to utilise knowledge, shift practice, evolve and respond within a critical time frame, are fundamental traits for fostering the industry into the future. The challenge for RD&E structures that the dairy industry provides to support adaptation (i.e. farmlets), internally require such attributes, while at the same time supporting such processes externally in the changing environment. These attributes are primary contextual considerations, fundamental to the analysis and data collection process for this study.

Chapter 3 adds greater definition to the problem domain by exploring theoretical approaches for guiding and informing the methodology presented in Chapter 4.

Chapter 3 Theory to inform a study of farmlets as learning platforms

3.1 Introduction

The previous chapter reviewed the Australian dairy industry locating farmlets in the RD&E continuum. It examined of both the role of, and approach to, research and extension as a basis for ongoing adaptation to internal and external challenges faced by the dairy industry. With a shift in emphasis to a farming systems approach there has been industry recognition, embodied in the 'learning' concept, that traditional models of research as knowledge generation and extension as knowledge dissemination, is no longer adequate. That is, all players including both research providers and beneficiaries can benefit from a structure or focus that allows each group to learn from the other and from the environment in which they operate.

This chapter has two aims. Firstly, to lay foundations for clear definition of the key concepts that constitute the basis of the following chapters. Terms such as farming systems RD&E, adaptation, learning, and learning platforms are used interchangeably and in some cases as generic terms within the rhetoric of extension literature, with the assumption that the true meaning and use of these terms is understood. In actual fact, the context in which these concepts occur profoundly influences definitions.

The second aim is to develop a framework for studying farmlets as learning platforms by reviewing learning theories most likely to be useful to this research, particularly in relation to each of the research questions outlined at the end of Chapter Two. Four popular learning theories including experiential learning theory (ELT), social learning theory, situated learning and activity theory are explored to establish the various attributes that may provide some guidance to a study of learning platforms. Activity theory, because it has the broad capacity to study the full attributes of a social system in action, will be argued to provide the most value for studying farmlets as learning platforms and is therefore explored in considerable detail to reveal the elements of activity theory that have utility for this study. This chapter concludes with a summary of the key concepts, their relationships, and how activity theory will be used as the framework to inform the subsequent methodology.

3.1. Definitions

Definitions provide boundaries and outline the distinct fundamental elements of concepts. There is a plethora of ways to understand and interpret the key concepts that provide the foundations to this study. Four concepts are defined below namely 'farming systems research and extension', 'learning', 'adaptation', and 'learning platforms', to ensure there is clarity of usage as well as clear positioning within the literature and perspectives that have been drawn on.

3.1.1. Farming systems research and extension

A useful starting point for a discussion of farming systems research and extension is provided by Bawden:

> "The concept of farming systems research has evolved into an 'umbrella term' for a class of research approaches, rather than a descriptor for a particular research methodology. Used under diverse circumstances, it was not surprising that a wide variety of different concepts, approaches and research methods would be grouped under a farming systems research heading, leading to considerable confusion as to what it really meant. The variations among the different types of farming systems research activity are associated with matters such as the intentions of the researcher, the extent to which farmers themselves are involved, the level of innovativeness, and the extent to which researchers beyond agriculture are involved." (Bawden 1995:65)

There have been further contributions to a definition (eg. Collinson *et al*., 2000; Ison *et al*., 1997; Reid, 1996) but the idea that farming systems research uniquely combines the biophysical and socio-economic phenomena seen in dynamic enterprises in which change, both reactive and proactive, is a condition for survival (Dent and McGregor, 1994) is sufficient for the present discussion. As pointed out by Simmonds:

> "…turning towards studying the farm as a "system" was a substantial step forward from addressing only its technical or economic dimensions, towards capturing the tight interplay between the agro-technical, economic, sociological, managerial, and cultural variables intrinsic to the farm unit" Simmonds (1985:45).

The application of a systems approach brought a new way to scope research and extension projects, and a new level of complexity in terms of the incorporation of the human dimension within research and extension. This has been highlighted by Woodhill and Roling, (1998:57):

> "A perceived entity is named a system to reflect the emergent properties. In my perspective on systems thinking, systems are not real structures – they are intellectual constructs that help us to understand the complexity of human experience. An 'ecosystem' is the name we give to our perception of a complex set of relationships and interactions with nature, but an ecosystem as such does not exist. In other words, 'systems' do not exist independently of human processes of inquiry."

Key factors that differentiate farming systems approaches to conventional research projects can be extrapolated from Gibbons (1994:64). It is suggested that the first major difference is the requirement of researchers to develop a holistic perspective of the social, economic, and political environment of rural communities. Researchers and extension practitioners need to fully recognise and understand the farm, the household, and their unit of analysis within the system hierarchy. The farm household may not always be the most appropriate unit of analysis, whereas other areas of the hierarchy, such as the farming system or the entire catchment, may.

The second area is that farming systems research and extension requires the involvement of a multidisciplinary team containing both natural and social scientists for the process to be effective. Such teams are required to develop interdisciplinary analytical and operational approaches. Along with this, the process must enable participation of farmers to focus on the problems and situations that provide context to the farming systems research and extension process (Gibbon 1994). The 'farming systems' approach to research and extension assumes that farmers possess a great depth of knowledge and understanding of their farming systems (Reid, 1996). Making the most of this knowledge and incorporating it into research and extension is essential.

What constitutes farming systems research and extension and where to set the boundaries around a project makes the approach to research complex to clarify. It incorporates a number of interconnected dimensions, and it is a complex process of definition as recognised by Hart,

> "If concepts are generalisations, a conceptual framework is a set of interconnected generalisations. Agreeing on a conceptual framework is one of the most difficult aspects of interdisciplinary research, and farming systems research is no exception" (Hart, 2000:41)

Thirdly, to be effective, farming systems research and extension projects need to link to other scientific programmes which can support skills to solve particular problems within specific technical domains and to the extension agencies, planners and policy makers. As a result, the process for farming systems research and extension develops in a dynamic, flexible way and continually responds to changing circumstances in an iterative manner (Gibbon, 1994).

Farming systems research and extension can be considered alongside many of the other systemic approaches to research and extension that have been developed.

> "Farming systems research and extension is one string to the bow of systems thinking. Different strings are determined in terms of the use of the word system. In farming systems research, it refers to the system as being a noun,

> as opposed to a way of thinking about things i.e. systems thinking, systems learning" (Ison *et al.,* 1997: 262).

Other systems based methodologies and tools have been summarised by Ison et al., (1997:21). Systems thinking and soft systems methodology (SSM) (Checkland, 1981; Checkland and Scholes, 1990) have informed processes such as rapid appraisal of agricultural knowledge systems (RAAKS) (Engel and Saloman, 1994; 2002), systems learning or systemic action research (Bawden, 1995), second order R&D and participative ecodesign (Ison, 1993) and 'platforming' concepts (to be explored further in section 3.1.3) introduced by Roling (1994) and Jiggins (1996). Each of these is differentiated by a dominant view of how to perceive the elements of a system for analysis and intervention around a problem.

Located in close association with farming systems research and extension is the use of modelling as a desktop approach to farming systems studies. Modelling brings a holistic approach to the study of farming systems by focussing on the interactions between system components. Models can be used as research tools to push the boundaries of research questioning and increase understanding of the behaviour of the system. Wilson and Morren (1990:75) argue that models are used to amplify the human process of learning and, in the context of systems thinking and practice, have four practical uses:

- to communicate complex interrelationships in farming systems;
- to communicate concepts about the meaning of something;
- as a novel construct for the search for new insights about how a system might be, might work, or might behave; and
- as a test bed or simulation for the evaluation of alternative strategies.

Farming system research and extension approaches can be distinguished from a component-based traditional approach using the scientific method as the basis for research. These approaches have opened the door to more participative research and extension, and incorporate a focus on the entire system including on the impacts of purposeful action.

Farmlet research and extension reviewed in chapter two are characterised by having experimental plots that are large enough to simulate farming systems on a reduced scale. This allows the production system to be reduced to a more manageable size to enable monitoring and measurement of the system component interactions. It is the focus on the *production* system interactions that positions farmlets as an approach to farming systems RD&E. Component research projects are analysed within the context of the segment of the systems, and also for impacts on the system overall including economic implications as well as environmental. However farmlets do not embrace the complete nature of true farming systems research and extension, in terms of the multidisciplinary team normally employed for such a research approach. Farmlet teams are small, generally consisting of less than five research, extension and technical support members. As such, the multidisciplinarity is dependent on the skills, knowledge and experience (i.e. a researcher who had experience in economic analysis or environmental impact) held by individuals themselves. Restricted budgets prevent expansion of team membership and skills.

3.1.2. Learning

> "In a world that is changing and becoming more complexly interconnected at an accelerating pace, concerns about learning are certainly justified. More than learning itself though, it is our conception of learning that needs urgent attention when we choose to meddle with it on the scale on which we do today…. Although learning can be assumed to take place, modern societies have come to see it as a topic of concern - in all sorts of ways and for a host of different reasons. We develop national curriculums, ambitious corporate training programs, and complex schooling systems. We wish to cause learning, take charge of it, direct it, accelerate it, demand it, or simply stop getting in the way of it – in any case, we want to do something about it. Therefore our perspectives on learning matter and what we think about learning influences where we recognise learning as well as what we do when we decide that we must do something about it – as individuals, as communities and as organisations". (Wenger, 1998: 9).

As Wenger suggests, there has been an increase in research into learning, particularly in agriculture but also in the workplace, over the last 30 years (e.g. Roling, Jiggins, Wagemakers). Scarcity of resources allocated to learning has meant that there is a need to ensure that where learning and change is the objective, this is achieved through the process design. Only in recent times has it been recognised that the learning process needs to fit the desired outcome, as opposed to boldly assuming or unknowingly delivering a process with only limited capacity to facilitate learning and change.

There is a multiplicity of learning definitions making a definition of learning a fluid one depending on the context of an activity. Obvious differences in definition occur with what is deemed the learning interface or the place and resources around which learning is occurring. Learning may be represented as a process or an outcome, contextually driven, achieved collectively or on an individual level. This may mean the emphasis in a definition of learning includes change in knowledge, behavior, attitude, or practice, the experience, the process, the transformation, or the construction or affirmation of existing of knowledge.

According to Knowles (1990:5), learning involves change:

> "learning involves change. It is concerned with the acquisition of habits, knowledge and attitudes. It enables the individual to make both personal and social adjustments. Since the concept of change is inherent to the concept of learning, any change in behaviour implies that learning is taking place or has taken place. Learning that occurs during the process of change can be referred to as the learning process".

Harris and Schwahn (1961) also see learning as involving change and add that learning is an experience that includes a process with various influencing functions. They conclude that there is an end-point to the experience and process, with learning the product. But how is it that such an intangible and dynamic feature of human existence can be described so linearly with start and stop points? There are few who would not argue that we are learning all the time, in everything we do.

Opposing a static one dimensional view of learning are the experiential learning theorists such as Kolb (1984:47), who focus on experience as the process of lifelong learning, concluding that "…learning is the process whereby knowledge is created through the transformation of experience".

A common thread though all of these definitions is the reference to a process that leads to some modification of behaviour and practice, the reformation of thoughts, the deconstruction of old knowldege and the reconstruction of new knowledege. The meaning given to learning is dependent on whether the emphasis is on the process itself, or the outcome of the process. Workplace and adult learning principles, incorporating people's approach to learning in the workplace, how they view themselves as learners, their perceptions of their learning requirements, and their motivation to learn are pertinent in the present context. Learning here is defined as the process where a person uses knowledge and instinct to adapt a response to changing events and circumstances. This definition acknowledges the preceding definitions, however the emphasis is on dynamic nature of the adaptation processes people use to adjust and manage their practice. The outcome of learning is emergent. We can only predict around the original intent of the process what the outcome may be. Therefore knowledge and change may or may not emerge as a result of the adaptation process, or may emerge as something different to that intended or predicted.

3.1.3. Adaptation

Inherent in the concept of learning is adaptation. In the broadest sense of the concept, adaptation refers to adjustment and alternation of structure and or function, enabling survival, replication, and change for something (e.g. a technological innovation) to become better suited to a new situation. Within the context of agriculture for example, as the reality of climate change is being increasingly accepted, addressing the challenges of adaptation is receiving as much attention as is describing the likely impacts (Ash *et al.*, 2008).

Adaptation has, for better or worse, allowed for the evolution of Australian agricultural systems since European settlement in 1788. For farming systems, purposeful manipulation and adaptations to the landscape through land clearing, conversions of land use through availability of water and irrigation infrastructure innovations, artificial plant adaptation through breeding programs, and livestock productivity improvements through genetic selection, are a few of the most important adaptations that have had profound effects on what is farmed and the way it is farmed in various regions of the country. Drivers for these changes were desire for productivity and profitability gains (see Chapter 2 section 2.4). Now, incremental adaptation options often involve building on existing approaches to better manage climate variability and offset predicted impacts (Howden et al., 2007).

Prior to the adoption of technologies at the farm level, technologies and research results require adaptation by farmers to their specific set of physical, economic and social resources (Gracia *et al.*, 2007). The success of traditional research-extension models and farming systems RD&E models relies on the technical innovations and research results being relatively 'market ready', enabling fairly direct flows to users with little requirement for adaptation (Gracia *et al,*, 2007: 1025). A known requirement for this to occur is support for this adaptation, which in general is limited, because little attention is given to the decision making process surrounding technology use (Gracia *et al,*, 2007: 1026).

This demonstrates that the responsibility for the adaptation process firstly rests with the researcher to ensure the technology is presented in a form that is both adaptable and hence adoptable. Adaptation processes then rely on an advisor-farmer relationship, with the purpose of cooperation to improve the efficiency of farm management advice and to improve the adaptation of farm management to the increasing uncertainty which presently characterises the agricultural sector (Cerf, 1999:157). Nettle and Paine (2003) highlight that extension practitioners are under increasing pressure from RD&E investors to contribute to rural industry performance, improve adaptation and uptake of research results and technology, and facilitate the achievement of sustainable industry outcomes.

There has been an assumption that a certain level of adaptive capacity exists among producers, and an ability of extension practitioners to manage it. It is a highly complex array of relationships that requires considerable technical competence matched with the right physical and intellectual resources. Chapin *et al*. (2008:65) assert that adaptive capacity is the ability of a system to learn, cope, innovate and adapt, which in turn depends on natural and social capital and social-ecological linkages. They move on to argue that resilience can be considered an emergent property of adaptive capacity, which is the capacity of a system to absorb the shocks to which it is exposed and sustain its fundamental function, structure and identity. Resilient systems are capable of recovery and reorganisation in a new context (*ibid*.:65). Arguably the emergence of a resilient system could be regarded as the measure of a successful adaptation.

This discussion highlights the relationship between adaptation and the requirement to assess technological advancements in the context of the system under which it was developed and the system it will subsequently be used in. Adaptation, is a fundamental part of the activities and stakeholders within farming systems RD&E continuum, as well as implementation at the farm gate level, requiring the responsibility of managing this to be shared amongst the collective stakeholders. Ash *et al*. (2008) conclude that adapting to climate change is more than just a farm-level activity and that it will require close collaboration between the biophysical science, social science and economic research communities in tandem with industry and governmental policy makers. Fostering adaptive capacity is now recognised as a collective imperative to manage and implement technology innovations, the detail and models on *how* this can be achieved effectively are yet to be realised for the complex, multi-stakeholder agricultural RD&E environment.

3.1.4. Learning platforms

A ‘Learning Platforms’ is an intellectual construct that is a variation on other platform concepts that have been developed for natural resource management. In general, such platforms have been used in different contextual settings to describe a tangible structure, place, human framework or process that has a specific purpose or desired learning outcome. The term first emerged in a study of a social ecological system by Woodhill and Roling (1998) to describe an element of a holistic approach to environmental management. The role of the platform was to provide a framework for studying human versus environment interactions and the effect one has on the other.

> “A platform for decision making was formed with the aim to take into account the various interests (of players), provide opportunities for conflict resolution, and build consensus necessary for concerted action…..the management of the case is question was not only a question of bio-physical information and technical intervention. Managing the area was impossible without accommodation between various human actors who are dependent on the same natural environment but with differing purposes and interests. They are interdependent in that each affects the desired outcomes of the others”. (Woodhill and Roling, 1998:56).

In this particular context, the human dimension within the system plays an equal role with that of ecosystem management in the emergent platform. The platform is about a way of understanding the human interactions with the environment to generate a functional relationship to reach a resolution. The process central to the platform is that of informed decision making and social learning for action.

Roling and Jiggins (1998) used a construct of platforms for resource use negotiations, similar to that of Woodhill and Roling's (1998) 'platforms for decision making':

> "Platforms can be one time meetings, elected committees, formally appointed boards or councils or even government bodies. An important issue is the representation of key stakeholders in the resource, and the accountability to constituencies without bringing the platform to a total impasse of immobile positions. In fact negotiating from explicitly state interests, instead of from positions, is considered a condition for effective operation".

Both Roling and Jiggins (1998) and Woodhill and Roling (1998) have used platforms as a way to make a connection between the human and the natural elements that are being managed in natural resource systems. They use the platform concept to encompass processes to enable collections of perspectives or social interaction to be incorporated into an agreed appropriate action. Woodhill and Roling (1998) focus on the platform for informed decision making, whereas Roling and Jiggins (1998) emphasise the platform as being the collection of people and their perspectives into an entity for a common cause of action.

These concepts offer little to help to formulate a definition of learning platforms for this study other than a basic recognition that they are a place for stakeholders to learn from one another through interconnected relationships that formulate in a mutual social context. The most recent addition to the intellectual construction of platforms from Boxelaar (2005) does provide insights into important attributes for analysis when observing stakeholder convergence for capacity building projects focussed on sustainable land management. Boxelaar (2005) conceives the construct as a post-productivist platform for change, which as the name suggests, argues that the rationale behind stakeholder integration that occurred during the productivist post-war era is no longer relevant to the rationale behind collaboration of stakeholders today.

The post-productive platform for change articulated by Boxelaar (2005) takes into account the diversity of stakeholders and sites of integration that provides contextual basis to convergence. Such sites included a community, a problem or issue, a practice, material substrate or object, or landscape. Accounting for, and fostering and managing diversity is a fundamental element to be considered with a post-productive platform for change, with design criteria of the site of integration required to challenge and expand the prevailing communities of practice, and secondly to understand the site of integration in a constructivist way that simultaneously constructs and problematises convergence to enable indifferences to emerge, be expressed and embraced. Reflexive practice is crucial to the performance of the post-productive platform for change which is dependent on the use of facilitatory tools to aid such behaviour (Boxelaar, 2005).

Learning platforms seek to further understand the interdependencies between stakeholders (players of science, extension and farming) purposefully working together. In the dairy industry context then, the farmlet learning platform is an intellectual construction that aims to take into the process, activities, outputs and outcomes that the dairy RD&E continuum use to set joint objectives and share physical and intellectual resources to manage adaptation.

3.2 Research into learning in agriculture

Ambiguity and plurality in definitions of learning and adaptation make them difficult activities to study. There has been, however, some ground made within agriculture to understand learning processes using popular learning theories. Learning theorists argue that learning processes have to shift away from a static view of learning to one which is dynamic, particularly when considered in complex, uncertain environments (Hill *et al.*, 2002; Ahonen *et al.*, 2000; Paine, 1998). For the present study, the learning process itself, theories on types of learning and views on the farming systems subject matter all impact on any evaluation of learning in the dairy industry community and the effectiveness of farmlets as primary foci for learning.

Criteria from Wenger (1998) allow a summary of why learning around farmlets and the broader farming systems RD&E paradigm needs to be understood. Firstly (as concluded in chapter 2), it is no longer dealing with a simple question of how to improve production. The dairy industry needs are far more complex in terms of survival of the individual farming systems and indeed an entire industry. Secondly, there is a need to tackle these issues collectively by those who formulate the problems, those who are challenged by the problems and those who help to deal with them. Thirdly, there is little understanding about learning processes themselves in the context of farmlet projects.

Ison *et al.,* (2000) conclude that, for the purpose of R&D, it is possible to conceptualise the process of inquiry itself as if it were a learning system. Using the example of Checkland's (1999) soft systems methodology, Ison considered that this is now regarded by those who use the methodology, do so as an organised learning system. The methodology is concerned with taking purposeful action in human activity that is experienced as complex and problematical and the word 'system' is used to describe the process of inquiry for dealing with the world (Ison *et al*., 2000).

Ison *et al*., (2000) concluded that there is a diversity of theoretical frameworks for learning which can be called on to explain phenomena that are experienced, or to design learning systems for mutual benefit. Paine *et al*., (2000) uses a relevant learning theory framework as part of focus group and case study design. It concludes that the theory needed to emphasise the need for researchers to appreciate farmers' context:

> "We were attracted to some aspects in both these learning perspectives (situated learning theory and experiential learning theory). Experiential learning appealed because it made reflection and the handling of information an explicit component of the learning cycle [2]. 'Situated learning theory' stressed the importance of activity and appreciation of the local understanding of practitioners. We were also concerned about some aspects of each perspective. Experiential learning treats knowledge like a commodity, a discrete entity of know-how that accumulates through learning….We were also concerned that situated learning theory lacked specification of the learning process…".

Through such an approach to the research process, Paine *et al*. (2000), found two complementary research pathways in terms of learning and farming systems research - a co-dependency pursuit in advancing reproductive performance of the New Zealand dairy herd (Paine *et al*., 2000). In this case then, a learning framework added to the outcomes of the process, by accounting for both new learning on farming systems, and the learning processes involved.

Cornish (1998) refers to a learning system approach for farming systems RD&E, describing the system as a series of subsystems, which are linked functionally, in some cases through the flow of information obtained through the continuous monitoring of key system attributes. The fundamental concept underpinning this innovation system is that it is a learning process and that all participants are learners. Farmers, researchers and advisors pass together through recurrent cycles of monitoring, evaluation, planning and action (Cornish, 1998). This system is intended to lead to the development and adoption of sustainable and profitable

[2] The learning cycle is described by Kolb, 1984

technology underpinned by scientific understanding (Chataway, 2000). In each of these cases, the approach is geared towards channelling research and intervention in the production system into the context of learning and how best learning outcomes can be collectively achieved.

Studies from Ison (2000) and Cornish (1998) are examples of research that has revealed generic principles which require consideration when studying learning processes which are useful for a basic analysis. For a more rigorous analytical framework to study farmlet learning platforms, fundamental elements of true learning theory, that is, where model subject has been scrutinised and considered comprehensively and parsimoniously with clear relationships established, require reviewing. Given the context (as reviewed in Chapter 2) in which the framework will be used, theory will need to:

- account for individual and collective (social) learning processes;
- provide insight into the interactions of physical and intellectual resources[3] and how they contribute to learning and adaptation; and
- provide guidelines to inform the development of variables for studying the inter-relationships between natural and social phenomena that affect learning associated with farmlets.

Experiential learning theory, social learning and Cultural-Historical Activity theory are now explored for these attributes and specific application.

3.2.1 Experiential learning

Experiential learning theory focuses on the learner and emphasises that the central role of the learning process is experience. The theory is considered "a holistic integrative perspective on learning that combines experience, perception, cognition, and behaviour" (Kolb, 1984:21). It was developed from the life-long learning approaches of John Dewey (1958), action research and group dynamics of Kurt Lewin (1946) and the development of knowledge through experience Jean Piaget (1980). Later, the emphasis of the theory was on the role of experience in the process of learning alongside cognitive aspects of learning; namely acquisition, manipulation and recall of abstracts (Kolb, 1984).

Experiential learning theory provides a clear framework for approaches to learning which can be seen in Figure 5. Four modes of experiential learning are modelled: concrete experience

[3] Intellectual resources incorporates the existing knowledge, skills and understanding generated from experience of those involved in farmlet projects

(CE), reflective observation (RO), abstract conceptualisation (AC) and active experimentation (AE). For effective learning, participants need to involve themselves fully and openly in new experiences (CE), reflect on and observe these experiences from many perspectives (RO), create concepts that integrate their observations into sound theories (AC) and then use these theories to make decisions and solve problems (AE).

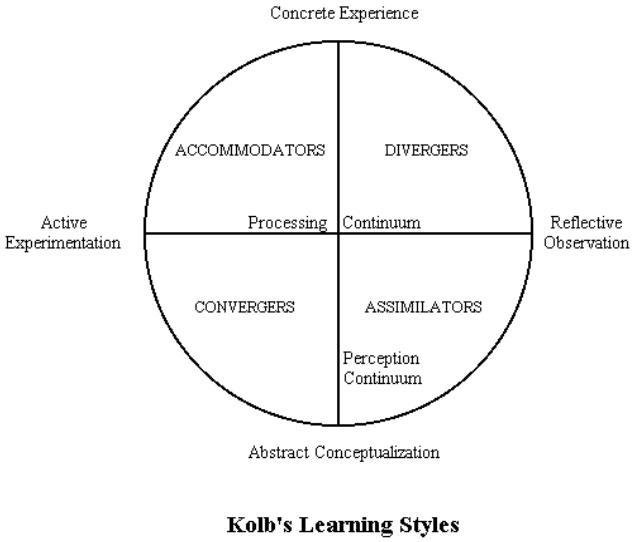


Figure 5. Kolb's learning styles. (Source: Litzinger and Osif, 1992:79)

Learning styles are central to experiential learning theory. Kolb (1984) described four different ways that learning can occur. Each means of learning begins with prehension of knowledge and finishes through a transformation process (Table 2). Knowledge that is apprehended through abstract conceptualisation and transformed by reflection is assimilative. Knowledge that is prehended by abstract conceptualisation and transformed by active experimentation is convergent. Knowledge that is apprehended by concrete experience and transformed by active experimentation is termed accommodative; and knowledge that is apprehended through concrete experience and transformed by reflection is termed divergent.

	Concrete experience	**Abstract conceptualisation**
Reflective observation	Diverger	Assimilator
Active experimentation	Accommodator	Convergers

Table 2. Summary of learning styles (adapted from Kolb, 1984)

Mezirow's (1990) explanation of transformative learning proved useful to Percy (2002), who studied the relationship between experiential learning theories and participatory technology development processes. It was argued that there are many parallels between experiential learning and participatory technology development (PTD) and the two were compared in the constructivist position of PTD and the positivist setting of conventional research and extension. PTD requires collaborative learning processes in which scientists, extensionists and farmers explore possible options and decide what to experiment on. The result is a collaborative process in which farmers and extensionists have shared responsibilities for the experiment and farmers and researchers reflect on the process and outcomes of the PTD and plan further cycles of experimentation. Percy concludes that experiential learning theory can explain the changes in perspective that need to take place in a shift from conventional research and extension to more participatory approaches. Extensionists, as adult educators, can facilitate the shift, which has implications for extensionists and scientists involved in research.

In the present study, the relevance of this theory to studying farmlets lies within the "learn by doing" concept, which fits well with conducting research at farmlets. However, farmlets in many of the regions have been there for years, and inevitably incorporate learning behaviour that is historically constructed. ELT focuses on the present learning process and does not make connection with past experiences and in so doing does not account for the learning task itself or motivations for learning.

3.2.2 Social learning theory

Social theory of learning assumes that learning is as much part of our human nature as is sleeping and eating, that it is life sustaining and inevitable. In essence, "learning is a fundamentally social phenomenon, reflecting our deeply social nature as human beings capable of knowing" (Wenger, 1998:7).

Woodhill and Roling (1998) provide a useful summary and application of social learning theory to agriculture. They consider social learning as an approach and philosophy that focuses on participatory processes of social change and is a concept, which gained prominence in the discourse on issues of the environment and development (Korten and Klauss, 1984; Milbrath, 1989; Weale, 1992) encompassing a belief in the potential for societal transformation based on Woodhill and Roling (1998: 53):

- critical self-reflection;
- the development of participatory multi-layered democratic processes;

- the reflexive capabilities of human individuals and societies; and
- the capacity for social movements to change political and economic frameworks for the better.

Wenger (1998) provided a focus for social learning theory in terms of learning as social participation. Participation in this case included being active participants in the practices of social communities and constructing identities in relation to these communities (Wenger, 1998:7). According to Wenger (1998), the four components necessary to characterise social participation as a process of learning and knowing are:

- Meaning in terms of changing ability;
- Practice in terms of ways to talk about sustaining mutual engagement in action;
- Community in terms of the social configurations in which our enterprises are defined and participation is recognizable competence; and
- Identity in terms of how learning can change who we are and creates personal histories.

Most recently, social learning has been associated with cognitive learning theory where players within a certain domain are referred to as cognitive agents and social learning described as a move from multiple to collective and distributed cognition (Roling, 2002). Multiple cognition captures the multiplicity of worldviews that different players have within a community. The aim of social learning is take multiple worldviews and transform them into shared views (collective cognition) or create complementarity between views for a common goal (ibid).

> "Cognition is driven by two processes. Coherence, which is the quality or state of cohering, especially a logical, orderly, and aesthetically consistent relationship of parts. The other is correspondence or the structural coupling between the agent and domain of existence" (Roling, 2002).

This accounts for the effects of environment, personal values/emotions, perceptions, theories and action, and the cohesion of these and the effect of the context in which a person is operating. This theoretical approach has been used as a way to manage extreme situations of interdependency between players within a community, where an environmental dilemma required social intervention (e.g. water quality issues in European countries).

Roling (2002:36) explains how individual players become interdependent, which is a process that can create an environment for social learning to occur.

> "Multiple cognitive agents tend to maintain their mutual isolation. But when they become interdependent e.g. with respect of a resource, they are likely to engage in conflict, work at cross-purposes, and engage in disjoint action. However when multiple perspectives are equally likely to grow into a joint rich picture, they can meet on platforms for land use negotiation, and decide on collective action. In this way, multiple cognition can grow into collective (emphasises the shared attributes i.e. shared myths or theories, shared values, and collective action) or distributed cognition (different but complimentary contributions that allow a concerted action e.g navigation of a battleship). Multiple cognitive agents can learn to act as a single cognitive agent capable of collective or concerted action. The interest is in how multiple cognitive agents can be facilitated in the direction of collective or distributed cognition".

The interdependence of players was considered by Roling (2002) as the driver for collective/distributed cognition or collective action. Interdependency between players, then, is what provides the motivation and incentive to learn to work together for a common goal under social learning theory.

Embedded within social learning theory is situated learning. Developed originally by Jean Lave, the theory posits that knowledge is contextually situated and fundamentally influenced by activity, context and culture (Lave, 1988), thus taking into account any given situation or activity that has been socially developed.

Evidence supports the view that farmer attitudes and behaviour cannot be adequately understood when separated from their practical context (Seppanen, 2004; Paine *et al.*, 1998; Paine, 1997). At the core of situated learning theory, is the notion that learning needs to occur within the framework in which the knowledge is to be utilised.

In the present context, social learning, provides a focus on the interdependencies that exist between players around farmlets. It allows for a focus on how players may learn for collective action, while providing their own worldview and experience and provides a process for re-establishing the adequacy of perceptions and sets an environment for perceptions to change. Situated learning theory acknowledges the role of social construction in the development of knowledge and the influence of the contextual environment on learning. However, while social learning theory relies heavily on the interaction of players, it does not accommodate different styles of learning that exist within and between groups of players. The theory lacks the incorporation of historical learning that builds an intellectual resource, but which may also create barriers to learning.

3.2.3 Cultural-Historical Activity Theory (CHAT)

Offering an alternative to these perspectives on learning is activity theory. Rejecting the notion that learning is purely an individual process, Cultural-Historical Activity theory (activity theory) has a capacity to provide explanation and analysis of the full social system and the process of learning.

Emerging from ideas of Georg Hegel and Immanuel Kant, as well as the theory of dialectical mechanical materialism developed by Karl Marx and Friedrich Engels, activity theory specifically evolved from the work of Lev Vygotsky, as he formulated a new method of studying consciousness and object orientated action mediated by cultural tools and signs (Vygotsky, 1978:40) . As summarised by Wertsch (1981: 134-35)"

> "For Marx and Engels, labour was the basic form of human activity… Their analysis stressed that in carrying out labour activity, humans do not simply transform nature: they themselves are also transformed in the process. The tools that are available at a particular stage in history reflect the level of labour activity. New types of instruments are needed to carry out the continually evolving new forms of labour activity. The other side of the dialectical coin is that each new level of tools or instruments gives rise to yet another round of ways of conceptualising and acting on the world. For Vygotsky, one of the main cornerstones of this psychology was the similarity between Marx's notion of how the tool or instrument mediates overt human labour activity and the semiotic notion of how sign systems mediate human social processes and thinking. In both cases the point is that instruments are not only used by humans to change the world but also transform and regulate humans in the process."

Leont'ev (1981) extended the theory through the addition of several features based on the need to separate individual action from collective action. The distinction between activity, action and operation was added to delineate an individual's behaviour from the collective activity system. Leont'ev provided an example using an individual and how they may have a number of reasons for reading a book: it might be to research something, to prepare for an exam or just for pleasure. Leont'ev points out that the nature of the activity is completely dependent on the goal of the activity in which an individual is engaged, and for this reason he argued that the concept of activity is necessarily connected with the concept of motive (Leont'ev, 1978: 62). Two people may be assigned the same task but the product of the task may be totally different depending on the perceived goal.

Engeström and Miettenin, (1999:4) summarised Leont'ev's relationships between collective and individual activity and the difference between actions, goals and objective.

> "The upper most level of collective activity is driven by an object related motive (objective); the middle level of individual or group action is driven by a

goal; and the bottom level of automatic operations is driven by the conditions and tools of action at hand."

With this came the addition of rules, community and the division of labour with the emergent model of the "activity system". This can be seen in Figure 6, where the subject refers to the individual or group whose point of view is taken in the analysis of the activity. The object (objective) is the summation of goal or target in the system. Instruments refer to the internal or external mediating tools that assist in achieving the objectives. Such tools or artefacts are described by Cole (1999:90) as "material objects that have been modified by human beings as a means of regulating their interactions with the world and each other. An important point is that artefacts carry with them successful adaptations of an earlier time and in this sense, combine the ideal and the material, such that in coming to adopt the artefacts provided by their culture, human beings simultaneously adopt the symbolic resources they embody".

The community is comprised of one or more people who share the objective with the subject. Rules regulate actions and interactions within the activity system. The division of labour describes how tasks are divided within the community.

The model of the human activity system presents a useful starting point to understanding a social system, raising questions about the dynamic situation and what lies within the relationships between the various system components. Activity theory as applied to agriculture has largely been used at the farm level of operations by Seppanen (2000, 2002, 2004) who found particular value in the theoretical concept of 'object' and its potential for seeing both the material and social aspects of the farming activity. Applying activity theory, theoretical interpretation, and offering tools for reflection contributed to understanding and development of organic farming systems (Seppanen, 2004:5).

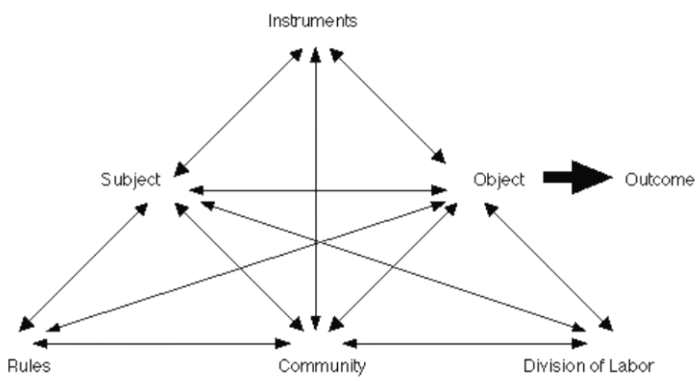


Figure 6. The human activity system (Source: Engeström, 1987: 78)

Limited studies in agriculture have been conducted using activity theory that explores the interplay of multiple activity systems. This has led for a call for a third generation of activity theory by the leading theorists (Engeström & Miettinen 1999, Hill and Botha, 2002, Seppanen, 2004). Hill *et al*., (2002) uses activity theory to analyse the learning behaviour of farmers in a study on the use of electronic tools as an aid to decision making. Here, the unit of analysis was the farmer's learning within the farm system and its relationship to both the meat processor and R&D organisation. It was concluded that activity theory can be used effectively when learning processes and tools are conceptualised in an activity theory framework. The relationship between the farmers, meat processors and R&D were described as loosely connected actors in an activity system. In this networked system the organisational learning that occurred in the project, barriers to learning and the implications for learning on farm are identified. Hill *et al.* also concluded that activity theory is an appropriate framework for identifying systemic issues between the activity of farmer suppliers, meat processors, R&D organisations and funding agency. Structured analysis of disturbances and problems in the actions of actors within the activity system are thought of as potential 'spring boards' for behavioural and organisational change.

Learning within an activity system is connected to the notion of transformation. Davydov (1999:42) succinctly describes from the point of view of formal logic, how the construction and use of various classification patterns by a person can be considered actions towards the transformation of objects, or cognitive activity. In order to study transformative process, Scribner (1985 cited in Engeström 1999:35) suggests 1) studying observation of contemporary/rudimentary behaviour; 2) reconstruction of the historical phases of cultural evolution of the behaviour; 3) experimental production of change from rudimentary to higher forms of behaviour; and 4) observation of actual development in naturally occurring behaviour. Fundamental to transformation is the concept initiated by Vygotsky called the zone of proximal development, which Engeström 1987:174 (cited by Tolman, 1999:75) summarises as "the distance between the everyday actions of individuals and the historically new form of the societal activity that can be collectively generated as a solution". Put simply, the zone is the gap between existing knowledge as historically developed and the new.

Engeström (2000) constructs a model of expansive learning that explains the process by which participants within an activity system deal with contradictions and reformulate an object. The model suggests that learning within an activity system occurs through problem solving leading to transgression, whether it be expansive and creative or acts to contract beliefs, knowledge, values or beliefs (Engeström, 1999). Seven steps comprise the model of expansive learning (Engeström, 2000:970) including:

1. Questioning of the accepted practice
2. Analysing the situation
3. Modelling the new solution
4. Examining the model
5. Reflection of and evaluation of the new model
6. Consolidation of the new model into a stable for of practice.

Expansion involves of the acquisition and assimilation of existing material or symbolic values such as commodities, business, power, influence and knowledge. Essentially, creative transgression entails the finding of solutions for new unconventional problems (*ibid*.).

Additional factors influencing transgression are perspective and culture. Perspective defines an individual's position and ability to recognise types of problems as conflicts or contradictions (Hundied, 1985, cited in Engeström, 1999). This state enables an interpretive position of the individual, which makes certain conclusions, judgements and insights plausible and evident or alternatively implausible and irrelevant (Engeström, 1999). This construct is similar to that of one's worldview (originating from the German term Weltanschauung), which is the overall perspective through which one sees and interprets the world and the collection of beliefs about life and the universe held by an individual or group (Checkland, 1981). Both concepts imply that one's original state (in values, belief and experience) will ultimately shape and direct the course of action and subsequent outcome of an activity.

Engeström (1999:10-11) advocates that true expansive transformation is always internal and external. Internalisation is related to the reproduction of culture; externalisation is creation of new artefacts and forms of activity. However, as Davydov (1999:42) points out, in many cases external transformation occurs without the internal transformation occurring.

> "Most frequently transformation is understood as changing the object. But careful examination shows that not every change is transformational. Many changes of natural and social reality carried out by people after the object externally without changing it internally. Such changes can hardly be called transformations. Transformation means changing an object internally, making evident its essence and altering it".

Further development of activity theory has seen the exploration of how networks of activity systems interact. Engeström and Miettinen (1999:8) argue that according to activity theory, any local activity resorts in some historically formed mediating artefacts, cultural resources that are common to society at large. Networks between activity systems provide for movement of artefacts, which are resources that can be combined, used and transformed in novel ways in local joint activity. Local, concrete activities therefore, are simultaneously unique and general, momentary and durable (*ibid.*). Connection of activity systems is considered the third generation of the model and requires further development (University of Helsinki, 2004) and debate to fully conceptualise the nature of the relationships between the variables of respective activity systems.

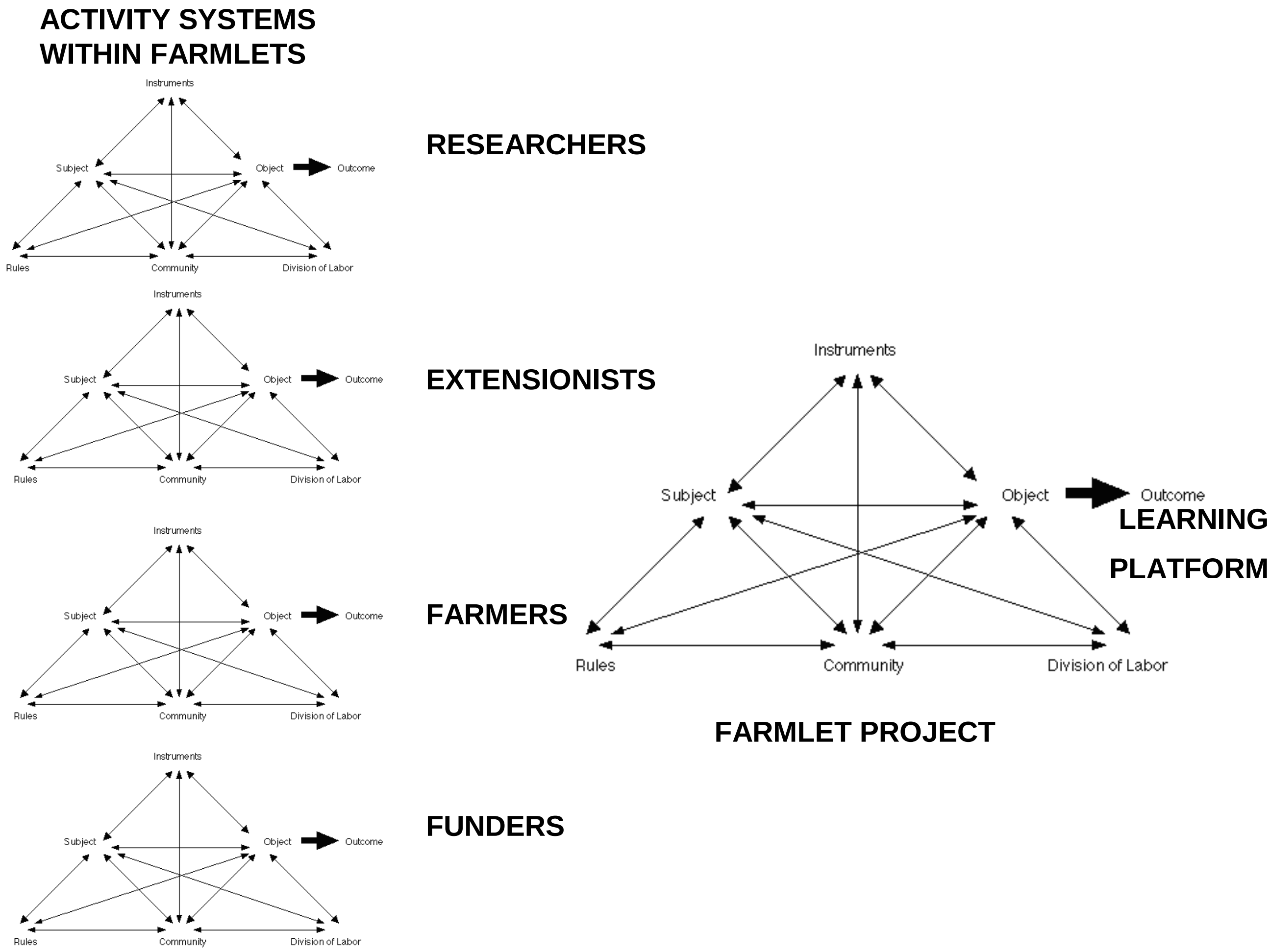


Figure 7. Framework for using CHAT and multiple activity systems to explore farmlets as learning platforms

A study of farmlets as learning platforms is well placed to make a contribution to the next generation of activity theory, by exploring how multiple activity systems connect around a joint object and work together as demonstrated in Figure 7. The model presented demonstrates four primary activity systems that purposefully converge to enable farmlet projects to function as an activity system. While represented as single systems, each of the individual systems contribute to the overall outcome of the farmlet project. Engeström and Miettinen (1999:9) proposal on how to analyse complex interactions forms the basis on how this framework is used, including observations on relationships and the constitutive elements of a system. Activity theory is a strong candidate to providing the units of analysis through the concepts within the activity system. The analysis will contain observations on the "internal tensions and contradictions of such a system are motive of change and development, accentuated by continuous transitions and transformations between the components of an activity system, and embedded hierarchical levels of collective motive driven activity, individual goal driven action, and automatic operations driven by the tools and conditions of action" (Leont'ev, 1978 cited in Engeström and Miettinen, 1999:9). This provides the key points of analysis for exploring farmlets as learning platforms.

3.3 Conclusion

This chapter has examined four interrelated concepts, farming systems RD&E, adaptation, learning and learning platforms, to provide meaningful definition to the study of farmlets as learning platforms. While farming systems RD&E provides the paradigm by which farmlets can be positioned, learning was defined to be a function of adaptation processes and adaptive capacity of both the system (physical resources), the individuals and groups of professionals (intellectual resources) within the activity of farmlet projects. Learning platforms is an intellectual construct that provides linkage across these concepts.

Perspectives and applications of learning theories enabled an examination of three perspectives, each providing alternative contributions for guiding a study on learning. ELT, while a comprehensive and sophisticated model of learning through experience, was found limiting by the predominance of individual learning being explained. Alternatively, while social learning theory offered an understanding of collective experience, it failed to elaborate how it is within a social system, how objectives are developed and influenced by actions, tools to mediate and facilitate meeting goals, and the roles of different stakeholders involved.

Cultural Historical Activity theory was concluded to be the most appropriate perspective to inform research on farmlets as learning platforms. Activity theory provides a framework by which one can logically deconstruct a social system brought together by an activity, to understand the validity and relationships of the individual parts that formulate the full activity system. This is critical, as the activity of farmlet projects brings together multiple but complementary stakeholders, interrelated objectives, tasks and tools. A framework highlighting the interaction of multiple activity systems was formulated as a tool to inform the research methodology, which will be presented in Chapter 4.

Chapter 4 METHOD FOR STUDYING FARMLETS AS LEARNING PLATFORMS

4.1 Introduction

This Chapter builds on Chapter 3 and provides a description of the method employed to study farmlets as learning platforms. Figure 4 provides a summary of the key elements to this Chapter. The aim is to describe the rationale for this qualitative research study, by firstly providing an argument for the epistemological position the research was built on. Methodological considerations require a grounded theory approach that incorporates the principles of participatory action research. Case studies are the method used, and participant observation and semi-structured interviews provide the major sources of data. Concluding the chapter is an outline of the constant comparative method used for data analysis, consistent with the principles of grounded theory and incorporating the framework outlined in Chapter 3.

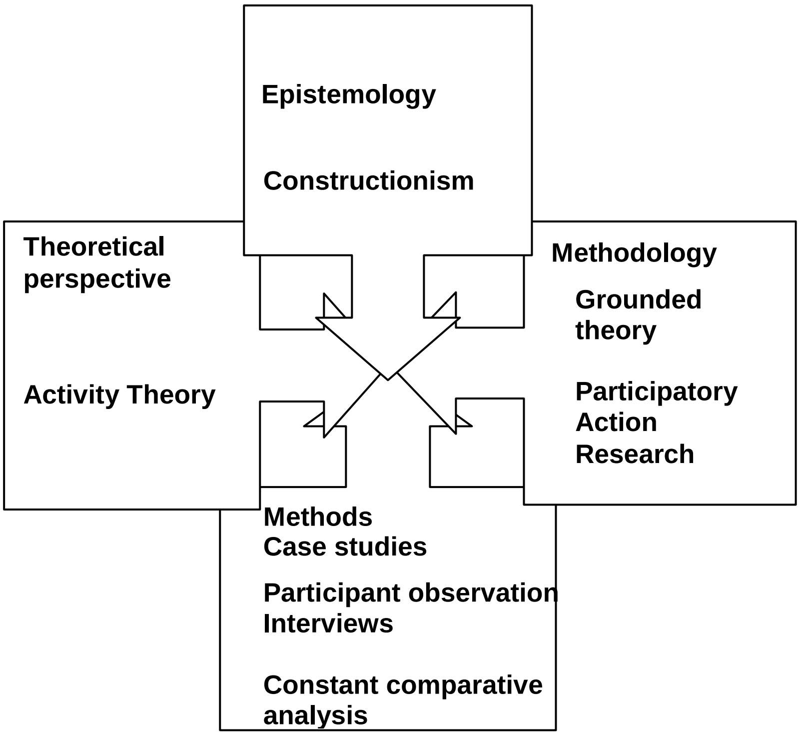


Figure 8.0 Research framework

As a starting point, though, based on the research questions and the contextual exploration of the problem domain provided in Chapters 2 and 3, the following criteria emerge for selection of methodology. The methods employed needed to:

- allow for studying learning environments, relationships and mechanisms in real time and real life context;
- allow establishment of constructed meaning that researchers, extension workers, farmers and investors give to farmlets;
- allow for learning to be analysed using events, activities and processes that brought the players of the RD&E continuum together;
- have the capacity to incorporate farmlet players own interpretations of their learning through the interaction with others;
- provide opportunities for generating trust and rapport with players, enabling critical, reliable dialogue for data collection; and
- provide the opportunity to engage those being studied to reflect and validate emergent concepts for their own learning.

These requirements have been used to guide the exploration of farmlets as learning platforms. Studying the process of learning poses a number of challenges to the research process. As outlined in Chapter 3, learning can occur through a number of means and from multiple sources. In true tradition, it is necessary to first provide a justification of how knowledge has been represented in this study through discussing the epistemological position used to underpin the research approach. Comparison is usually made between positivism versus constructionism. For the purpose of this thesis, the debate was formulated through analysing the two approaches from the context of farmlet research and extension projects. The constructionist approach is the most appropriate epistemological position as discussed further below.

4.2 Epistemology: positivism vs constructionism

This section argues why the constructionist position has been employed for this research. Both paradigms are described, and, focussing on the research domain, the merits of each position is discussed. Though there are various ways to argue an epistemological position, comparing and contrasting two polar paradigms has been chosen in this instance. The aim here is to demonstrate the requirements of the paradigm to adequately provide the foundations for addressing the questions that this research seeks to answer.

> “If we take in our hand any volume; of divinity or school metaphysics, for instance; let us ask, Does it contain any abstract reasoning concerning quantity or number? No. Does it contain any experimental reasoning concerning matter of fact and existence? No. Commit it then to the flames: for it can contain nothing but sophistry and illusion.” (Hume, 1875 cited in Hughes, 1980:20)

Here Hume lays out the very essence of the positivist philosophy. Typically, words that describe the philosophy are ‘quantity’, ‘experimental reasoning’ and ‘fact’. Positivistic research seeks to explain the empirical relationships between variables by showing they can be deduced from more abstract theoretical statements (Waters, 1994:4). The approach is often credited as originating with Comte, who felt that society could be studied and understood logically and rationally, and that sociology could be as scientific as biology and physics.

According to Giddens (1977:28), the positivist philosophy spans the perspectives that have made some, or all of the following claims. Firstly, reality consists essentially of what is available to the senses. Second, it is dependent on the findings of science, with an aversion to metaphysics as having any rightful place. Thirdly, as alluded to by Comte, the natural and social sciences share a common, logical and methodological foundation, though different procedures are required to study different subject matter. And fourthly, there is a fundamental distinction between fact and value, science dealing with the former while the latter represents an entirely different phenomenon beyond the scope of science.

Positivism, then, is of the view that all human qualities are beyond the reach of scientific understanding (Hughes, 1980). Only two forms of knowledge are recognised as having any legitimacy, the empirical (natural sciences) and the logical (mathematics). Ontologically, it is considered as being naive realism, in that research results are ‘real’ – there is a reality and it is apprehensible. The research is dualistic and objective and the methodology is experimental and manipulative. Research questions are posed in terms of a hypotheses that the research process aims to verify.

The value of positivistically orientated research has been demonstrated throughout the decades with the advancement of science, and is largely associated with quantitative empirical research. A positivist foundation for research requires the researcher to avoid being part of the research, being completely objective, not affecting the outcomes. Denzin and Lincoln (2001:243) describe a social convenience in positivism:

> …..“the positivist version of quantitative research is socially convenient for those in power who do not want to be the subjects of social research and who do not want criticism for their social actions to be brought forward in social research. Invoking impartially and objectivity, positivistic social science absents itself from the controverted social arenas in which the ills produced by bureaucracy, authoritarianism, and inequality are played out, or washes out this profile through the deployment of numbers and words”.

Horkheimer (1937 cited in Scott, 1995) describes positivism as advocating a dualism between the researcher and what is being researched. The researcher is detached throughout the research process, and there is no accounting for any connection between what is being controlled and the influence the researcher may have on the subject.

> "Positivism makes too sharp a separation between human knowledge of the social world and the actual social world of human interests and values itself. No separation is possible. Science is a social activity and knowledge is orientated by practical interests and concerns. The apparently detached and objective knowledge of the natural sciences was, in fact, oriented by a technical interest in controlling and manipulating the world, this model of science led to a focus of attention on the superficial, more controllable phenomena of social life and a failure to relate these surface features to their underlying and essential structures" Horkheimer (1937 cited in Scott, 1995:229)

To fit a classical positivist methodology, the empirical observations, events and patterns recorded for this project would have demonstrated connections, causal correlations, explanations and quantifiable models. even laws. Social reality would be regarded as made up of facts able to be observed independently as empirical patterns, regularities and irregularities. If the circumstantial connections can be charted between empirical variables then these, in themselves, may constitute an explanation.

In terms of the research questions posed in Chapter 2, such a positivist approach is too rigid and narrow and does not encompass the capability of dealing with individuals' interpretations and meanings. It also does not allow or acknowledge that as the study proceeds, there is a current and growing relationship between the researcher and the researched. Such a relationship is fundamental to this research process, enabling theory generation that is grounded in context.

In the Australian dairy farmlet projects, the most meaningful components of the social environment are the players themselves. The array spans scientists, extension workers, farm managers, farm workers, management committees, farmers and the regional community. The social dimensions combine a complex community with a matrix of world views, attitudes and beliefs, languages and knowledge systems, centred on the institutional structure of State government departments and the farmlet project. It is the presence and interaction of these social actors that gives research stations their purpose, goals and outcomes.

Considering the complex of community and cultural factors impacting on the overall learning outcome and the context of the study inevitably resulting in an increasing level of involvement, the objective positivist standpoint is considered to be inadequate for this research and a constructionist approach more useful.

> "Constructionism is in the view that all knowledge, and therefore all meaningful reality as such, is contingent upon human practices, being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context". Crotty, (1998:42).

The attributes of constructionism compared to positivism, as highlighted by Crotty, are that knowledge, meaning and indeed reality are constructed by humans not a discovered pre-existing entity. Constructionism assumes the relativism of multiple social realities, recognises the mutual creation of knowledge by the viewer and the viewed, and aims toward interpretive understandings of the subjects own meanings [Guba, 1994:145]. Constructionists picture people as carpenters trying to construct or restore the relational world in which they live (Griffin, 2000:110). The core assumption of constructionism is that "persons make sense of the world through systems of personal constructs" (Nicotera, 1995:52). Constructs are cognitive templates that fit over reality to bring order out of chaos (Griffin, 2000).They are contrasting features used to classify perceptions.

The constructivist strand in sociological theorising can be traced from theorists Georg Simmel and Max Weber, who offer broadly similar arguments that draw on the distinctions made in German philosophy between the natural and cultural sciences (Waters, 1994:7). They insist that human behaviour is fundamentally different from the behaviour of natural objects and humans are always agents in the active construction of social reality. That is, the way they act depends on the way in which they understand or give meaning to their behaviour. Sociological observers must interpret and give meaning to the meanings established by participants.

Constructionists believe that individuals already have an implicit theory of communication, which helps to interpret and shape the social environment. People make sense of the world through systems of personal constructs (Nicotera, 1995) and constructs are contrasting features that are used to classify perceptions (Delia, 2000:111). Interpretations of meanings, experiences, accounts, actions, and events can be developed into explanations and understandings and other analytical logics such as those used in positivist research make no sense because they exclude these observations.

Constructionism is not about conjuring up a series of meanings and imposing them onto the subject being studied. That would be referred to as subjectivism (Crotty, 1998). Meanings emerge from a personal interaction with the subject and relate to it essentially. The process was described by Crotty (1998:48):

> "…the meanings are thus once objective and subjective, their objectivity and subjectivity being indissolubly bound up with each other. Constructionism teaches us that meaning is always that".

There is a subtle distinction between constructionism or constructivism that is elaborated by Crotty, (1998:58):

> "Whatever the terminology, the distinction is an important one. Constructivism can point up the unique experience of each of us. It suggests that each one's way of making sense of the world is valid and worthy of respect as any other, thereby tending to scotch any hint of critical spirit. On the other hand, social constructionism emphasises the hold our culture has on us: it shapes the way we see things and gives us quite a definite view of the world".

Constructivism is committed to studying the world from the point of view of the interacting human being (Denzin and Lincoln, 2000) with "human being" taken literally as being in the world and the human and the natural are not separate entities. The subject and the object, distinguishable as they are, are always united (Crotty, 1998:45). Because of the essential relationship that human experience bears to its object, no object can be adequately described in isolation from the conscious being experiencing it, nor can experience be adequately described in isolation from its objects (ibid).

The principles of both constructivism and constructionism are complementary and aligned to the requirements of studying learning platforms. Both epistemologies allow for the multitude of socio-cultural attributes of farmlet teams as well as connecting individuals to their working environment. While the distinction warrants mention, the constructionist approach will be used as the basis to this study with acknowledgement that constructivism provides additional critical principles that require consideration.

While a constructionist approach is concluded to be appropriate for this study, this poses an interesting challenge and opportunity. Despite the typical epistemological debate that has been provided, my unique position is as a student who has shifted from agricultural science to rural social research or from the post positivist to constructivist world view. In struggling to be in either one or the other camps, this thesis crosses the boundaries of both. The way in which this thesis has been formatted in a linear progression of chapters demonstrates a clear linkage to the post positivist roots of my education. Also considering the study environment, working with researchers and extension practitioners, their experience and training has developed and emerged from post-positivist [4] principles and approaches. Sometimes they have little understanding or appreciation of constructionism, that would have helped me to provide justification and legitimacy for this social research. The challenge meant that the research explanation and legitimacy of the research approach required careful composition at the commencement of research relationships with stakeholders. The opportunity was to try to foster learning and appreciation of alternative research approaches within farmlet teams, through participatory action research, dealt with in the following sections.

4.3 Methodology: Grounded theory

Grounded theory methods developed by Barney Glaser and Anslem Strauss are complementary to constructionist epistemology and cultural historical activity theory. The position of theory generation in sociology as described by (Glaser, 1971) has a number of parts: to enable prediction and explanation of behaviour; to be useful in the theoretical advance in sociology; to be useable in practical applications – thus, prediction and explanation should be able to give the practitioner understanding and some control of situations; and to provide a perspective on behaviour - a stance to be taken towards data and to guide and provide style for research on particular areas of behaviour.

Grounded theory consists of systematic, inductive guidelines for collecting and analysing data through coding and generating theoretical frameworks. Throughout the research process, grounded theorists develop analytical interpretations of their data to focus further data collection, which in turn is used to inform and refine their developing theoretical analysis (Charmaz, 2000: 509), a process described as the constant comparative method. The method uses data gathered in a number of different forms (eg. interview transcripts, field notes and historical documents) collected typically using interviews, workshops, focus groups and participant observation.

The power of grounded theory and constant comparison lies in its capacity to generate an understanding of empirical worlds (Charmaz, 2000: 510). Glaser (1971), describes two

[4] Post-positivism is the modern version of positivism. While the underlying principles of positivism still apply in post-positivism, a more critical and less rigid use of the rules apply. It is termed critical realism in that 'real' reality exists but only imperfectly and probabilistically apprehendable. The evolution of positivism into post-positivism saw modifications in experimental designs and falsification of the hypothesis.

grounded theory types: substantive or formal. Substantive theory is generated through comparative analysis between or among groups within the same substantive area. Formal theory generated through the comparative analysis is made among different kinds of substantive cases, which fall within the formal area, without relating them to any one substantive area.

Grounded theory begins with the data source, and open questioning of events. The process of refining the questioning and coding (see Section 4) of data eventually leads to the development of conceptual linkages (Figure 9). The constant comparative method involves continuous searching, returning to the original data and conducting repetitive comparisons. Memo writing is used throughout the process, to record concepts as they emerge. The memos are used at each stage of the conceptual analyses and when saturation occurs (i.e. no new concepts emerge), the concepts are integrated into a theoretical framework.

The theory that eventually emerges is grounded from the constant comparative process. Thus the hypotheses and concepts not only come from the data but are systematically worked through during the course of the research (Glaser and Strauss, 1967).

Glaser's position on grounded theory remained that data should be gathered without forcing either preconceived questions or frameworks upon it. Whereas, according to Glaser (1992), a Straussian methodology of grounded theory evolved to be dependent on deductive preconceptions which forces data to fit preconceived ideas.

Despite the conflicting directions adopted by Glaser and Strauss, their epistemological positions remain guided by the principles of positivism (Guba and Lincoln, 1994 cited in Charmaz, 2001:510). However, according to Charmaz (2001:510)

> "A constructivist approach to grounded theory reaffirms studying people in their natural settings and redirects qualitative research away from positivism. Grounded theory strategies need not be rigid or prescriptive; a focus on meaning while using grounded theory furthers rather than limits interpretive understanding and; we can adopt grounded theory strategies without embracing the positivist leanings of the earlier proponents of grounded theory".

The rigour of the grounded theory approach offers qualitative researchers a clear set of guidelines from which to build explanatory frameworks that specify relationships among concepts (Charmaz, 2001:510). Grounded theory methods do not detail data collection techniques; they move each step of the analytical process toward the development, refinement and interrelation of concepts (Charmaz, 2001: 510).

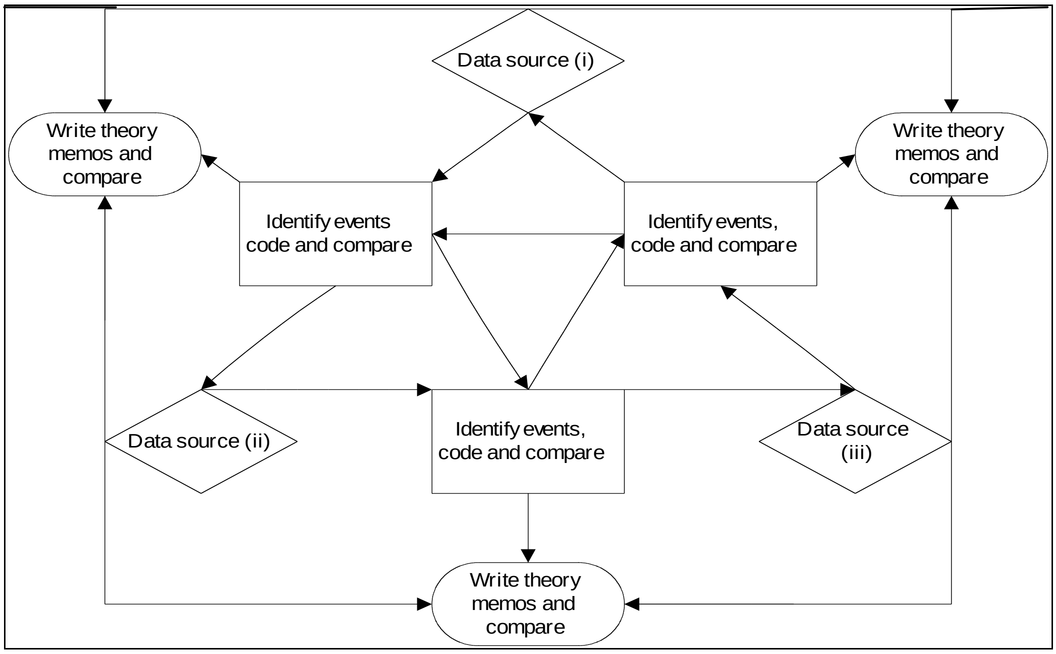


Figure 9. Constant comparative method used in grounded theory

A constructivist approach to grounded theory has been taken for this study, firstly due to the nature of the problem domain. Little is known about the substantive area of farmlet learning platforms and starting with a 'clean theoretical slate' will allow theory to emerge without preconceived ideas. Secondly, the methodology for this project needed to have flexibility and not require detailed data collection techniques, rather allowing for an emergent process where each stage of the analytical process moved towards the development, refinement and interrelation of concepts. Thirdly, the methodology needed to account for an interactive research process with the researcher being part of what was being observed rather than separate from it. And finally, constructivist grounded theory remains open to refinement and accounts for social reality being dependent on human action. This means that this project is the starting point for developing the conceptual construct of farmlet learning platforms and studying how the RD&E continuum work and learn together.

4.4 Participatory action research

The process of Participatory Action Research (PAR) offers a way to conduct a qualitative research project that has mutually beneficial outcomes for both the researcher and the participants. It provides a useful framework that is complementary to the constant comparative methods employed within a grounded theory approach, with the continual phases of reflection and taking stock of where you have go to with your research, at incremental stages.

Participatory research has become increasingly accepted since its popularisation in the 1970s, as a methodology for improving the outcomes and relevance of development and poverty reduction projects and assisting the poor to improve their situation within their own context (Okali, Sumberg & Farrington 1994). Action research is a methodology that has the dual aims of bringing about change in a community, organisation or program and to increase understanding for social action on the part of the researcher and the participants. Participatory action research (PAR) is a field of the action research concept, and it emphasises the participation of stakeholders relevant to the research domain.

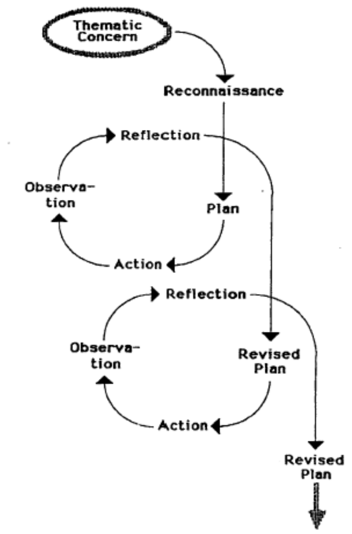
Central to the practice of PAR is involvement in a spiral of self-reflective cycles of (Kemmis and McTaggart, 2000:595)

i) planning a change;
ii) acting and observing the process and the consequences of the change;
i) reflecting on these processes and the consequences, and then;
ii) replanning, acting, observing and reflecting.

A diagrammatical representation of this process is provided in Figure 10.

The process outlined by Kemmis and McTaggert aims to provide a rich learning experience for all participants involved and McTaggert (1997:79) describes the approach as being:

- an approach to improving social practice by changing it;
- contingent on authentic participation;
- collaborative;
- one that establishes self-critical communities;
- a systemic learning process;
- one that involves people theorising about their practices;
- requires that people put their practices, ideas and assumptions about institutions to the test
- one that involves keeping records;
- one that requires participants to objectify their own experience;
- a political process;
- one that involves making critical analyses;
- starts with small cycles and small groups; and,
- allows participants to build records.



Kemmis, S. & McTaggert, R. (1988). *The action research planner (3rd ed)*. Victoria, Australia: Deakin University Press.

Figure 10. The action research spiral

Action research can be regarded as a research paradigm, which subsumes a variety of approaches. Within it there are several established methodologies that may be employed instead of PAR, (e.g. Revan's (1980) approach to action learning, Checkland's (1981) soft systems analysis, or Argyris' (1985) action science). Kemmis and McTaggert (2000:570-571) provide some insight into these alternative approaches and their applications. Action learning has generally been employed in the public sector whereby organisations seeking to emulate what are perceived to be successful collaborative business management practices. 'Soft systems' approaches have their origins in organisations that used 'hard' systems of engineering for industrial production. 'Soft systems' methodology is the human systems analogy for systems engineering. It has developed as a science of product and information flow. Action science emphasises the study of practice in organisational settings as a source of new understanding and improvements. The field of action science systematically builds the relationship between organisational psychology and the practical problems experienced in organisations.

These alternatives to action research are largely focussed on creating action for organisational management and change, whereas the PAR process is more individually focused, providing a clear path for research that empowers participants and sets in place learning processes for all involved. For the present study, it offered player ownership of the both the project and directions for current and future action on Australian dairy farmlet research and extension projects.

While PAR is appropriately aligned with the constructionism epistemology and grounded theory approaches to qualitative research, it is now pertinent to elaborate on the pragmatic aspects of the research approach, that is on how data was collected and arranged for analysis. The method employed was case study research, which is now described.

4.5 Case study research

The framework for this research was case studies. The use of case studies was based on the need for a method that allowed for the collection of contextual information; the research to be exploratory; and to gather data that is about action, behaviour and past experience.

The research required a method of empirical enquiry that allowed for the study to be conducted within its real-life context, especially when the boundaries between phenomenon and context were not clearly evident (Yin, 1994). Yin (1994: 68), described case study research as follows:

> "…the case study method is used because the researcher wanted to cover contextual conditions, believing that they may be highly pertinent to the phenomenon of study".

Murray and Butler (1994) argue that the use of case studies in agriculture can develop a better understanding of constraints, innovations and human interactions in various production systems. In general, Yin (1994) suggests that case studies are the preferred strategy when 'how' or 'why' questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real life context. In case study research, all cases are necessarily contextualised and generalisations made from case studies must therefore be qualified.

Despite case studies being a distinctive form of empirical inquiry, many research investigators have disdain for the strategy (Yin, 1994). The greatest concern is the potential for case studies to lack rigour, a concern from past investigations where equivocal evidence or biased views have influenced the direction of the findings and conclusions (Yin, 1994). Paine (1997) notes that some critics claim case studies provide little basis for scientific generalisation and are not sufficiently explained to be valued as quality items of science. He suggests that case studies can be defended against these criticisms when all evidence is fairly reported, and researchers and their audience share a grasp of the research logic. Mitchell (1983) also argues against the criticism and concludes that case studies are a reliable and respectable procedure for social analysis.

Triangulation is a method for ensuring rigour within a research process using case studies through collecting and analysing multiple sources of evidence. Case study enquiry relies on multiple sources of evidence, with data needing to converge in a triangulating fashion (Yin, 1994).The use of multiple sources of evidence (i.e. multiple measures of the same phenomenon) allows for the development of converging lines of inquiry, thus any finding or conclusion is likely to be more convincing and accurate if it is based on several different sources of information (Yin, 1994). Construct validity, or establishing the correct operational measures for the concepts being studied, is also derived from case studies.

Construct validity and triangulation were used to ensure this case study research is rigorous and valid. The use of multiple measures of the problem domain were used including the following:

i. the creation of a dialectic was achieved through the use of different informants within farmlet projects including researchers, extension practitioners, farmers, investors and members of the NDFS team;
ii. studying different research settings across farmlet projects; and
iii. collecting data from members of the RD&E continuum at different times at regular intervals.

This research was conducted within the boundaries of four major case studies created using sub-case studies. In light of the problem domain established in Chapter 2, criteria were developed to determine the necessary attributes of further case studies for studying farmlets as learning platforms. The case studies were required to:

1. be representative of the farming systems research and extension activity in the Australian dairy industry;
2. provide a means for studying the requirements and opportunities for learning from Australian dairy farmlets;
3. to provide a way for studying how learning was represented;
4. allow for the tracking of learning processes involved within dairy farming systems projects;
5. have boundaries and a clear path for study;
6. encompass and identify different ways that learning is viewed and achieved by stakeholders; and
7. provide a way to establish learning opportunities from Australian dairy farming systems RD&E projects.

To meet these criteria, case studies located in the Australian dairy farmlet research and extension RD&E continuum were constructed. Two major case studies were developed at the regional and national level and each contained a series of activities and practices which enabled chronological recording and tracking of learning processes, and the establishment of learning requirements.

4.5.1 Regional dairy farmlet research and extension projects

The first case study examined the learning processes within Australian dairy farming systems RD&E projects. This was constructed around four farmlet research and extension projects located in four dairying regions (see Figure 11).

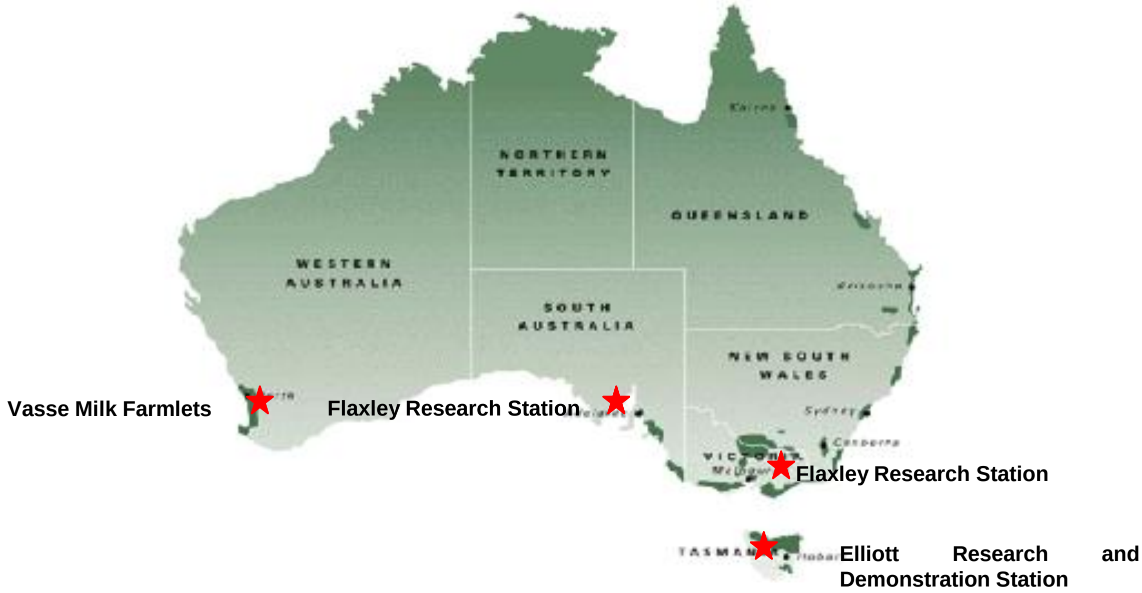


Figure 11. The project locations: case study farmlets around Australia
Source: Australian Dairy Corporation 2000

The selection of these four farmlet sites from the seven dairy farming systems projects around Australia was based firstly, on the level of resources allocated to extension. As extension is the assumed provider of learning processes and extension resourcing is highly variable between farmlet projects, cases were chosen from both ends of the resource spectrum to establish the effect this has on the learning platform.

Secondly, institutional and operational models vary from State government controlled operation, to farmer cooperatives. Consequently each of the farmlet projects included in the case study has a different institutional model. Thirdly, the location of the farmlet projects was also an important factor. As discussed in Chapter 2, the spatial separation of farmlet projects

means that on a regional level, farmlets face different challenges. Farmlets in four different regions were selected to ensure that potential regional affects were included.
The key attributes of the four selected sites as described in the following sections:

4.6.1.1 Elliott Research and Demonstration Station (ERDS)

ERDS is one of the oldest operating dairy research facilities in Australia, commencing dairy research in the early 1980s. The research station is located on the north-west coast of Tasmania, the major dairying region in the State. In 2001, ERDS finished its farmlet project and at the time of the study was in the process of building a new farmlet project for the site. The development phase provided an opportunity to track the learning processes involved at this stage of the development and also corresponded with an examination of the farmlet for RD&E and discussion of alternative farming systems approaches.

The other key attribute of this case was the relatively large extension capacity and financial resources that were provided by the State government of Tasmania to the dairy industry.

4.6.2.2 Flaxley Research Farm (FF)

Complementary, but polar to the attributes of ERDS project is the FF case study. It commenced dairy research in the early 1990s and is located approximately 100km south-east of Adelaide. This farmlet had completed a year of data collection on the new farmlet project, and, learning processes within an operating farmlet project could be observed for the final two years of the planned project. Just prior to the commencement of the present study, the South Australian government had withdrawn all funding and resources allocated to dairy extension. This left the farmlet project operating without an extension arm, providing the basis for a study of how farmlets act as a learning platform when government extension resources are limited and largely dependent on private providers.

Within the farm management group there was significant controversy over its role in the farmlet project arising from expectations developed in earlier projects. The farmlet is also located in a region with declining dairy activity and a four hour drive from an area with a rapidly expanding dairy industry.

4.6.2.3 Vasse Research Station (VMF)

The Vasse Milk Farmlets (VMF) began the farmlet project used for the present study in 2000. VMF is located approximately 200km south of Perth. The Vasse Milk Farmlet project was chosen as it was a first farmlet project for the region and for all of the players involved.

There was also a change in State government extension policy and personnel during the course of the study.

4.6.2.4 Macalister Research Farm (MRF)

Located in the east Gippsland region of Victoria, MRF has a long history of dairy research, dating from the 1960s. This research farm was a cooperative of 232 dairy farmer shareholders. At the time of the present study, a farmlet project studying stocking rate and grain feeding systems was in its first year of operation. The site was managed by a project manager responsible for both research and extension activities

4.8 Data collection

Three key methods were used to collect qualitative data for the two major case studies. These were semi-structured interviews, participant observation and secondary data analysis. Table 3 shows the methods used for the case studies and Figure 12 outlines the overall process and timetable.

Methods
One to one semi structured interviews
Unstructured interviews
Participant observation
Secondary analysis
Snowballing

Table 3 Summary of methods employed

The majority of data was collected through a series of semi- structured interviews. Murray and Butler (1994) suggested that interviews offer a way to understand and interpret how people see a particular situation or idea. The process involves collaborative learning through exchange of information and perspectives, which can generate information and insights that may not emerge from individual interviews.

To maximise learning, interviews were conducted through a deliberate and intentional process. Interviewees were identified through the process of ‘snowball sampling’ (Mason, 1996:103; Berg, 1989:60; Babbie, 1995:287). This entailed contacting a key informant from the farmlet location and firstly interviewing them, and then asking their advice of who should be interviewed next.

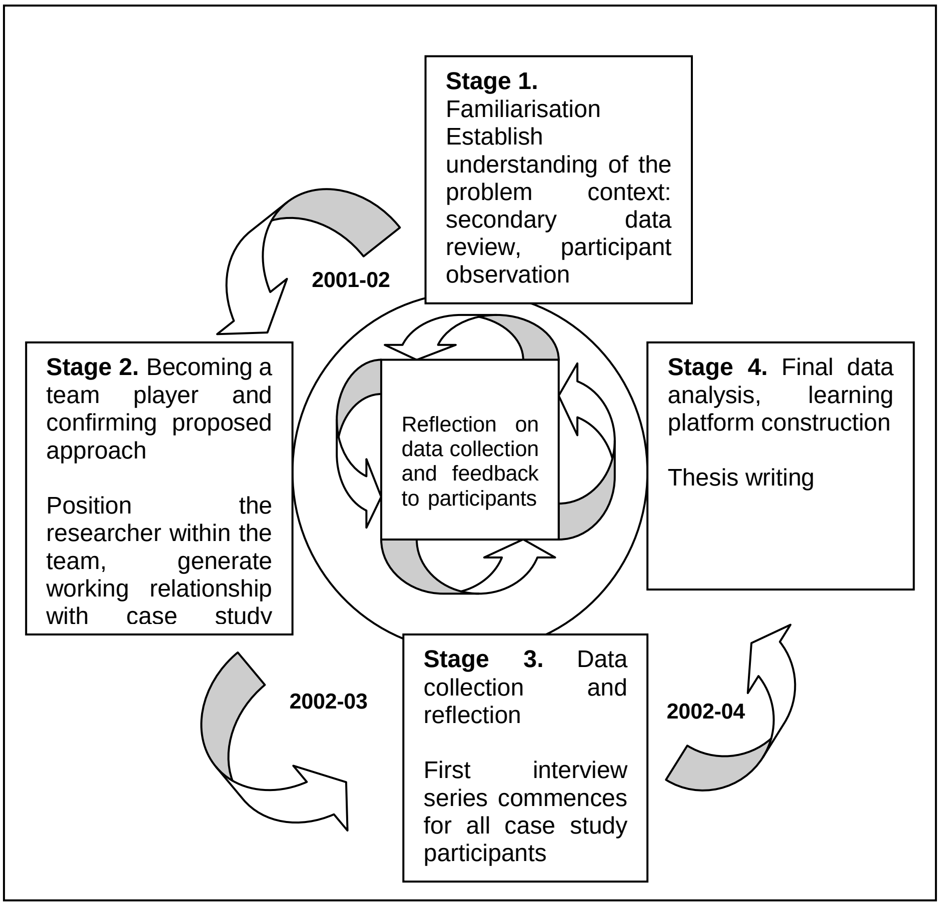


Figure 12 Data collection process and timeline

All potential interviewees were sent a letter describing the project objectives and why they had been approached. The letter invited their participation, and was followed up with a phone call to answer any questions about the project or process, and to confirm their participation. All interviews were conducted at either the interviewees place of work or their home, at a time that was specified by them. The researcher either travelled to the location or a phone interview was carried out. If requested by the interviewee, questions giving a framework for discussion were provided prior to interview.

At commencement of interview, the interviewee was asked for their written consent and also whether they were happy for the interview to be taped. Participants were able to review a copy of their transcript for accuracy and to delete any quotes they did not wish to enter into the data set. The series of interviews for each case study continued until it was deemed that no new knowledge or information was being general.

	ERDS	MRF	VMF	FF	NDFS	DMOD
Interviews						
Researchers	8	8	8	8	8	8
Extension practitioners	8	8	6	6	6	5
Farmers	8	8	8	8	6	0
Investors	2	2	2	2	2	2
NDFS team	2	2	2	2	5	2

Table 4 Semi structured interviews conducted

A total of 152 interviews were conducted with 39 participants. Table 4 shows how these interviews were divided between each of the case studies.

4.8.1 Participant observation

The researcher attended the majority of formally arranged events that were held as part of the farmlet and national projects during the data collection period of 2001-2003. Through participating in farmlet and NDFS team activities, the action learning cycle was initiated. Data was collected using the framework presented in Table 5, with typed transcripts of the group activity recorded. The aim of the framework was to provide a checklist to create a record of the group dynamics, levels of participation and dialogue generated by individual participants. These notes were also retained by the NDFS team as a record of events. Transcripts were entered into the data analysis tool NVivo and thematically coded. All transcripts were reviewed after the event and follow up questions were put into interview schedules for follow up with participants after events.

Observation checklist for events, meetings and workshops
Demographics of participants • List of professions and number of each e.g. researchers, extension practitioners, investors, dairy farmers • Age range • Gender
Workshop process • Objectives and purpose of the event • How participants were engaged • Content of presentations, format • Overall learning environment – room attributes, positive/negative vibe • Evaluation process and were the objectives of the day achieved – how did activities during the day deliver on the objective, what were participants public reaction to the day • Linkage/relationship of the activity to others
Participation • Comments, dialogue content and questions generated – who said what • Who were the dominant participants? • Who had limited participation?

Table 5. Framework used for participant observation data collection

4.8.2 Secondary data analysis

Data were also obtained from reports and related outputs from the farmlet and national projects. Of particular interest and useful in the triangulation process were milestone reports for each project. These provided regular updates of project progress and highlighted emergent learnings over time. A complete list of all reports collected and analysed is within the list of references.

4.8.3 Data analysis

All documents generated including transcripts, memos, reports and historical documents were analysed using constant comparative analysis, consistent with that of grounded theory. Using QSR's NVivo™ Version 1.3 (Richards, 2002) qualitative data analysis software, data was stored and sorted by topic before creating and developing abstractions. After each data collection activity, there was an assessment of relevance, where people were positioned in the farmlet and/or NDFS project, and ongoing refinement of the research questions. Themes that emerged from the data were constantly retained in memos and analysed collectively to establish gaps in the results and areas where further data collection was required. Figure 13 shows the process of coding and thematic analysis implemented.

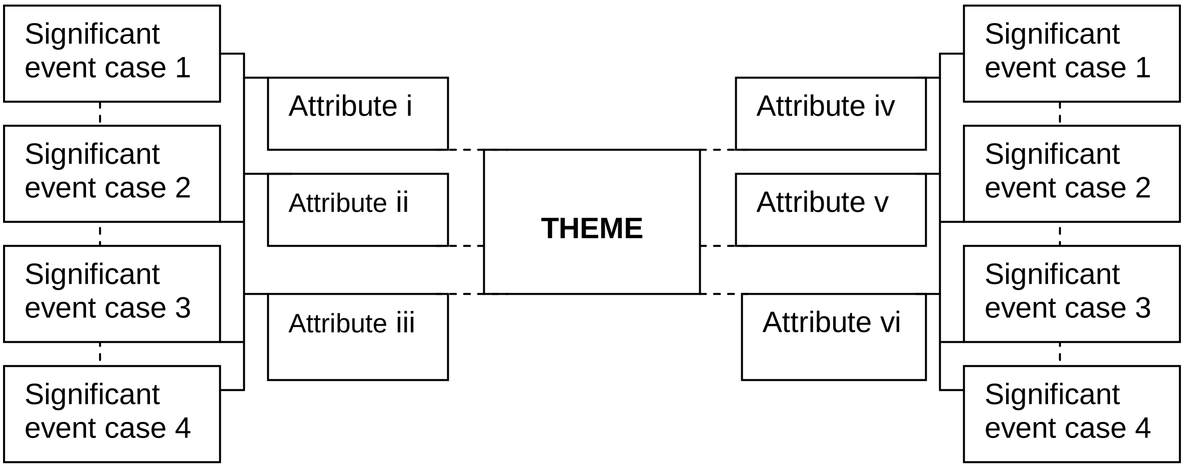


Figure 13 Thematic analysis process

Evidence around themes continued to be collected to search for alternative positions that were contrary to the original theme. Constant comparative analysis was used to build the theme attributes and explore additional dimensions. Data collection and analysis ceased once all dimensions had been found and exhausted. Confirmation that all dimensions were found was achieved once the same themes kept emerging from the data. Further detail on the thematic analysis for each of the case studies is provided as a roadmap at the commencement of the Chapter.

Finally a more in-depth analysis of the data was achieved through studying the intervening factors around learning behaviour and processes that varied between farmlets and the two projects in the national dairy farming systems. The primary focus was to establish attributes of learning that emerged as a result of the interactions and relationships formulated throughout the significant events where data was being collected for this study. Emergent concepts from this analysis were established by using the model and definition of learning introduced in Chapter 3, where each concept was analysed in terms of how it contributed to the process of learning around farmlets.

Each of the individual case studies were written up into a descriptive format, presented in chapters 5-8, to support the across case analysis which forms the crux of this study in chapter 9.

4.9 Conclusion

This chapter has provided an argument for research to be qualitative using a constructionist perspective, informed by cultural historical activity theory. Due to a lack of previous research into farmlets as learning platforms, a constructivist approach to grounded theory was deemed most appropriate with the analytical tool of the constant comparative method. This methodology, in association with the methods of case studies, interviews and participant observation, it was argued would elicit results that would enable the research questions to be rigorously addressed. Thematic analysis was used in conjunction with the learning framework developed in Chapter 3 to draw conclusions from the data. Chapters 5 through to chapter 8 now present results and initial analysis of the study.

Chapter 5 Regional farmlet case studies: overview

This chapter presents four case studies that provide insight into the concepts and issues associated with farmlets performing as learning platforms. The four farmlet projects investigated were the Elliott Research Station (Tasmania), Flaxley Agricultural Centre (South Australia), Vasse Milk Farmlets (Western Australia) and Macalister Research Farm (Victoria). These four cases have been analysed as activity systems. While fundamentally based on the objective to deliver farmlet research, development and extension, through regional differentiation they individually different versions of, and perspectives on, the learning platform concept. Subsequent cross-case analysis is presented in Chapter 8 revealing a theoretical framework of farmlets as learning platforms which provides consolidation of results from all the case studies. Collectively then, Chapters 5, 6, 7 and 8 provide a foundation for conclusions about how farmlets perform as learning platforms for the Australian dairy industry.

Four case studies on farmlet projects are introduced in Chapter 5, and are presented to demonstrate how each contributes to answering the research questions detailed in chapter two. The unit of analysis was the farmlet activity system and the relationships and interactions of stakeholders around the farmlet. Fundamental attributes of the activity system explored included the six attributes of the activity system model (instruments, subject, rules, community, object, division of labour) that lead to the outcome or performance (or otherwise) of the farmlet learning platform. Each case study begins with an introduction to the farmlet site and a timeline outlining the significant events included in the case study. Analysis of the significant events moves to establishing the critical issues impacting on learning and the farmlet activity system. Each case then concludes with a summary of the relationships between emergent concepts that give a response to the research questions outlined in Chapter 2. At the conclusion of the final regional case study in Chapter 5, a summary of key concepts is provided to draw together the emergent learning from the regions. This is then further analysed in the cross-case analysis found in Chapter 8. The format of the case studies is elaborated on in Box 4.0.

Each of the four case studies was selected to provide an alternative perspective on learning around farmlet projects. The chapter commences with the Elliott Research and Demonstration Station in Tasmania, a site with a long history of farmlet research and had a well-resourced extension program. The chapter then moves to Western Australia, where farmlet projects were a new concept to the region, and the extension team faced significant challenges of depleting resources while trying to build the reputation and value of the farmlets to the surrounding community.

Box 4: Format of presentation of Case Study material in Chapters 5-8.

1. A brief description of the case *background* provides an introduction to the case study to provide the context of the learning environment.

2. Significant events relevant to the research commence the analysis process. These events provided evidence grounded in activities of the RD&E continuum that were involved around farmlets. A significant event generally consisted of a number of activities directed towards a common objective related to the farmlet activity system e.g. new project development or initiation of a new extension program. Events demonstrated the variable contextual relationships within the farmlet activity system, learning processes, knowledge management and the resulting interplays of stakeholders around farmlets.

3. *Critical issues* are then explored. These concern identification, exploration and conceptualisation of factors impacting on farmlet learning platform. The critical issues are categorised using the boundaries of the activity system to guide identification of concepts and relationships for analysis. Of greatest focus were the attributes of learning plaforms, namely the relationships between the physical resources (tangible resources), intellectual resources (nature of the information and knowledge held by stakeholders) and adaptation throughout the course of events. These elements provided the additional filters for conceptual development. This analysis was built from coding, memoing and constant comparison of data generated at the significant events and supporting interview material, using the grounded theory method as described in Chapter 4.

4. *Emergent learning* provides the conclusion to the analysis, where key conceptual relationships are presented to contribute to an understanding of how farmlets as an activity system perform as learning platforms. Conclusions from each case study raised further questions that are investigated in the subsequent case studies, which conclude at the end of chapter 6.

Following the Western Australian case study is the South Australian farmlet project at Flaxley. At Flaxley, there were challenges of minimal extension resources due to the withdrawal of government provisions, along with considerable negativity generated due to negligible farmer engagement around farmlet activities. The final case study is in Victoria, an alternative institutional model of farmlet projects. Here a farmer cooperative owned and operated the farmlet project in the Macalister Irrigation District. At Macalister, issues of farmer management committees, combining research and extension within one person's role and issues of location present interesting implications for learning around farmlets.

Chapter 5 Case study 1: Elliott Research and Demonstration Station

5.0 Introduction

Elliott Research and Demonstration Station has been presented as the first case study as it might be considered the model definition of farmlet research, development and extension in Australia. The physical set up of the site, the human resource allocation and the objectives the site seeks to achieve, make it a good comparison with the other farmlet projects.

This case study presents knowledge management processes around farmlets that occurred during the development of a new farmlet project for the Elliott Research and Demonstration Station (ERDS). It is presented through two interdependent events. The first focusses on the events that occurred specifically for the new farmlet project development process. The second focusses on the events that occurred around the farmlets in parallel but independently of the new farmlet project development process.

5.1. Background

Elliott Research and Demonstration Station (ERDS) was the first location in Australia for farmlet studies to be implemented. Beginning in 1981, the site was to function as a "place for demonstrating management systems, evaluate techniques developed elsewhere and to undertake applied research, particularly into problems peculiar to Tasmanian dairy farms" (Fulkerson, 1989:1). The primary focus of the work conducted at ERDS was in the area of pasture management, as this was identified as having the greatest potential for improving farm productivity at the time.

The original ERDS farmlets commenced with a large team of research, advisory and technical staff, under the leadership of one of the most locally respected researchers in the industry, Dr Bill Fulkerson. By 1990, the team consisted of four scientists, eleven dairy advisors and four full time technical officers. Five dairymen managed the dairy.

Farmlet projects at the ERDS also linked with component studies of the dairy farming system, in most cases studying attributes of new pasture species, soil management and irrigation.

Associated with the significant history of farmlet research was the Dairy Advisory Service provided by the State government. Since the inception of farmlet research, a large team of dairy advisors were operating alongside the farmlets, conducting traditional extension activities. In a typical year, multiple activities were initiated including short courses, field days at ERDS, seminars, workshops, farm walks and discussion groups (Hubble, 1989). In 1989 the first focus farm was initiated, where a Dairy Advisor worked one to one with a local farmer to concentrate on improving components of his dairy system that were considered as limiting productivity (Stevenson, 1989). Farmlet research and development work was used as a core knowledge resource informing the focus farm activity.

By the year 2000, an extensive amount of dairy farming systems knowledge to direct the future farmlet research and extension had been accumulated. Budget constraints created through State elections, where agriculture was a low priority meant that the team physical and human resources were under threat of being subsumed into other more politically sensitive activities. The farmlet team had already been reduced from previous years, to having one full time scientist leading the research, eight full time dairy advisors, two technical officers and two dairymen. Team resources continued to deplete as the organisation didn't reappoint new staff to the positions as source of cost saving.

Extension conducted through the advisory service continued to implement standard communication and group activities that utilised the farmlets project as a central information point for discussion and learning. A dairy advisor facilitated localised discussion groups, with each group autonomously operating, setting their own agendas and goals annually. The dairy discussion groups were a major point of social learning between farmers and for the extension practitioners to stay in touch with farmer learning needs.

Monitoring farmer learning needs, as well as adoption of practices and innovations from the farmlets was an integral component in directing future farmlet RD&E activity. A 'tracking system' consisting of a five yearly skills audit and survey of dairy farmers provided longitudinal objective measure of knowledge and skill improvement across the industry. This survey process commenced in 1984 and as a result considerable knowledge on farming practices, business profitability and farming system changes in Tasmanian dairies has accumulated and used to direct subsequent research and extension interventions.

The 1999 Department of Primary Industries, Water and Environment Survey of the Tasmanian Dairy Industry for the season 1997-98 indicated that despite the increase in the use of inputs (such as grain, nitrogen, fertiliser and irrigation) very little improvement in per cow or per hectare production had been achieved (Bowman 1999). The survey showed that farmers were making greater use of inputs to increase production per hectare (and not succeeding) and as a method of drought proofing or risk management (Freeman, 2002). This indicated that while the technology was 'proven' at the farmlet level to increase productivity and profit, the skills in management practice to integrate the technology effectively were lacking in the majority of farmers. This gave impetus for there to be a shift in the goal of farmlet RD&E to demonstrate management and skills around existing proven technology implementation rather than testing a new technology or intervention.

Further evidence of the need for a shift in farmlet research was provided through the results of the Tasmanian 2000 Dairy Farm Business Management Award (DFBMA), covering the 1998-99 season, which showed that, of the entrants, (50%) were achieving estimated Return On Capital (ROC) of less than 7%, with the lowest quartile only achieving average returns of 1.9% (Fergusson 2000). The finalists from the DFBMA had three very different farming systems, ranging from very low input to very high input systems. All finalists achieved high levels of production off grass and ROC of 11-13%, thus demonstrating that efficient grass management is a key to success in Tasmanian dairy farming systems (Freeman, 2002).

From this brief description of ERDS, it can be deduced that the farmlet activity system mediated a significant knowledge economy between researchers, extension practitioners and farmers. Despite the diminishing human resources to conduct the farmlet research and extension, much knowledge had accumulated over the years on the technical aspects of dairying, with a significant flow of knowledge from the research process through extension. Of considerable priority in knowledge development and maintenance was the understanding and monitoring the skills and capacity of Tasmanian farmers over time. Therefore, linkage of the technical innovations from the farmlets with the needs of farmers was a key activity in knowledge management for the team. Maintaining the momentum in the flow of information and farmlet activity through the research life cycle was a perpetual challenge and is now explored in the following sections. The first significant event followed the process of developing a new farmlet project. The second established how a farmlet performs as a learning platform even when there wasn't an official project funded and in operation.

5.3. Significant events

New project proposal developed		Existing farmlet project finishes	Next TOP program commences	New farmlet proposal review meeting with DA and NDFS team		NDFS national workshop		New project proposal abandoned and national farmlet project commences
Feb-01		**Jun-01**		**Nov-01**		**Apr-02**		**Aug-02**

Figure 14. Significant events at ERDS

New project development was a normal part of the cycle of farmlet research and extension for all the dairy farmlets in this study. In general, most farmlet projects were funded for a period of three years, incorporating funding resources from the State government and operating funding from industry through Dairy Australia. In early 2001, the ERDS team began constructing the proposal for a new farmlet project. This was around six months before the farmlet project already in operation was due for completion. This lead time was given by the farmlet team with the intention to start the new project straight after the old one had been finalised. Figure 14 presents the timeline of significant events that occurred during the study period and provided the basis to the key activities used within the case study in conjunction with key informant interviews.

As alluded to in the previous section, through the farmlet team's knowledge contained in the surveys and tools used to understand industry learning needs, there had been a shift in the kind of knowledge that the farmlets needed to be delivering. Instead of a primarily technical focus (e.g. pasture varieties and stocking rates) there was a move towards a focus on systems of farm management and profit (ROC) as an attempt, according to the project researcher and extension leader, to demonstrate in greater detail to industry how to take stock and use existing extensive knowledge on how to implement more productive and profitable systems. As explained by the researcher at the time, the focus was about "*not* to grow more grass but to make more capital with the resources and technology we already have" (Freeman pers. comm., 2002).

The challenge then for the farmlet team and for funders, was how farmlets could continue to be used as the mediating tool, and use with a different objective and questions of management skill development rather than the traditional questions around a technological innovation.

From the perspective of the farmlet research and extension team, it was possible to construct a farmlet project that had an alternative goal. The new farmlet project for ERDS was to have five farmlets operating with varying levels of irrigation from 100% dry land to 100% irrigated. These systems would be modelling five different farming systems typical to Tasmania. An economic target of 10% return on capital (ROC) was set for each system, or an increment of 2% ROC to be achieved annually. Each farmlet was to have a committee to manage the project decision-making, and to develop an annual business plan that would direct farmlet activities to achieve 10% ROC. A Dairy Advisor was responsible for managing the strategic direction and day to day decision making of each farmlet. The researcher was responsible for data collection, analysis and consolidation of information in a form ready for the extension team to adapt for industry delivery.

The research component of the project consisted of data collection and analysis of production, soil/pasture/animal/environment interactions, and the economics of all decisions. All management practices and changes were to be documented throughout the duration of the project under the areas of feed supply (budgeting forecasting, conservation, cover); irrigation practice (start up, intervals, grazing management); cow management (calving dates, spread, induction level, health and welfare and reproduction); fertiliser management and; pasture, pest and weed management (Freeman, 2002). Each of the farmlets would have a companion farm[5] working in parallel, to implement the decisions that the farmlet imposed.

The first contact with industry funders regarding the new farmlet project application was in June 2001. The contact involved a meeting with Dairy Australia and also members of the newly appointed (by DA) National Dairy Farming System team (see appendix 2). Members of the NDFS team consisted of individuals with expertise in national dairy feedbase research and extension, innovation and change management, project alignment and co-ordination skills. These members of the RD&E continuum were engaged to assess the new ERDS farmlet project application in terms of the strengths, weaknesses, opportunities and threats of the proposal to delivering both regional and national industry outcomes.

The NDFS team analysis of the project proposal was the first point where the farmlet team realised there was far more complexity involved with the new project than had been anticipated. From the NDFS team perspective, the hypothesis and intent of the new project was valid and worth pursuing, however the probability of achieving reliable and

[5] Companion farms associated with the ERDS farmlets were commercial farms that were similar systems to those being studied at the farmlets. Each companion farm had the opportunity to mirror the management being imposed at the farmlets if the commercial farm owner agreed.

implementable results from the use of a farmlet project came under significant scrutiny. The project questioned the appropriateness of the farmlet capacity as a research methodology (i.e. are farmlets the best way to go about studying a question of management?), and whether management can be scientifically and rigorously examined. The NDFS team also drew attention to the project merging social science with science, which was new ground for all stakeholders involved in the meeting.

The outcome of the first meeting and review of the project proposal resulted in the start of a positive agreement to work together and develop the concept further into a form that was agreeable to both parties. The change in focus for the ERDS farmlet project represented an exciting new challenge and era for farmlet RD&E, however significant work was still required to ensure the “right tools” with the appropriate functionality were being used to enable a robust outcome.

Significant time elapsed before the parties re-engaged. In fact, no contact was initiated by either party until after the farmlet team sent the proposal to DairyTas, the Regional Development Program[6] for approval. The RDP approved the project, which meant it was endorsed by the industry at the regional level. The proposal was then forwarded to Dairy Australia for refereeing, however instead of following what would be standard procedure, DA organised another meeting with the NDFS team and the farmlet team, along with additional social research experts who were involved to assist in developing social science methodology for the new project. By this stage there was still considerable uncertainty expressed by the industry funder (at the national level) and the NDFS team around the project design and whether farmlets were the right tool for answering the question.

The outcomes of the second meeting between stakeholders called by DA led to a revised structure to the project and a significant increase in the influence of rural social research methodology. The meeting reduced the research question into parts, to enable assessment of how each component could be measured, analysed to produce rigorous and transferable outcomes. Figure 15 highlights the outcomes of this process. Commencing with the original research question: “Is a return on capital of at least 10% achievable regardless of the available resource base for dairy businesses in Tasmania?”, the discussion then explored possible avenues and related questions that could be used to construct a study of management.

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[6] Regional development programs are regionally based boards that are organised and funded by Dairy Australia to identify and fund research that are regional priorities. An explanation of the funding application process and the role of the RDPs is provided in chapter 2.

As Figure 15 shows the project required a large component of research around the social domain of decision making, goal setting and information flow. The social research skills within the NDFS team allowed for a rigorous discussion and analysis of the project proposal, which was the first contact the farmlet team had had with such knowledge and approach.

After this meeting the enthusiasm of the ERDS team for the project began to wane, as the focus and objective of the original project had significantly changed from the original proposal. The considerable time delay of 18 months also meant activity at the farmlet was significantly reduced by waiting for the new project to be approved. Commencement of preliminary measurements gave rise to some activity which included the biophysical aspects of the project (soil fertility, pasture composition and growth etc), in anticipation that the new project would eventually be funded. Maintaining activity at the site was critical, as there was always a constant threat the resource would come under scrutiny by the State government and possibly lose funding support or be sold.

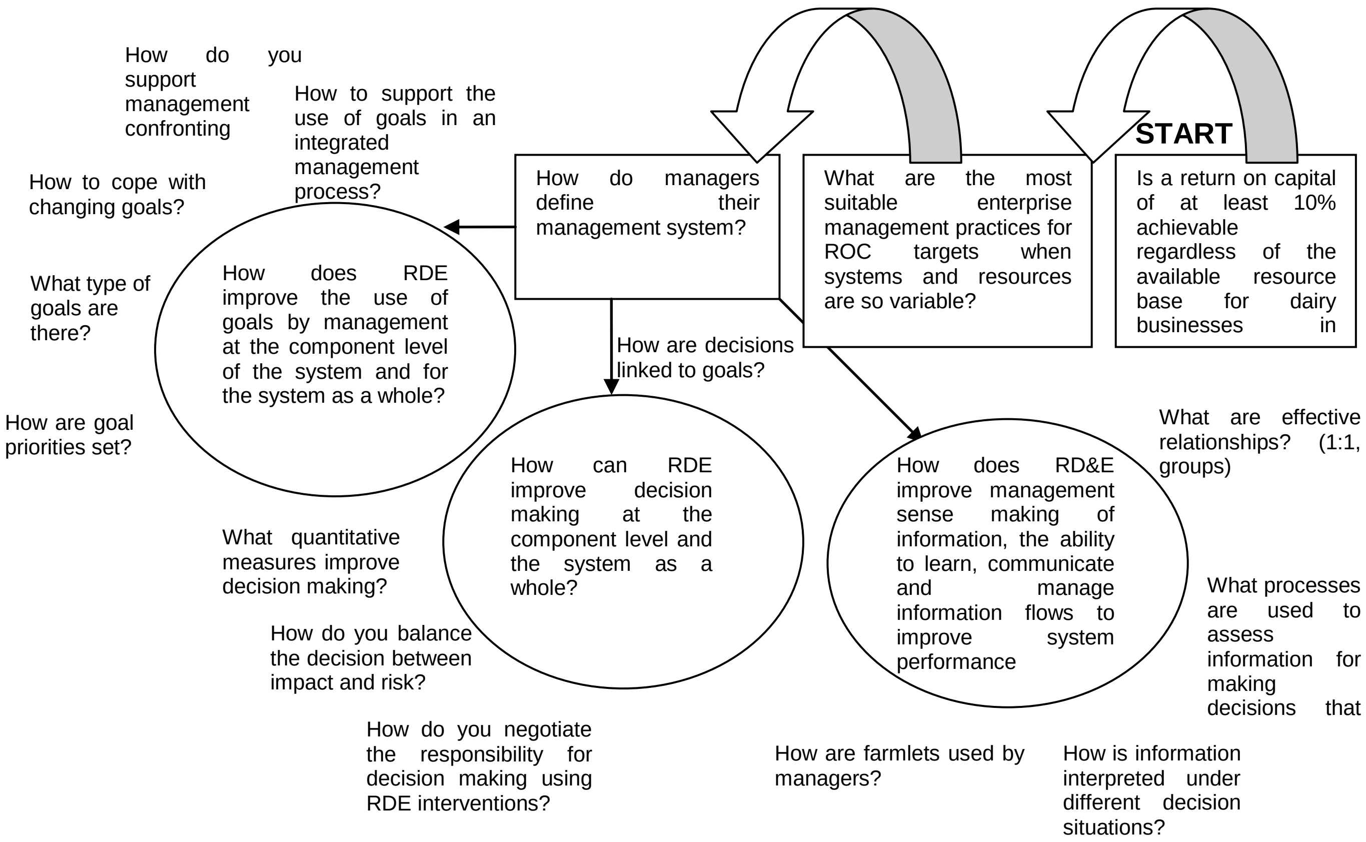


Figure 15. Questioning the question in farmlet project development

In the meantime, two concurrent events indirectly impacted on the new ERDS application process. The first was that DA were particularly sensitive to new types of farmlet research questions, as they had just been through a similar application process with the Queensland "M5" farmlets project. The M5 farmlet project was designed to study five different farmlet systems and the triple bottom line effects of farm system intensification. This project, like the ERDS project, had significant local ownership built through understanding the needs of the regional industry, however DA did not support it on the grounds that the methodology was not robust enough to produce rigorous scientific outcomes to advance the industry. DA co-ordinated a significant review process of the M5 project, that resulted in a complete redesign of the project, to include a substantial modelling component to analyse the project outcomes. As a result a key researcher resigned from his role due to the arduous and difficult process used to get a resolution. However, collectively a positive outcome was achieved in that stakeholders considered the new direction of the project to be more beneficial, providing greater potential outcomes. Interestingly, there was no reflection or review of this process to allow learning about project development processes; they were not considered an important activity.

The second activity occurred only a few weeks after the meeting with stakeholders, where the ERDS project application was used at the NDFS annual workshop to demonstrate use of newly developed guidelines for Farming Systems Research, Development and Learning projects[7] (Barlow et. al., 2002). The process involved the ERDS senior researcher initially presenting the revised ERDS project, however the complexity of the project was explained by one of the NDFS team members. This indicated that by this stage, understanding of the revised farmlet project objective and ownership of the project was more aligned with the NDFS team than it was with the ERDS team.

While the intent of the NDFS activity was to add value to the ERDS project and argue the case for the utility of the guidelines in new project development, the outcome was that the ERDS team became defensive and openly frustrated by the process due the significant lag time created by the development process. The presentation at the NDFS workshop indicated that despite the reviewing process that had been endured over 18 months, the ERDS team had not rearranged the original application in line with what had been negotiated and agreed at the preceding meetings with DA, NDFS team and the social research specialists. This was evidenced through the reliance of the ERDS researcher on the NDFS team to go through the newly designed questions to provide explanation to the audience.

[7] Presented in NDFS project overview in appendix 2

As highlighted below, while a better project may have resulted from the full process from when DA and the NDFS team first engaged in the project development, it was a player external to the regional farmlet project team who adapted the project, which at the time was considered a joint approach to project development, but acted to disenfranchise the project team from the concept. As highlighted below:

> "It has been a slow journey getting here, and in some ways it is a pain because we haven't got anything off the ground. But in the same time each time it is revisited it becomes a better project. It wasn't until the most recent Melbourne meeting and Bob's ability to pull it all together that it turned into something crystal. The draw-back of the process is poor communication…..we hadn't asked for it (all the input from DA and NDFS) in the first place, but we got it. Being in the south you don't get visitors all that often, so we have been trying to develop it in isolation. We are now happier, but really concerned that the project could be pulled apart to a point where it is something I don't want to do. In effect that is what has happened already though". (ERDS team leader, 2002)

Engaging in dialogue with other farmlets at the NDFS workshop about the farmlet project development process provided the opportunity for teams to vent their frustration on the project development process in general. This debate acted to overshadow the peer review process of show casing the farming systems guidelines using the ERDS project as a case study, to targeting the process in general and how farmlet teams negatively perceive the overall project development process. The participant quoted below contributed to the discussion and highlighted the significant tension with the process and between stakeholders.

> "There is no continuity in (the process of) funding farmlet projects. This will be the third year of trying to get people engaged within this particular project. Each site needs to have people engaged, with plenty of time lines. For 3 years we have tried to get a project up, but with a high level of frustration, but yes it has evolved markedly. The whole project has changed from 3 years ago. The high level of frustration is caused by the fact that the concepts we have floated, all popped up in another project which was funded. We thought our detail was more thorough. It is not as simple as it being a time frame thing or ideas thing though. We have all the historical documents, but it all gets back to that "it doesn't really excite us" (DA), so start again. So the question is then what do they want and the response we get is we don't know but come back with something different. There is a cost associated with this process. We think we have submitted a good product and then that is it rejected. All the issues are the same. The problem is we are asking more difficult questions and so we are not getting past go because the questions are hard to nail down". (Participant, NDFS workshop, 2002).

However, despite the frustrations, some benefits within the process were found in terms of "questioning the question" to get it right and learning alongside others about the complexity of the issue. The process allowed for thinking in a different way about the issue, and recognising that the project team and interest in the project goes beyond the regional boundaries. As highlighted below by the team leader at the workshop:

> "What has been useful about the process is that we didn't get the question right. There has been the requirement of exposure to many people, forums such as this (Melbourne NDFS workshop) with useful thinkers, to help to get the project to the next level. Re writing the project has enabled us to tighten it up. It is all about communication but there is a lot of the fall down is within the system. We all tend to be working in isolation and not involve people, but the thing is everyone is on the same train and not necessarily trying to derail you". (ERDS team leader, 2002).

Shortly after the NDFS workshop, ERDS resubmitted the project to DA for funding which was subsequently rejected and the farmlet project proposal was abandoned. In its place an alternative pasture species trial was initiated for three years across the farmlets which linked into a National Southern Farming Systems project using traditional and consistent methodologies for farmlet R&D.

The critical issues and themes drawn from the significant events, pertinent to answering the research questions, are now presented.

5.4 Critical issues

Table 6 presents the actions and perceptions that occurred across the farmlet activity system through the new project development process. In the context of the farmlet project activity system, there were a number of issues contradicting and competing against the joint outcome (i.e. new project initiated) trying to be achieved.

ELLIOTT RESEARCH AND DEMONSTRATION STATION

Element to activity system	**Data collection**	**Researcher**	**Extension officer**	**Farmer**	**Funder**
Outcome (desired)	Initial face to face interviews (appendix1)	New farmlet project that will create new benefits knowledge, information and tools for industry in Tasmania	New farmlet project that will create new benefits knowledge, information and tools for industry in Tasmania	New farmlet project that will create new benefits knowledge, information and tools for industry in Tasmania	New farmlet project that will create new benefits, knowledge, information and tools for the industry nationally
Object and tasks to achieve the outcome	Initial face to face interviews (see appendix one for questions)	Develop an innovative project application that would address a different question (ROC) instead of one addressing productivity. To maintain momentum in farmlet project activity and to maintain resources and outputs to local industry	Contribute to the project application process to ensure extension is integrated and an integral component to the project delivering adapted knowledge to local industry	Through the RDP process, provide feedback and guidance on the project proposal to ensure the project is aligned with State industry strategic plan and meets the RDP project criteria.	Ensure project developed will meet the needs of national as well as regional industry priorities
Mediating artefacts	Initial face to face interviews (see appendix one for questions)	Farmlet site, farmlet reports and past history of R&D, team meetings, application template, industry strategic plan	Farmlet site, team meetings, skills audit and DFBMA, farmlet reports, application template, industry strategic plan	Application template, informal contact with farmlet team, new project review meetings, RDP/DA project criteria	Application template, DA program objectives, national strategy, NDFS project
Subject (as considered by the respective activity system, those who form the activity system)	Initial face to face interviews (see appendix one for questions)	Primarily farmlet team of researchers and extension officers, secondary DA and RDP	Primarily farmlet team of researchers and extension officers, secondary DA and RDP	RDP committee and DA, farmlet team equally	DA, RDP, farmlet team, NDFS team

Rules	Initial face to face interviews (see appendix one for questions)	Researcher writes and manages the application development as done so in the past, engage with funders after application written and get sign off/funding generally linear process with no defined structure for development other than previous experience	Contributes to writing the application as directed by researcher and allocating extension resources to the project, not necessarily engaged directly with funders for farmlet project	RDP project review process using RDP criteria	Review projects in line with alignment to industry objectives and likelihood of achieving outcomes - no defined structure or process, case by case basis
Community (the groups affected by the outcome of the activity system)	Initial face to face interviews (see appendix one for questions)	Tasmanian DPI (farmlet team), Tasmanian dairy farmers , DA	Tasmanian DPI, Tasmanian dairy farmers , DA	Tasmanian dairy farmers, DA, Tasmanian DPI	National network of State government, private consultants, industry bodies, dairy farmers nationally, NDFS
Division of labour	Initial face to face interviews (see appendix one for questions)	Writing the application, research design, management, delivery and reporting, pitching the proposal, attending meetings	Write extension component to the application, maintain extension activities based on existing K with farmers	Review the finished application and approve/reject based on alignment with project application criteria	Critically review applications again regional and national priorities
Outcome (achieved)	NDFS national workshop notes, follow up one on one interviews via phone.	A farmlet project that aligned with a national project not one regionally specific for Tasmania, strained relationship	On-going delivery of extension activities despite lag phase in project development, seek to find other ways to conduct proposed activity in the farmlet study	RDP process under question by DA as being the right process to assess new project proposals	A national farmlet project funded however integration of social science and opportunity to initiate new farming systems model lost

Table 6. Summary of the critical issues impacting on the ERDS learning platform

Interviews that explored the desired outcome for all stakeholders involved revealed that the attributes of the overall endpoint were the same between stakeholders. There was an obvious interdependency between industry funders (DA) and the farmlets project (and team) which provided the rationale for the convergence. They all wanted innovative benefits in the form of new knowledge and information from a new farmlet project. However, the motivation or primary drivers behind the desired outcome were different between the local farmlet team compared with the funding organisation.

For the farmlet team, there was a necessity to gain 'industry support', represented through DA funding (i.e. producers levy payment) and signalled industry endorsement across the state, giving it credibility. The farmlet team specifically focussed on regional knowledge development, having considerable regional dairy systems technical knowledge linked to local farmers needs through the regular skills auditing system. Overall, the State government was the primary provider of resources to the project which meant that the project first and foremost needed to address the local requirements of the industry.

The other imperative for the farmlet team was to ensure the farmlet physical resource was kept utilised for dairy research, development and extension which meant the new project proposal commenced using the physical resource to drive the activity and then fitting a project and outcome around it rather than (as per Steven Covey recommendation) starting with the end in mind and then determining the required means to reach the end.

For DA, addressing regionally specific needs was important as they too had to invest in Tasmanian levy payers through supportive research, development and extension services. However, for DA, the alignment of the new farmlet project needed to also contribute to the broader national strategic agenda. The way in which the ERDS farmlet team had done this in the past was to incorporate farmlet project activities with DA national best practice learning programs such as InCalf (reproductive management), Countdown Down Under (mastitis management). This was an accepted approach to contributing to the national agenda as evidenced by the approval of previous projects. DA's national approach had extended, though, to develop further linkages across farmlet projects, to create greater cohesion, coordination and increasing the scale of benefactors from projects (through extrapolation of results) nationally compared to only the regional benefits from projects. DA also focussed on the international pressures of the marketplace (as described in Chapter 2) and being accountable to levy payers nationally and the Federal government, which meant any investment made into farmlets needed to be based on a rigorous methodology, and improve productivity, profitability and sustainability of the industry.

This raises the first key concept impacting on the farmlet activity system and emergence of the learning platform: connecting and disconnecting drivers and motivations.

Key concept: Connecting and disconnecting drivers and motivations

The drivers and motivations refers to the underlying factors that direct individual stakeholders to converge to achieve outcomes from farmlets. Connecting drivers are factors which are common between parties and can create an independency for collaboration. Disconnecting drivers are those which are imperative to individual stakeholders as determined by who they are accountable to, but not necessarily an imperative of the other collaborating stakeholders.

Allocation of tasks to achieve the outcome of a new farmlet project was based on processes used for previous applications for new projects. This meant the tasks for developing the new project proposal were determined by the rules which had emerged over time in terms of whose role it was to drive different elements to the project development. The rules were defined by the requirements of the profession and individual organisation role in the process. As highlighted by Table 6, the standard process described by stakeholders tended to be a linear process where the researcher with contribution from the extension leader, would write the proposal. This would be sent to the RDP for input, amendments and sign off, prior to submission to DA for final refereeing, negotiation and approval.

The problem with this approach, however, was that the rules around what constituted a farmlet project had been challenged, which meant the historically constituted/organisational rules for developing a farmlet project were also challenged. The new question being posed by the ERDS team of the new farmlet project were considerably different meaning an alternative process of engaging interdependent stakeholders earlier in the project development would have been beneficial, along with the development of new rules for new farmlet project development. This highlights the second concept of old rules, with implications for the farmlet activity system and emergence learning platform.

Key concept: Old rules

Old rules refer to the principles that direct actions based on organisational, professional cultural criteria as well as previous involvement and history of a process that engages multiple stakeholders.

The change to the rules then had implications on the subject or as described here as the stakeholders, who were directly involved with the activity system. Based on the old rules, this meant the farmlet team, the RDP and DA were normally the primary subjects required to carry out their respective tasks to deliver the desired outcome. However, given the change to old rules around the object, DA saw the need to draw on additional expertise and subjects by engaging the NDFS team in the process and subsequently a new rule of engagement, without consulting with the ERDS team[8]. A new rule is the third concept that emerged from the data.

Key concept: New rules

New rules are principles that direct actions, developed as a result of the old rules no longer being adequate or relevant.

An important attribute of the new rule was the lack of consultation to changing who should be involved in the process. The isolated nature (i.e. from within DA activity system) of the rule development was similar to the way the ERDS changed the rules around the new farmlet project concept. They just did it, because within their own individual activity system deemed it was the correct action to take for their own individual desired outcomes. This highlights an important concept around the relationships between interdependent activity systems that have a history of working together to achieve joint outcomes. A high level of familiarity between subjects and organisations because of previous interactivity meant there was an assumption that individual corrective actions to address new problems would be beneficial to the joint outcome and so joint analysis of the new problem wasn't considered (by individual activity systems) to be necessary.

A key concept within independent rule development was the stability of the relationships to withstand change. However the flaw in the assumption of stability is that it was based on what constituted the historical relationship between activity systems rather than a new basis on which the relationship was formed where significant rules for engagement had changed. Rather than being a standard process of negotiation, both activity systems were going

[8] The impact that changing the question for a farmlet project to answer was highly significant to the way in which activity systems adapted the rules for interaction. This highlighted there are certain changes in actions can have significant influence over the entire nature and stability of an activity system. Changing the question can metaphorically be linked to a traffic intersection which was once governed by a give way sign but changed to a stop sign. Those within the organisation who changed it and understood the reasons for the change knew it was there and what they had to do. Those not within the organisation, treat the intersection as they always have, until they end up having a smash realising the rules at the intersection have changed and the old way of negotiating were no longer appropriate.

through a process of making sense, learning and understanding how the new farmlet question might be answered adequately (i.e addressing both activity system desired outcomes). The emergent nature of changing the rules was the method by which activity systems were adapting to the change. However, the independent nature by which the adaptation processes were occurring was problematic as it created mistrust and uncertainty between the activity systems.

Key concept: Independent rule development

Independent rules are those created by an individual activity system but impact on the outcome which is being achieved by interdependent relationship with another activity system. The development of such rules is done so based on a positive intent of the acting activity system. An assumption is made that the relationship between the two activity systems is stable enough to withstand the introduction of new rules without consultation of the other activity system.

This brings into question the mediating tools and artefact used to manage the actions within and between activity systems. Firstly the physical resource of the farmlet site was the primary resource facilitating the convergence of activity systems through providing the facility and site where the joint outcomes would be achieved. Given the history of the site, there was a preconceived notion of the role and capacity of the farmlet site held by the respective activity systems. For the farmlet team, they were seeking to adapt the farmlet tool to demonstrate management practices. For DA, they questioned the capacity of a farmlet structure and methodology to achieve this through a rigorous, validation process. These perceptions formulate a critical concept of the cultural definition of tools that mediates interactivity between systems.

Key concept: Cultural definition of tools

Cultural definition of tools are the rules or criteria governing value and utility of tools for particular contexts, as derived by the individual activity system. Identification and understanding of different cultural definition of tools between multiple activity systems is required to achieve alignment and joint utility.

Communicative action was used to explore the new concept for farmlets, with the written proposal and formal meetings between DA and the ERDS team mediating the discussion. Such actions attempted to achieve alignment of perceptions and agreement of the role that a farmlet project may take. After two successive iterations it became apparent to DA that considerable adaptation and revision of the farmlet model was required. This introduces a further concept of tool reinvention, the certain adaptive capacity of tools to be adjusted to address alternative issues they were not originally designed to be used for.

Key concept: Tool reinvention

Tool reinvention refers to adapting an existing tool to having utility in a new context. Adaptive capacity is dependent on the nature of the tools and the cultural definition of tools defined by individual activity systems.

The considerable adaptation of the farmlet model required further mediating tools beyond what initial discussions had used. DA considered additional pertinent skills were required to assist with reaching a satisfactory outcome to discussions. So, the NDFS team were incorporated at the interface of discussions to mediate critical review. The NDFS team had complimentary attributes to the process including knowledge and understanding of DA objectives, ERDS objectives, social research and farmlet research in Australia and New Zealand which infused new contextualised knowledge into the pool of the debate. This action from DA introduced a mediating action to assist the adaptation process and reinvention of the farmlet tool. This concept is captured as infusing innovative interventions.

Key concept: Infusing innovative interventions

Infusing innovative interventions is a process of introducing alternative/new approaches and worldviews into a joint activity to assist in adaptation of tools for new contexts. The infusion process requires sensitivity around the cultural definition of tools to ensure there are minimal barriers to negotiating the adaptation of tools.

However the way in which DA dealt with the NDFS team without consultation with the ERDS team meant their intervention was viewed as an interfering imposition rather than a tool that would help with the adaptation of the farmlet tool. The knowledge exchange process that occurred when the teams met face to face consisted of intensive dialogue. Much of the intensity was due to the process of interpretation in the first instance, where DA and the NDFS team were working through the proposal and aligning their own knowledge base with the content. The parts of the proposal that didn’t align were then used as points of discussion to seek clarification. This was necessary to enable NDFS to understand what the ERDS team were seeking to achieve. Throughout this process, the project developed more richly through rigorous debate, however, with the injection of new knowledge from NDFS, the farmlet team lost their own understanding and alignment with the project content and their own knowledge base. Ownership of the proposal shifted at that point, to belonging to DA and the NDFS team rather than the farmlet team. This occurred largely by the NDFS team introducing social research as a critical dimension to the new project, which the skills required for the project were not contained in the existing farmlet team. This process disenfranchised the farmlet team from the process and the new project almost completely.

This introduces a further concept that highlights the process of shifting ownership of an activity system outcome.

Key concept: Shifting ownership

Shifting ownership refers to a process between multiple activity systems when the balance of ownership of the joint outcome shifts to be meeting the needs of one activity system over the other. Shifting ownership may be the result of unsensitised infusion of innovative interventions and a disproportionate allocation of power within one of the activity systems over another.

Dialogue was critical to foster the linkage between science and social science that would satisfy the desired outcomes of DA and the NDFS team. During the meetings, exploration of the domain of social science around farmlet projects could be explored, however in general the meetings had limited time to provide an adequate learning process for the farmlet team to really enable an understanding of social research processes and why it would provide a valuable dimension to the new farmlet project. The social side of agricultural research had already a poor reputation due to an inability of social researchers to adapt their disciplinary requisites (see NDFS case study) so that scientists could comprehend and give credit to the methods and methodology behind the discipline of research. It was quite a leap in knowledge and understanding and required a significant shift in attitude and appreciation before the ERDS team were prepared to take it on. Much time needed to be allocated to abstraction and codification of what was being learned (by both sides), which was impossible to achieve with the limited time frame of formal structured meetings. There were too many degrees of separation between the knowledge, paradigms and approaches that the NDFS team were working from compared with where the ERDS team were at.

Key concept: Degrees of separation

Degrees of separation refer to divergence that exists with cultural definition of tools, knowledge and worldviews of subjects across different activity systems. Where there are minimal degrees of separation, there will be minimal restrictions to achieving a joint outcome. Where there are a number of degrees of separation, there will be many restrictions to achieving a joint outcome and will require significant negotiation processes will be required.

While some ground was made at the meetings in closing the degrees of separation, maintaining the momentum and fostering the learning relationship between the face to face contact was an intent of both activity systems, but did not occur. The lack of informal communication between actors in between the formal meetings meant the knowledge exchange process was limited through lack of reinforcement of what was learned. At the end of meetings a series of actions and adjustments to the proposal were agreed, however only limited changes and adjustments were made to the project proposal. This indicated that the abstraction process (pulling the proposal into parts to enable understanding and then putting it back together) was not complete for the farmlet team and further engagement of an informal nature could have been used to fill the gaps and make sense of any confusion. Casual contact to ask clarifying questions was not initiated by the NDFS team members or the farmlet team, indicating that there was an assumption that there was joint understanding of the process outcomes. The lack of follow up on both teams behalf with the farmlet team meant the momentum and management of knowledge flow and application stalled. This leads to question the division of labour and the actions involved to complete the project application.

While it was historically the role of the researcher to write up and finalise project applications, in this instance ownership and understanding of the project had shifted from the farmlet team to the NDFS team and DA. The extended negotiations, prolonged and perceived to be overly extensive by the ERDS team, meant that ERDS were not willing to continue with the process as too much was at stake (in terms of resource allocation and maintaining the farmlet site). For NDFS and DA, the lack of progress in subsequent project proposal drafts was a signal that the ERDS team had not engaged with the new project concept that had been developed and so this meant they were no longer party to further development. The issues of both activity systems formulate the final concept of deal breakers.

Key concept: Deal breaker

A deal breaker is an individual or combination of attributes that fundamentally changes the joint outcome that is being sought by two interdependent activity systems. Deal breakers are linked to the division of labour, and the expectations of the completion of tasks as jointly negotiated by the activity systems involved. If actions/tasks are not carried out, then the original outcome becomes modified.

The final outcome achieved compared to the desired outcomes demonstrated a significant shift in what was originally being sought from the activity system. Even though a new farmlet project was eventually initiated, it was a totally different farmlet project that belonged to a national agenda which still had benefits for Tasmania, but didn’t target specific local needs. It was evident to all parties, that desired outcomes were only partially met. Considerable damage to the relationship occurred as a result. Having a joint outcome that focussed on development of a new farmlet project meant the basis for engagement was the proposal itself rather than the project development process and engagement between the activity systems. This meant that there was a lack of consideration of how to engage with each other, or planning and accounting for what the existing relationship between the process, content and context entailed and how it needed to be adapted.

5.5 Emergent learning

The preceding analysis and concepts found within this first case study are presented in Table 7. Figure 16 then depicts these concepts, interrelationships and contributions to understanding of learning platforms in the context of new project development activity. The summary of attributes and concepts will be used to formulate the discussion on the key findings of this case study prior to a formal address of the research questions.

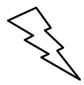
Coding category	**Implication in the activity system relationships**	**Concept**	**Symbol**
Alignment of objectives and rational for collaboration	Outcome	Connecting and disconnecting drivers and motivations	
Principles driving actions within the activity system	Object/task and rules	Old rules	Old rules
Criteria of subjects within the activity system	Object/task, subjects and rules	New rules	New rules
How individuals responded to changes in rules	Object/task, subjects and rules	Independent rule development	IRD
Perceptions of the role and form of tools used to carry out actions	Tools and mediating artefacts	Cultural definition of tools	CDT
Adaptive tool usage and alignment of perceptions	Tools and mediating artefacts	Tool reinvention	TR
How innovative approaches were incorporated into the activity system	Tools and mediating artefacts	Infusing innovative interventions	- · - · - · - · ->
Consequences of engaging new subjects with different skills	Object/task and subjects as mediating tools	Shifting ownership	⊗
Differences in worldviews, paradigms and approaches to activity	Object/task and subjects as mediating tools	Degrees of separation	⟷
Allocation of tasks	Division of labour, rules	Activity leadership	AL
Criteria that makes or breaks negotiations for a new farmlet project	Division of labour, rules	Deal breakers	DB

Table 7. Summary of concepts from analysis

As a learning platform, the history of the ERDS has built considerable intellectual and social capital for the Tasmanian dairy industry. The situation analysis provided evidence of this, with each consecutive farmlet project building knowledge and skills of dairy farmers, as well as building the capacity of researchers and extension practitioners. On the production and sharing of technical knowledge between activity systems, the description indicated that the farmlet team at ERDS is highly effective and active in this process. However, this case study was not observing that particular process, rather the farmlet activity system and learning platform that emerged through the new project development process at the end of a farmlet project that was complete, to the beginning of a new project.

This case study has revealed key factors that influence as well as constrain the emergence of an effective learning platform. This is explained through the activity system presented in Figure 16.

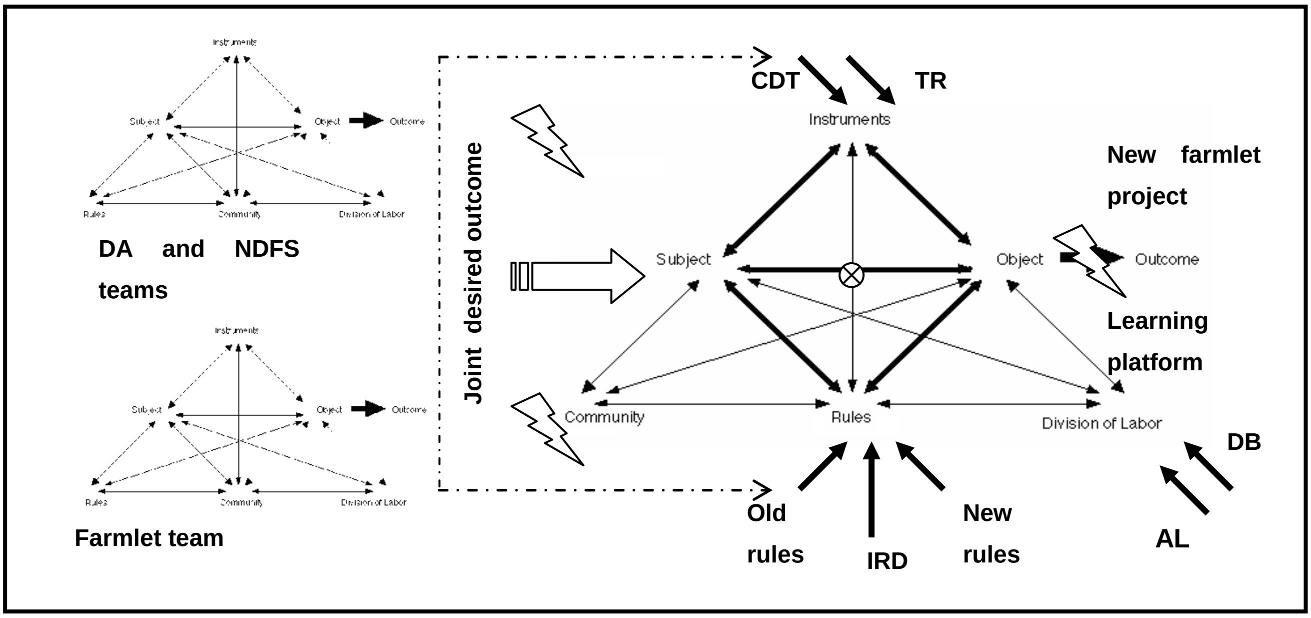


Figure 16. Interrelationships of emergent concepts within the ERDS learning platform.

Three key features provide the overall picture of what the diagram represents. Firstly, the dominant attributes and relationships at play within this activity system are emphasised by the symbol for ‘degrees of separation’, to highlight these factors (rules, subjects, instruments and object) were the driving interactions of the activity systems, despite each stakeholder working with divergent perceptions of what subjects needed to be involved, what tools/instruments were required to achieve the object and subsequent outcome.

Secondly, the position of rules in the activity system has shifted from an element that is directly influenced by community, the object/actions and subjects, to an area that depicts the dominant relationship and impact that the different types of rules had on the emergence of the learning platform. Positioned here, the old and new rules directly influenced and dominated all actions and elements of the collective activity system.

Thirdly, while the overall outcome the separate activity systems were both seeking to achieve was the same, the connecting and disconnecting drivers and motivations for each activity system to work together, were directing their actions independently from one another to achieve the desired outcome. Instead of both teams working together jointly to determine the project development process required to meet the needs of both parties, isolated actions created frustration and tension and ultimately failure in achieving the desired outcome. Actions were based on old rules and previous experience of the two activity systems working together, which was a fundamental factor constraining effective interaction.

As a learning platform, this case highlighted the resilience of the respective activity systems modus operandi to change to how they work together to achieve the joint outcome. This particular activity required both parties to have a capacity to adapt to a new type of farmlet question, alternative approaches to using farmlets to answer the question, engaging with social science and new knowledge types. Again old rules and independent actions constrained the adaptive capacity of the respective activity systems to work together.

However, there was evidence of learning and transformation within the statements from ERDS activity system, with some value placed on the introduction of new subjects to help work through the issues and develop a more appropriate question for the new farmlets. 'A better project emerged' and acknowledgement of the original farmlet question 'not being right' demonstrated the elements of the project development process facilitated learning and adaptive thinking for the ERDS team. However the transformation process remained incomplete, as there was a failure to follow through with the new project. Attribution of this failure was the result of DA and NDFS perceived (by the farmlet team) to have taken a top down interventionist approach to engaging in the process, compared to working in partnership with the farmlet team to learn together how to develop an effective new project. This shifted ownership and interest of the project from ERDS team to DA and NDFS. Counter to this was ERDS team (perceived by DA) engaged DA more as a bank for funding as opposed to a core partner in the learning process.

A response is now provided to the research questions to summarise the key findings of the ERDS case study. The effectiveness of the learning platform in this case was particularly constrained by the factors just outlined, which provide insight into factors that impact on learning platform performance.

Firstly, how can an understanding of learning platforms and adaptive processes inform future farming systems research, development and extension projects? This case study highlighted a number of constraining issues that should be considered when a learning platform is inevitably setup by the convergence of stakeholders:

1. When there are significant degrees of separation between the individual activity systems rules, perceived subjects required to be involved and the instruments being used, there will be a disconnect in the object/actions carried out to try and achieve the joint outcome. In this case the joint outcome was never achieved.
2. Introduction of new subjects into a joint activity system would benefit from an integrative and negotiated process between activity systems, rather than an interventionist approach.
3. An activity such as new project development requires a concerted effort by the activity systems involved to focus on the activity of engagement and working together as much as focusing on the technical project itself
4. Adaptation and transformation potential will be inhibited once ownership of object and outcome becomes dominated by one particular activity system.
5. Where there is a fundamental shift from a historical outcome being sought by joint activity systems converging, assessment of how adequate existing rules, instruments and subjects competency against the object and outcome is required
6. The interdependency between stakeholders requires farmlets to facilitate learning and adaptation on both regional and nationally relevant research questions
7. The imperative from joint investment to deliver on both regional and national research questions forces a process of questioning a proposed research question for farmlets which acts as the interface for interaction and joint learning (when constraints to the learning platform are addressed).
8. The result of questioning the question highlights that the farming systems nature of farmlets enables a flexible and broad definition of what constitutes a farmlet project, and that farmlet project design and delivery team can be adapted to address combinations of economic, social and environmental issues within one project
9. Farmlets that have been in operation for a number of successive projects have built a library of systems knowledge that can support extension practice and farmer learning, even when an active farmlet project is not in operation.
10. Farmlet project teams with a strong historical influence and systems for tracking impact are resilient units to change, particularly when change is viewed as an imposed intervention. Tracking systems (i.e. skills audit) assessing farmlet project impact and farmer skills and understanding support the adaptation of successive farmlet projects to meet the needs of the local industry.

This case study, while focussing on a highly contextualised aspect of farmlets and the project development process, leaves a number of questions to be answered. If ERDS provided insight into the project development phase, how to farmlets perform as learning platforms when a project is operational? And do farmlets without a substantial history (as found with ERDS) perform as effectively as learning platforms? The second case study on the Vasse Milk Farmlets now seeks to address these questions.

Chapter 6 Case study 2: Vasse Milk Farmlets (VMF)

6.1 Overview

Vasse Research Station demonstrates a different farmlet activity system to ERDS. As a new farmlet project, it didn't have local historically constituted knowledge on which to draw on to formulate and direct farmlet activity and stakeholder interaction. This case study brings understanding of farmlet learning platforms, in an industry environment under considerable uncertainty. Uncertainty here applies across the industry: an unstable milk processing sector, pressure on producers to increase milk production and, a research and extension continuum that had never used farmlets before.

The uniqueness of the VMF allowed an exploration into learning platforms in terms of how the farmlet team who were new to the approach, worked to understand appropriate farmlet research and extension practice, to set up learning processes and relationships that enabled initiation of the project. Significant hurdles throughout the project, such as institutional restrictions on activities and the disruption of extension processes due to practitioners leaving, impacted significantly on the performance of the learning platform.

The Chapter begins with a brief situation analysis of the WA industry and how farmlets were chosen to support the industry. This case study is divided into two significant stages of the farmlet activity system development across the duration of the study period. Critical issues and emergent learning are presented prior to a discussion on the emergent concepts, the interrelationships between concepts across the activity system, and the implications for the research questions.

6.2 Background

The relatively small size of the West Australian dairy industry, the market in which milk product is sold and the failure of a key milk processing company to deliver the projected improved milk prices all contributed to the lack of confidence and uncertainty within the Western Australian dairy industry. At 4% of Australia's milk production, Western Australia is the smallest contributor (Dairy Australia, 2008). Dairying was a large employer and considered one of the highest value adding industries in Western Australia, producing ice crème, cheese, and local fresh milk brands (McRae, 2003). The majority of milk product though, was sold on the international commodity market and was, thus, affected considerably by fluctuating commodity prices and increases in the value of the Australian dollar (McRae 2003). As a result the gross value of milk produced in Western Australia declined by 6 cents per litre three years post deregulation (ibid).

There are four major raw milk processors in WA. The majority of farmers supply to National Foods (100 farmers) and Peters and Browns (166 farmers), with a small proportion of farmers supplying Challenge Co-operative (40 farmers) and Harvey Fresh (18 farmers). The initiation of the local Challenge Co-operative in 2001 through a $10 million dollar government grant, gave producers some hope that milk prices would improve. In 2003, the Challenge Co-operative announced a joint venture with China's Beijing Sanyuan Food Company. The outcomes of the joint venture were presented in a report to the State government on the Western Australian dairy industry:

> "The Sanyuan Challenge Australian Dairy joint venture planned to develop new processing facilities to produce value-added exports for the Chinese retail market. If this strategy succeeded in achieving a price premium over commodity exports, it should have increase farm gate returns and eventually provided leverage to arrest the decline in domestic milk prices. Completion of the joint venture saw modest improvements in milk price, but these have not been sustained or grown as predicted. This was largely a result of a depressed export market. Low international commodity prices and the strong Australian dollar have reduced returns to farmers. All global dairy exporters have been affected. The unit value of Australian dairy commodities has declined by more than 36% since their peak in September 2001". McRae 2003:3

The price 'squeeze' that the WA industry was experiencing, meant the pressure for increasing productivity within dairy farming systems was mounting. Seeking options on how this could be achieved became a focus for the State government Department of Agriculture with the intent of establishing the most appropriate research and extension processes that could deliver pathways for the industry to improve competitiveness. An exploration into farmlets was initiated by the newly appointed dairy researcher within the Department. The following sections further describe the significant events that lead to the initiation and delivery of the VMF program.

6.3 Significant events

The relevant events that occurred during the study period around the VMF project are presented in Figure 17. Each of these events have been allocated into two key stages of the farmlet activity, which for the VMF project were building and maintaining the VMF activity system and then reinstating stability of the activity system after a number of complications and issues hit the project. These stages are presented in Box 5.

New farmlet project commenced	Extension strategy review	Dairy innovation day	Extension leader resigns	Extension strategy review	Visit to Flaxley Research Station	New extension leader appointed	Dairy innovation field day	Farmlet survey	Companion farms initiated
May-00	**Oct-00**	**Sep-01**	**Oct-01**	**Mar-02**	**May-02**	**Jun-02**	**Sep-02**	**Sep-02**	**Dec-02**
STAGE ONE						**STAGE TWO**			

Figure 17. Significant events at VMF relevant to farmlet learning platforms

Box 5 Significant events as two primary stages in the learning platform development

1. Building and maintaining the Vasse farmlet activity system January 2000 – June 02
Here the dairy researcher actively searches for learning about farmlet research and extension requirements and builds the WA farmlet team including a committee to guide farmlet activity. An extension and communication strategy was developed under the direction of outside expertise and the farmlet project commences and the framework for the activity system is formulated. Throughout this period a number of changes within the farmlet team require significant adaptation of the activity system elements to enable the momentum of activities to be maintained.

2. Stabilising the Vasse farmlet activity system June 2002 – December 02*
Appointment of new team members and a shift in strategies reinvigorates the farmlet activity system to be back on track to achieving the original outcomes.

* end of study period not the farmlet project per se

6.3.1 Stage one: building and maintaining the Vasse farmlet activity system

Farmlet research and extension was new to the Western Australian dairy industry, including the team of professionals who would be operating the project activities. The most favourable aspects of farmlets for the dairy researcher were the (anecdotal) reputation of farmlets for fostering learning and also the existing network of farmlet expertise across Australia and New Zealand. Farmlets offered the methodological process and capacity to develop the required knowledge and information for what was being sought in the next dairy research and extension project.

> “One of the reasons why I went into farmlets in the first place was that I had always been told in New Zealand and in Australia how great farmlets were for farmer learning ……. I guess we fairly and squarely went into this farmlet project because we were just using, you know, experience interstate and overseas that farmlets were the next best thing and the way to go for our needs”. (Researcher, VMF, 2002).

Twelve farmers and staff from the State Department assessed the feasibility of a farmlet project based on increasing pasture utilisation and milk production. A concept proposal for the farmlet project was presented and discussed at length by local stakeholders (researcher, extension officers and farmer representative committee), prior to a detailed project being constructed. A case was made to internal funders (within the State Department) for approval and subsequently sent to the local RDP and Dairy Australia for broader industry endorsement and funding.

Previous dairying research had been conducted at a facility in the irrigation region of WA. However, with the onset of deregulation the facility was closed which meant the new farmlets project had to be conducted at the remaining agricultural research station at Vasse. Located in the dryland[9] zone of WA the facility at Vasse had been focussed on beef research and a significant conversion was carried out to turn the facility into dairy farmlets.

The farmlet project commenced in the year 2000, to demonstrate the extent that dairy production in Western Australia (WA) could be intensified and the implications for profit, risk and sustainability. A six farmlet project was established at Vasse. Each farmlet had different stocking rates and different concentrate feed (silage and grain). The farmlet design incorporated one farmlet (1.2 cows per hectare) with the same stocking rate as average dairy farms to enable a benchmark comparison. The additional farmlets aimed to explore higher stocking rates and levels of concentrate feed in the diet. The full treatments are presented in Table 8.

Farmlet	**1**	**2**	**3**	**4**	**5**	**6**
Stocking rate (milkers/ha)	1.2	1.6	1.6	2.0	2.0	2.4
Concentrate (kg/cow/year)	900	900	1800	1800	2700	2700

Table 8. Vasse Milk Farmlet experimental treatments

A farmlet management committee was formed to a) contribute to decision making around the project; b) direct capital expenditure; and c) contribute to the design of the extension program. Made up of three Department staff and four farmers, the committee worked directly with the farmlet team (researcher and newly appointed extension practitioner) through meetings held approximately every 10 weeks at the farmlet site. Membership of the

[9] Dryland refers to a region that does not use irrigation for production

committee remained consistent throughout the duration of the farmlets project, which was facilitated by the compatibility of personalities and commitment of the stakeholders to the farmlets delivering benefits to the industry. As highlighted by the researcher on the farmlets project:

> "They work well together, the same farmers have been on the committee since the beginning of the project. It is rare to have such a committed committee of people that take notice of what we are doing, contribute constructive suggestions on how to achieve better management and get better results at the farmlet level". (Researcher, 2002).

Early extension activities around the farmlet project were initiated by the researcher, as there wasn't any particular employee allocated to the role at that stage. Monthly articles in the local dairy newsletter were written by the researcher, providing awareness of the project design, development and the objectives of the project. Some support to the researcher was provided to assist with the communication of the project, however enthusiasm from assistants was considerably lacking as the activity was over and above their usual job.

> "The feeling in the beginning was very much that the project was still sort of feeling its way. It just wasn't clear I guess that there needed to be a champion for extension to drive the communication side and nobody was really keen to take on that role. I know that, Bob was the person who was doing it, but he didn't want to be doing it". (Extension leader, 2002).

Part of the lack of enthusiasm to assist with the project was due to a lack of understanding of how large a farmlet project was in terms of the required resources (researchers and extension practitioners) to conduct the basic activities of the project. After the commencement of the farmlet project, a communication plan was written by engaging an outside expert. Primary activities were to be based on focus farms and discussion groups (typical activities within the region) as the delivery channels for communicating farmlet messages. Without a dedicated person within the extension role, however, progress on utilising these communication channels was limited.

> "The team was pretty small in the beginning. There was excitement about it from the researcher. Like a big new project, everything was pretty exciting, but people were still really feeling their way and I think the researcher was probably the only one who really understood the scale of what was about to happen, and even then probably not so much on the extension side, but certainly on the research side. I think he understood what was happening and nobody else really knew quite how much time and effort would really be required". (Extension leader, 2002).

Several months into the project saw an extension practitioner assigned to the farmlet project for 70% of her work time. The role was described as the extension 'champion', indicating a leadership responsibility for the delivery of farmlet project outputs to industry. At the commencement of the new extension champion activities, a planning meeting was held with the project team, which by then consisted of the researcher, the dairy program manager and two other technical specialists, none of which were full time on the farmlets. The original communication strategy that was developed with outside expertise was deemed inappropriate because it was based on approaches that were not effectively operating. Discussion groups at that stage were almost finished or focussing on political issues such as deregulation and a review of the focus farms found that they were not operating in a way that would be compatible to working with the farmlets (Staines, 1999).

> "Over a period of probably five years extension went from being active discussion groups to being practically nothing, and I think also there was a feeling -- the Department had changed its emphasis a lot from not having a focus so much on research and I've spoken to people in some of those discussion groups and they were all saying "Look, you know, there's just nothing new to talk about. We're stagnating. We can get together, but we're not actually learning anything. There's nothing to talk about and that deregulation was making people very, very negative and it was better to feed the negativity". (Extension leader, 2002).

The new extension plan consisted of utilising communication tactics such as newsletters, the farmlet website, face to face meetings with consultants, monthly farm walks and annual open days. Activities for the extension practitioner in the early stages of the project were largely focussed on generating awareness, as there had been a reduction over the years on dairy research in the region. It wasn't long though before the extension strategy proved inadequate according to the extension leader. Providing the farming community with details on the research project structure and activities was important, however information needed to move on to another level and provide a greater depth in supporting the farming community to learn more about the decision making processes within the project and how the incremental farmlet results related to commercial farming systems.

> "It was kind of like these are the things we're going to do (discussion groups and focus farms) because these are venues available and these are the people that need to know about the project. There wasn't a real understanding of what are we trying to communicate here and what's it all about. There wasn't really a deeper understanding I think. And I was going to be doing most of the work, but everybody in the dairy team was going to be involved in it and I certainly felt that things were a bit haphazard. It was just, "this is the way of reaching people", so this is what we're going to do, and the main focus was on communicating results at that stage. Like the aim for extension would have been to get everybody to be aware of

> farmlets and understand why the project was running. And also what was going to be in it for them at the end. So the emphasis had really been on the trial, getting the research side right and then communicating those results to people.” (Extension leader, 2000).

The questioning the adequacy of the extension approach led to the external extension expert being engaged was once again, to work on a revised extension strategy. For the extension leader, this event was significant in facilitating herown learning, and helped to make sense of inadequacies of the current approach, to then plan an effective path forward for extension and communication:

> “Having Mark come over that visit was really, really good for me. I guess because I’d just finished a review of the dairy focus farms, and I had these ideas about decision making and, you guys were saying “OK, well look at the decisions. What are the decisions that are happening at Vasse and tracking those, the things that were happening on the farmlets, and relating that back to individual farms… that was really useful for me”. (Extension leader, 2000).

The new extension plan provided a framework that addressed short and long term learning processes needed in the region, by tracking and communicating the decision making on the farmlets. In the short term, the farmlets were encouraged to provide light at the end of the tunnel, and build confidence in the dairy industry again by providing information for their current needs i.e. economic analysis of farmlet activities (input and output costs). For the long term VMF needed to be providing learning processes that built the reputation (credibility) of the project (particularly in the irrigation region) and provided technical knowledge that attributed some change in farm management practice, in association with increased farm profitability. The project needed to be perceived to be making positive contributions towards the development of a profitable and sustainable post-deregulation dairy management system.

In principle, the strategy for extension moved to focus on key messages that emerged from the decision making on the farmlets and linked to related seasonal activities and issues that farmers in the region were also dealing with. Extension activities that were already initiated such as the newsletter, web site and farm walks continued, however the key messages conveyed were focussed on the real time issues, and how the farmlets were managing.

Other tactics engaged the researcher as part of the inter-personal extension activities such as farm walks with local farmers. The annual open days were considered a rewarding and successful extension activity due to high participation and the feedback received from the farming community who attended the days.

> “The open day gave people lots to talk about. People said they really enjoyed it. We have a good system for running open days, the time frames were good. The first year dragged a bit but this year was punchier. Last year didn’t know how familiar people were with what Vasse was doing. This year we assumed there was a fair level of understanding. People did have the opportunity to ask questions for clarification. Last year we had people there to knock project and also supporters. This year had mainly people who were interested in project and interested to hear what the team had to say.”(Extension leader, 2000).

An email bulletin was used to engage and inform private consultants and other rural service providers in the region. Considerable difficulties were encountered with private consultants as they opposed the project due to a low opinion of the State Department. Many consultants were ex-employees of the State department and disgruntled from negative experiences associated with their employment (Anonymous pers comm. 2002), which meant their opinion of any State Department activity was generally unfavourable. However, consultants represented a valuable network that could be used as part of the extension strategy, to encourage them to bring their clients to Vasse and use the site as a resource for working with their clients. In an effort to engage consultants and overcome the negativity they had towards the project, the communication strategy defined categories of consultants and their information needs from the farmlet project. Quarterly meetings were intended to be held between consultants, however only one meeting was ever held due to consultants not responding to any further invitations.

Notwithstanding the difficulties encountered with the consulting sector, it took nearly two years to establish the farmlet project using the physical and intellectual resources available to the team.

6.3.2 Stage two: stabilising the Vasse farmlet activity system

The difficulties in engaging and managing consultants and the multiple activities of the extension leader role which not only included initiating and maintaining the extension activities, but being immersed in the research process in terms of data collection and analysis of the pasture utilisation and management, lead to the extension leader resigning after being involved in the project for approximately 16 months. The young and inexperienced team was under considerable pressure, which in the end could not be tolerated.

Once the extension leader left, there was a significant crisis in the resources allocated to the project extension. The current professional staff remaining were the project researcher (60% FTE), a senior extension practitioner, (26% FTE), as well as some backup from staff with technical skills (e.g. data processing), and some extra farm labour (Crawford, 2002). The remainder of the team had resigned (project leader), retired (senior economist) and not replaced, and the other extension practitioner (26% FTE) had taken leave without pay for twelve months and was also not replaced. The project researcher's contract was due to finish in January 2003 and the farmlets project wasn't due to finish until June that year.

A significant lag phase then occurred in extension activities around the farmlet project. Over nine months passed prior to another extension leader being appointed. Another extension practitioner was allocated part-time to the farmlet project, however this employee had just joined the Department and had recently graduated from University, so was limited in experience as an extension practitioner and in time allocated per week for farmlet extension.

Being young and freshly out of University meant that the extension practitioner was unable to take a leadership role and was dependent on the researcher for direction on extension activities. Activities were reduced to what the researcher was capable of maintaining, namely the annual open day, farm walks and also assisting with newsletter updates that the new extension practitioner developed. The extension practitioner also had to manage the results emerging from the project, and work to have these published on the Department of Agriculture website, a time-consuming task in itself due to the accumulated back log of results.

Support and assistance from the National Dairy Farming Systems Extension Leader was welcomed by the farmlet team, who travelled to one of the annual open days to assist with planning and contributing as a speaker on the day. Working with the VMF team on the open day acted as a catalyst for further activity with the team, to provide additional extension support and reflect on the project progress and plan for the final year of the farmlets. Because of the resourcing of the project at that time, the farmlets needed to re-adjust the research and extension activities, increase the capacity of those working on the project through training and support, and work towards increasing the project credibility and learn more about the possibilities for economic analysis.

Support from the NDFS team and considerable lobbying of the Department of Agriculture senior officers by the researcher of the project lead to the funding of an extension leader to the farmlets project around two months after the review. Appointment of the extension leader acted to lift the morale of the researcher and others within the farmlet team, particularly because the person appointed had a long history working as an extension practitioner in grazing industries.

The newly appointed extension leader had been a practitioner for over 20 years in both the dairy and red meat industries. The first activity for the extension leader was to travel to the eastern States and South Australia, to visit other farmlet projects and learn about the various extension strategies being employed at different sites. The new extension leader initially had a poor perception of the farmlets, which soon changed after developing an understanding of the issues around the project from his travels.

> "Well my perception when I came in was that the farmlets irrespective of the good work that was being done - there was a feeling in the industry from producers and certainly some of the consultants that the farmlets were irrelevant in terms of that they were just small little farmlets. There was no real good kind of factual data coming out of them and I suppose my strategy first of all was to investigate whether that was true. I certainly convinced myself looking at the farmlets that that was not the case. There was a good lot of information there. It just hadn't been packaged correctly". (Extension leader (c), 2002).

The extension leader spent significant time scoping the best way of packaging the information and the needs of the farmers in the industry.

> "So my role with the farmers is to develop an effective communication extension program, helping Bob analyse the research findings and put them into everyday language so that farmers can see what drives each production system and because we've got a desire for our industry to be sustainable, to increase production. I suppose my role is to use the farmlets as a means of assisting farmers make those fairly massive management changes in terms of maybe not expanding by buying more land, but either by producing more from the same cows and/or increasing the stocking rate and running more cows and/or producing more milk at the same time and that's I suppose the great thing about the farmlets is that they do give quite a diverse range from low input, low stocking rate, low grain right through to substantially higher stocking rates that's currently run with more grain than would be fed normally". (Extension leader (c), 2002).

Central to the strategy of the new practitioner was understanding the issues (politics and negativity) around the project and establishing ways to manage these. Key to this management was his capacity to draw on the networks he had developed and intended to maintain over the duration of his extension career. Involving the milk processing companies in the information loop was a way of ensuring they were always up to date with farmlet activities. Also the extension leader contacted local consultants one to one, to discuss the farmlets' outcomes.

> "I started by trying to turn around the perception of the industry to be receptive to the information from the farmlets. So that involved networking again the old networks, talking to farmers and to industry as to why they felt that the farmlets weren't relevant and that involved what should've been done in the early days". (Extension leader (c), 2002).

Through networking and getting a feel for industry perceptions of the farmlets, the extension leader then developed a comprehensive survey to validate the level of knowledge, attitudes and confidence the farming community had in the farmlets. Also measured was how farmers use farmlet information and the relevance the farmlets had to them, to confirm if the existing communication strategy was adequate for the requirements of the farming community and to generate ideas about how the farmlet extension messages could be improved.

The survey carried out by an independent consultant revealed the importance that farmers placed on people such as veterinarians who provided one-to-one and typically expert-type information. It also revealed that industry newspapers were valued by farmers and, furthermore, confirmed that the VMF initiative and its intentions were well-known to them. Only one respondent was unaware of the VMF. The majority of the farming community surveyed saw that the main purpose of the VMF was to undertake research and development in pasture management, feeding regimes, stocking rate and fodder conservation. Farmers used the VMF to compare their own performance and for general information on pasture and feeding programmes. The survey also confirmed that the current communication strategy should continue i.e. farm walks and the monthly articles in newsletter in particular were well received, though there was a need to change the underlying messages.

> "We needed to be focussing on production issues, which we know are relevant and topical to farmers at this stage and then, if you like, delivering the message for those in a broad text with examples from the farmlets. So in other words not leading the extension with "the farmlets -- this is good for you" -- but just basically using the farmlets as an indication of how we've coped and are managing the challenges of the industry at the moment". (Extension leader (c), 2002).

To help further adapt information from the farmlets the new extension leader initiated a series of companion farms to complement the farmlets project. The aim was to close the information loop by step-by-step implementation of the farmlet practices with commercial farmers. The project team considered most of the learning around the farmlets would come from the companion farm process.

> "Most of the learning from the farmlets we expected to come when the companion farms were implemented on a real commercial farm. The farmlets are the place where you can take risks that you would never want to take on a commercial farm. But, you know, there's still a whole range of things that they can learn for their farm and so I guess that's really the challenge of this whole companion farm process is to add some (commercially) realism into the whole process. There are high expectations on the part of farmers and service providers as to what we should actually do, but we also wanting to take pride in what has been achieved in the whole process and recognising that we are not the be all and end all -- you know we are in the game of learning just as they are. And so that's the challenge for the extension team leader to make that work I guess". (Researcher, VMF 2002).

Initiation of companion farms as opposed to focus farms - the model previously implemented in Western Australia - was a critical step in the learning process taking the farmlet information into a commercial system. The extension leaders explored various models of companion farms and focus farms, and was able to adapt the approach to the VMF project and the resources available. Focus farms are used within a region to promote best practice, whereas a companion farm is associated with the farmlets project directly, mimicking practices and the processes of decision making.

Originally the extension leader intended to set up five companion farms associated with the farmlets, however only two eventuated. The model of the companion farms commenced with an advertisement in the local paper for expressions of interest from the farming community to become a companion farm. The extension leader was looking for farmers who would be committed to the process and had a system that was similar to one of the farmlet projects. The companion farmers nominated a local committee of their choice, which would assist the decision making process in management. The extension leader's role was to facilitate discussion, with the aim that the group would eventually be self-managing and not reliant on the extension leader to generate activities and discussion. The extension leader's role was to ensure the companion farms continued to meet.

Overall, the first two and a half years of the farmlet project was disrupted by significant changes in resourcing and in particular extension capability. However then, activity seemed to settle into a routine, and hence it was a timely point to cease data collection for this case study. Six months remained before the farmlet project was due to finish and by this stage the researcher had commenced negotiations with DA for an extension to the project. A number of inter related critical issues were identified across the activity systems that impacted on the performance of the farmlets as a learning platform which are now discussed in detail.

6.4 Critical issues

Table 9 presents a summary of the various attributes of the Vasse farmlet activity system over its first two years of initiation. There are four key activity systems (research, extension, committee and NDFS project). To achieve the objective of the Vasse Farmlets project, there was differentiation in the respective actions required of each element, the tools required for practice, the rules guiding practice and the division of labour. Consistent between the four elements were the subjects they worked with, the community involved and the overall outcome that was achieved from their effort. The critical issues associated with these attributes are presented in the discussion below.

Element to activity system	Researcher - farmlet leader	Extension leader	Farmer committee	NDFS
Outcome (desired)	Productive and profitable dairy farming systems models to support adaptation and growth of the local WA industry	Learning systems and networks from the farmlet project supporting WA producers to adapt and improve their business management	Commercially relevant, adaptable, productive and profitable dairy farming systems models to support adaptation and growth of the local WA industry	A successful (to achieve the local objective) farmlet research and extension program that utilises best practice and is supported by a national network of dairy farming systems projects
Object	Initiate and on-going maintenance of the physical infrastructure, data collection monitoring and measuring and analysis of the farmlet treatments	Development of an extension strategy, directing and managing extension team, assisting with the farmlet monitoring and measuring, timely delivery of farmlet results	Provide regular input at meetings on the decision making and management of the farmlets	Provide external support to farmlet research and extension strategy development
Mediating artefacts	Farmlet site, pasture plate metres, spread sheets, computer software, dairy, results	Extension strategy, researcher tools, newsletter, website, radio, field day, key messages - calendar of events and seasonal issues	Reports, meetings	Reports, meetings, extension theory/papers and tools
Subject (those who internally form the VMF activity system)	Researcher - farmlet leader, extension leader, farmer committee, NDFS team			
Rules (guiding respective activity towards the object)	Rules of activity are determined by institutional requirements, and also advice from other farmlet project managers and scientific method.	Rules of activity are determined by institutional requirements, work experience and existing systems also 'best practice' advice from external experts (NDFS)	Self developed knowledge, skills and commercial dairy farming perspective on farmlet management and decision making	Known best practice farmlet research and extension tools, processes and practices
Community	WA dairy farmers, milk processors, consultants and agribusiness, AG WA, other farmlets			
Division of labour	Management and delivery of research component, contribute to extension and communication	Management and delivery of extension strategy and team, also contribute to research data collection and reporting	Attend farmlet management committee meetings, review results and reports	Provide input into best practice farmlet research and extension strategy meetings also foster and manage the national network of farmlets
Outcome (achieved)	A fully operational farmlet project that includes both research and extension activities delivering outputs and outcomes to industry			

Table 9. Critical issues impacting on the Vasse Milk Farmlets learning platform

Setting up the new activity of Vasse Milk farmlets required a number of actions and developments at each point of the system, (i.e. rules, division of labour, mediating artefacts, subjects, community etc) to be achieved simultaneously to enable the project to commence. This required significant leadership, vision and networking skills of the research leader, who had been given the task of initiating the farmlets.

> Key concept: Outcome driver
>
> The outcome driver refers to the person who takes the leadership role in identifying the number of objects and critical actions that need to be carried out to ensure the desired outcome is achieved. This subject acts as a broker of actions, to ensure the mediating tools, division of labour, additional subjects are brought into the activity and that the relevant community around the farmlet is created.

Fundamental to the initiation of the project was having a person who was capable of driving the activity to shape, design and set up the farmlet project. The researcher was the 'driver' in this case, largely utilising the knowledge and expertise of other farmlet managers, to construct the farmlets. Researching other farmlet sites was a vital component to the learning process for the researcher. Flaxley Research Station in South Australia was a particularly useful site due to the similarities in farming systems management between South Australia and Western Australia. As highlighted by the researcher:

> "I am going over to Flaxley to spend some time there. There is a similar climate and they have high levels of grain going into their system. But they are able to achieve higher levels of production. We can learn from the Flaxley experience as they have had greater experience with their farmlet studies. The main differences are they calve seasonally in WA and they also use annual pastures in WA". (Researcher, 2001).

This highlighted the need for co-learning around farmlet development and formed the basis to new found learning relationships across projects. This meant that the site at Vasse was built using the experience and knowledge of others, avoiding many problems that other site managers had incurred in the past. The researcher was able to identify potential adaptations in management practice that could be implemented in WA.

> "I went over for three days and just had a look at some of the things they do differently from how we approach them, and talked about some common practices or elements of our systems and sort of gathered a few pointers -- as to where we should be heading with our summer feeding program next year." (Researcher, 2001).

National initiatives such as the National Dairy Farming Systems (NDFS) project were also explored by the researcher. The outcomes of the NDFS project are contained in appendix 2, however it is relevant in this case study due to the value and reliance the researcher placed on the program to inform decision making and direction for the farmlet project. Developing and maintaining learning relationships with peers gave considerable support to the researcher

> "I participate [in the NDFS program] for a whole range of reasons. I guess it's a forum where we can just be made aware of what other teams are doing. I think that's important for me, in terms of going to pick-up ideas, or how we could improve things in the farmlets, how we actually manage our herds, how we go about communicating results, how we go about interpreting results. I guess that's probably the prime reason, but there are other important reasons as well. There's a bit of an element of sanity in there, being with like-minded people and I guess we tend to appreciate what each other is doing. I think that's a really good issue there. It's a group of people that are taking the same approaches and trying to address similar issues, so there's a bit of camaraderie in there as well and that's always important." (Researcher, 2001).

Key concept: Learning relationship (peers)
Learning relationship (peers) refers to the nature of an important relationship with their peers that farmlet teams depend on. The relationships are based on the practices associated with conducting farmlet research and extension, where ideas for common practice and adapted practice exchange between stakeholders.

Just as important, was the development of learning relationships internally within the Vasse farmlet team. A work environment that enabled regular social interaction and co-learning within the team, was achieved through regular team to meetings. As described by an extension team member, "we all needed to learn together what it would take to operate a farmlet project – it would seem you can never have too many resources, it takes time and a lot of commitment for any part of it to run well".

Team meetings included reviewing all farmlet operations and activities, which over time worked to build the team learning and understanding of farmlet research and extension practice. The extension leader in particular, managed the meetings to ensure communication channels were well maintained.

> "I was sort of the chairperson for it I guess because I wanted to know what everybody else was doing, whether the group activities were related to farmlets or not related to farmlets. I thought it was really important for people to see what was happening there and it was a really good sounding board, to find out what people had been doing, what had been working, what hadn't worked, why hadn't it worked and also what were we all planning to do for the next little while". (Extension leader, 2001).

This process was valued, particularly by part-time tem, as a way to stay in touch and learn together.

Definition of roles and responsibilities was a task that also fostered the development of learning relationships within the farmlet team. There was a need for considerable ‘overlap’ in the allocation of tasks and responsibilities of the farmlet project, allowing interaction and interdependency, but also presenting the challenge of how to make the ‘overlapping’ operational. For experienced farmlet teams (e.g. Elliott Research Station), the way in which tasks were shared didn’t require definition or formal organisation as previous experience provided the rules about how the team operated. While other farmlet teams could offer models clear definition of tasks could only be determined once operations commenced at Vasse. Due to the limited experience and resource allocation of the various staff members, the team had to adapt their approach to practice accordingly.

As a starting point, the Vasse team (using the experience of others) maintained and fostered the research and extension interdependency as a fundamental aspect to successfully making the farmlets operational. The research side of the project depended on the extension process through ensuring industry was brought on board and kept up to date, as well as contributing to data collection and analysis. For extension processes, the research needed to contribute new information, technology or tools for extension delivery, to give substance and value to industry engaging with the project - particularly at the farm walk and open days. The farm walks were a valuable process for the researcher to engage directly with the farming community as it enabled the researcher to have direct exposure to the questions that producers had at particular times of the farmlets as well as receive overall impressions that the farming community had of the farmlets. This form of direct feedback was particularly rewarding for researcher, with the mutually beneficial engagement (between producer and researcher) and reinforced the need to maintain this role as a core component to the research process.

Key concept: Role definition and boundaries

The process of role definition refers to how tasks are allocated within the farmlet activity system once the project commences. The co-learning environment of new farmlet activity suggests that the boundaries of roles and responsibilities are emergent with responsibilities becoming apparent only after action for the project commences.

In contrast, some roles did require significant boundaries to be defined at the outset of the program, in particular the farmlet steering committee which had membership of predominately local farmers and the farmlet team. Rules were formulated by which the group operated and defined its purpose: to provide input into decision making for the farmlets and assist in formulating key messages for industry that emerge from the farmlets. Input and assistance for the farmlet team was the mandate, rather than final decision making. These rules guided the operations of the group from the outset. Clear definition of the role of the steering group was constructed and managed by the researcher and he could use the group's guidance in his own decision making.

Systems for sensitising the broader dairy community to the farmlet activity and generating interest were also required. The team needed to be presenting information that was newsworthy, validated and relevant to the commercial context of dairy farming systems. This created an interesting tension for the team: conveying key messages and information to a community that expected expertise, while still at the elementary stages of understanding themselves. This was a major concern to the project leader as highlighted below.

> "There's a never ending list of things that we're learning with regards to managing of pastures or cows or mating, or, animal health or calf rearing, transition cow management, nutrition, fertiliser use, extension. You name it the list goes on and on and on. It's been very valuable for me personally and for my team. But that's not what it's about so much as learning outside the farmlet project. But I think that people (external to the project) forget that we are all new to the farmlet game. We're a team that haven't done these sorts of studies before and so inevitably we have a lot to learn ourselves. Experienced players such as Elliott (Tasmania) or Ellinbank (Victoria) as well - they've done this sort of stuff for quite a long time, so for them it's much more familiar ground. But there had to be a lot of learning for us and if we hadn't done that then, you know, we wouldn't have progressed at all. (Project leader, 2002).

The communication strategy provided a framework tool which allowed for a systematic approach to engaging the broader community and also facilitating concurrent learning of the farmlet team. Learning for all was incremental, and done collectively using a team approach to analysis and decisions making within the farmlets. This led to understanding of how and why certain action was taken seasonally, rather than just the outputs of the project at certain points in time. Seasonal issues included fertiliser application, silage and hay making, formulating a richer picture or the full farming systems 'story'.

Key concept: Contextual learning

Contextual learning refers to the need for farmlet information and planning strategies to account for the current challenges affecting practice, whether it be research, extension or farming. Accounting for the context of a management strategy is undertaken encourages a review of the tools being implemented in the strategy, and evaluation of alternative approaches and use if more appropriate. Local knowledge is what informs contextual learning around farmlets.

The farming community was able to develop a learning relationship with the farmlet information through ‘identity points’, elements within the information that individual businesses could relate to and compare with their own performance and decision-making.

Key concept: Identity points (rules and relationship)

Identity points refer to part of the learning process that the farming community use to connect with the farmlet project. Identity points provide a language or common point within the management of the farming system that can act as a benchmark for comparison between the commercial farming system and the farmlets. An economic analysis, or providing the cost inputs and the profitability of the system management is an example of an identity point.

This approach enabled transparent and systematic presentation of the farmlet results, which stimulated interest feedback from the farming community, received either through random contact or at the farm walks or field days. This farmer summarised what all farmers interviewed were looking for: essentially a breakdown of the practical ways in which the VMF were achieving the results:

> “One of the, not criticisms, but one of the concerns was that you’re only telling us what Vasse is doing. That’s fine, but how can we relate it back to our own business? Like ok, Vasse is harvesting 7 tonnes of grain out of whoopee doo. How did they do it? How can we make those steps on our farm? Not so much -- we did this, a bit more of the how -- or maybe you could try this. But once they changed the format of what they communicated, presenting why they do things it has been great”. (WA Farmer, 2002).

The presentation of results was adapted as the result of the community wanting an economic analysis presented alongside the farmlet results, to add further identity points.

Key concept: Significant incremental learning events

Incremental learning refers to the different 'stages' of learning around a farmlet project. Incremental learning accounts for the changes in key messages that emerge from the project that work to build a full and transparent picture of the farmlet project activities.

Presentation and communication of the farmlet results was a sensitive and complex task as it was information used by the farming community formulate their own identity points and learning relationship with the farmlets.

Key concept: Learning relationships – industry

Learning relationships with industry refers to an additional type of learning relationship associated with the farmlets, and seeks to capture how industry (farmers and associated professionals) connect and learn from the farmlet project.

Related to this key concept, is that of barriers to these elements for individuals outside the activity system. In the first two years of the farmlet project, the production and profitability of the farmlet project was sitting at best where the industry average was. This impacted on the credibility of the project which created doubts within the team as to whether farmlets were going to be valued by the industry as a learning opportunity. The expected targets were not met in the first and second year, distracting attention away from the overall objective the farmlets. The team managed this by making was through the extension and communication as transparent as possible. As highlighted by this farmer on the management committee:

> "Look I really thought it was important that they [the farmlet team] brought the communication focus back to include information on the decisions, as people were looking at the trial itself and any mistakes that were made and, why wasn't it meeting it's production targets became the focus? The focus went back to the practicalities of the trial rather than saying "Well, hey, you know, we've got opportunities to learn about, mix ration feeding" and all the other things that are happening as well, but nobody in industry was drawing attention to that, just the poor results". (Farmer, management committee, 2002).

To try and maintain industry interest and faith that the project had something to offer, the team sought to build a relationship with the farming community, with acknowledgement that it was a learning process for both the farmlet team and industry.

> “Inevitably for us the first year was a very fast learning curve and I would say it’s only fair to account for this and the average performance of the farmlets, because we were still finding our way. And our second year as it turned out we haven’t been able to achieve some of the improvements that we had hoped to achieve. So you could argue that we’re still learning. And so people should acknowledge that we are not experts in this, but we are learning as we go. All we hope is that with that learning other people will learn as well, you know. But again I have the perception that a lot of people expect us to be absolutely perfect”. (Research leader, 2002).

Importantly, as this demonstrated, the farmlet team were seeking a co-learning relationship with the farming community, rather than the more typical linear presentation of information in the form of research results (in numbers and tables) without any mechanisms for feedback and debate. The monthly farm walks were the ideal set up for this as the farmlet decisions and results could be discussed and debated with the participants in a series of gatherings.

Along with building industry credibility, other significant challenges included the need to build the relevance of the farmlet approach to research and extension and position it with commercial operations. The following farmer was able to empathise with the farmlet approach and understand why the farmlet treatments remained, even if the commercial reality of decisions was nonsensical at certain times.

> “Some of the criteria [of the farmlet treatments] that they used, and especially this year with grain prices gone through the roof made absolutely no sense. They were very rigid in maintaining what they were doing in the project -- they had to stick with their format. But a research project has gotta have the aims and you can’t swap half way through so they had to keep going with some of them and a lot of the farmers were going -- well we changed tack, you know, 6 months ago, why hasn’t Vasse? Oh, you know, so it’s a bit of that commercial versus research side of thing that, yeah, that gets people a bit lost if that makes sense. You know you’ve [a farmer] gotta make a decision today and put it into place tomorrow. Whereas, you know, research projects well you’ve gotta go with what the project has set out to do and there’s the risks I guess – that it might fail or succeed, and that’s a positive for it. (WA farmer, 420 cows, 2002).

In contrast, this dairy farmer could not find any positive attributes to the farmlets.

> “They [the farmlet team] had a huge problem with the way they were set up for starters in that if these farmlets are to illustrate to farmers what can be done under 6 different sets of parameters. It has to be done as a research project, but it has to have some sort of commercial relevance. I’m not into this sort of research, to me it has to be practical and applicable and the way the farmlets were set up was not practical and not applicable. They got off to a bad start, they finally then started to put dollar values to things, but at the end of the day the commercial

> application -- was still not there. For example, when you're pushing the boundaries with stocking numbers and pasture and fodder conservation one of the things that you have to be aware of is your herd fertility and when you're pushing too hard you're herd fertility is usually the first indication of that. These herds had twenty cows per herd/30 cows per herd, and if one didn't get in calf then they would just replace it. I mean how does that fit?" (WA farmer, 680 cows, 2002).

Relevance was also diminished through the location of the farmlets and not having a treatment that accounted for irrigated farming systems. As highlighted by this farmer:

> "There used to be a research station in the Harvey irrigation district and there used to be a Vasse research station. So they had two in two different areas -- 2 different dairy farming areas, 'cause this is traditionally the main dairy area before de-regulation in the irrigation area. Now Vasse doesn't have any form of irrigation, so a lot of the people in the northern area got a little bit of – well what would they know? They're not farming like we're farming, you know, they've got no trials on irrigation, blah, blah, blah. So there was a bit of a bad perception". (Farmer, Harvey region WA, 320 cows).

These issues indicate regional obstructions to building learning relationships between the industry and the farmlet project which impact on the activity system.

Key concept: Obstructions to learning relationships
Obstructions are factors that impact on the relationship that an industry stakeholder has with the farmlets. Obstructions are factors that limit the number of identity points, and influence the attributes of the learning relationship a stakeholder may have with the farmlets.

Ongoing management of the internal and external learning relationships was a critical component to the day-to-day operations of the farmlets. Maintaining momentum in activities that enabled learning relationships was challenged by team members leaving and the team resource base changing. This called for the re-adjustment of the farmlet extension strategy, to align with resources available for delivery. With every change in the strategy, the nature of learning relationships changed due to the alteration in the mediating tools.

When the original extension leader resigned, there was a significant lag phase in extension delivery and researcher had to take a greater role in extension processes. Time limitations meant there was only limited capacity to maintain the general communication activities. This meant – for that period of time - the learning relationship with the external broader community was only at a basic level of one way communication of interim farmlet result that were not contextualised into broader industry seasonal issues. Two way communication processes were also hindered, which meant the transparency and important debates and questioning of the result implications were not facilitated. An extension strategy is extremely sensitive to resource fluctuations. Such fluctuations are catalysts for ongoing adjustments in actions and mediating tools. This process of adapting extension strategies is a critical attribute of the VMF activity system.

> Key concept: Adaptive extension systems
>
> Adaptive extension systems refers to the necessary process of assessing and re-assessing the adequacy of extension processes and resources to enable the goal or objectives of the farmlet project to remain achievable. This process involves reviewing tactics and tools in line with available resources and adapting the actions of individuals accordingly.

Over time and with the need to adapt in mind, staying in touch with the broader farming community perceptions and needs was important. Regular affirmation that farmlets were delivering value, or areas for improvements in communication was deemed critical for the team. As highlighted by the researcher:

> "Farmlets apparently have strong farmer appeal, but we had no evidence of that, it was purely base on an informal hear say – we had no formal evaluation to base this on. I worked on a project before the farmlets called "profits from pasture", and an evaluation was done on that project, and so we neede to do something similar. We needed someone to spend time on the phone with farmers, make appointments and ring them, and design a questionaries. It was a substantial task but necessary. We need to keep a feel of what is the real state of affairs and what is the usefulness of the project because if the general agreement is that it's not useful then there's no point in doing it". (Researcher, 2002).

Evaluation was a tool for adapting strategy and focal points. Affirmation of practice is then the final concept that provides insight into the Vasse farmlet activity system, in association with the relationships between rules and division of labour.

> Key concept: Affirmation of practice
>
> Affirmation of practice refers to a learning need of farmlet researchers and extension leaders, whereby evaluation tools are used to mediate the measure of value and areas for improvement in the respective practices and set new rules for action.

The discussion now moves to elaborate on the emergent learning on the farmlet activity system and how the concepts from the analysis relate to the farmlet as a learning platform.

6.5 Emergent learning

Table 10 presents a summary of the key concepts that emerged from the data analysis and figure 18 demonstrates the interrelationships between emergent concepts. Fundamentally, to successfully initiate and maintain the VMF activity system, the outcome driver was an essential element to maintaining consistency and focus of the desired outcome. Primarily, the predominant actions enabling the learning platform to emerge was those used by the farmlet researcher and subsequent extension leader to create and maintain internal and external relationships and adapt the rules and division of labour with changes in resources. A second level of action was the adaptation of existing tools in line with the resource base, which functioned to mediate internal and external relationships.

Coding category	**Implication in the activity system relationships**	**Concept**	**Symbol**
Leading, initiating and managing actions in farmlet activity	Object/actions/outcome	Outcome driver	OD
Addressing learning needs of farmlet team – contact with others	Subject/mediating tools/objective/community/rules	Learning relationship - peers	LR_P
Allocation of tasks between farmlet team	Division of labour	Role definition and boundaries	RD
Linking with farming community	Community/subjects/tools	Learning relationship - industry	LR_I
Communication and farmlet key messages	Tools/rules	Contextual learning	CL
Farming community connecting with the farmlets	Tools/rules/community	Identity points	IP
Points in time where communication and linkage with the farming community were made	Tools	Significant incremental learning events	◎
Antagonistic factors to building relationships around the farmlets	Subjects/community/tools/rules	Obstructions to learning relationships	⊘
Extension strategy reviewing	Subjects/tools/rules/division of labour	Adaptive extension systems	A_E
Evaluation and assessment of performance	Subjects/tools/rules	Affirmation of practice	A_P

Table 10. Summary of the emergent concepts from VMF

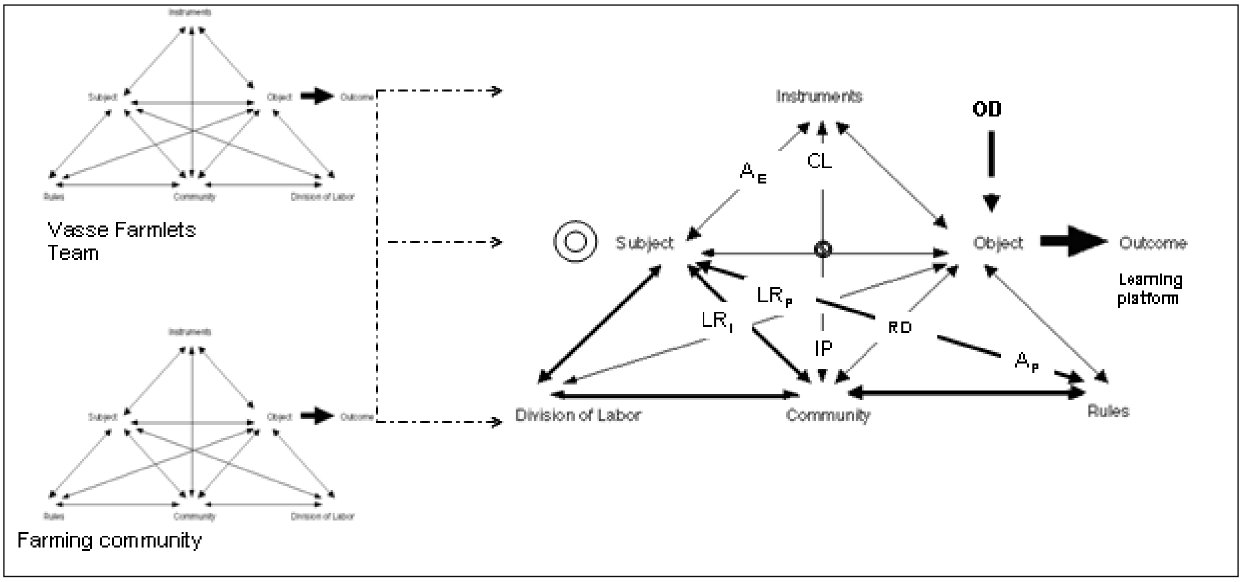


Figure 18. Interrelationships between emergent concepts of the VMF learning platform.

In terms of the implications of these findings to the research question, the following conclusions can be made from this case study.

1. Learning relationships are a fundamental factor contributing to the emergence of farmlet learning platforms. Learning relationships in this case were defined by activities that enabled questioning of practices (research, extension and farming), seeking feedback on actions, seeking justification for actions – all around a common object of the farmlet project.
2. In the context of this case study, the learning relationships occurred internally and externally to the farmlet team, requiring a central and consistent driver that manages and creates linkages between internal learning relationships with those that are external to the farmlet team. Learning relationships were mediated and shaped through the types of tools available to maintain the internal and external learning relationships.
3. A fundamental role of the learning relationship is to facilitate adaptation of pre-conceived/existing knowledge, information, and beliefs into new knowledge and confidence. Establishing networks and maintaining them is essential.
4. An important element of the learning relationships is that it remains a priority internally to maintain and utilise the extensive networks created to enable clarity and review of the actions required to achieve the object.
5. Maintaining the integrity of the desired object is critical as it creates the anchor for all actions. The learning platform will emerge as a result of reflexive processes, enabled by the various learning relationships and mediating tools. The continuity of an object enables stability.

6.5 Conclusion

This case study focussed on the initiation stages of a farmlet project and tracked the operational processes of the activity system to further establish how farmlets perform as learning platforms. Farmlets were a new activity for the team at Vasse, representing an opportunity to study how the activity system may emerge without any historical precedents guiding development. Activity was primarily based around the development of learning relationships between the farmlet team members (internal) and the relationship formulated with the farming community (external). Relationships were mediated largely through extension tools, and the farmlets.

The third case study on the Flaxley Farmlet project moves the focus to South Australia, and a farmlet project that had significantly less extension resources (compared to ERDS and Vasse) and a volatile, highly political industry environment.

Chapter 7 Case study 3: Flaxley Research Station

7.1 Overview

The Flaxley farmlets project was located on the Fleurieu Peninsular an hour's drive south west of the capital city, Adelaide. At the time of this study, the site had commenced the second farmlet program and was a well-established and recognised activity within the region. Extension resources associated with the project were extremely limited and the local dairy industry highly politicised. There was very little government extension within the dairy industry due to the shift in State government policy towards a withdrawal of these services. Any dairy extension services were largely left to private consultants, local veterinarians and agribusiness representatives. The limited government provision of extension was allocated to maintaining discussion groups that were dwindling in numbers, indicative of the dramatic impact the policy shift had in terms of learning around the farmlets and the capacity to engage with farmers. This case study explores the Flaxley Farmlets program as an activity system, to establish the attributes of whether a learning platform can emerge without critical resources allocated to the extension component of the R&D continuum.

Key issues impacting on the Flaxley Farmlets project activity will be provided first. Then the four significant stages of the farmlet activity system development in the duration of the study period will be discussed. Critical issues and emergent learning is then presented prior to a discussion on the emergent concepts, the interrelationships between concepts across the activity system, and the implications for the research questions.

7.2 Background

The farmlet project in South Australia was located at the Flaxley Agricultural Centre, which had been in operation for approximately 13 years as a dairy research facility. Much of the research involved pasture variety merit testing, calf rearing trials, grazing management research and management demonstrations such as testing pine bark on laneways to prevent lameness in the herd. The centre had multiple purposes beyond dairy research. The site was used by the local Technical and Further Education (TAFE) branch for training dairy traineeship students in machinery use and cattle management. The dairy herd improvement service in South Australia also used the dairy herd at Flaxley for artificial insemination training.

Flaxley farmlets were selected as a case study for three reasons. The first relates to the research station staff resources: Flaxley started with four researchers and a full time extension practitioner who was located within the State government institution called Primary Industries Research South Australia (PIRSA). Over time, the station team was reduced to two full time researchers (one allocated to the farmlets) and no extension practitioners on site. Progressively the research staff working at the facility also diminished, with two research scientists being allocated to the most recent dairy research project and no extension practitioners on site due to the State government withdrawal of extension services to the dairy industry. The Government rationale was to shift resources into emerging industries (not necessarily agriculture) with the expectation that the private sector would fill the void in extension service provision. The implications of this are further explored later in the chapter.

The second reason for the choice was that the new farmlet project development was fraught with controversy due to the change in the way farmlet research was to be managed and the loss of control farmers had over the project activities. Two farmlet projects had been conducted at the site over the 13 years of dairy specific activity. Projects were managed by a management committee which consisted predominantly of farmers. Despite expectations of the management group continuing in their previous role this was to change. The new farmlet project was set up more scientifically (rather than as a demonstration project), which changed the skill requirements for management. This mismatch of expectations had significant fall out with local producer engagement and hence the development of a learning platform for industry.

Finally, the location of the farmlets was away from where the majority of industry growth was occurring in the far south east of the State (at least 400km away from where the Flaxley farmlets were located). Significantly large dairy operations were being developed in the south east at the time the new farmlet project was initiated. Despite recognition by farmers generally (evidenced by interviews) that the farmlets were a valuable resource, there was still significant criticism and reluctance to engage with the farmlet project. While this criticism came from a small group of farmers, they were very influential due the large size of their businesses and active lobbying of government and the media on the shortcomings they perceived in the Flaxley Farmlet Project.

7.3 Significant events

Figure 19 demonstrates the significant events that occurred at the Flaxley farmlets during the study period. Each of these impacted on the farmlet activity system and emergent learning platform. The case begins with a situation analysis of the farmlet project including an overview of the concepts of research and extension being employed, the initiation of the SA dairy network, and activities that engaged the farming community. Critical issues from the activity system and factors impacting on the emergence of a learning platform are then explored prior to the conclusions regarding emergent learning.

Withdrawal of State Government dairy extension services	New farmlet project developed and initiated	Farm walks commence	Farmer committee members leave	SA dairy network project commences	Flaxley Field day	Farmlet project extended for two years	Farmlet meeting in the south east	New extension strategy developed with NDFS team
Jun-98	**Jun-99**	**Oct-00**	**Jun-01**	**Mar-01**	**Mar-02**	**Jun-02**	**Jul-02**	**Sep-02**

Figure 19. Timeline of significant events at Flaxley farmlets

7.3.1 Flaxley farmlet project

A farmlet project was established at the Flaxley Agricultural Centre in 1999 to quantify the effect of stocking rate on the productivity, profitability and sustainability of pasture-based dairy farming systems. High inputs of purchased supplementary feed under dryland and irrigated management systems were additional treatments in the study, conducted in a typical Mediterranean agro-climatic zone. At the highest stocking rates this farmlet project was pushing the resource capability (both natural resources and human capability) of typical dairy farming systems in the State and was therefore a high risk project for investors. Table 11 presents the treatments studied.

	Dryland Farmlets					**Irrigated Farmlets**			
Stocking Rate (cows/ha)	2.7	2.9	3.3	3.6	4.1	4.1	7.2	6.3	7.4
Area (ha)	8.8	6.7	7.8	7.3	4.6	7.4	4.2	3.8	3.4
No. of cows	22	19	19	19	19	22	22	24	27

Table 11. Flaxley farmlet treatments

Milk production, pasture growth rates and utilisation, lactation lengths and supplementary feeding rates are the key measurements. These measurements were presented in a bi-monthly update written by the researcher and provided to the main milk processor for the State. Gross margins to establish the profit margin were calculated for each herd when they were dried off for the year.

7.3.2 Managing Flaxley Farmlets

The farmlet project underway at the time of this study had been generated from an earlier demonstration project (1996 – 1999) between farmers and consultants and the farmlet staff in the local region. The previous project had significant farmer input into the activities of the demonstration, with decision making largely the responsibility of the farmer committee. Utilising participatory extension principles, the approach aimed to generate farmer and overall industry interest in the program through this farmer input. The government extension practitioner's role was to convene the management group and act to facilitate meetings.

At the completion of the demonstration project, significant industry support was generated for a new farmlet project that focussed on stocking rate and its relationship to profit. As highlighted by this stakeholder:

> "At the end of that 3 year program the farmer panel sat down and said "Well why don't we just look at stocking rates bona fide as the topic for our new 3 year project?" and after I suppose a series of 4 or 7 workshops that not only came up with a proposal, but actually attracted a hell of a lot of farmer interest -- I mean I remember at the final planning meeting, we had a management committee there that had something like 12 -- 17 very progressive farmers around the table. It wasn't just sort of the guys that were 2 miles down the road. This program -- well this proposal had attracted a hell of a lot of interest with very progressive farmers around the table saying "This -- you know we can demonstrate best practice in a whole stack of areas here. Best practice dairying, best practice R&D, best practice interactive learning, best practice extension." (Consultant, 2002).

The newly developed farmlet project continued to utilise the demonstration methodology of two large farmlets of around 80 hectares, one for dryland and the other for irrigated. Each of these farmlets was to have a high stocking rate to determine the issues that needed addressing if a farming system moved to this higher stocking rate. The key essence of what the committee were trying to do is captured below:

> "The project design was a matter of going and doing [to see what was possible]" – we're proposing to simply manage each of those reasonably large scale farmlets as a high stocking rate enterprise, no holds barred -- that is we're going to pluck 7 cows per hectare out of our bum as what we think it might be achievable. We're going to run that with our best practice ideas for the next year, fertilizer, animal health, you name it. If something crops up

> we'll either try and fix it or if we see that as an insurmountable barrier we'll back off to 4 cows per hectare and see if that's sustainable. They [farmers and management committee] wanted complete flexibility to run a large scale project. I suppose not purely just to be able to work out can we run 7 cows per hectare or only 4, but because the panel were recognising that we have such diversity across the State that even if we found that 7 cows per hectare were sustainable at Flaxley, is it going to be sustainable at Meningie or Mt Compass. What they wanted to do was run a large commercial scale high stocking rate farmlet, so that if they ran that for a year and issues like lameness became a really big problem they would have the ability to be able to pull whatever levers they could without commercial constraint to try and solve that lameness problem or similarly if it was pasture pugging in or cow reproduction". (Consultant, 2002).

There was a strong sense of ownership of the new farmlet project across the farmers involved. This was considered a major imperative and strength in the planning process by the extension officer who was facilitating the activity of development. Overall, the committee was keen to maintain its previous role for the farmlets, having considerable influence over the decision making, and having a project that had the flexibility to change treatments if things went awry. From an extension practitioner's perspective, the process was extremely positive in terms of setting the foundation for learning processes associated with the new farmlets project:

> "It's not very often that we come up with an industry R&D and extension project where its creation has been by farmers, where there is a strong role for farmers to be involved in driving it, to have a feeling of ownership of it and the ability to just keep driving the system over time. All these farmers are sitting here saying, "This is directly relevant. We all know stocking rate is the go. Let's just drive, pull the levers and on a commercial scale, you know, demonstrate to ourselves and to the industry what barriers you have to tackle as you increase in size and stocking rate and how to overcome them." Now from my point of view that's -- a fantastic extension scenario". (Former extension practitioner Flaxley, 2002).

After the significant effort by the planning committee to write a proposal, efforts were then directed towards generating support for the proposal from other stakeholders in the industry. Policy organisations such as the South Australian Farmers Federation provided their support, as did the two major milk processors in the State. Overall, the new project proposal had a high profile around the State, and gained significant momentum with many stakeholders ready to engaged with the new farmlet project.

The next stage was to then apply for funding, and so engage with the industry funding body the Dairy Research and Development Corporation (now Dairy Australia). Until then, the DRDC had had no input into the project design or development. While the work developing the project was acknowledged by DRDC, the methodology of the project did not stand up to the requirements of research programs.

> "It was at the stage of submitting that proposal to DRDC as the likely funding agency that DRDC themselves came in and said "Well look this is all great, you know, fantastic, good industry support. But we would be loathe to fund a program that basically has very little scientific merit." It was going to be a demonstration farm. No replication, you know, obviously not a hell of a lot of rigidity to the methodology of the project. Their feeling very much was well this sort of demonstration activity has worth, but from our point of view we would rather not see one of our government research facilities tied up with something like this that could be almost engaged on a commercial farm. That is can you not simply use 1 or 2 commercial farms as demonstration farms, assuming that those guys are driving stocking rates for profit anyway". (Consultant, 2002).

There was a conflict in the perceived role of farmlets and the types of objectives that justified investment from industry (DRDC) and public (State government) resources. From the DRDC perspective, the farmlet design needed to be scientifically valid, providing results that could be statistically analysed and hence result in some rigourous conclusions. Demonstration farmlet projects were considered to be an activity that was not rigorously testing a hypothesis, outputs were not statistically significant and results limited in extrapolation capacity. From the farmer committee perspective, the project needed to be on a commercial scale to manifest the problems that occur with increasing stocking rates. Within small scale farmlets, if one cow dies it affects the performance of the whole herd. Large herd management issues were a core part of the project as was addressing the problems as they evolved, changing treatments if necessary. On the other hand, small scale farmlets enabled replication and integrity in the experimental design.

At this point there was a shift in who was taking responsibility for writing and shaping the new farmlet project proposal. A researcher at the farmlets site was engaged to adapt the farmlet to address the requirements from DRDC. The management committee had expected the researcher, who had previous experience in developing research agendas as well as success in generating funding from DRDC, to maintain the intent of the already developed proposal. However, it wasn't long before the disconnect in objectives became apparent, and the researcher was put in an impossible position. This farmer from the management committee demonstrates the unrealistic expectations they all had:

> "There will always be the expectation from farmers when they're negotiating and discussing with researchers, I think it's fair enough to say that the expectation is that those researchers -- they're talking to the people that have control over the research and extension agenda. The researcher was seen as the man to talk to - to influence the direction of the farmlets. He

> was given the job of writing a proposal that he agreed to and supported with industry only to have him come back to the meeting and say, “Oh DRDC has rejected that or we need to do this to get funding.” I suppose part of the frustration was finding he was not in control of the research agenda and then thinking well why the hell are we talking to you? I remember thinking, who is in charge here or does DRDC decide what research goes on and if they want farmer involvement why aren’t they across the table talking to us instead of you? I think it’s ludicrous to have people engaging in the industry that can’t respond directly to that feedback”. (Farmer, 300 cows Fleurieau Peninsula, 17 years).

This was a turning point where DRDC provided substantial feedback in terms of the design of a stocking rate project they would fund. Feedback was provided directly to the researcher, who negotiated directly with DRDC to shape the project design. The resultant project remained focussed on stocking rate, and maintained the farmer management committee to assist in the project decision making, however it was designed so that the farmlets followed a replicated, more rigorous research program that would provide deliver statistically valid outcomes.

The new farmlet project had a rocky start, particularly evident by the way the management committee functioned. The role of the management group wasn’t clearly defined and so by default the committee assumed the same role as in the previous demonstration project. The project design had set different boundaries without allowing the flexibility to amend treatments and this created significant tension. For example, the highest stocking rate farmlet experienced significant pugging[10] damage and the committee decided that the treatment should no longer continue because it was seemingly not working. However the high stocking rate treatment was maintained, to establish how the problems that emerged could be managed. By the end of the first year of the project, a large majority of the group had resigned because of this issue. The resultant negativity towards the farmlets tended to filter through to the local discussion groups:

> “It seemed to me there’d been a shift in what they were doing and I heard a bit of flack about it and I went and spoke to a friend who is in a discussion group at Mt Jago and asked him -- I know they’d had a lot of input over the years and asked him what’s going on. He said, “We asked them to stop -- not to go on with it [highest stocking rate treatment] because we reckon they’d gone far enough in the direction that they wanted to take it.” He said, “We weren’t listened to.” and then he said, “We pulled out of the Management Group.” (Farmer, Meningie region, 400 cows, 30 yrs).

[10] Pugging occurs when paddocks are affected by heavy trampling of stock under wet and boggy conditions.

7.3.3 Loss of extension resources

At this time, extension resources had disappeared from the Flaxley farmlet team, which was having a considerable impact on relationships both within and external to the farmlets. The State government decided to withdraw dairy extension resources and divert these into emerging industries, based on the assumption that the private sector would fill the void in service delivery.

Historically, dairy extension in South Australia was provided free of charge through the Department of Primary Industries. When the Government decided to withdraw extension out of some industries including dairy, they did so by retrenching staff positions and not replacing them. Many of the retrenched Government extension practitioners became private consultants. At this time, there were three private consultants in SA who worked only within the dairy industry. There were other private consultants who provided some service to the dairy industry, however this was not the primary focus of their business activity.

As private consultants, those originally involved with the farmlets maintained relationships with many of the farmers on the management committee, however they didn't have a direct role in directing any of the farmlet extension activity. The principle researcher was given the responsibility of initiating and managing the extension strategy around the farmlets project in the first 18 months of the project. Extension for the farmlets project was then determined by the way he perceived the role of extension, and the level to which his role as a researcher (time and resources) allowed him to initiate and manage the extension activities. Essentially two mechanisms for extension were employed. The first was to provide bi-monthly updates to the local milk processor who distributed the information through its respective newsletter. The second was monthly farm walks where industry was invited to visit the site and view each of the treatments and respective results.

7.3.4 Initiating new extension resources

Recognising the problems associated with the poor extension activity, around eight months into the farmlet project the regional development program (DairySA) set up a co-funded (between SARDI and DA) extension program called the South Australia (SA) Dairy Network. The program was an attempt to support and promote learning opportunities for dairy farmers (Salter, pers. comm. 2002). A project leader was employed to work on the strategic direction of the program together with an extension project officer who had the role of co-ordinating and supporting existing discussion groups and field days that were held at the Flaxley farmlets.

In the initial phases of the project, the strategic role of the Project Leader was to determine the communication channels between the network, the private extension providers, and the Flaxley farmlets. For the Project Officer, the key was to work with discussion groups to identify their learning needs and broker information and activities identified. As highlighted below:

> "My role involves working with dairy discussion groups across the state in terms of identifying what their learning needs are. And developing programs for them to achieve that -- those learning needs and then to also identify what the wider industry's learning needs are and to develop courses to suit those and co-ordinate the delivery of those courses. We use the themes that are coming out from the group to determine the learning needs of the wider dairy industry. So I'm not involved with the farmlets as such. My job at present doesn't involve the extension of Flaxley research". (Project officer, SA dairy network, 2002).

The SA dairy network created linkages with farmlets in a variety of ways. The 20 discussion groups already functioning were given the facilitation role, aimed at helping the groups set the strategic directions and a timetable of activities for the year. Guest speakers were invited to the group sessions to provide specialist knowledge on a particular aspect of the dairy farming system. Linkage with the farmlets occurred on an ad hoc basis: in most cases a visit to the farmlet project was arranged on an annual basis. Much of the facilitation role was geared towards trying to get the groups to become autonomous and running themselves, rather than requiring the ongoing support and resources of a SA dairy network employee.

The SA dairy network contributed to the annual field days at the farmlets. The role of the network was to help design the day, attract speakers and also encourage participation of the industry. The field days were attended by significant numbers (130-140) of dairy farmers who were mostly from local dairy farms within 170km of the farmlets. The Dairy SA network had regular weekly formal contact with the researchers at the farmlets to ensure they were updated on farmlet activities and progress, however they did not have a role in directing any of the decision making around the research activities.

An issue associated with extension capacity and the farmlets was the reach that was possible in effectively linking with the full industry across the State. The farmlets project was separated by over 400 kilometres from the fastest growing dairying region. Not only was the south-east region the fastest growing in dairying, it also had a large and very vocal political influence. At the inception of the farmlets, representatives of the region expressed concerns over the relevancy of the farmlets treatments as well as the limited ability of the region to stay in touch with outputs and learnings that were to emerge over time.

As highlighted by this farmer:

> "Before we came here we had a herd of cows doing just a little bit under 9,700 litres and there's just not that type of information being generated that's been useful to over here. I had a look around for it as well because as you can see we're not the only large farm. If you go back to 1998 there was only one herd over 300 cows in the South East, so now there's five or six over 1,000 and a couple like ourselves and one other which is approaching 2,000."

A self-organising group of dairy farmers had formulated the South East Regional Dairy Group (SERDG) and decided to arrange an information day whereby the farmlet researcher was invited to present the farmlet results that had been achieved to that point in time. Facilitated by a private consultant from the region, the SERDG was set up to represent the south east dairy farmers interests in terms of creating linkages with the remainder of the dairy industry, and in particular, source and arrange activities for learning. The group was keen to establish better linkages with the farmlets' information and stay in touch with outputs, and so an information day was arranged for an update on the Flaxley farmlet project as well as other national dairy programs.

Approximately 80 dairy farmers, local private consultants, attended the information day. While the meeting began with intentions of being an information session with the opportunity to interact with the researchers, because there had been significant tension brewing due to the lack of contact and information farmers had received from the farmlets, the information day turned hostile. Most of the south-east farmers supply milk to Victorian based companies, which meant they didn't receive any of the farmlet updates. The farmlets were an eight hour return drive away to get to from the south east so it was difficult to attend field days at the site and remain up to date with information through that mechanism. Farmers considered the information day long overdue, and the farmlet researcher giving a presentation on the day was met with a very negative response. As highlighted by this farmer:

> "I would say in the past there hasn't been enough of the researchers actually going out and doing the PR work at audience level. You know there's too much just written reports put out - rather than actually going out and telling you what they've actually been doing and what they're achieving out of something – this means a hell of a lot more than trying to read a piece of paper". (Farmer, 300 cows, Meningie region, 30 years).

The audience challenged the farmlet project through questioning project relevance, logic and objectives. Farmers were looking for a point at which they could connect with the farmlets that would be beneficial for their learning. This farmer was particularly disappointed.

> "Well there was a brief presentation of half a dozen research projects, probably four of them from Flaxley. What the four of them were about I can't think off the top of my head. So the scientists gave a little presentation of what they were doing generally on Flaxley – and what the farmlets were doing. Most of it was received OK, but the farmlet one got a bit of a hiding because people couldn't see where it was going. You couldn't really see if there were any advantages and if there were then it wasn't being articulated very well". (Farmer, Meningie region, 300 cows, 30 years).

The researcher presenting the results found the process difficult to manage and considered the outcome to be based on historical events. The researcher was expecting a poor reception, and was resolute that the only way that the south-east would be receptive was if the farmlets were located in their area.

> "The SE people pretty much blew raspberries with regards to the farmlets. History goes back 17 years - they wanted the research farm in their area. So now everything done at Flaxley is considered irrelevant. They were not pleased that it would be extended for 2 years. When we developed the project we had people from the SE on the planning group and when they found out we were not doing exactly what they wanted they didn't turn up. To solve the problem we needed to establish a farmlet project down in the south east. They always have an excuse for it to not be relevant or they already know it. The attitudes are hard to address. We can go down and deliver all the information under the sun. Any turn around in attitude will take a long time. I just don't know how to address the relevance problem. It probably needs a greater extension effort, but we had extension officers bale out just when project started and I just don't have the time". (Researcher, Flaxley, 2002).

While from the researcher's perspective the day was disastrous, and it reinforced for him the amount of work required to build a relationship with the region. The engagement and participation of the Flaxley researchers in the south east day was meant to be an active demonstration that they were willing to try and bridge the gaps and connect with the farmers in the region. This farmer considered one of the greatest values of the day was to get the researchers into the region to see what their specific needs are from the farmlets:

> "Well -- what's his name? The main researcher there he went through the overview of what they are doing at Flaxley, what they had done in the last 12 months. Like a little bit of stuff on bark chips, rearing calves with using junket tablets in the initial feed with the colostrum. We had a guy over speaking on fertility and work that DRDC had been doing getting cows in calf. I don't know. We had about ten subjects for the day. Yeah it's was a pretty handy day. Just a good information day. I reckon if you get two things out of day you've done well. But it was just good to get the researchers down here to have a look around what we need down here. (Farmer, Meningie region, 400 cows, 30 yrs).

Another positive element for some of the farmers was the benefits derived from direct interaction with the researchers from the Flaxley site. This farmer considers the learning experience more valuable than if he received it from an extension practitioner. He was also looking for a level of competency as well as a willingness to engage with farmers:

> "It depends on how good scientists are giving that information. I mean if an extension person can put that information out very well that may be as good. But if you can get a researcher up there that's actually done the work and you're really intrigued with it, you can ask them questions and they can respond to you -- it probably does mean a bit more because when it comes to that hands on work and you start asking the questions they can actually answer it because they know everything about it." (Farmer 1000 cows, Mt Gambier, 2002).

The positive attributes that emerged from the day tended to be lost though, with the researchers returning to the farmlets feeling deflated. The researcher then wanted to wait until the negative reactions of farmers had died down, and write an article for the popular rural press on the farmlet program and interactions with the SE region. Overall, the experience reduced any inclination of the researcher to return to the SE region.

> "The effect the south east experience has had – well it doesn't do anything to moral that is for sure – it is nice to think that you are helping the industry. We are just waiting for it to quiet down but then put an article in the stock journal that is targeted to the south east information. Until then, we will be pressing on as we have done to date." (Researcher, 2002).

Over time (around 2.7 years had elapsed of the original three year program), the strategy of the SA dairy network activity in association with the farmlets and other private extension deliverers came under scrutiny by Dairy SA. The opportunities for improved linkages and co-ordination of activity were deemed worthy of exploration through a workshop between the private extension providers, scientist from the farmlets, SA Dairy Network representatives and a member of the National Dairy Farming Systems project. The objective of the meeting was to co-develop and generate commitment to a State dairy extension strategy that centred around the Flaxley farmlets.

Key messages that had emerged thus far from the farmlets were consolidated. The immediate message was that increasing stocking rate led to improved utilisation and profitability subject to farm systems and management issues. Additional analysis was needed to support this finding in order to meet the expectations of stakeholders (farmers, funders, consultants) including benchmarking data, a subdivision investment [benefit cost], the differences between irrigation and dryland systems, the impacts of increasing stocking rate on pasture quality and monitoring and control over pasture increasing (Crawford *et al*., 2002).

The group then allocated a strategy with a three stage process incorporating awareness, workshop and mentoring approaches (Crawford *et al*., 2002). The awareness approach was to have regional days that focussed on activities, milk tanker drops of newsletters, frequent media releases, Flaxley Innovation Days, a core information pack; booklet and presentation materials, expansion of the network through existing discussion groups and engagement of service providers through agribusiness industry awareness days.

Beyond awareness, the strategy then moved to the development and delivery of workshops in the various regions, to provide pathways for increasing stocking rate and profitability, based on the outcomes of the farmlets. These workshops would engage the SA Dairy Network and also private consultants.

The third activity was to conduct companion farms in association with the farmlets. The companion farms were to be based on local champions and facilitated by local consultants. The role of the researchers at the farmlets was to provide information resources to each of the activities.

The strategy intended to deliver multiple contact points for the farmlet activities. It also provided clarity of the roles for each stakeholder, and developed pathways on which each stakeholder could take action around the key barriers for extension (see Box 6). Overall, the approach was agreed upon, with the next steps requiring funding and delineation of delivery responsibilities between stakeholders in the workshop.

Box 6 Key challenges to extension of the Flaxley farmlet outcomes
(Crawford *et al*., 2002)

- Perception of Flaxley location affecting information relevance and credibility;
- Historical baggage of project establishment;
- Farm profitability – farms struggling were not interested in messages
- Farmers leaving industry with reasons [including lifestyle and job satisfaction]
- Some farmers don't know where they are and where they can get to [knowledge base]
- Intensification impacts on lifestyle farm system were unknown.
- Environmental regulation messages not accounted for with increasing stocking rate
- Water use issues becoming more dominant[capped water supply]
- Support/extension structure in the state
- Diversity systems/ farm size/ distance [geographic spread], cultural differences
- Farmers' time limited
- Timeliness of information
- Shift to the south [cows], larger farms/ better managers [still minority], larger herd sizes
- Not integrating research & delivery
- Ability of SARDI to support extension
- Risk dependence on 1 person who's role is science

Overall, the workshop was very successful in generating an agreed strategy which would enable better engagement of industry with the farmlets. Enthusiasm for the workshop reinvigorated private providers interest in linking their activity with that of the farmlets project, and the exercise of being included in the strategy development process went some way towards rebuilding relationships. However the strategy didn't ever eventuate, as the Dairy Network project officer given the task of completing the strategy and applying for funding resigned from her role shortly after the workshop to become a private consultant.

The critical issues and themes drawn from the significant events, pertinent to answering the research questions, are now presented.

7.4. Critical issues

Table 12 presents a summary of the critical issues within the Flaxley farmlet activity system over the duration of the study period that impacted on the emergence of a learning platform. Four key individual activity systems (research, extension, management committee and project funders (DRDC, DairySA), had differing perceptions of required actions, the tools required for mediating relationships, the rules guiding activity and the division of labour, while all working with the same community. Consistent between the four activity systems were the subjects they worked with, and the community involved. The critical issues associated with these attributes are presented in the discussion below.

Element to activity system	Researcher	Extension officer	Farmer	Funder
Outcome (desired)	New farmlet project - with industry funds - to establish stocking rates and associated management implications	New farmlet project - with industry funds - to establish knowledge and information on stocking rates and associated management implications to convey to the regional industry	New farmlet project that will demonstrate the impacts of high stocking rates	New farmlet project - with co-investment and rigorous design, that will create new benefits, knowledge, information and tools for the industry nationally
Object	Initiate and maintain data collection on a farmlet project set up using an appropriate experimental design that will enable the emergence of validated new knowledge on dairy system intensification. Also communication of results to industry.	Facilitate the management committee and initiate extension strategy that creates linkages with industry through adapted/contextualised information emerging from the farmlets (n.b. this object of extension only existed at the planning stages of the farmlets, but was reinstated with the initiation of the SA dairy network)	Through the management committee process, direct decision making and guide farmlet management to maintain relevancy and formulate messages for industry.	Address national and regional industry priorities by deploying resources that will enable validated knowledge to be developed and delivered to industry.
Mediating artifacts	Farmlet site, farmlet data, research team and management committee meetings, processor newsletter, field days	Farmlet site, team meetings, management committee (then with the initiation of the SA dairy network) discussion groups, private sector activities, NDFS team, processor newsletter, field days	Farmlets, farmlet data, management team meetings, commercial perspective, previous farmlet project	Application template, DA program objectives, national strategy, NDFS project
Subject (as considered by the respective activity system, those who are re)	Primarily farmlet team of researchers and extension officers (at times when they were there), secondary management team, DA and RDP	Primarily farmlet team of researchers and extension officers (at times when they were there), secondary management team, DA and RDP	RDP committee and DA, farmlet team equally	DA, RDP, farmlet team, NDFS team
Rules governing action towards the outcome	Researcher is the overall manager of the project and primarily responsible for ensuring outcomeis achieved. Reporting and manages the day to day actions of farmlet research. Regular communication of outputs.	(When there was extension resources) they were deemed responsible for the facilitation of the management group, organising activities that facilitated farmlet information to be conveyed to the industry	Decision making, commecial legitamacy and communication with industry.	Provide funding, manage milestones, ensure outcomes for regional and national imperatives are achieved and have an impact with industry.
Community	PIRSA/SARDI (farmlet team), SA dairy farmers , private sector deliverers, NDFS			

Division of labour	Writing the application, research design, management, delivery and reporting to management committee and extension, funders	Extension strategy, activity delivery to industry, maintain relationships with researchers and industry, reporting	Review farmlet progress towards objectives, contribute to decision making, finding solutions to problems, communication to industry	Critically review applications against regional and national priorities, review milestones, provide industry support/funding.
Outcome (achieved)	A farmlet activity system with limited capacity as a learning platform due to industry perception, poor information delivery and tools to mediate relationships, a fragmented extension system and disgruntled industry.			

Table 12. Critical issues impacting on the Flaxley Farmlet learning platform.

Because relationships were not well-managed, as a learning platform this farmlet was restricted in many ways. The project development process was driven largely by the need to receive industry funding (whatever it took), with poor communication and negotiation between the management team, the farmlet research and the funders. Where a learning relationship could have been developed through understanding rationales behind decisions, a damaging divide with farmers was created. Missing from the process was any appropriate 'negotiation forums' to reach a platform of understanding and agreement. This division between activity systems was to overshadow the learning platform throughout the duration of the project.

Key concept: Activity system division

Activity system division refers to barriers that obstruct multiple activity systems to engaging in collective activity. Potentially damaging to existing or on-going nature of the relationship, activity system division can occur from disproportionate power relations and lack of facilitated negotiation forums to define an agreed outcome and the actions required to achieve it.

The fundamental issue was that all parties wanted the same outcome from the farmlet activity system (stocking rate project), but had different decision rules on how to achieve it. Research versus demonstration design was the sticking point, with research design ultimately winning the task by dictation from the funder based on their decision rules guiding investment. Farmlets sites have the flexibility at the initiation of a new project to be set up utilising different designs that are either demonstration orientated or arranged using replicated treatments. There was an opportunity for the learning relationship to build in terms of understanding the requirements of a research project compared to one using a demonstration design, and seeing the benefits at the end of the project to having consecutive years of data sets. Using treatments enables a research approach as opposed to demonstration sorting through issues that arise without fundamentally changing validity of the final outcome. Experimental design provides the integrity and hence consistency in data collection and analysis which reduces the risk that an outcome won't be achieved against the research question. Demonstration sites represent a greater risk of not reaching an outcome due to the flexibility in management, and capacity to change the direction of the project and the fundamental questions being explored. Differentiation in decision rules is a critical concept that impacted on the interactive ability of the respective activity systems.

Key concept: Differentiation of decision rules

Decision rules refers to the criteria (form and function) that activity systems use to determine the actions to be employed to reach the outcome. In joint activity systems, the activity systems may have different decision rules based on experience and understanding of what is required to achieve the joint outcome.

Such points of differentiation offered the opportunity for a learning relationship to be developed and hence the learning platform initiated around the new project. The withdrawal of extension resources had considerable implications for this, as the facilitation mechanism was withdrawn with it. The facilitation mechanism was the enabler of farmer participation in the process at both the project development stage as well as with the management committee. Farmer participation was a precedent set from the previous project and without the extension role, participation of farmers was no longer valued, managed or encouraged, as explained below by the retired extension officer:

> "The original project enabled farmers to be more comfortable about that project, and I think we saw this was a good way to engage the farmers in participatory research, with them actually being involved in the research as much as looking at the research and using the result. There was plenty of scope for farmers to I suppose pull the levers along the way when we encountered problems, and I suppose one of the problems with those farmlets is that they were looking at direct farmer involvement as a key extension methodology for those farmlets but it didn't happen. That is, we were going to have farmers managing this thing and they'll be involved in presenting results, networking information to the industry and what I'm suggesting -- what my view is that it's very difficult to engage farmers when there's nothing for them to do because of the level of rigidity there in the new farmlet project design." (Retired extension practitioner, Flaxley farmlets, 2002).

The relationship enabling capacity of extension then was a critical attribute of the farmlet activity system.

Key concept: Relationship enabler
Relationship enabler refers to a function performed by extension with the role providing the mechanisms (tools) and supporting actions that bring separate activity systems together to work towards a joint outcome. Extension in the context of learning platforms performs this mediating role between knowledge systems because of the relationship extension has between researchers and commercial farmers.

Along with the enabling role in building and maintaining the relationships around the farmlets, the other considerable loss to the activity system by not having a designated extension role was to set up expectations and new rules for engagement with the management committee. The farmer management committee associated with the farmlets indicated to industry that the activity of the farmlets was driven by farmer needs and input into decision – in a traditional sense of farmlet activities (see ERDS, Vasse and MRF case studies) - such a committee is an essential part of the project process. The extent and depth of input into the new farmlets project did not necessarily need to be any different to that of the preceding farmlet, because the role was to assist with decision making and provide a commercial lens to management options. What was different with the new farmlets were the various elements across the project that could be changed along the way, versus those that were non-negotiable. This was never explored or explained by the researcher with the management group and highlights the requirements of the learning platform to have systems that set the rules for engagement across different activity systems.

> Key concept: Rules for engagement
>
> Rules for engagement refer to a jointly agreed (across activity systems) set of criteria that outlines the roles and responsibilities of each individual activity system that is subscribed to and enables formulation of appropriate actions to achieve the desired joint outcome.

A lack of definition of the rules for engagement, led to a dysfunctional platform on which they were operating, which ultimately resulted in the management committee ceasing activity altogether.

Role definition was particularly pertinent for extension at the time when resources were re-instated for the dairy industry within the SA dairy network. The SA dairy network was very strongly focussed on maintaining the struggling existing discussion groups, and very direct in highlighting it was not set up specifically for the farmlet project. This was problematic as it meant the linkage between the farmlets and the SA Dairy network was never clearly established or formalised. Interaction was more ad hoc and a reactive process (i.e. we need to arrange a field day) rather than through a planned strategy for joint activity.

This lack of defined relationship with the farmlets and confinement of the SA dairy network to the discussion groups was also problematic as it translated into limited learning relationships with dairy farmers more generally. Without the SA dairy network being strongly embedded within the farmlet activity system, the kind of information and tools that could be used for extension to build learning relationships were basic and tended to be a linear, one way delivery of output information. Output information was simply basic results on the performance of the farmlets at a given point in time, delivered in isolation from the full context of information, decision making processes and rationale for action, incidental learning events and how they were handled. This basic and irregular delivery of information constrained the possible learning relationships with industry, and didn’t allow for the full contribution and value of the farmlet’s information to be conveyed or utilised by farmers. This limited the capacity for information to be positioned or related to farmers’ own activity and the development of identity points, a key concept demonstrated in Vasse Milk Farmlets case study.

Key concept: Learning relationship constraints

Learning relationship constraints refers to factors that reduce the potential for a learning relationship to be fully enriched with two way feedback mechanisms and the ability for information resources to provide the complete explanation or full story that enables dialogue and debate around particular elements of the farmlets.

The attempt to formulate a strategy for integration of the SA dairy network activities with the farmlets created renewed enthusiasm amongst the respective teams that improved systems for linkage were to be put in place. This was not a self-organised activity by the farmlet or SA dairy network team; it was organised by the NDFS team which meant the ownership and drive of the activity and output sat externally to the team. Transferring this ownership and drive was only partially successful with the nominated champion within the SA dairy network taking on the role to follow through with the key actions for the strategy to be completed. The fact that this person left, and no other member of the group either internally or external to the farmlets took on any of the actions, indicated that the commitment to create improved linkages was weak and conditional.

Ultimately in order to achieve collective ownership and responsibility of the tasks identified at the meeting, it was critical to maintain momentum and work together to create a relationship. Coming together to formulate the extension strategy was essentially the commencement of a learning relationship strategy initiated a new way to operate collectively with the potential to reinvigorate the profile of the farmlets. It was unfortunate that it was to no avail.

Key concept: Learning relationship strategy

Learning relationship strategy refers to a map to guide actions for a farmlet activity system that outlines how collective actions will be delivered by respective individual activity systems. It outlines key issues and barriers that need to be addressed to ensure the outcome is achieved, roles and responsibilities and the mechanisms and tools on which learning relationships will be based (internally and externally to the farmlets) across activity systems.

Maintaining momentum across learning relationships was a fundamental issue for the researcher that impacted on the farmlet as a learning platform. In the absence of extension in the beginning of the farmlet project, as well as the significant time (nearly 2 years into the farmlet project) prior to the SA dairy network initiation, it was the researcher who believed it to be part of his role to convey farmlet information to industry and hence maintain a form of learning relationship. It was time consuming and a difficult task to incorporate extension activities along with maintaining the day to day operations and functioning of the farmlets.

Because of this, the researcher was not able to maintain momentum with learning relationships, which created tension, misunderstanding of the farmlets and a lot of negativity.

The SE dairy information day demonstrated the importance of maintaining momentum in the learning relationship. Setting up of the day represented an opportunity for a relationship to be reinstated - albeit starting from a tenuous link. Nonetheless, there was still a willingness to engage with the farmlet team and an indication from the farming community that it was welcomed despite the reservations expressed about the farmlets. A consistent comment from farmers from the region was that research and development is vital, and the work at the farmlets - just by the basic fact it was focussing on dairy farming systems – would result in some beneficial knowledge. Had there been some form of follow up in the relationship, improved advocacy and support for the farmlets would have emerged.

> Key concept: Learning relationship momentum
>
> Learning relationship momentum refers to the process that maintains and enables a learning relationship to expand due to ongoing linkage and effective communication / extension mechanisms. Momentum is achieved through regular organised interaction between activity systems, and expansion is achieved through increasing activity systems' depth of knowledge and understanding of the actions involved in their respective practices.

The processes used to maintain momentum were important across the learning platform, and the content of information being conveyed was another. The focus on high stocking rates at the Flaxley farmlets was a high risk with many learning opportunities arise. Not only were the results of production performance (feed consumption versus production) important, but also the incidental unexpected events arising along the way. For example, when there was excess pasture feed in winter in the lowest stocking rate farmlet, the excess pasture was preserved and cut for hay. At the same time, grain supplements were maintained, as this was part of the experimental treatment that could not be changed. To farmers this may have been ludicrous and not a pragmatic way to manage a farming system (why feed grain when there is more than enough pasture?), but there were multiple key learnings associated with what had occurred, which enriched the farmlet learning platform.

For the learning process to incorporate the full farmlet outcomes, however, the researcher – who was ultimately in control of what information was conveyed – needed to recognise the learning value of such incidents and have the ability to contextualise messages and convey the decision logic associated with the actions taken. The researcher did not have the ability or the inclination as evidenced by his reluctance to engage directly with the farming community with anything beyond immediate performance results of the farmlets. The researcher acted as a significant gate-keeper of information, the final critical concept impacting on Flaxley farmlet activity system.

Key concept: Information gate keeper The information gate keeper concept refers to a role played within the farmlet activity system by the person in control of what information is conveyed to the broader industry. The level of skill of the information gate keeper in identifying valuable learning opportunities and contextualising information, has an influence on the depth of learning relationships that may be maintained around the farmlet activity system.

The implications of these critical issues for the farmlet activity system and the emergent learning platform are now discussed.

7.5 Emergent learning

This case study presented key attributes of the Flaxley farmlet activity system and in particular the factors that impacted on the robustness of the emergent learning platform. Table 13 presents the complete summary of the concepts that emerged throughout the analysis, which are further positioned within Figure 20.

Essentially the analysis found that the actions within the Flaxley activity system were dominated by issues associated with building and managing relationships. This preoccupation meant there was little priority directed towards role definition (division of labour), strategy development or the analysis and implementation of new tools (instruments) to mediate learning relationships. The broken line symbolising the divide between activity systems represents the nature of the divide, whereby old decision rules, subjects and tools were used to create the Flaxley activity system and were adequate to get the system up and running.

Coding category	Implication in the activity system relationships	Concept	Symbol
Project development and stakeholder engagement	Subjects / object / actions / outcome / tools	Activity system division	
Addressing learning needs	Subject/rules	Differentiation of decision rules	D_R
Building relationships between activity systems	Rules / subjects / division of labour	Relationship enabler	R
Role definition and delineation of responsibilities towards achieving the joint outcome	Subjects / rules / division of labour	Rules for engagement	R_E
Farmlet linkages with industry	Subjects / mediating tools / community	Learning relationships constraints	R
Activity system linkages and collective action.	Tools/rules/subject/division of labour	Learning relationship strategy	R_S
Points in time where linkages occurred between activity systems	Rules/community/subject	Learning relationship momentum	R_M
Information / content conveyed from the farmlets	Subjects/community/tools	Information gate keeper	GK

Table 13. Summary of emergent concepts associated with the Flaxley farmlet activity system

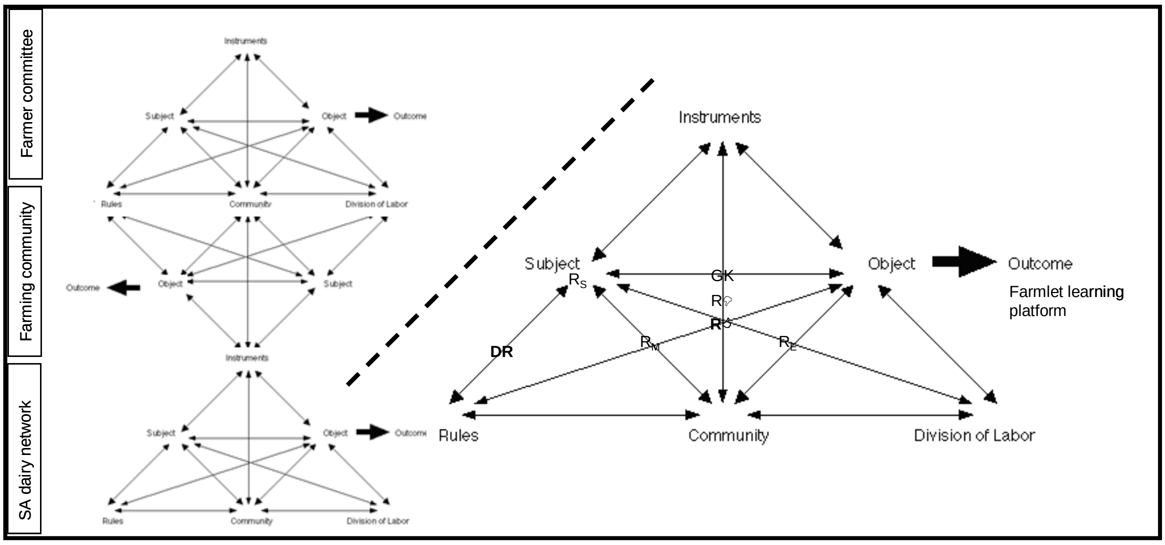


Figure 20. Interrelationships between the emergent concepts of the Flaxley farmlet learning platform

So from this case study, how did the farmlets contribute to learning and adaptation in the Australian dairy sector? The following conclusions can be made from this case study.

1. Fundamentally, this case study demonstrated the implications to a farmlet learning platform when extension is withdrawn from the activity system. What was lost was essentially the mechanism that enabled:
    i. A mediating/facilitation role between research knowledge system and farmer knowledge system (management committee) to work and learn together through the development of agreed decision rules;
    ii. The setting up of relationship strategy underpinned the review of tools (and appropriate stakeholders) that mediated and contextualised the outputs of the farmlets;
    iii. The brokering of information that emerged from the farmlets to maintain learning relationships across regions;
    iv. Sharing of the role of gate keeper to enable a more enriched delivery of the farmlet information; and
    v. Building of the learning relationship overtime with various regions through extending (and building) the farmlet outputs over time;
2. When there are multiple activity systems seeking to achieve the same outcome, the learning platform needs to set up a forum whereby consensus is achieved about the actions and division of labour required to achieve the outcome.
3. Learning is in the actions of the farmlet activity system not just the production data outputs. Such learning is largely held by those carrying out the tasks. A learning platform requires a process that enables those carrying out tasks to be sensitised to learning events so that they can convey them to others.
4. Mechanisms and structures for conveying learning events that will maintain learning relationships are vital for a farmlet learning platform to be effective in sharing resources.

The final regional case study is now presented and moves the focus to Victoria. Up until this point, the case studies have all been based on farmlet projects that were underpinned by a variable State government resource base. This next case is a farmer funded and managed farmlet demonstration site, which explores how a farmlet performs as learning platforms when it is not run by a government department and the role of researcher and extension practitioner are combined.

Chapter 8 Case study 4: Macalister Research Farm

8.0 Introduction

The final case study in the regional farmlet series covers the Macalister Research Farm (MRF). In contrast to the other three case studies, MRF is unique, being owned and managed by a farmer co-operative of around 280 district dairy farmers. This case study enables exploration of a farmlet activity system that is self-organising by the farming community rather than government research and extension teams.

A large component of this case study explores ways that farmers position farmlets within their learning processes to assist and improve their farm management. The case is also interesting from the perspective of the farmlet as an integrated activity system, where demonstration and extension activities are managed through one person compared to a team with many members (as in the ERDS and Vasse case studies in particular). This MRF model of farmlet demonstration and extension is one that is held highly accountable to delivering outputs to the local farming community, and ensuring outputs remain relevant and capable of advancing the regional industry.

8.1 Significant events

Figure 21 highlights the significant events that occurred at the MRF during the study period.

New project manager appointed	Farmlet project and extension activity initiated	Native shelter trial commenced	Farm AGM	Seed and pasture expo	Fixed spray and farm safe field day	Annual field day and fodder day/AGM	Dairy effluent innovation day	Fixed spray irrigation field day	Project manager resigns from MRF
Jun-99	**Nov-99**	**Sep-00**	**Oct-00**	**Feb-01**	**Jun-01**	**Oct-01**	**Feb-02**	**Mar-02**	**Feb-03**

Figure 21. Significant events at MRF relevant to farmlet learning platforms

These events and related activities have been consolidated into three key events which provided the primary points for exploring the MRF activity system. As presented in Box 7, an overview and analysis of how the MRF activity system was forms the first stage of the discussion. Key events then presented in the timeline above provides the subsequent activities used for the analysis. The appointment of the Project Manager in June 1999 and initiation of the farmlet project is the second stage of the case study. The third and final collection of events includes an overview of the various farmlet activities initiated to maintain learning relationships with the farming community and the role of the MRF management board.

Box 7. Significant learning relationship events

1. Initiation of the MRF co-operative (1962)
Where the farming community purchased a farm using shares to be used as a learning resource with the dividend information of the Macalister Irrigation District.

2. Appointment of a Project Manager (PM) and initiation of a farmlet project (1999)
Where the Board of Management employed a Project Manager who essentially coordinated learning activities and managed relationships with the MRF board, shareholders and the wider community. It was at this point that a farmlet project was initiated. Various research and development projects that were complementary to the farmlets were already in operation.

3. Implementation of the farmlet project and relationship maintenance (2000-03)
Where the project manager initiated major events at the MRF for shareholders and others to visit the site and learn about the project outputs.

8.1.1 Initiation of the MRF co-operative

Located in the Macalister Irrigation District (MID) of Victoria, MRF has researched and demonstrated new systems of dairy farm management since it was first purchased in 1962. The dialogue below provides the story from the perspective of a local farmer of how the original MRF co-operative was formed.

> “Prior to the mid-1950s virtually there had been no Department of Agriculture representatives in the district other than your inspector. And then around about the mid-1950s, we had appointed here a pasture researcher. Now the researcher then started off trying to improve production, trying to improve pastures and, basically showing the value of fertiliser and what using the right amount of fertiliser at the right time to increase production could do. This was a soldier settlement area that had been developed and the irrigation scheme was in place after the Second World War – that starting to move the area along in the very early 1950s. They weren’t big farms and some of the chaps coming back were keen to try and improve the places. It was pretty poor soil, you know, nothing -- they’d been a bit of cropping stuff and the old story was that you could flog a flea right across it and you could see him move away. You know most of the time -- because it just didn’t grow anything very much. Well, of course, water changed that and, some of the returning soldiers wanted to improve production. Some of the older farmers around here wanted to improve production too and some of them volunteered parts of their property for the researcher to do pasture trials. That might have only been an acre of ground and he’d subdivide it off. They were just plots and they used lawn mowers and cut the grass. But the problem was that -- and the perception was in the district that -- oh it’s fine to do this sort of thing, but it had no relevance the

> grazing animal and, that was a problem that people saw and the researcher saw that people saw. So the researcher suggested there was a need in the district for a community owned research farm that worked on a commercial scale, so that it could be a normal dairy farm and which they could replicate some of this work on the farm using the grazing animal. Anyway, so it was decided at a meeting here to form a co-operative and raise money through selling of shares and the shares were sold at £1 each". MID Dairy farmer, retired 2002.

Four opportunities within the region created the need for a research farm to be established. Soldier settlers were keen to learn about farming; there was access to water through the irrigation scheme, opening the door to new dairy farming systems; poor soil fertility; and existing farmers were looking for ways to improve their management. It was also considered that the MID covered a significant area, with dairy production systems inherently different between farms in the MID region compared with other Gippsland areas and Victorian dairy farms. As found by the Victorian Dairy Industry Association (VDIA) (1994) average herd size and stocking rates in the MID were higher than other Gippsland regions. The report also concluded that farms in the MID were producing larger volumes of milk from smaller farmers with generally higher production per cow (VDIA 1994).

Collective action to raise the required funds to purchase a local farm was achieved through a community meeting that was held to form a co-operative society. Money was raised through selling of shares in 50 to 100 lots at a value of 50 cents (AUD) each. Issued capital was $11,277 (AUD) made up of 22,555 ordinary 50 cent shares spread amongst 400 share holders (Atkinson, 2002). The constitution stated that shareholders were to receive a dividend in the form of knowledge and learning rather than a financial return. The other interesting stipulation was that farmers who were not shareholders were still able to receive the information despite not being financial contributors.

The money raised by the co-operative was used to buy a herd of cows and the remaining money was used as security for the farm operations. The then Commercial Bank of Australia agreed to support the project with financing loans and, through the co-operative lobbying government, enough money was raised to buy what is now known as the Macalister Research Farm. The original property was 55 hectares, which was the average size of a farm in the district and it had an average carrying capacity of 60 to 80 milking cows.
Since inception, a Board of Directors consisting of seven farmer shareholders has managed the MRF co-operative activities. Up until 1999, the farm was reliant on the Victorian State Department of Natural Resources and Environment staff to conduct component research and extension activities. After this time, the Department continued to play a major role in the MRF activities, however in 1999 the Board appointed a full time Project Manager to initiate a

farmlet project and to co-ordinate all the activities operating at MRF into one research, development and extension strategy. By this point MRF system had increased in size to 92 hectares with a herd of 310 cows that had been built up over 40 years by artificial breeding. A total of 80 hectares of the MRF was under irrigation. The original water rights remained, and so the system continued to utilise and demonstrate irrigation best practice to increase pasture growth through the traditional system of flood irrigation, and the incorporation of a more modern sprinkler system. The value of the MRF (including stock, land and plant) at the time of this study was in excess of $1.6M (AUD) (Atkinson, 2002).

Box 8. Mission and objectives of the Macalister Research Farm 2001 - 2002

Mission
To enable shareholders to improve the profitability of their farms and their lifestyles, through demonstration of superior and sustainable management systems, and the provision of education programs necessary for their adoption.

Key objectives of the MRF
- Operate a commercially viable and profitable business;
- Regularly seek out alternative management techniques which have the potential to lift profitability and improve lifestyle for local dairy farmers;
- Demonstrate those techniques which, after thorough examination, appear to have useful roles to play on local farms;
- Keep share holders and other interested parties fully informed, at all times, on the impacts of all management systems in place at the farm;
- Conduct small scale research activities to help resolve local farming issues; and
- Support agricultural education in the MID.

Source: MRF annual report, (2002)

A further 48 hectares had recently been purchased to ensure that the farm scale remained viable, profitable and sustainable for the following 10 years (Atkinson, 2002). The purchase of this additional land provided an opportunity to demonstrate how to manage the challenges of farm expansion and remain committed to the mission and objectives of the MRF as shown in Box 8. Central to the MRF model was that the farm was demonstrating and communicating new and improved management systems on a commercially operated dairy farm, addressing specific local issues and engaging with educational institutions (i.e. local technical and further education institutions, schools and university). While shareholders were the primary beneficiaries of the learning outputs from the MRF activities, all members of the community were welcome to receive information and attend any field days at the farm.

8.1.2 Appointment of a Project Manager and initiation of a farmlet project

Since the MRF began operations, a part time manager had been employed to oversee all activities conducted at the farm. Roles and responsibilities of the manager included liaising with the various researchers conducting demonstration projects, and also working with the share farmer who was responsible for running the commercial dairy farm. In 1998 a strategic planning session was held with Board members and industry representatives such as the local RDP GippsDairy and the State Department of Agriculture, to determine the future activities for MRF. Recommendations resulting from the new strategy included the commitment of funds to further develop the MRF program, including the appointment of a new full time Project Manager if funding applications for the position were successful. Other plans included the development of a new project to study nutrient monitoring and also the review and re-construction of an advisory group that had been assisting the Board with the decision making processes around MRF activities. The Project Manager position was successfully in initiated, due to partial funding provided by the Dairy Research and Development Corporation (DA) for three years, with the remainder of salary provided by MRF.

The role of the Project (PM) Manager was multifunctional, requiring significant skills in agricultural research, extension and communication with a variety of industry stakeholders. Working in conjunction with the share farmer, primarily the position of the PM was to bring together information and expertise to test and implement management practices that address the priority issues within the region. This included managing, reporting and conducting the research extension associated with the farmlet activities, collating information on technical and management issues considered important to dairy farmers (as determined by the Board) in the MID and work with multiple project partners and a research steering committee to secure funding and initiate new demonstration and research activities.

The position was advertised in the Victorian press and attracted a number of applicants and a person was appointed to the role in 1999. Ideally placed for the position, the successful applicant had previously been associated with the MRF through her extension practitioner role with the State government and so was familiar with the day-to-day activities involved with the site. She also had a strong farming systems research and extension background, and understanding of the region's dairy farming systems.

Shortly after the PM was appointed, a survey of shareholders was conducted to determine the direction of the next major project that the farm would orchestrate. The survey confirmed that a large scale demonstration project was what the farming community were looking for one that focussed on comparing two feeding systems typical of the region. A demonstration trial using two farmlet treatments was to be constructed: one focussed on feeding moderate levels of supplement and the other on high supplementary feeding. The stocking rate for both demonstrations was equal. The object of the farmlet study was to measure and demonstrate the major benefits and costs associated with two high stocked systems of farming in the Macalister Irrigation District.

The new large farmlet demonstration project was part of the response to the new strategic direction for the site, which included lifting the profile and interest within the farming community of MRF of activities. A significant decline in the number of shareholders in the farm had been occurring steadily since it was initiated in 1962, with the number of shareholders down from 400 to 250 in 2002. While this was explained by the decline in farm numbers and farmers which was a typical trend within the industry across Australia (as discussed in Chapter 2), the Board were also concerned that the MRF was not providing enough interest for farmers.

8.1.3 Implementation of the farmlet project

Since establishment in 1962, MRF has conducted numerous demonstration projects dealing with most aspects of dairy production. Hides (1992) published the findings of many of the MRF projects, which included typical research station demonstrations on pasture species management, fertiliser management and dairy waste management. The most recent farmlet project addressed the profitability of increasing stocking rate, to assist farmers in the district to consider the issues associated with increasing variations in stocking rates on their own farms (Atkinson, 2002).

The new farmlet project was a feed management demonstration with two farmlets using a stocking rate well above the local average of 4 cows per hectare. The project manager describes the objectives of the project below:

> "The study is all about increasing stocking rate and we wanted to know if the system went to a higher stocking rate, was it profitable to double the supplement feed? The control farmlet is what we have been doing at MRF for a period of time, it was the constant. So far we have found 4 cows per hectare most profitable with 1 tonne of grain. The balanced herd has the same stocking rate but higher levels of supplement, at 2 tonne. The control is fed a moderate amount of supplement feeding (1 tonne) with set targets of fat and protein and crushed grain is fed with no additives - similar to what district farmers do. The balance herd has higher production targets. The aim is to feed 2 tonne of mixed grain supplement, triticale and wheat and other additives throughout the season and establish the effects on profitability". Project Manager, 2002

A summary of treatments for each of the farmlets is presented in table 14. Essentially all inputs and outputs under each system were to be analysed and the influence on herd health and fertility monitored. The control farmlet was used as the benchmark of existing practices and performance, and consisted of using the long standing industry standard for supplementary feeding in the region.

	Balanced herd	**Control herd**
Number of cows	150	150
Farmlet area (hectares)	38.5	38.5
Production Targets Litres Fat (kilograms) Protein (kilograms)	6,930 (1,143.421 total) 295 (34,744 total) 242 (36,300 total)	5,177 (776,607 total) 223 (33,468 total) 180 (26,937 total)
Grain supplement	Mixed grain supplement (including buffers, rumen modifiers, minerals and trace elements as required)	Cracked grain (no buffers)
Grain/cow (tonnes)	Approx. 2.0	Approx. 1.0
Hay / cow (tonnes)	Approx. 0.75	Approx. 0.75
Nitrogen (kilograms per hectare)	200	200
Condition Score (at dry off)	5.5	5.0

Table 14. Main treatments for the MRF farmlet project

Engaging a team of stakeholders with complementary knowledge and skills was the process used to formulate the design and in particular the feed ration for the treatment farmlet. The steering group from the Target 10 program[11] was engaged for this role and to also ensure Target 10 principles were incorporated into the farmlet monitoring and management practices. An additional benefit was the extended publicity generated towards the site with a network of 35 Target 10 extension officers aware of - and promoting – the MRF. Overall it a successful and positive move by the PM to engage with the Target 10 program:

> "When Target 10 got involved things really turned around and the publicity has been really good. NRE are now telling people how the MRF is going and publicising what we are planning to do". Project Manager, NDFS Workshop, 2002.

[11] Target 10 was a major industry driven dairy extension program that was introduced in Victoria in 1992. Target 10 was a collaborative program funded by the Department of Natural Resources and Environment in Victoria and also the DRDC. Other institutions involved included United Dairy Farmers of Victoria, University of Melbourne, dairy processors and agribusiness sponsors. The program originally aimed to increase pasture consumption per hectare through delivering principles of grazing.

Project name	Aim of the project	Collaborating organisations
Demonstration of a whole farm irrigation and nutrient management plan	To improve the sustainable use of natural resources and minimise downstream involved in farming in the MID	GippsDairy (RDP) NRE Target 10 University of Melbourne Natural Heritage Trust MRF
Fixed spray irrigation demonstration	To demonstrate the labour input, water use efficiency, potential productivity, environmental sustainability and economic performance associate with a fixed spray irrigation system over two irrigation seasons	NRE McCracken's Water Services MRF Natural Heritage Trust Murray Goulbourn (milk processor) Southern Rural Water Victorian Government Gippsland Lakes Rescue Package
Advanced tall fescue trial	To trial the autumn establishment of 'advance' tall fescue on laser graded soils with poor soil structure	Pacific seeds MRF
Occupational health and safety demonstration	To demonstrate the implementation of a low cost, yet effective occupational health and safety program to provide a safer working environment for employees and visitors	FarmSafe Victoria Wellington Farm Safety Action Group MRF
Bovine Johne's Disease Eradication program	To demonstrate a management system designed to eradicate BJD from a commercial dairy herd	Maffra Veterinary Clinic NRE

Table 15. Additional projects to the farmlets that the MRF Project Manager managed.

Compared to other farmlets, the MRF project needed to secure financial and physical resources from a variety of sources. Sponsorship and in-kind contributions to the project were vital to securing the required resources to effectively operate the farmlets. A feed company sponsored the supplementary feed contribution of the project. Sponsorship was viewed as a way of engaging other companies in the project, increasing the knowledge and awareness being extended from the project. Significant financial support from industry investors to fund the initiation of five additional research and demonstration projects was achieved by the PM. Table 15 presents the projects that the PM was co-ordinating in addition to the farmlets, and demonstrates more than fifteen organisations involved. Each project was developed and initiated in response to a local issue highlighted by farmers and conducted as a partnership between key organisations within the regional dairy industry.

Of most note to the projects in the table is the number of stakeholders and projects that the PM was required to maintain, including a multitude of different relationships and different type of activity systems to work with.

8.1.2 The MRF Board

In addition to maintaining relationships with multiple project partners, of fundamental importance was the different relationship and communication that the PM maintained with the MRF Board. Fundamentally the role of the MRF Board was to make decisions on a strategic level around the primary activities to be conducted at the research farm that would be of benefit to shareholders and the broader regional industry. The Board met with the Project Manager monthly (or more frequently if required), and determined policy, setting the annual budget and associated targets and oversaw the operations of both the commercial farm and its research and extension program (Atkinson, 2002).

General consensus from farmer Board member interviews was that they considered their role to use their individual industry experience and farm perspective, to identify what the issues were to the regional, to the determine how the MRF could be used to find solutions. To this farmer, being on the Board was primarily about learning, but also about helping to make informed decisions.

> "I suppose my sole interest in being on the Board is selfish. I'm there for me to learn, whether anybody else gets any value out of me being on the Board is up to them……Like, I'll not say influence, but, I'm there to you know, bring up ideas like whenever we're setting up new trials. I feel by being there I can try to make sure that the things that I find important on my farm I can discuss with the other Board members -- you know in a Board situation. It's not like I'm trying to influence the Board, but just to present the things that I find are perhaps limiting my production and hope that the rest of the Board see that they're limiting theirs and try and find a way to trial it or prove what the best way to handle the issue is". Farmer, Macalister region 400 cows

All activities of the PM required Board approval prior to implementation, with a formal application process required to be completed before any major changes to the MRF activities could be implemented. While this process facilitated rigorous and justified planning processes, it also slowed implementation of activities. In general, meetings and communication with the Board were to review the progress of project and strategic direction of the overall management, however there were times where the Board tended to drop into making operational decisions rather than strategic decisions. As highlighted below:

> “Working with the Board was time consuming to manage, requires significant communication to keep updating and address any issues. It was hard to please everyone and make decisions - everyone has ideas and agendas. Putting all those dimensions together to get a final decision is difficult. It is important to have a clear role definition and commitment to that role from everyone”. Project Manager, 2002

Having a Board of Directors that consisted of farmer shareholders meant that control of the MRF activities was maintained by representatives of the ‘owners’ of the facility. However, as the Board was made up entirely of farmers, decision-making processes around the research and demonstration activities were not necessarily as informed as they would have been had there been research and extension officers to provide additional input. The tension between maintaining a strategic role compared with dropping down into an operational role was common. A typical example of this occurred when the high input farmlet was not out-performing the control herd at the level the Board expected. The Board then wanted to change the treatment two years into the demonstration. The Project Manager had to argue and justify why the program needed to continue for the final year, to generate another year’s worth of data to then draw conclusions. This was a similar to that situation experienced in the Flaxley Farmlets case study.

8.1.3 Maintaining relationships with the farming community

So far, the discussion has provided an overview of the multiple relationships and activity systems within the MRF. A final addition to this was the important role that the PM managed with the farming community through a consistent extension and communication program. This role had particular significance, due to the considerable resource allocation required to maintain relevance of the site to the broader farming community.

Three attributes influenced the approach to extension around the MRF. Firstly, the extension activities were directed by historical approaches. Secondly, activities were under the control of what the Board were looking for and thirdly, the time and capacity of the Project Manager to enact the activities (in between the other roles). As a result, the extension focus was largely based on conventional methods creating awareness within the community through activities that were delivered on a routine basis (either weekly, monthly or yearly) and in a regular format.

Weekly farm walks were used as an open invitation to all interested farmers in the community to visit the farm and learn about management issues and the latest learning outputs. These walks were incorporated into the day to day management of the farmlet’s grazing and feeding which enabled participants to be involved first hand with some of the farmlet activities.

Weekly reports were used to document the data collected on the farm walks, along with the details of all management decisions made as a result of the walk. These results were broadcast on a local radio station at the same time every week, and also in local newspapers on the same day. An electronic discussion group, managed by the University of Melbourne and consisting of over 350 participants was also a vehicle used to publish the weekly results. A key objective of the weekly reports was to enable farmers to benchmark or relate their business performance against the performance of the two farmlet feeding systems.

Monthly activities included a more detailed report, which detailed seasonal events and the progress of all projects on the MRF. A key feature of the monthly report was that it was published in a local newsletter and newspaper using performance figures accumulated for the overall year. At least three or four field days were held at the MRF every year to present the results of projects and also to highlight topical issues and how MRF responded to seasonal affects. All farmer discussion groups were encouraged to visit the site, to become familiar with the MRF activities and enable more meaning to the regular reports they receive of MRF performance.

All project outputs were compiled in an annual report, which contained a full financial analysis for the year presenting the full business performance to compare with the broader industry. A library of short reports that emerged from the farmlet activity over the years was a valuable resource for anyone needing the information.

8.2 Critical issues

The critical issues impacting on the MRF activity system as a learning platform were the attributes of the different actions required for the delivery of the MRF strategic plan. The other area was the ability of the project manager to maintain relationships between multiple stakeholders and, hence, a multitude of interacting activity systems. The form and function of mediating tools to deliver on the strategic imperatives to maintain relationships was the other defining feature and enabled shifts in the nature of relationships over time. These critical issues spanning the various activity system are presented in the Table 16.

In contrast to the other case studies, the MRF activity system was driven by a strategic plan which outlined key focal areas for action which would achieve the overall object of the site. The strategic imperatives set by shareholders and the Board, served as a formal structure that guided activity and ensuring the (multiple) objects were achieved. Highly structured reporting was required, with considerable transparency needed in the operations and day to day actions. This was a fundamental responsibility of the project manager to deliver to the Board, as well as shareholders and the broader community.

Having the formal structure had both positive and negative impacts on the capacity of the MRF learning platform. A positive was that the structure provided clear definition of the object and boundaries to the actions required to achieve the objective. This indicated the process of running the MRF was systematic in management, with all subjects involved in operations clear on their roles in delivery. Monitoring of actions towards the object was made efficient and reporting tools such as the Board reports, annual report, and broader industry communication tools were useful mediating artefacts to facilitate this process.

Element to activity system	Researcher / Extension (Project manager)	MRF board	NRE / other project partners	Farmers (community)	Funder/s
Outcome (desired)	Orchestrate the achievement of the MRF strategic plan objectives.	Ensure the MRF site is effectively utilised to deliver knowledge (as the dividend) to shareholders using a farmlet demonstration project as the central activity.	Conduct on-farm dairy R&D projects that will provide innovations and new practices that will advance the industry.	Validated knowledge and information to assess and improve performance	New farmlet project - with co-investment and rigorous design, that will support the industry to prosper from the knowledge, information and tools (outputs).
Object	Operationalise the strategic plan, initiate and maintain data collection, establish and co-ordinate extension and communication mechanisms to manage/maintain relationships.	Initiate a strategic plan for the MRF and monitor progress against objectives.	Trial and commercially validate innovations for industry.	Build skills and knowledge to support a profitable productive and sustainable business.	Address national and regional industry priorities by deploying resources that will enable validated knowledge to be developed and delivered to industry.
Mediating artefacts	Strategic plan, communication plan, farmlet site, farmlet data, communication tools, MRF board	Strategic plan, Board meetings, Project Manager reporting.	Project proposals, experimental design frameworks, plots, data collection tools, farmlet communication plan/activities.	Multiple tools to gain knowledge and information including farmlets, farmlet data, other research projects.	DA program objectives, national strategy, NDFS project, multiple projects
Subject	Project Manager, MRF Board, shareholders, individual farmers/attendees at the site events	Project Manager, MRF Board, share holders	Researcher, MRF project manager, shareholders, individual farmers/attendees at the site events	Own business employees, consultants, government extension professionals	DA, RDP, farmlet team, NDFS team
Rules governing action towards the outcome	Determined by the MRF Board approval of project proposals	MRF constitution and strategic plan	MRF strategic plan, MRF reporting structures, communication plan, research design, funding body reporting requirements.	Criteria for relevant information, business goals, decision rules	Provide funding, manage milestones, ensure outcomes for regional and national imperatives are achieved and have an impact with industry.
Community	MRF Board, MRF project manager and staff, shareholders, NRE project managers, Target 10 extension officers, broader dairy farmers, DA				
Division of labour	Designing and managing (including reporting to the Board) the operations of the farmlet project, designing and managing the communication with shareholders/industry, managing and linking other R&D projects at the site	Oversee activity against the strategic plan for the MRF, ensure the knowledge dividend is delivered to shareholders and the constitution is subscribed to.	Conduct and manage R&D projects relevant to the region and that complements the objectives of the MRF farmlets project.	Attend and support activities at the site, provide feedback on outputs, utilise the information.	Critically review applications against regional and national priorities, review milestones, provide industry support/ funding.
Outcome (achieved)	An active and multi-dimensional farmlet activity system with significant capacity as a learning platform due to industry engagement and ownership, based on real-time information delivery and tools to mediate relationships				

Table 16. Summary of the critical issues impacting on the MRF learning platform.

The negative aspect of this approach, was while being systematic the operational structure was also quite rigid and became task orientated over time. This didn't necessarily mean the overall object for the strategic plan was lost. Rather the capacity to question whether various actions – particularly in the area of extension and communication – were still the right tactics or if alternatives should be employed, was reduced.

Boundaries set by the strategic plan helped to set criteria for additional projects that could be carried out at the site and also meant the learning platform was set up with significant capacity to leverage industry resources. Additional projects, while adding significant value to the overall learning platform, did come at a cost to the site, in terms of managing relationships and expectations around individual project outputs and outcomes. The multiple projects set up multiple layers of the activity system which meant there was a plurality of objects, individual and complementary actions etc that needed to be managed and integrated into the overall strategy. Having the project manager as the central orchestrator was critical in enabling reporting consistency and maintaining linkage between the strategic and operational management. Exploring this with the Project Manager revealed that it consumed considerable time maintaining this role – placing further restrictions on being able to carry out any further activities outside routine (standard) actions.

The format, function and position of these additional projects was an interesting addition to the farmlets learning platform. Across Australia and New Zealand, where on-farm research is conducted there are multiple designs that can be implemented to achieve different outcomes (see Chapter 2). There is an age-old debate within scientific circles about the whether or not farmlets should sit within a "research" or "farm demonstration" paradigm. The question could be asked, "Why would this matter?", however it has implications on the type of questions being posed, the outcomes being sought and the level of validated application/extrapolation of results that can be conducted. The MRF farmlet was always considered a demonstration project by design by the Board and the project manager and implemented because that was the need identified by shareholders and the broader regional industry. As highlighted by the Project Manager:

> "A perceived weakness of the farmlets is that sometimes the work that we're doing at the research farm may not be as scientifically or technically sound and that's something that from the outset we've tried to make clear that we don't want to be another Flaxley or an Ellinbank or all those organizations that can do that really quite scientific type research. We want to try and keep it more at a commercial scale and have commercial relevance to local farmers and that means that we can't closely monitor every specific thing in the system, particularly with feed management or farmlet type studies looking at productivity and performance of commercial foods with say 150 cows. We do scientific research with the nutrient monitoring project and that's renowned and recognised worldwide, but

certain projects we just don't design within those boundaries because we're not from the outset setting out to do that". Project Manager, 2002

Being clear on where the distinction lies between research and demonstration is necessary for this case study as the two approaches to farming systems RD&E were used in the milieu of activities conducted at the MRF. Table 17 highlights the key attributes of research and demonstration projects, which have emerged out of the data collection across all of the case studies.

The table shows that the two approaches are different, each being distinguished by the purpose, process and outcomes of the project. Fundamentally, for MRF each approach had a place, purpose and role. One approach was not superior to the other rather, they were complementary, with a different form and function, aiming to jointly achieve the object of the site. This enriched the resources available to be shared across projects at the one site, hence enriching the capacity of the MRF as a learning platform. Maintaining the commerciality of the farmlets and the size of the herds, maintained the relevance of the site, and enabled the farm to be positioned as a close to a normal farm, with the distinguishing feature that it was a research farm.

Attribute of farmlet project	**Research project**	**Demonstration project**
Theory/principles informing approach	Scientific method / experimental design	Commercial farming systems production
Purpose/question being answered	Wanting answers - Development of new decision rules	Answer known - Extension second round of learning on the new decision rules
Project design	Experimental design used, replicated treatments, statistical analysis, large data sets generated; set design – constant for the duration of the project	Limited treatments (one or two), limited data sets created, analysis restricted to economic, environmental affects – design is flexible
Key actors involved	Researcher, extension practitioner, technical staff	Extension and farmers, though researcher may be involved
Process	Exploratory	Application
Stage in learning around farmlets	First stage of learning new knowledge	Second stage of applying new knowledge
Main outcome	Creation of new knowledge and farm management decision rules	Using new knowledge decision rules and adapting to a commercial context

Table 17. Comparison of farmlet research and demonstration projects

While the multiple projects formed the basis for activity at the MRF, mechanisms and criteria for building relationships with shareholders and the broader community was a fundamental attribute of the learning platform. Underpinning this, was the communication strategy which enabled the farming community to "stay in touch" regularly connect with the farmlet outputs through a variety of mechanisms. Opportunities to engage with the site included passive learning activities (radio, newsletters, publications where there was a one way flow of information) and more active learning activities in the form of field days, farm walks etc (with a two way flow of information and dialogue was achieved). All these occurred as part of a monthly routine / cycle which meant that the community became sensitised to the opportunities and integrated the systems into their own routine of activity. The radio program was particularly popular as highlighted below:

> "The radio program comes around quickly every week and it is very heavily supported by the farming community -- for example when it was threatened for us to stop running it and not to have it, the station had 50 letters sent in from farmers objecting to not running that weekly report. And that was unsolicited. Like we didn't ask the farmers to do it, they just did it off their own bat. So we kept it running". Project Manager, 2002

This highlights that there was considerable loyalty with in the farming community to the communication activities and the MRF as a result of the consistent delivery of useful information. Exploration of this issue with the farmers interviewed showed that the MRF activities were seen as an important part of their on-going learning external to their business. There was a clear role of the MRF activities compared with other learning activities they were engaging with. This was particularly evident when they spoke of discussion groups in comparison to the MRF as highlighted below:

> "Discussion groups give you a look at your system and members give you their opinions, their ideas, whereas the research farm they don't look at your system. They're just showing you their system. Discussion groups are a two-way system. So they're each important, but we're far better off having both if you can because it gives you another perspective to look at, but they don't help you to sought of compare your system with theirs – that is up to you to manage. They can't compare what they're doing to what you're doing. You can only compare what you're doing to theirs [performance]. Whereas the discussion groups it's much more two way. You work as a group and you throwing in ideas. You can develop an idea with heaps of little ideas. Whereas at the research farm it's just "Now this is what we've got. Make the most use of it as you can". Farmer, 350 cows, MID 2002.

Discussion groups are able to facilitate mutual dialogue as part of the learning process, however, there are limits to depth of discussion due to farmers being in control of the amount of information they are willing to divulge. On the other hand, the accountability around the research farm demands that all information is transparent and open to any interested person within the community. The transparency of learning facilitates farmers' learning and helps to guide their comparisons with their own farming system. As this farmer comments:

> "The problem that I find with going to farmer run discussion groups. Is that everybody's got to know what is happening in your business so they can discuss what they're doing. But unless you know exactly what all their inputs are, it's useless to you. It doesn't tell anything. Whereas at least up there [MRF] you know all the figures, you know all the costs, you know what their soil types are like, what their water is like. It just gives you a lot more confidence, I think to have that to compare it to. And, you know, that information to anybody in the district, that's interested in it, it is available and I don't know where else you can get that level of information from -- there's no other farm -- I don't know of any other farm I could go to and look at his actual financial figures. There are not many other farms that would show you exactly what their financial costs have been for the year". Farmer, 600 cows, MID 2002.

Farmers valued being able to compare the MRF performance with their own farming system and do this longitudinally, in real time. Benchmarking was a way farmers actively made use of the farmlet information and was a key activity encouraged by the weekly reports. The continuity of contact throughout the season and the options presented for managing the issues presented by the season was an essential component to the learning process. The MRF was a useful check point for farmers, to assist with trouble shooting operational problems as they occurred. As highlighted by this farmer:

> "Occasionally you look at the yearly statements and those sort of things (from MRF) and have bit of a comparison, but it's more -- more the daily or weekly issues that arise and how they are handled that is interesting – like say you're having a cold snap and all of a sudden the cows are dropping and you think "Oh what's going on here?" Then you look at their production – and theirs have dropped as well. So you think "OK, it's not my management, it's just a condition for the district at the time. So it gives me a sort of a comparison that I can get without having to ask questions from anyone." Farmer, 300 cows, MID farmer, 2002

Comparing systems indicates considerable trust around the farmlet information because of the transparency of the information, and reinforcement of principles through farmers seeing for themselves the activities on the farmlets. Farmlets are very visual, a major attribute of learning processes around the projects. Seeing data and figures in written form was one source of information – validating this by actually visiting the site and seeing it in action added further value to the learning platform.

> "I did the irrigation course that Frank and Gavin run and a lot of the days we actually had at the research farm because of their systems being located there. They have got automatic irrigation and the sprinklers were going in, so that information went straight from the research farm into the course. We looked at it in the course, then we had the field days to look at it -- straight off. So, you know, it gives you a better mental picture and, from the farmers point of view -- you know my father and myself can't necessarily get what you need straight out of a book. You've got to see it, got to get a mental picture to see working to be able to bring it home. And, you know, you can really go off to Melbourne [Victoria] or down Warrigal or something every other day just to have a look at a system that's being trialled just to try and bring it home. If it's at the research farm it's very easy to go and get that mental picture to bring home". Farmer, 400 cows, MID 2002

The independent nature of the research farm gave the opportunity for the farming community to be openly critical and constructive, as there isn't the impediment of becoming too personal or offending the farmer who owns the farm. This openness, enabled by the transparency of information, enriched the learning process compared to other mechanisms such as the discussion group. This extension practitioner who conducted a project at the site highlights the implications of this:

> "On the research farm they (farmers) can sort of feel a little bit less personal and say "Well I think the farm's stupid in doing that" where they (farmers) wouldn't normally say that. So there's an opportunity to actually, say things that maybe are not always positive, but sometimes negative because sometimes you end up focussing so much on the things you agree with -- you're so careful in a group situation about making sure that you don't step on toes or, you know, get somebody offside, whereas that sort of environment where it's a little less focussed or personalised on an individual farmer, but more on a farm that's sort of owned by everybody that they can actually have a chance to say things that they wouldn't otherwise say. So there were a few different things that happen out there. If it was a farmer's farm like a focus farm, you need to build a very strong rapport with that particular farmer before you'll say certain things whereas at the research farm you might be more likely to open up and create a much greater depth of discussion than you would otherwise." Extension officer, MID, 2002

With confidence and trust, the community uses the research farm as part of their risk management strategy in decision-making. Farmers were seemingly taking a 'watch and see approach', particularly for the high capital cost projects (e.g. fixed irrigators) where significant economic investment was required for implementation. High risk projects at the research farm were particularly what this farmers was looking for, and considered the work they were doing to not be testing the boundaries of the farming system production capacity enough for his learning requirements:

> "To me their management is probably district average whereas they want to be right on the latest information, the latest technology, the latest methods, all those sort of things to really make it work......You know we've been doing those sort of managements here for the last two years and we've increased production and all those sort of things and it's so frustrating to see that they're not doing it and they're not showing the district what can be done with grass......but other than that they're doing a good job." Farmer, 300 cows, MID 2002

The MRF needed to find a balance in terms of taking risks as the farm was a commercial system and some caution was needed as to the level of risk the system could carry. After all, if a program was too high risk and went bankrupt, the entire facility would be lost. There were considerable expectations on the farm from the farming community to be their risk taker. As pointed out by this State government extension practitioner:

> "I mean the farmers certainly expect the research farm [to be out performing everyone else] -- there was some criticism recently, whether or not the farm should or shouldn't adopt the fixed sprays. Which are very expensive to put in on a per hectare basis and the Board of the MRF was saying "Oh no we don't think we should do that. It's too expensive. It's probably not economic etc, etc" and other farmers were saying "For Gods sake they're a research farm. They're the ones that should be living right on the edge and proving one-way or another whether or not those sorts of systems actually do pay for themselves in our environment. And so some people would be looking at that "Well, great they've done it. Yes it did pay for itself or no it didn't pay for itself" and they'll take that information quite happily". Extension officer, MID, 2002

The tension between having to be a commercially operated research farm while at the same time taking considerable risks on behalf of the industry was a factor that had to be managed by the Board. This restricted operations of the site to taking a demonstration approach to farmlet projects, mainly because there were not the resources to stock and operate multiple treatments and replicates with commercial sized herds. It was necessary to trade off having the next best thing to a normal farm, but compensating for the way farmlet activities could operate.

> "The other thing that I find important about the information that comes from that farm it has to run commercially -- the farm is self-sustaining. Like it's not government funded so if it can't make money it would go broke. It would cease to exist, so, it has to be an efficient business just to exist even though it gets a lot of funding and a lot of support from sponsors and that sort of thing. The Board does its best to make sure that any of that money goes into say capital works or into the cost of running demonstrations. It doesn't go into the running costs. The running of the farm has to be self-sufficient. You know it has to be a viable business to remain operative and for me, and I'm sure for other farmers in the district, that's what makes it credible. You know, where we look at say stuff that

> happens at Ellinbank (Victoria) they're all little farmlets and its run by the government. I think they're, you know, 15 cow farms and I think there is about 30 staff managing it. Well it's pretty hard for us to look at that and say "Oh well we can do that 'cause they're doing it down there". Farmer, 800 cows, 2002.

Maintaining external relationships with the farming community was important, however maintaining relationships with research partners such as the Target 10 group and other State Government researchers, was a different kind of relationship for the PM to manage. Both parties required mutually beneficial outcomes. The MRF was intent on achieving its learning objectives through increasing research income and project activities along with increasing the profile of the MRF to the farming community. The project partners needed to demonstrate the principles and outcomes of their research on a commercially operated, but independent farm. These relationships were bound by the formalities of project contracts, and therefore regular communication and dialogue was required between the parties.

Issues of control over project management and the day to day management of projects at the site tended to create tension between parties, however the benefits of their involvement far outweighed the difficulties in working with a number of actors from various organisations. As highlighted below:

> "Having the Target 10 guys was great as they formulated the diet for the farmlets. It can be challenging working with the agronomist/nutritionists that make the decisions though when you are trying to provide input from the farms perspective as well. It's especially problematic when decisions are made and then not see the effects and change in the results as expected. We really needed clearer roles in the group on the decisions we were meant to be managing. It is something we should have determined when the group was set up. It needed a formal structure and a time frame on how long people needed to be involved and the kind of commitment they needed to have. Maintaining interest and ownership was necessary. Project Manager, 2002

The roles of the MRF project manager, compared with the researcher for respective research projects, were undefined which made the relationship difficult to manage. Lack of role definition meant that the rules for engagement were not established, and there was a more 'muddling through' approach to operations and meetings were held in an ad hoc fashion.

Relationships with peers beyond the regional site is the final critical issue impacting on the learning platform. The demanding role of the PM included the roles of research and extension practitioner and the demanding nature of the role which limited the opportunity to interact and become a major player in the larger network of farmlet projects across Australia. The PM found the experience of attending a workshop with the National Dairy Farming Systems project (see appendix 2 for the program outline) particularly rewarding and inspiring, and this suggested there was a level of professional isolation in working within a farmer cooperative, where the learning emphasis was largely geared towards the shareholders. Accountability for delivering learning outputs was core business and only if there was clear benefit to contributing to this, were professional development opportunities included in the PM activities:

> "Being that in the farmlets case anyway, I am the researcher and extension practitioner means it's up to me to get it done. I manage it, but when the results are not doing what they are meant to do, then it would be nice to have another person from the Farm, who is as involved in the project as I am, to bounce off." Project manager, 2003

The combined roles of research and extension had implications for the learning relationships operating around the farmlet, and created professional isolation within the project. The need to seek affirmation of existing performance (similar to the way the farming community used the MRF) as well as to share activities and learn about how others conduct farmlet RD&E was extremely valuable to the PM. Compared to other sites, there wasn't the opportunity to develop a learning relationship between the two professions (as there is when the roles are carried out by separate people) and so there was no contribution to other's practices or learning at a professional level for the PM. The Farm Manager worked closely with the PM at MRF and assisted with pasture management, however on an analytical level, the PM was on her own. By being part of the national program, a whole new world opened up and instead of just being part of a regional community, the PM became a contributor to a much larger national project.

As the PM describes it:

> "I felt after this last NDFS conference in South Australia -- more part of the National team than I had in the past -- admittedly I'd missed most meetings in there, but, there was certainly a lot easier to talk to people like George and, Bill and so forth about their projects. Finding out how they've set them up and realise that "Oh God, we're just a research farm but it excited me to see that in terms of communicating results we're doing well. It stacked up to Flaxley and things -- it made me see that we are doing some things better. Sure there's lots we've got to work on, but we're not as low down as I thought". Project Manager, 2002

NDFS enabled the sharing of particular intellectual resources unique to farmlet RD&E, whereas the regional focus of MRF and the very small team was limiting.

8.3 Emergent learning

Fundamentally, the MRF represents an example of a self-organising system, whereby farmers – not a State government organisation – is managing the convergence of resources into a learning platform. The financial investment of farmers allocated to sustain and grow the MRF, using knowledge and learning as the dividend, introduced an alternative approach to managing and organising the farmlet activity system. What has been revealed at this particular site, is a dominance and sophistication in the development of mediating artefacts and the division of labour, with an emphasis on formalised governance structures and relationships. Community involvement was also a major driver within the activity system. This is now explained using the emergent concepts driving the MRF learning platform.

> Key concept: Formal relationships
>
> Formal relationships refer to the learning relationships around farmlet projects where the boundaries are set for the activity system. Boundaries to the activity system are negotiated between knowledge systems (farmers, researcher/extension practitioner), to determine the appropriate actions required to the object of the site. The relationships are formalised through a constitution that stipulates the planning and reporting requirements, as well as an order of operations for interaction.

As the farming community owned MRF, the drivers of the object for the activity system had imperative criteria as did the form and function of actions to achieve the object. Farmers were the drivers of actions at the Board level as well as from within the community. At the Board level, there was significant structure and formality in how actions were driven for the MRF learning platform. Governance, tracking achievements against the strategic plan, and reporting to the community provided the framework for operations. The project manager was a major influencer in this process, providing knowledge and information as guidance. The interaction the Board and the project manager was a major driver of the MRF activity system.

In comparison to the formal structures and relationships underpinning the MRF activity, relationships with the external broader community were far more informal, but an important component to the farmlet activity system. Maintaining linkages and enabling a learning relationship to be formulated between the MRF and the community gave the site legitimacy and kept the site relevant to the needs of industry. Without the broader community support, interest and active engagement the site would not be maintained. It was the communication tools used by the project manager as the mediating artefacts that enabled the relationships to be maintained. The form of the communication tools shaped the relationship that was developed. For example, passive approaches such as the radio enabled the community to stay in touch with the MRF activity system without having direct two way dialogue with those managing the activity system or any depth to the information being presented. In contrast, the more active communication mechanisms such as the farm walks enabled two way feedback and dialogue. The mix of communication tools was the critical element, enabling the community to engage at various levels to meet their own learning style and needs.

Key concept: Informal learning relationships

Informal learning relationships refer to the relationships farmlets generate with the farming community based on the extension / communication mechanisms. Just as valuable as the formal relationships to the functioning of the learning platform, the role of informal relationships is to maintain legitimacy of the site, provide a suite of activities to enable interaction and hence legitimise and maintain relevancy through the community utilising the information that emerges.

The informality of the relationship with the farming community draws attention to the lack of structure and rules associated with the interaction compared with the formal relationships. This was not necessarily a negative attribute of the activity system as it fostered engagement of the community on their own terms. However, the lack of formality meant the follow on affects and major impact (profitability and productivity gains, practice change) of the MRF activity on the community was difficult to measure. Hence tools for evaluation could only ever contribute to understanding basic subjective measures such as satisfaction and value of the MRF activity and hence the monitoring and evaluation served to affirm the activity system had support from the community, rather than whether it was having a significant impact. This level of monitoring and evaluation was adequate for the requirements of the MRF site and investors at the time, but the opportunity was missed to really understand how the activity system changed the community and to different actions – particularly in the area of extension and communication – that might extend the impact of the MRF. Just as the site outsourced research projects to extend the knowledge generated at the site and complement the farmlet demonstration, outsourcing additional extension and communication projects could have extended the capacity of the learning platform.

The multiple learning activities in operation at the MRF - research, demonstration and extension/communication – provided a solid continuum of knowledge development, in the form of decision rules that emerged from the convergence of activity systems. Research was the provider of new decision rules and demonstration was the application of the new decision rules in a commercially operating dairy farming system. Research provided new answers, and the demonstration then validated the decision rules in a fully commercialised context. Essentially, the demonstration project and commercial validation increased the considerable value to the learning platform. The demonstration activity enabled deconstruction of the research output by putting it into the farming systems context, and then reconstructing the decision rules around how the innovation could be implemented in a commercially viable way. This convergence of decision rules through to commercial validation was a unique feature of the MRF compared to the other case studies.

> Key concept: Convergent decision rules
>
> Organisation of decision rules refers to the different levels of decision rules that can emerge from farmlets. This creates a continuum of knowledge development through decision rules that emerge from farmlet *research* projects or other component research projects, that can be further developed through being applied in a second round of learning through a *demonstration* project, which adapts and refines the knowledge into a commercialised farming context.

The way in which the new knowledge and information was presented and shared with the community was particularly pertinent to the value of the learning platform. The dominant theme of commerciality and the independent nature of the MRF in comparison to other privately operated farms, meant that the information could be scrutinised, questioned and used for comparison by farmers which significantly enhanced the learning platform of MRF. Being a commercial farm owned by the farming community meant there needed to be an open learning approach, to ensure that access the data including economic analysis, productivity and profitability gains. Information transparency thus a key concept capturing this attribute of the MRF learning platform.

> Key concept: Information transparency
>
> Information transparency refers to the detailed nature of farmlet data presentation that allows for open questioning and a deeper level of learning due to the site not being privately owned. There is a greater opportunity for rigorous dialogue and to fully critique the farmlets in comparison to a private enterprise.

While the form of the MRF knowledge and information (decision rules and transparency) were critical elements to the learning platform, the particular functions of the MRF knowledge, information and activities for the community were the other important attributes. Transparency of information was critical, however the regularity and routine delivery of results from projects – in particular the farmlet information – enabled farmers to observe the farmlet activity in real time as it played out, which enabled a particular tracking function to be performed by the farming community

> Key concept: Tracking system
>
> The tracking system refers to one of the primary attributes of the learning processes enabled through regular transparent knowledge linkages with the farming community. Through the provision of regular transparent information, farmers could identify with and compare their own performance against the farmlets. Discrepancies between data from the farmlets between reports, and also during comparisons on the farmer's own system, led to analysis and further questioning of differences in performance and identification of deficiencies in management.

The MRF was well positioned to be responsive to local issues, to provide ways of managing challenging situations unique to a region. Along with being responsive, predicting the future challenges and having answers ready for when they are needed is also part of the learning challenge. Constantly being forward thinking and looking to where the industry is heading within a region and addressing the issues in both an active and reactive way is critical. The regional location of the MRF farmlets contributed to its relevance and formulated it into a regional identity, and part of the social capital of the farming community.

> Key concept: Regionality
>
> Regionality of learning refers to local situations that farmlet projects respond to finding new decision rules that enable management of the situation. Issues are regionally specific and need to be studied within the region. An example of this was the nutrient management plan development.

As part of the social capital of the region, the MRF was a recognised site for learning, highlighting the importance of the industry to the region as well as the value and commitment the community placed on learning and advancing the industry. This acted to provide a location for long term learning partnerships between institutions, and a location or home for research and development supporting industry learning and change. The site enabled co-ordination and alignment of dairy farming systems learning for the region where projects actively worked together and could be viewed in conjunction, compared to having separate projects on separate sites in different regions.

Key concept: Centralisation of learning

Centralisation of learning refers to the way that farmlet projects provide a central focus within the community on dairy systems learning. Farmlets can accommodate a range of complementary learning programs, which creates a platform for networking and collaboration with additional institutions, and extends the learning outputs around the farmlet project.

The final major function that emerged from the case study analysis was the way in which the site performed a role of risk taker for the farming community – testing and validating new practices and innovations. In this role, there was a tension between remaining a commercial farming system and operating as a 'normal' farm, then conducting high-risk projects that might put the entire MRF facility in jeopardy. The trade-off was to run medium risk projects, rather than high risk. There was a cost to learning processes in doing this, although it ensures the longevity of the facility. The farmlets were thus facilitating learning around the first stage of decision-making processes on farm for medium risk management situations.

Key concept: Risk taker

Risk taker refers to the way farmlet projects acted to stimulate learning and decision-making processes for the farming community. This role was one that farmers depended on when making decisions around major capital investments. The learning process involved farmers monitoring the progress of interventions, and at the end of the project assessing the outputs to determine the feasibility of implementation. Trust in the farmlets is critical.

Summary of the MRF case study

Table 18 brings together the key concepts that have emerged from the MRF case study. The concepts developed are presented in terms of the activity and analytical point from which the concept has emerged and the actors who have been affected in learning relationships have been affected.

From the table it can be seen that the majority of learning platform actions around the MRF farmlets occurred largely from the activity initiated and managed by the Project Manager with the Board of Directors and the farming community. A number of learning processes were identified to be operating around the MRF, which were matched by learning outcomes. Figure 22 demonstrates the interrelationship between these concepts and where they are positioned within the overall MRF farmlet activity system.

Coding category	Implication in the activity system relationships	Concept	Symbol
Interaction with the Board	Rules/subject	Formal relationships	F_r
Engagement of farming community	Community / Mediating tools / rules	Informal learning relationships	I_r
Information requirements/format	Rules/mediating tools	Information transparency	I_t
Developing and using decision rules	Mediating tools/rules/subjects/community	Convergent decision rules	DR_c
Utility of learning outputs	Mediating tools / rules / subjects	Tracking system	TS
Local learning needs and farmlet responsiveness/focus	Rules/community/mediating tools	Regionality of learning	R
Participation in industry learning programs	Mediating tools / rules	Centralisation of learning	C
Multiple roles within farmer learning	Mediating tools / rules / community	Risk manager	R_m

Table 18. Summary of key concepts that emerged from the MRF case study

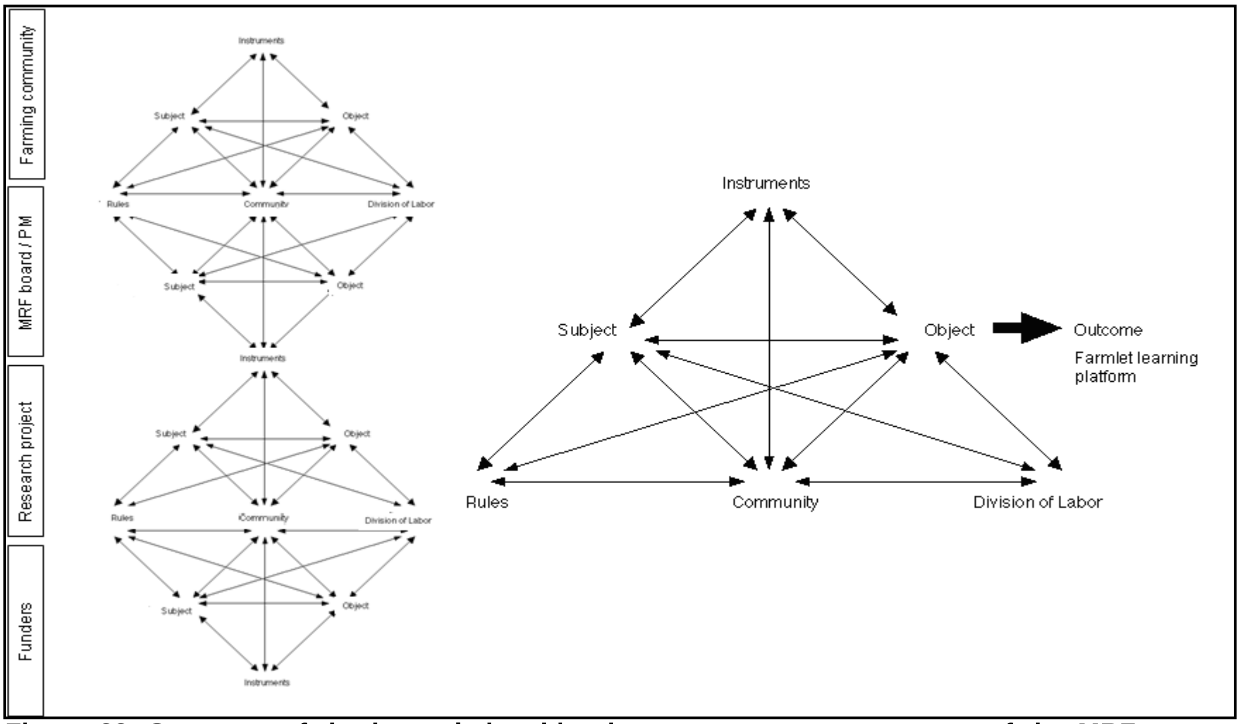


Figure 22. Summary of the interrelationships between emergent concepts of the MRF case study.

8.4 Conclusion

The following conclusions can be made from this case study against the research question of how farmlets act as learning platforms for the Australian dairy industry.

Fundamentally, this case study demonstrated the implications to a farmlet learning platform when the farmlet site is organised by farmers themselves. The implications of this are:

a. More formal structures and boundaries are required to enable actions to be defined and sharing of information that ensures the functioning and operations of site are maintained and accountability to shareholders is maintained.
b. Developing and maintaining rules associated with the actions involved to achieve the object was an imperative role of the PM. This included maintaining a standard form and mix of activities (research, demonstration, extension) in terms of alignment of objects, and outputs in the form of commercially validated decision rules and transparency of information.
c. Where there are multiple relationships, with formal and informal definitions, consistent and appropriate mediating tools in the form of strategic and operational plans are critical to maintaining the boundaries of activities in maintaining relationships.
d. Where research, demonstration and extension/communication are carried out by one individual, activities will remain focussed on the object but be limited by resources in expanding actions or trying new approaches.
e. On-going real time delivery of information enabled a sustained learning process for the farming community to remain engaged with the site. Therefore the process of conducting the farmlet project and additional research projects over time presented the opportunity to share and support learning in the long term, not just at the completion of the project.
f. Transparency of information enriched the capacity of the learning platform.
g. The location and ownership of the site embedded it as part of the social capital in the region which meant it was valued as key focal point and critical resource to local industry development and advancement.

This concludes the exploration of regional farmlet studies. Chapter Nine now discusses the overall research, including an analysis across the four case studies to provide an overall response to the research question.

Chapter 9 A cross case analysis: Farmlets as learning platforms

9.1 Introduction

The four case studies have been analysed in depth, focussing on farmlets as an activity system and their attributes as learning platforms. Essentially, each case study provided a different context for de-constructing and reconstructing the actions and elements that enable a farmlet project to be developed and initiated and hence perform as a learning platform at various levels. Individual activity systems associated with a farmlet project were used as the units of analysis, identified by the primary object or role in the research, extension or farming industry continuum. A complex interplay of relationships was revealed with variations in roles and the implementation of different mediating tools. The most prominent feature was the dynamic and changing nature that constituted the farmlet activity systems, largely due to shifting or different application of resources. This meant each activity system had to adapt and amend its actions according to the resources that were available to enable a learning platform to emerge.

This chapter brings together the findings of the individual case studies, to provide an analysis of the fundamental elements required for the learning platform to emerge and additional elements that allow one to be more effective than another. Essentially what is indicated is that there is no a set 'recipe' for farmlets to be a learning platform, rather there are some critical ingredients in functionality and form that make the difference between being adequate, and being really effective at supporting learning and adaptation across the RD&E continuum. There are some common attributes in the relationships between the various components of the farmlet activity system, and there are atypical attributes peculiar to a particular context.

The discussion will then move to formally address the research question of *"how farmlets act as learning platforms for the Australian dairy industry RD&E continuum".*

This section sees the process of expansion and transformation in action, whereby the four case studies and their respective concepts and analysed collectively. It refers back to the processes of adaptation and transformation from chapter three as the fundamental mechanisms of learning within activity theory, combined with the results of the individual and cross case analysis presented here.

9.2 Cross case analysis: regional farmlet learning platforms

Thirty seven concepts that influence farmlet activity systems as learning platforms were found across the four case studies. These are summarised in Appendix 3. Here, they are considered further identifying outline similarities and differences across farmlets and how this impacts on performance of the learning platforms overall. The model of a generic activity system is deconstructed into the various components that formulate a system, to establish the important attributes and considerations for each dimension of farmlets as learning platforms. An analysis then reconstructs the farmlet activity system to establish the implications where there are differences between how activity systems function as a learning platform.

The variables that emerged for each respective farmlet case study were different, with different emphases, tensions and contradictions found across the four case studies. Four attributes were major contributors to these differentials: the stage of the farmlet project; the level of maturity of the region and history of conducting farmlet projects; physical resources and the structure of the farmlet team (see Table 19). These factors heavily influenced the context of each case study and what influenced farmlet activity systems as a learning platform. The individual elements of the farmlet activity system are now explored.

	Elliott Research & Demonstration Station	Vasse Milk Farmlets	Flaxley Farmlets	Macalister Research Farm
Stage of farmlet project	Commencing new project	Year one of new project	Year two of new project	Year two of new project
History of farmlet projects	>10 years	1 year	4 years	6 years
Physical resources	Government maintained facility	Government maintained facility	Government maintained facility	Farmer co-operative
Structure of the farmlet team (intellectual resources)	Farmer committee, researchers (2), extension team (5)	Farmer committee, researcher, extension team (variable)	Farmer committee, researcher (2), associated extension team (2)	Farmer Board, Project manager

Table 19. Fundamental differences between the farmlet case studies.

9.2.1 Farmlet Activity System: Defining the object

The most complex component to the analysis of the farmlet activity was around definition of the object, or what is fundamentally driving the activity. Without such definition, the actions underlying the activity are meaningless or could be misunderstood, and any seemingly contradictory tensions across different elements could be misinterpreted. Is it the farmlet project, the research question, or learning and adaptation that drives the object or all of them that form the object of the activity system?

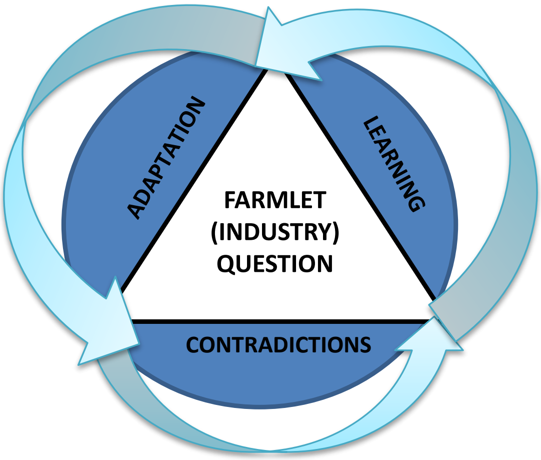


Figure 23. Key elements to setting the object for farmlets

As indicated by Figure 23, and after much grappling with this question, ultimately all of these things collectively provide a multifaceted object, for a multidimensional activity system. These critical components need to be aligned to provide a stable and clear object for the farmlet activity system. Achieving such clarity in the object is where the process of expansive learning occurred, albeit sometimes using clumsy and informal policy as a guide. This is now further explained with the farmlet case study results.

Setting the object for farmlet projects is an activity within itself that required conscious and formal effort from all involved. It needs to be a joint effort, one that brings together the right mix of intellectual prowess along with physical resources enabling appropriate problem (object) definition. It is a situation akin to what was outlined by Kilpatrick et al. (2010:175) as part of their study on inter-professional engagement:

> "The common goal and purpose needed to be apparent across all the groups and in working towards achieving common goals a key factor was having a range of people who understood not only the importance of working together but could actually make things happen as a result."

Defining the "right mix" of these resources is a significant factor in shaping what constitutes the farmlet activity system, along with the individual or organisations conducting the definition of activity. The case studies from ERDS and VMF, that were in the early stages of planning and implementing a new farmlet project provided insight into this. By comparison, the approaches were considerably different with ERDS drawing on historical, internal local knowledge and actions compared to VMF that drew on the experience of others external to the agency. Two very different approaches to developing an object for the same activity of a farmlet project, were demonstrated.

ERDS sought to expand the object of farmlet projects to business management/decision making analysis rather than technical dairy, by drawing on local knowledge and historical outputs from the site and initially using those within the local team to define the question. The engagement of those external to the historical outcomes and local knowledge, brought new perspectives and intellectual resources. This challenged the process and set the platform for significant expansive transformation of both the internal and external team, even though the evidence in the data suggests this was never fully realised. This is a common phenomenon described by Davydov (1999:42), where in many cases external transformation occurs without internal transformation.

> "Most frequently transformation is understood as changing the object. But careful examination shows that not every change is transformational. Many changes of natural and social reality carried out by people alter the object externally without changing it internally. Such changes can hardly be called transformations. Transformation means changing an object internally, making evident its essence and altering it".

Without internal transformation occurring within the ERDS team throughout the process of engaging with the external stakeholders, a damaging stalemate occurred. Ultimately it was the historical starting point of local industry priorities and necessary imperatives to maintain the farmlet facility that was the driver of the ERDS team to construct the object they put forward.

Degrees of separation (DOS) was found to be a fundamental concept that was both driving and impeding the development of the object, particularly because it had to be a joint effort between multiple stakeholders. Different experience, knowledge and worldviews could be brought into the thinking, however if the disparity is too great it is difficult to negotiate a shared object. Multiple factors create key differences between perspectives, experience and key drivers of stakeholder groups with an interest in shaping the object. The DOS impacts on transformation processes in the following ways:

a) Disparity across individual drivers: the more disparate and unparalleled the drivers (priorities) of different stakeholders, the more convoluted and difficult it was to reach any consensus on the object.

b) Time pressure: the need to ensure there wasn't a substantial time lag between linkages between projects and communication with industry. Maintaining momentum across projects was an important factor in linking historical knowledge to the rationale for any new project.

c) Resource utilisation: pressure to ensure resources are used, to demonstrate value and not be lost. The physical site of the farmlet, the intellectual resources of the researchers, extension and technical staff put pressure on the projects to ensure there was a legitimate basis for maintenance.

d) Hierarchy of industry needs with regards to local, regional and national priorities: overall these three levels of needs feed into each other with each level contributing to creating a relevant object. While the actual hierarchy facilitates the development of a joint object, the epistemological perspective of stakeholder groups on how to achieve it may create insurmountable differences.

e) Preferred platform/s for negotiating a shared object: different preferences between stakeholders may exist around the mechanisms for convening, and encouraging dialogue and processes for resolution. Some may be content to use traditional mechanisms, whereas others may seek to challenge the "old ways of doing things".

Having the skills required for the practical collaborative work is a significant challenge, and a common problem across many disciplines (Kilpatrick et.al 2010; Milbourne et al 2003; Atkinson et al 2002). Old approaches were found to be inadequate by the ERDS team which were maintained despite lack of success. Part of the issue was the sense of urgency to ensure a farmlet project was in place within a certain period. This was important to all the local farmlet teams, as if the physical resource were not used there was potential for them to be lost to other activities (or sold off to generate funds for other government projects). Such pressure are additional barriers to transformation and expansion.

In summary, differing DOS are affected by 6 critical elements:

	Separating element	**Critical elements**
1.	Spatial	Different working biological/physical systems also time frame requirements
2.	Organisational	Various policy differentiation, organisational objectives, culture, resource utilisation
3.	Worldview	Epistemological differentiation
4.	Intellectual resources	Knowledge base and critical analysis capability
5.	Physical resource	Tools of the trade (farmlet site etc), level of innovation available, human resources
6.	Historical platform precedents	Previous experience that guide subsequent farmlet activity

For the ERDS system, the key elements that affected DOS in formulating the object were differences in worldviews, combined with historical precedents that needed to be overcome before a truly joint object would have emerged. The inadequacy of the platforms used to negotiate a new object prevented any major transformations occurring.

Much seems to be assumed by stakeholders when there is a historical perspective and approach to draw on. In contrast the case of the VMF with a clean slate was able to try something new. As stated by Kallio (2010:34),

> Activity systems differ from each other according to their objects as objects evolve during their history. Defining the object demands object specific historical analysis. By understanding the history of its origin, one can understand the transformation of the object of an activity as well as the contradictions within the activity.

For VMF, the history of others was a critical component in enabling the development of the object, and instead of history impeding progress it provided a good starting point of what worked, what didn't and which were the fundamental rules that should guide the farmlet activity. Because the VMF was following a very traditional farmlet study format and design (focussing on stocking rate), the degrees of separation in worldviews were minimal. The major DOS for VMF were in terms of spatial separation which introduced issues around production systems and regional differentiation. The issue required various communication platforms to overcome the issues.

In association with DOS and key drivers of the object are the concept of old and new rule development. Overall, it is the development of new rules and different tools that provide evidence of change and internal and external transformation. For ERDS, there was little evidence to suggest any transformation had occurred, with the exception of valuing more rigour in the peer review process of any new project. For the VMF team, there were ongoing mainly internal transformations occurring, with new actions implemented largely in the area of communication strategy as a result of unsatisfactory feedback from the community.

In all case studies, the object was the key element which defined the requirements of all other parts to the activity system. Teams put significant effort into "getting the object right" as the investment within a farmlet project required the object to remain the same until completion. Once a project commenced, there was little flexibility to change the object; rather the actions and other elements within the activity system were adapted to find the answers to the object. This is at odds with the notion within activity theory that the object is constantly shifting due to contradictions within the activity system (Engeström, 1987) and hence transformation is occurring.

Maintaining the object once it was agreed to by stakeholders is a critical component to farmlets, but it is particularly problematic when the farmlet project encounters serious and unexpected issues or contradictions. An example of this was from the Flaxley farmlet case study, where the high stocking rate farmlet treatment experienced significant paddock damage due to instability of soil type and high rainfall that could not sustain the high number of stock in a small area. This created differences amongst stakeholders on the required mitigating actions, with a divide between farmers on the management committee and researchers in control of the project.

Such contradictions highlight Engeström's theory (1987) of expansive learning, in particular the role of collective reflection triggered by discrepancies in individuals' views and understandings. In a review of organisational knowledge creation, Virkkunen (2009:150) summarises Engeström's theory (1987) and the role of contradictions in the dynamics of knowledge creation, and states it is not primarily on the level of representation, but rather on the level of different (contradictory) forces within human activities. He moves on to say:

> "The primary contradiction within the activity systems in between the use value and the exchange value of its elements. When the activity and its context change, the system moves from a relatively stable first state to an in articulated "need state" and then to a stage of increasingly acute secondary contradictions between some elements of it. Secondary contradictions push the system farther away from a quasi-stationary equilibrium, eventually to a bifurcation point where a new solution is necessary…..an increase in the instability and in the number of problems in the activity system leads the actors to a need state, and to making a conscious effort to analyse the causes of the problems and find a new object for the activity".

Given the purpose of farmlet projects is to maintain the object developed in the initial design until an answer is found, needing a new object within a project could make the project seem a failure because some element went horribly wrong. Such contradictions cause significant DOS between stakeholders and competition between knowledge systems. Time pressures and inability to negotiate an agreed position (as in the case of the FF case study) mean stakeholders remove themselves from the activity rather than stay within such a frustrating environment. No positive transformation can occurbut rather, negative sentiment develops seriously undermining the activity.

So despite the notion within activity theory that suggests the object should be dynamic, with activity being the ongoing construction of the object (Engeström, 1995:69-70; Miettinen, 2005 cited in Kallio, 2010:34), this is not how the activity operates in farmlets. The object cannot be too ambiguous and have too many large contradictory accounts nor can it have any real potential for change in the duration of the project otherwise there would be too many distractions and an inability to find solutions. The challenge within farmlet projects is to ultimately find solutions to multiple contradictions and problems throughout the project without changing the original object, but with opportunities for internal and external transformation.

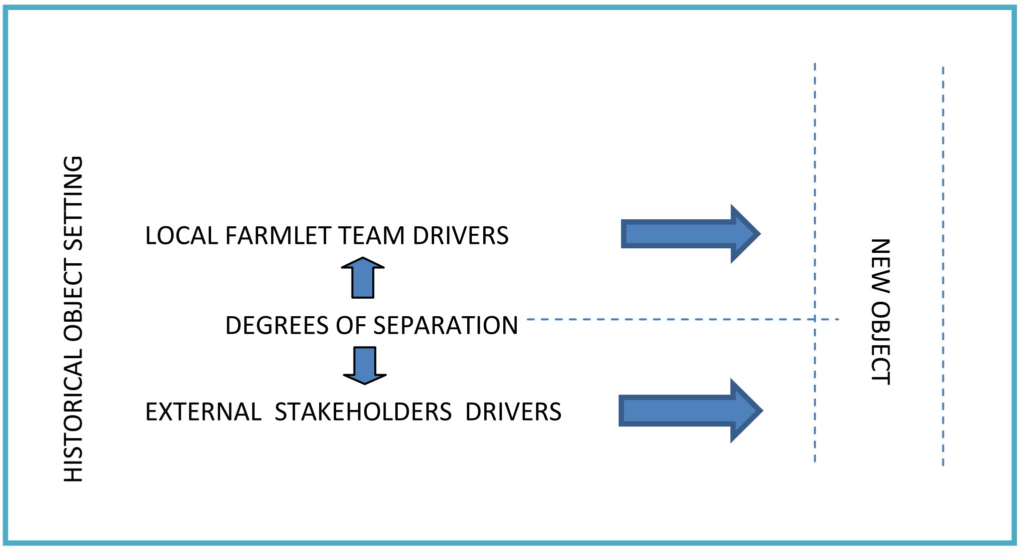


Figure 24. Elements to the object setting process within farmlets, presenting the influence of historical object setting and degrees of separation between subjects on negotiating a new object.

This is a key element to establishing how farmlets perform as learning platforms and essentially occurs through shifts and changes occurring in the other elements of the activity system (subjects, tools, community, division of labour). The overall key considerations for object setting within a farmlet learning platform are presented in Figure 24.

9.2.2 Subjects

Subjects in activity theory provide the intellectual resources within farmlet learning platforms. Relationships between the subject and the object farmlets depends on role definition, tacit knowledge utilisation and creation and the development and maintenance of learning relationships. Farmlet learning platforms are the outcome of a number of subjects (individuals) actions in relation to the farmlet object. In essence subjects are viewed in line with how they have been described by Engeström and Miettinen (1999:10).

> Activity system as a unit of analysis calls for complementarity of the system view and the subject's view. The analyst constructs the system as if looking at it from above. At the same time the analyst must select a subject, a member or multiple members of the local activity, through

> whose eyes and interpretation of the activity is constructed. The dialectic between systemic and subjective-partisan view brings the researcher into a dialogical relationship with the local activity under investigation. The study of an activity system becomes a collective, multi voiced construction of its past, present and future zones of proximal development (Engeström, 1987).

Activity theory supports the concept that a subject's relationship with the objective world is always mediated by activity and most behaviour should be viewed as 'purposive and culturally meaningful actions' rather than reactive to environmental stimuli (Kozulin, 1996 cited in Kilpatrick et al 2010:162). Farmlets are an activity dependent on the purposeful actions of multiple subjects. Therefore subjects within farmlet projects were never viewed as individuals, but rather as "collective subjects" (Lektorsky, 2009:82) whose actions and behaviour were a product of their own experience and intellect relevant to activity associated with farmlets. The assumption has been that relations between subjects within and across farmlet projects are always different, along with being mindful that individual subjects can adhere to strict rules or can imitate some patterns of activity (ibid).

Eight major themes emerged from the data regarding subjects within the farmlet activity system and these revolved around the development, maintenance and barriers of relationships, roles (gatekeeper, peers) of subjects, rules that guided subject behaviour and needs of individual roles (differentiation of decision rules, affirmation of practice). These themes were particularly significant for the two less experienced farmlet projects, Flaxley and Vasse, indicating that relationships between subjects is a critical component to early farmlet site establishment.

Subjects across farmlet projects were identified by their professional role, which was essentially an individual complementary activity system operating within the larger activity system of a farmlet project. Across all case studies, the subjects were grouped as either researchers, extension practitioners, farmers, funders or external stakeholder groups (i.e. NDFS). This being the case, there were a multitude of interpretations, world views and needs of subjects within a farmlet project that were observed in the research process with three critical influencing factors to subject roles identified. These were associated with managing information and knowledge, ways of interacting with other activity systems and evaluating the performance of collective activity (or seeking affirmation).

Multiple knowledge systems involving differences in tacit knowledge, language, disciplinary methodology and practices of subjects need to be managed in order for farmlets to operate. The more subjects involved in the actions associated with farmlet function, the more management required. ERDS presented the largest team and was potentially the most complex to manage. In comparison at MRF, the team consisted of one main subject driving all management of knowledge and information. However it was in the types of knowledge and information and systems for sharing that emerged as an important factor.

Types of knowledge consistent across case studies included blending localised tacit knowledge of commercial farming systems (farmers) with farmlet research (researchers, demonstration and extension (extension practitioners). The “blending” process occurred through questioning and comparative processes of why and how certain practices were done (both in the commercial and farmlet farming systems). Positioning of farmlet farming systems information contextualised messages into decision rules (e.g. if X occurs under Y circumstances then Z strategy will be implemented), which enabled greater meaning and relevance to different subjects along with a more effective ability to scrutinise information. It was on this platform that subjects built the commonly shared language and the ability to use it collectively, a critical element to directing and achieving a joint object according to Lektorsky (1984).

Complexity in managing information was not necessarily a function of the size of the team rather how well systems were set up to enable subjects to integrate and work effectively together. Internal team operations and communication all revolved around regular team meetings which was a straightforward process. Sharing knowledge and information externally was more of a challenge with maintaining continuity (ongoing sharing) and generating two way knowledge sharing systems and initiating innovative systems for sharing knowledge (of which there were none observed). Adequacy in existing structures and limited scope (budget, time) to go beyond traditional communication mechanism were cited as the reason for no innovative approaches. Table 20 below highlights the contrasting features in knowledge sharing approaches across the four case studies.

Knowledge sharing attribute	**ERDS**	**MRF**	**VMF**	**FF**
Maintaining continuity	Weekly publications in rural press	Daily radio, weekly publication	Newsletter, website	Processor newsletter update
Generating two way sharing	Monthly farm walks, six monthly field days	Weekly farm walks, bi-monthly field days	Monthly farm walks, yearly field days	Yearly field days, public forum
Innovative sharing systems	Nil	Nil	Nil	Nil

Table 20. External knowledge sharing systems across four farmlet case studies

Willingness to share knowledge and information was more of a problem within a profession rather than across professions. One of the best things about farmlets was the ability of farmers amongst themselves to review the information and know the complete story of management. This differed to farmer group activities run externally from the farmlets, whereby many farmers felt information shared by other farmers was not necessarily complete with only the positive components to the business presented.

Across researchers and extension practitioners, knowledge sharing occurred mainly at the level of methodology and results. The platform created by the NDFS program (see appendix 2 for a complete description) to facilitate knowledge sharing consisted of a number of approaches, with the annual workshop being cited as the most popular venue of all for two way dialogue. Hard scientific data sharing posed a near insurmountable challenge, with a barrier created due to differences in methodology and metrics used across regional projects. Despite this, the differences created an opportunity for dialogue and exploration of alternative approaches which was deemed a vital and rare opportunity for professional development and advancement of farmlets as learning platforms. Knowledge sharing enabled the development of key outputs, such as the "*Guidelines for Farming Systems Research, Development and Learning*" and DairyMod biophysical model (see Appendix 4 for knowledge sharing around DairyMod) which were examples where some internal transformations occurred as evidenced by the use of these tools within farmlet teams. However no significant evidence of internal or external cultural transformations occurred as a direct result of these tools, as usage seemed only to occur when facilitated or encouraged by the NDFS team. The tools didn't ever become embedded as part of everyday practice.

The clear roles were defined by each profession involved with the respective farmlet projects representing the responsibilities in capturing, analysing, translating and communicating farmlet knowledge. Analysed further below within the division of labour section, these actions drove day to day activity within the farmlets. How well these actions were being performed formed the basis of the "affirmation of practice" theme. Overall the evidence indicated that affirmation was sought intra-professionally from peers rather than inter-professionally. Researchers used other researchers, extension practitioners used other extension practitioners, and farmers used farmers. The role of the farmlet in this process essentially provided the platform on which these subjects converged and provided the common contextual point for dialogue. Affirmation requires an individual subject to be active/purposeful in seeking it rather than a passive accepting when it was forthcoming.

Timing of knowledge sharing and determination of what farmlet knowledge should be shared across activity systems was an additional common theme between the four case studies.

The “information gatekeeper” role which was a key theme that emerged from the FF case study highlighted the issue of when the most appropriate time was to share information from the farmlets with the broader community. The subject most likely to make this decision was the researcher, but where there were extension resources to draw on it was a joint decision on how to present the information. This latter point was pertinent to the FF case as it was the researcher who managed the process without input from an extension perspective. Other case studies with extension practitioners, by comparison, were able to maintain regular and consistent contact with the community, which meant the relationship between community and the farmlets grew over time.

Responsiveness and addressing contradictions and issues was a critical element to the gate keeper role of subjects. Contradictory events and actions were a fundamental part to farmlet learning platforms. How these events were dealt with as a learning opportunity was dependent on the subjects’ perspective on the event, what the learning benefits were and how this should be communicated. This required a careful balance of remaining transparent (telling the complete story of contradictions and solutions) whilst not undermining the validity and reputation of the farmlets. All farmlet case studies were required to be responsive in this way, with those farmlets such as ERDS and Macalister being the most effective at this due to having the tool/mechanisms (covered below) in place to enable management of contradictions.

Overall, the roles and actions conducted by the individual subjects for the joint effort of the farmlet activity system fundamentally shaped the development and maintenance of intra and inter team learning relationships. As depicted in Figure 25, how well learning relationships were developed and maintained was directly related to the role definition, ability to share knowledge, responsive capacity and affirmation processes used to improved actions and practice.

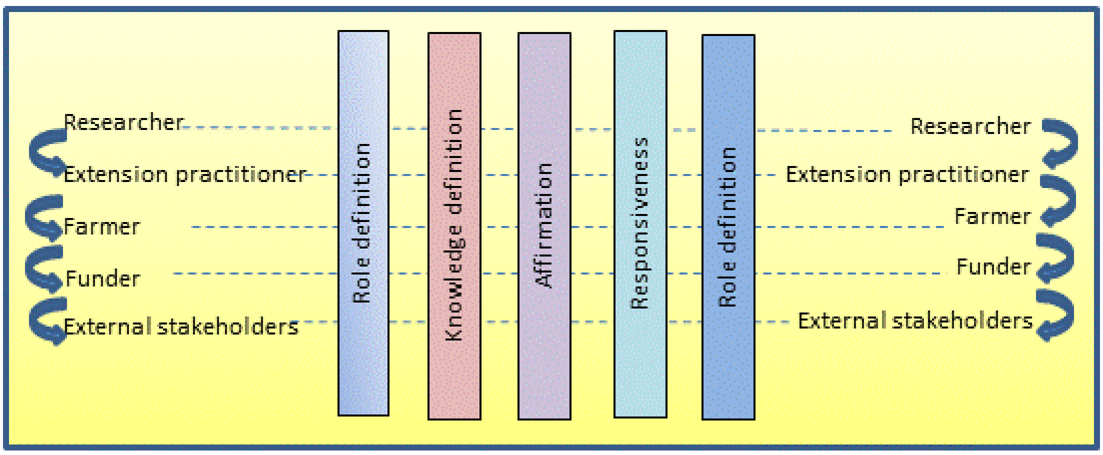


Figure 25. Subjects and learning relationships within farmlets

To develop learning relationships required significant time frames and purposeful effort on behalf of the subjects. Teams such as ERDS and VMF placed considerable value on maintaining relationships, as did MRF. FF did not acknowledge the value of these processes, citing internal team disputes as interfering, along with a lack of capacity to be responsive. Nonetheless, each respective subject within a team was an invaluable intellectual resource and any removal created instability within the farmlet activity system, requiring significant adjustments across the entire activity system. A case in point here was the VMF with the loss of the extension leader. The loss of tacit knowledge, systems and strategy along with the established learning relationships meant significant effort to rebuild stability impacted on the ability to maintain the object for a period of time.

Thus far the analysis has covered the object/outcome and subjects the context of the relationship between the subject and object and outcome. The proceeding section now analyses and recognises the role of the mediating tools and fundamental relationships to the object and subjects.

9.2.3 Mediating tools (artefacts)

Engeström focuses on the role of tools (artefacts) within activity theory in mediating activity, compared to Vygotsky who was concerned with instrumentality and how tools influence behaviour (Blackler 2009). Overall, in the context of farmlets it was difficult to separate activity from behaviour and as such needed to be analysed together. As depicted in Figure 26, tools were primarily mediating the relationship between physical resource of farmlets and the subsequent behaviour of subjects and the respective intellectual resources. Differentiating activity from behaviour can be simplified by defining the activity of “what is done” which subsequently requires defining “how” it is done and by “who”.

Eleven key themes emerged across the case studies that provided insight into the tools within farmlets that influence learning platform capability. Overall, the data indicated that the types of tools, their cultural definition and the enabling attributes of the tool were the main influences. These are now explained below.

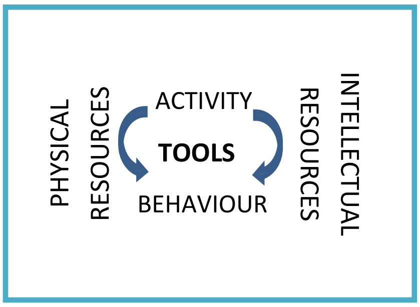


Figure 26. Role of tools brokering relationship between physical and intellectual resources.

9.2.3.1 Types of tools

For farmlets, the type and mix of tools available for mediating relationships and behaviour influenced the effective sharing of resources. Within the cross case data analysis the various major tools utilised across farmlets were divided into those that were physical resources compared to intellectual resources used to formulate the farmlet activity system. These are presented below in Table 21.

The broad categories of physical and intellectual tools represents the tangible and intangible resource base underpinning farmlet activity systems. Within each of these categories is a list of the major “tools of the trade” that were common across the four case studies as identified and confirmed by the respective farmlet teams. Differences occurred not so much between farmlet case studies, rather the way in which subjects defined the utility of each tool which is indicated by the different behaviours elicited by the intellectual resources associated with the farmlets. This was found to be the cultural definition of tools.

Farmlet tools	Activity	Behaviour outcome
Physical		
Farmlet facility	Convergence of farmlet research, extension and commercial farming practices	New (improved) decision rules for commercial farming, research and extension methodology.
Research plan/proposal	Development and outline of farmlet project object and summary of resource usage though joint development of stakeholders	Actions guided and initiated as a result of stakeholder negotiations and finalisation of an agreed plan
Models	Desk top action scenario testing using bio physical models	Determination and testing of actions, treatments and potential output from farmlets.
Guidelines for Farming Systems (FS) RD&L	Project planning and resource identification using a checklist	Scoping, questioning and sourcing of the required elements for an effective FS project.
Milestone reports	Regular reporting to stakeholders on meeting agreed milestones and budget expenditure	Taking stock of actions against the object, reporting on contradictions and adaptive responses.
Annual reports	Summary and store of annual events and expenditure	Reflection and analysis on yearly results, activity outputs and financial expenditure
Data collection tools (e.g.) pasture plate meters	Collection of relevant quantitative data for analysis	Routine observations and measurement, questioning and problem solving
Quantitative data	Collation of datasets for objective and empirical measurement and analysis to enable statistically significant conclusions to be drawn.	Using agreed metrics to seek an answer to the object.
Knowledge management systems	Storage, analysis and reporting of data using computer hardware and software	Questioning, problem solving, interpretation, explanation
Funding	Provision and allocation of industry and public funds to conduct farmlet project.	Investment into advancement of the dairy industry.
Human resources	Researchers, extension practitioners, technical officers, management committee, external support	Working jointly to develop, deliver, report and share learning outputs /outcomes of farmlet facility activity.
Marketing logos	Creating a symbolic representation of an organisation	Labelling and generating activity identity for communication tools
Evaluation sheets	Seeking affirmation and feedback	Generates dialogue and can initiate adaptive actions to improve performance
Newsletters, rural press articles, websites, posters, flyers	Standardised regular communication	Distillation of key messages used to enable passive on-going linkage between subject and community
Intellectual resources		
Researchers KS	Farmlet research using farming systems RD&E principles	Questioning, problem solving, analysing, communicating and reporting to funders, managing contradictions.
Extension KS	Farmlet extension using farming systems RD&E principles	Fostering relationships, developing and maintaining communication tools to facilitate relationships, translating research results into commercial farming systems terms, evaluation of actions.
Farmer KS	Using farmlets to identify innovative practices to improve business performance as well as affirm existing practices within a commercial farming operation to create a source of income and lifestyle.	Engage with the farmlets using passive (newsletters, updates, website etc) as well as active (physical attendance at the farmlets for an activity and interaction with farmlet team).
NDFS team	Creation of a community of practice for creating a national network for resource sharing (physical and intellectual) across farmlets.	Collective workshops, specialist project teams, tool development, peer review processes.

Table 21. Summary of the major farmlet mediating tools.

9.2.3.2 Cultural definition of tools

The output and outcomes of the tools used within farmlets are highly representative of what constitutes activity within a farmlet system and of the emergent behaviour. The overall farmlet object created the opportunity for different professions to create their own cultural definitions to achieve alternative purposes. While tasks were divided between professions in achieving the interdependency of each profession the overall farmlet object created a synergistic learning relationship. The best example of this was how the physical resource of farmlets was used differently by each profession involved.

For researchers, the farmlet site was a research instrument used in an experimental design. Extension practitioners used the farmlet site as a source of validated farming systems information and a place to convene discussion and dialogue with the farming community on farming system management and innovations that might improve commercial on-farm profitability and productivity. The NDFS team were seeking to build a community of practice[i] consisting of a national network for resource sharing across farmlets. Farmers were using the physical site for assistance in improving their business management, to affirm existing practices and to assist in managing risks associated with implementing new practices (see in particular MRF case study). Funding providers saw the purpose of farmlets as a means to address national farming systems priorities through regionalised farming systems studies. These interdependent, synergistic processes are what set up internal and external transformative processes which are dealt with in discussion relating to the division of labour section below.

Where the farmlet activity system tools and different subjects operated in isolation – most particularly research and extension – the capacity to achieve the overall farmlet objective was severely hindered as were opportunities for transformation to occur. Such was the case with the FF case study, where there was a disconnect between the researcher and the limited extension capacity associated with the project, largely because each professional involved belonged to a different organisation. The only tool linking researchers with extension was the farmlet physical resource as a location to convene respective activities. This was in comparison to MRF where the two roles of research and extension were the responsibility of one subject. While this should have made the synergistic linkages seamless, the job was so large that transformative processes were constrained because of the lack of capacity to do any more than the most basic fundamental activities of the two tasks, research and extension.

Tools were dealt with earlier in the chapter in the context of how they are used to mediate knowledge sharing across subjects (see Table 21). Sharing knowledge was a core outcome of using tools purposefully to broker inter-subject learning relationships. Across the case studies, tools were also found to act as enablers for brokering other outcomes that form part of the learning platform. The enabling qualities of tools emerged and are discussed below.

- Message consolidation and translation in a farming systems context
  One of the key factors of the farmlet learning platform was that the information was formulated analysed and communicated within a farming systems context. This activity was dependent on connecting many tools, starting with the farmlet physical site and R&D practices, to construct the right and relevant message for a particular region. The farming systems capacity of farmlets also meant other new innovations could be tested to demonstrate benefits within a region. The implementation of national programs within the farmlets such as InCalf (FF) and Countdown Down Under (ERDS) were examples of this.

- Tools to create identity points for community engagement
  Creating relevance using tools was a key factor in developing identity points for stakeholders, which then acted to encourage their involvement in the farmlet activity. Farmers in particular, were looking for attributes in the farmlet study with which to compare their own systems and practices. Location of the farmlets, data interpretation and the level to which information was analysed at the commercial level were key identity points. All farmers interviewed across the case studies highlighted areas where the farmlets were required to be similar in farm system attributes and have above average production performance (see identity points highlighted in MRF & VMF). The specific tools that enabled this to occur were the regular publications, but most effective were the farm walks where farmers could visit and determine the identity points for themselves.

- Creating learning pathways
  Ultimately the farmlet projects enabled learning pathways to be created given there was a start and end point to a project and significant object-orientated activity in between. The tools utilised during the project to provide regular communication of activities, outputs, contradictions and adaptation, maintained identity points (or not as in the case of FF where only limited communication was conducted with the community), created new ones and shared the expansion and transformation

resulting from the farmlet project. Regularity and transparency in communication tools were key attributes of the learning pathway created by farmlet projects.

9.2.4 Farmlet community

Community, or the collection of individual subjects who were the primary beneficiaries of the farmlet activity system, was a difficult element to define and analyse. This was because of the broad definitions of what constitutes the community, and where the boundaries are. The farmlet team, located at the farmlet site, formed the core component to the 'internal' community, which then expanded to the 'external' community consisting of the immediate locality of dairy farming and related organisations (e.g. milk processors, consultants), to the region/state level of stakeholders, and finally to the national level consisting of industry organisations such as funder Dairy Australia. This is depicted in Figure 27 below.

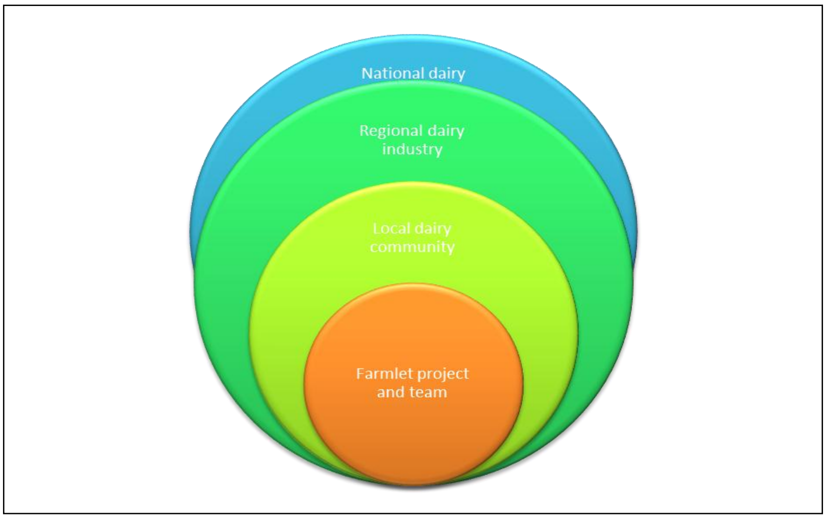


Figure 27. Farmlet community: expansion of definitions of community. A representation showing the central farmlet team linking the other layers of the industry.

Internal community formation was an organisational function, exposed and dependent on policy changes in resource allocation, retaining staff for significant periods and contingent upon finding the right people with the skill set for the job. Issues associated with this and overall functioning of the internal community implicated the learning platform emergence.

For all case studies, the external community to the farmlets project was broad and self-organising. Taylor (2009:230) was forthright in stating that a community is "not just part of the background, an enveloping context; it is an outcome. Community must be constructed, and in this sense it is also the object of an activity…an end to be accomplished". For farmlets this was an imperative, as the community valuing of, and engagement with, the farmlets is fundamental to their existence and legitimises resource allocation. Aptly stated by Taylor (2009:238) "no system of activity is going to persist very long if it doesn't produce its own community in the very act of accomplishing the practical purposes of the people who make it up…the crux of the matter is the question of how a community reproduces itself".

The internal and external concepts of community form as a result of the farmlet activity itself and reproduce with successive projects. For farmlets, active (external) community engagement was found to be dependent on actively addressing specific needs, which in turn was reliant on the use of appropriate tools to highlight relevancy and benefits. Parallel learning relationships at play were identified, one being based on broad connection with industry (learning relationship – industry) initiated by the farmlets and the other more informed learning relationships initiated by subjects on their terms. These are now dealt with separately.

Industry learning relationships were driven by the internal farmlet community (team) and generally started with consultation processes that enabled definition of community attributes and needs and expectations of the farmlet project. ERDS was found to have the greatest connection with community, supported through the long history of projects, but more so through implementing processes to maintain connection and understanding of farmer learning needs (see objective assessment of skills using audit surveying techniques in chapter five). MRF and VMF used a survey technique using self-assessing questions to determine industry needs from the farmlets, and also gauge value and satisfaction from activities.

At the parallel level, only a sub-set of dairy farmers seemed to actively engage (i.e. attend farm walks, field days, engage in dialogue direct with farmlet team etc), which was cited by advocates as being an issue of location and the farmlets being too far away. The further away a farmer was from the farmlets, the harder it was for points of identity to be recognised (see tools section) and the greater the amount of extrapolation of key messages. Overall it seems that the majority of farmers are passive observers, following the learning pathway and staying in touch through the passive learning tools (e.g. newsletters, rural press articles, radio etc). The greatest gain from this type of engagement seems to be where there are opportunities created by extension activities for dialogue such as discussion groups. ERDS extension made a point of ensuring the entire extension team integrated farmlet activities and outputs into all presentations and discussion group activities.

Overall dairy farmers are the biggest proportion of the community around farmlet projects mainly because they have invested through paying industry levies and tax. However, only a few farmers actively engaged and interacted directly with the farmlets. These farmers had clear learning requirements and a clear agenda as to how they could be satisfied by the farmlet activity. Participation on management committees was the most formal means of interacting with the farmlets with farmers from both MRF and VMF citing that "being right at the coal face of the farmlets means you learn first-hand, anything that is new". This active pursuing of knowledge and information was a common characteristic of farmers that attended farmlet activities. They valued the resource and what it had to offer, even if they disagreed with elements of the project. The VMF project as well as FF case study highlight that farmers would always rather have the resource than not. This was typified by the consistent comment from farmers interviewed "there is always something going on there to learn from".

Consultants and other industry professionals formed a minority community, but actively engaged when it was beneficial to do so. Issues associated with disgruntled employees (particularly in VMF and FF) influenced whether consultants were willing to be part of the overall farmlet community, but for those without this history, engagement was as passive as that of the broad farming community.

9.2.5 Farmlets and division of labour

Division of labour within farmlets cut across the layers of community and driven by the cultural norms and organisational structures. Three key themes emerged from the case studies specific to division of labour within the learning platform. These were role definition and allocation of tasks, rules for engagement and how to access expertise, and the hybridisation of roles which are depicted in Figure 28.

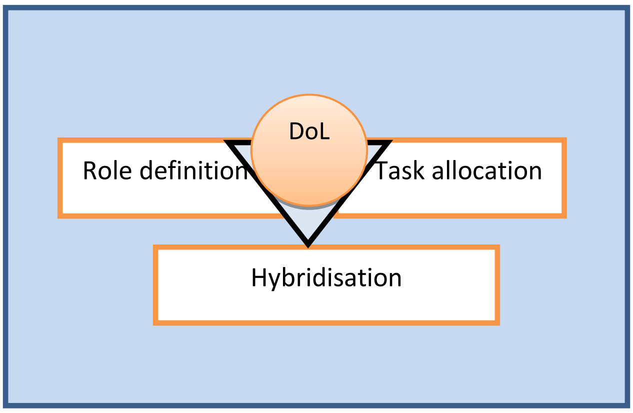


Figure 28. Depiction of the linkages between key attributes important to the DoL within a learning platform.

Role definition and allocation of tasks across farmlet projects for research and extension were largely prescribed by historical processes. It has to be a joint effort between the two activities to legitimise the activity. Maintaining research processes of data collection, storage and analysis is fundamental to achieving the original object. This task was ‘non negotiable’ and always remained the responsibility of the researcher to be maintained. The task was set by the contractual arrangement between farmlet and industry funding organisations, plus the imperative to justify outcomes empirically. Extension activities by comparison seemed to be more negotiable and without such imperative, as evidenced by the cases at FF, and the incidence at VMF when extension resources were absent for some time.

Boundaries around tasks and responsibilities were made clear through job allocations by organisations, however the data demonstrated significant interdependency of roles. Farmlets cannot function without shared action on research, extension and farming. The unique ‘blending’ feature of these activities and respective responsibilities of different knowledge systems creates an environment where roles become hybridised. This has been a process previously observed by Warmington and Leadbetter (2010:80) who used the term to represent inter professional working, involving boundary crossing and utilisation of distributed expertise.

For farmlet projects, this interdependency was a critical component to research and extension practice. In cases where resources were extremely limited such as FF or VMF (only for a period of time), the integration of roles was forced with the researcher taking on both tasks as key responsibilities. In the case of the MRF, the farmlet Board deemed it necessary to formally integrate the responsibilities onto one role. But as already discussed, while this may be beneficial from the view that there is an innate relationship and linkage of practices, it also places significant constraints on extending the tools and activities that can be deployed for sharing physical and intellectual resources. It also constrains the worldview on extension if the activity is driven from a research top-down perspective. Data from the case studies where this occurred indicate that strategies revert to top-down, linear methods when resources are reduced.

9.2.6 Farmlet activity rules

Rules across farmlets governed the behaviour and actions of subjects within the farmlets. Patterns of behaviour within farmlet teams conducting farmlet activities were (not surprisingly) very similar, and within the farmlet teams it was evident that cultural norms guided interaction and daily activity. Examples of this included the way farmlet projects were designed with, the focus typically on ways to achieve productivity gains through feedbase management. The structure of the farmlet team consisted typically of the researcher (team leader), with some extension resources and a farmer management committee and extension tools were almost standardised procedures (newsletters, reports, field days, farm walks etc). Where a farmlet project was a new initiative such as the VMF, rules governing behaviour were created as a result of social learning from other farmlet projects. Overall, the conduct of farmlet projects was based on formalised written rules, made tangible and repeatable by reporting processes of previous projects.

These basic rules guiding farmlet practice set the baseline for appropriate joint activity. Across the case studies, the key rules were found to relate how the basic tasks of farmlet practice were initiated, managed and evaluated, who was responsible for achieving the task along with how relationships were managed. Six inter-related concepts (see Appendix 3) were found to provide context and evidence of how rules support the functioning of learning platforms but how they can also be a constraint. This is now explained.

The notion of rules worked logically to describe what was guiding the farmlet activity systems. Taylor (2009:233) however, states that the notion of rules does not capture the full significance of what people accept as the way to govern their life. The rules governing each respective subject within the farmlet projects enabled consistency in approaches, development of a common dialogue for practice and an overall comfort zone in which to operate. The long history of farmlet RD&E (e.g. ERDS) meant rules for what constituted appropriate farmlet activity had been developed over time using a number of consecutive projects. Overall experimental design, analysis, skills and expertise required to conduct a farmlet project were well practised, also was the case for extension methodology. With methodologies clear, basic roles and responsibilities were clear for internal and external stakeholders and there was no need by stakeholders to test the methodology.

How dominant or embedded rules were (i.e. how inflexible) was really demonstrated when there were contradictions in practices that led to rules being questioned or challenged. Flexibility was determined by how different rules were either written/formalised within the farmlet culture or unwritten but fundamental and guiding practice or use of a particular tool. Ultimately, it is the organisation or subject that is enforcing the rules that determines their execution and flexibility.

A component of farmlet activity is engaging external stakeholders to assist in various activities. This seemed to be the major point where farmlet rules were questioned, with significant debate and dialogue presenting opportunities for expansion and transformation to occur. The ERDS case exemplifies this with the development of the new project and engaging the NDFS team. An interesting attribute in this case was questioning the appropriateness of the farmlet tool to addressing the research question, and whether a challenging if a farmlet project could go beyond addressing technical production questions. An inability to change the rules that meant the opportunity for true internal transformation to occur was missed. Similarly in the FF case, the management team questioned why the high stocking rate treatment would be pursued when it seemed to defy commercial and environmental application. The restrictions on farmlet methodology and rules of application meant the treatment had to remain. The inability of the researcher to convey the importance of these rules created tension and discontent of the final decision.

Kilpatrick et.al (2010) established the main areas of tension within inter-agency activity occurred across rules, community and division of labour. They found that understanding of the roles of external agencies was particularly important when viewed in conjunction with the rules governing behaviour within the activity system. As summarised:

> The written and unwritten rules set by external organisations, whether they are directly involved in the partnership or not, can act as a constraint on effective collaboration and innovation. To the extent that they are involved, then the risk associated with this is probably lessened. Where they are not directly involved there needs to be some other mechanism (other than rule breaking) that allows for critical examination of inappropriate constraints. Kilpatrick et.al (2010:182).

The NDFS program sought to challenge the rules, support greater collaboration and encourage innovation across farmlet sites (see Appendix 3). Essentially the point made by Kilpatrick on the extent to which the NDFS were involved with farmlet activities was a key element to the success and failure of some activities initiated by the NDFS to expand the rules around farmlets. The nature of the relationship, where it was not essential but only desirable to be engaged with the NDFS too an passive approach to trying to achieve buy-in and ownership of the terms of the farmlet projects. Without any authority to enforce participation, this was the only approach that could be used. The rule to engage was unwritten and highly flexible, which made it difficult to create a culture of ongoing joint activity and learning for farmlets. Any gains or increments in expanding the rules took significant drive from the NDFS team itself, with any outputs remaining unwritten rules to practice (and not necessarily used as practice). Such was the case with the initiation of the Guidelines for Farming Systems RD&L, and DairyMod.

This completes the discussion on the factors across the elements of farmlet activity systems that affect the capacity of the learning platform. The discussion now moves to specifically provide a response to the research question of how farmlets act as learning platforms.

9.4 Conclusion: Farmlets as learning platforms

In chapter three, farmlet learning platforms were defined as "an intellectual construction that aims to take the process, activities, outputs and outcomes that the dairy RD&E continuum use to set joint objectives and share physical and intellectual resources to manage adaptation".

Essentially farmlets act as learning platforms through the multiple opportunities available for internal and external transformation that stem from each element within the activity system adapting to contradictions or unexpected results. Ultimately it is the dynamic nature and ongoing shifts in each of the elements within the activity system that creates instability and internal contradictions that then require adaptive capacity.

Table 22 presents, the fundamental attributes of each element of the farmlet activity system impacting on the capacity as a learning platform. These allow the learning platform function to be most effective; that is knowledge is shared, learning relationships are formed, contradictions are managed. If all these elements were in perfect alignment and addressed appropriately there would be a perfectly stable learning platform, where no contradictions were at play within any of the elements of the activity system and the answer found as the object is achieved. Opposing this position, would be a farmlet activity system that has complete instability, where no elements of the activity system are without severe problematic contradictions. Neither position is desirable for an effectively functioning learning platform. A perfectly stable activity system would represent limited opportunity for transformative processes to occur compared to a totally unstable activity system which would be in complete chaos and cease functioning.

Table 23 represents this conceptual model using indicators to quantify different levels of stability. Five represents an ideological, perfectly stable farmlet activity system, 1 is a completely unstable farmlet activity system with the numbers in between scaling down to represent increments in instability.

Level of stability	Description	Object	Subjects	Tools	Division of labour	Community	Rules
5	Perfect stability	Stake-holders, drivers, degrees of separation addressed	Roles, knowledge management, language, learning relationships, responsiveness, performance evaluation	Types of tools, cultural definition of tools, enabling attributes	Inter and intra professional hybridisation, knowledge management	Industry and informal relationship, engagement and motivation for self - organisation	Historical influences, perceptions on how to act, written and unwritten rule definition
4	Minor instability						
3	Medium instability						
2	Major instability						
1	Serious intervention required						

Table 22. Stability indicators of farmlet learning platforms that were found from this research.

These stability indicators have been drawn from case studies to demonstrate how these are differentiated in capacity to act as learning platforms. This is also presented diagrammatically in Figure 29 to further the activity system. This highlights the areas where there is greatest potential for internal and external transformation to occur. Where instability has been detected, there has been a ranking on the basis of two main conditions: i) that there were contradictions at play; or ii) the physical and intellectual resources were not present. The more extreme instability was found within an element of the farmlet activity system, the more complex it was likely to be and the more difficult it would be to restore the balance the activity system

	TOOLS	COMMUNITY	DIVISION OF LABOUR	SUBJECT	OBJECT
ELLIOTT R&D STATION	4	4	4	4	2
VASSE MILK FARMLETS	3	2	3	3	4
MACALISTER R&D STATION	3	4	4	4	4
FLAXLEY FARMLETS	1	1	2	2	2
FARMLET ACTIVITY SYSTEM (MODEL)	**5**	**5**	**5**	**5**	**5**

Table 23. Stability indicators across the four farmlet case studies that emerged from this research.

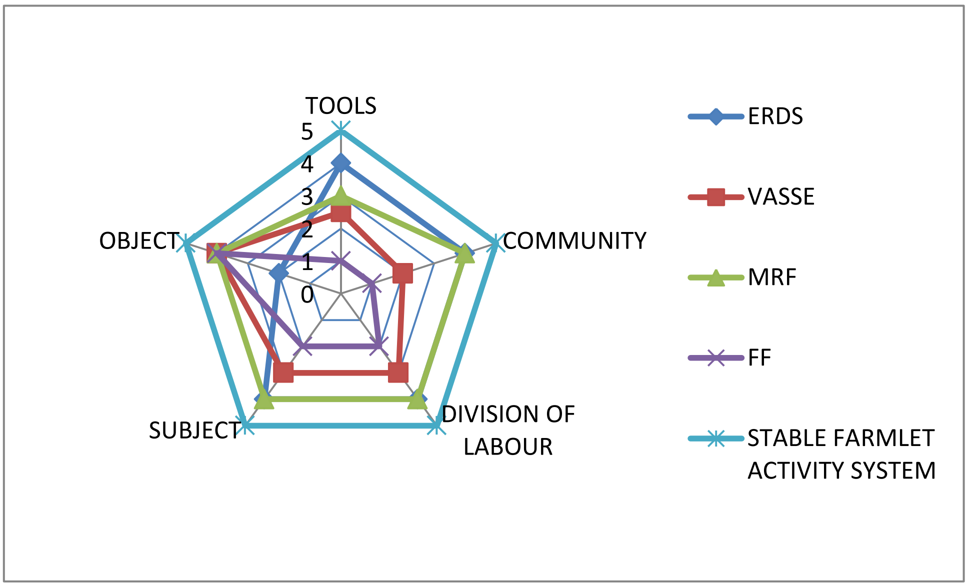


Figure 29. Diagrammatical representation drawn from the case study farmlets to demonstrate differing levels of instability and function as a learning platform.

Figure 29 provides a representation of the position of each case study in terms of relative stability, based on contradictions, impacting on the various elements of the farmlet activity system. FF presents the case with the most instability across the activity system, particularly in the area of tools, subjects and community. This combination, while the farmlets still functioned, indicated that much of the transformation occurred internally within the project team because the elements in the activity system that promote external transformation had very little stability. MRF as a learning platform paralleled the "model" learning platform, with mild levels of instability caused through lack of resourcing. ERDS mirrored this based on historical performances, however defining the object was highly problematic for the new farmlet project indicating this was the area that needs addressing for stability to be improved. VMF, being new to the farmlet game, was constantly seeking ways to improve stability and fluxed in and out mainly in the area of subjects.

Essentially the concept of learning platforms is an ideological construct, that implies that there is always a positive net learning outcome as a result of sharing resources to manage adaptation around farmlets. However, the case studies demonstrated key characteristics and actions that occur across different farmlets and national programs that contribute to a significant positive net effect. There are no hard and fast rules or recipes for how to develop and maintain a farmlet as a learning platform. However what this research has demonstrated are the key elements within the dimensions of the activity system that are important to the functioning of a learning platform.

9.4.1 Role of contradictions and expansive learning in learning platforms

Activity theory was chosen as the analytical framework for this study in part because of the use of contradictions within an activity to underpin transformation. Engeström's (1987) phases of expansive development are particularly pertinent to a study on farmlets as learning platforms as contradictions formulate the basis for object/question formulation, and once a farmlet project has been initiated, working through contradictions that arise throughout the duration of a project. The primary contradiction within the activity system is between the use value and exchange value of its elements (Engeström's 1987).

Contradictions in part, explain what underpins learning platforms is problematic as the language does not make it immediately obvious in definition. This can be attributed to assumptions and unwritten rules of what is likely to occur as a result of initiating a farmlet project, with no real idea of the problems that may arise along the way. There are significant levels of unpredictability across the full activity system, and over the duration of a farmlet project it is unknown what problems may occur. Contradictions within farmlets commence after a project is initiated with a starting point where the object is defined and the remaining elements of the activity system are stabilised.

Expansive learning, a fundamental element underpinning activity theory, involves the capacity to expand and interpret the definition of the object of the activity and respond in increasingly enriched ways (Leontév, 1978; Engeström, 1987). Expansive learning by definition in practice, is structured to produce culturally new patterns of activity by expanding understanding and changing practice. Engeström (1999:10-11) advocates that true expansive transformation is always internal and external. Internalisation is related to the reproduction of culture; externalisation as creation of new artefacts and forms of activity.

Internal and external expansive transformation in farmlets was problematic to determine, largely because of the number of subjects involved and the dynamic nature of farmlet activity systems. Because the object was fixed at the beginning of a project, expansion of the object was largely to do with unexpected events that occurred. Tracking and defining specific transformation and expansion across the case studies was complex, because changes in practice were usually unwritten, minor and not documented. This was the case for researchers, extension practitioners and farmers. It was largely anecdotal evidence in interviews that revealed where transformation had occurred, as there were no systems in place to track and quantify transformation and expansive events. The culture of farmlet practice, meant the focus on the technical farming systems question was paramount and little or no focus was placed on how the activity system functioned to determine a satisfactory result. The value of this research, is that it focused on the need for those involved with farmlets to be conscious of how they act collectively and individually within farmlets and seek to transform it and in the process transform themselves – fundamentally be conscious of what they are doing, how they are doing it, and adapting as a result of dealing with the challenges and unprecedented events that occur throughout a project.

This concludes the final discussion. The full conclusion and implications of this research to farmlets and farming systems RD&E is now presented.

Chapter 10 Conclusion

The Australian dairy industry provided the contextual setting for this study and was found to be an outstanding example of how a primary industry - that is very focussed on enhancing productivity and profit - seeks to maintain a valued and highly skilled research, extension and farming industry continuum. Building industry capacity and growing industry skills to maintain efficiency in production, continues today to be a fundamental investment. This is not surprising, given the relentless cost price squeeze (as outlined in chapter 2) and ongoing competition in the market. Competition in the dairy industry is everywhere – including competition for natural resources to be allocated to other industry development, as well as competition for R&D funding to be re-deployed away from production research and development to issues around climate change.

Farmlets have been a major investment of industry for a number of years, which followed the production principles of farming systems R,D&E. This study sought to explore the hypothesis that Australian dairy farmlets are a learning platform for the industry. This was not meant to be an evaluation on farmlets as a methodology that provided a synopsis of whether farmlets were a highly beneficial and worthwhile investment for industry or otherwise. Rather, this research aimed to explore and seek to understand the utility of the learning platform construct, determine greater understanding and definition, and identify factors that are impediments or support farmlets to be effective learning platforms.

By definition of the learning platform construct and basic observation from anyone in the industry, this notion could be received as being nauseatingly rudimentary and a blatant statement of the obvious. However this research has demonstrated that farmlets as learning platforms represents a complex number of interdependent activity systems with an enriched capacity for expansion depending on the stability and breadth of the resource base.

Farmlets are a complex resource that provide a learning platform for the convergence of multiple facets of activity including multidisciplinary and multiagency collaboration. Within chapter 9, the farmlet activity system was deconstructed and reconstructed using four case studies to establish how farmlets act as learning platforms for the Australian dairy industry. Learning platforms acknowledge the state of a farmlet system as being dynamic, rarely in balance or stable from contradictions which is what provides the potential for expansion and transformation. Such instability creates the learning platform and the opportunity for transformation and expansion across the farmlet activity system. Extremes at either end of the scale of stability are undesirable, as both constrain the potential for transformation and expansion to occur. Dealing with instability requires sharing of physical and intellectual resources, which requires full engagement of all elements of the activity system.

10.1 Implications of this research on farmlets and farming systems RD&E

This research has presented a case that farmlets act as learning platforms for the Australian dairy industry. With this, there are implications on farmlets and farming systems RD&E on alternative approaches to thinking and practices by fostering a learning platform approach to the activity. These are outlined below.

1. **Actively seeking transformation and expansion, recording it, sharing it**

   The research highlights there is significant potential for expansion and transformation to occur with significant contradictions occurring across the activity system. Much of the opportunity to capture the benefit is lost, not recognised or measured.

2. **Embracing contradictions as a core component to learning and change**

   The research demonstrated that contradictions and problematic situations are a core component to the learning platform, of which the farmlet team and key subjects within are the primary beneficiaries. Embracing contradictions and seek to develop better systems for capturing the genesis, action and adaptive solutions towards achieving the object, to enable more effective sharing of intellectual or physical resources.

3. **Broaden the object to go beyond technical farming systems output**

   The fundamental object of farmlet projects was found to place the greatest importance on the technical aspects of dairy farming systems production. This falls short of enabling and creating any accountability towards subjects and communities interaction, sharing and building knowledge and skills. If is not made an overt component of the original object, then it can only ever be a collateral and subordinate object that is never really accounted for.

4. **Actively scrutinising historically constituted norms and question questions**

   The research showed that farmlet activity relies heavily on previous project activity within a region, or from other regions if the activity was a new initiative to a team. Processes of actively and regularly scrutinising previous projects and question historically constituted cultural norms to assess if they are still adequate to continue addressing farmlet objects, would support greater expansion in the concept of farmlets and encourage internal transformation.

5. **View farmlets as an object-orientated activity system**

Farmlets can actively use activity theory to plan and execute a project with greater rigour. The process of deconstructing and reconstructing farmlets as an activity system enables recognition and planning around contradictions and have prepared strategies to adapt.

6. **Recognise the profound influence of subjects, creation of community and the role of tools and the division of labour in influencing the learning platform.**

Transformation within the learning platform was found to occur within farmlets by expansion of the object. However this was not by changing it, rather generating greater understanding of the implications it has from the unexpected contradictions it creates over time and adapting other areas of the activity system to seek the solution to the question. Maintenance of this perspective enables a solid foundation for sharing resources, as the key focus and purpose of activity remains clear.

10.2 Research methodology and cultural-historical activity theory (CHAT): help or hindrance?

Coming from a strongly post-positivist background within agricultural science to a research domain that utilises a constructivist perspective took a long time to come to terms with. It was a struggle to comprehend how research could be done on object orientated human activity system objectively. The discovery of CHAT enabled significant transformation within the researcher, as it was suddenly clear how a study of learning platforms could be done.

Overall, cultural-historical activity theory provided a very useful framework for conceptualising complex interacting systems, people and organisations sharing resources to manage adaptation within their practice. As constructed by Engeström (1989) and further developed by Daniels (2001), it enabled a thorough and systematic unpacking of the farmlet activity system, to reveal critical elements impacting on the learning platform.

Overall, CHAT was appropriate for this research because it could deal with:

- Farmlets by their nature of clear starting and stopping times are task orientated projects and are suited to a study that uses the activity as the unit of analysis;
- Farmlet activity in itself is multifaceted and works across multiple activity systems. As a theory it has expanded and developed over time to encompass the complexity of multiple activity systems converging at any one time;
- Farmlet activity (actions) is dynamic and changes – therefore the relationships between the elements changes
- Logical deconstruction of an activity system to determine key factors influencing relationships between the various elements;
- Bringing to the fore the validity and relevance of historical cultural norms and enables questioning of on-going legitimacy; and
- Seeking to embrace contradictions as an enriching force for expansion and transformation across all areas of the activity system.

Key areas where CHAT restricted the research were:

- That ultimately there is not an equalised relationship between the various elements of a farmlet activity system. At any one time there is instability and as such the activity system can rarely be represented using the typology of the activity system;
- That the model assists at a high level of object, however when there are a multitude of sub-objects required to be met to achieve the higher level object, the model requires a greater level of complexity;
- That theory focuses on the human activity system and so the focus is on human action and how it impacts on the world around us. Farmlets are a human activity system working within the natural activity system of farming systems. Dealing with nature and the environment adds an additional dimension to the types of contradictions impacting on the human systems. The current typology does not lend itself to taking this into account.
- The language used to describe the elements of the activity system is ridged, and difficult to grasp due to ambiguous definition. Examples of how it is used in practice helped tremendously with interpretation.

Along side CHAT was the data collection methods, based on participative processes. Doing this well required a balance of not intruding in farmlet activities and being a burden to the farmlet teams to making some kind of beneficial contribution to their practice. Over time the learning relationship grew between me and the farmlet teams, with most of the perceived value to their involvement was having to reflect on their practice every six months and be able to explain what happened and why certain actions were taken. This was cited as an enriching process, and enabled far greater clarification on what had been achieved compared to what had been reported on in written reports. Teasing out the "story behind the story" became a normal part of their routine for the duration of this project which was really valued.

A negative of the participatory data collection was that some perceived this project a threat with the impression it was to be an evaluation of whether farmlets are valuable asset to the industry and worthy of continued investment. This was not the purpose of the research, rather it was to conduct an exploratory study of how farmlets act as a learning platform. Over time and after considerable dialogue, this concern shifted to positive engagement.

10.3 Conclusion

In this chapter the key findings have been summarised and the implications for farmlets and farming systems RD&E discussed. A synopsis of the methodology and underpinning theoretical perspective of CHAT was also provided to determine how the study was assisted and hindered through the approach that was employed. To conclude, the definition of farmlet learning platforms is revisited from Chapter 3.

Farmlet learning platforms were defined as "an intellectual construction that aims to take the process, activities, outputs and outcomes that the dairy RD&E continuum use to set joint objectives and share physical and intellectual resources to manage adaptation". What underpins this construction is fundamentally a series of processes. A learning platform commences at the onset of a project, whereby the object is formulated and will remain fixed. Commitment to remain focussed on the farmlet object leads to contradictions emerging over time, which take the form of challenges to rules of practice, utilisation of tools, changes in subjects, and maintaining community engagement. Added contradictions are the challenges to farmlet practices put forth from external stakeholders. Contradictions underpinning the learning platform seek to challenge cultural norms and adequacy of practice. It commands embracement and management of contradictions as a fundamental part to practice, rather than an inconvenience or interfering event. Dealing with contradictions is the daily task of the farmlet team, which, depending of the nature of the contradiction will create instability across elements of the farmlet activity system and determine transformation and expansive potential. Four contrasting case studies provided the evidence which supports this conclusion of how farmlets act as learning platforms.

Overall, the purpose of this research is to encourage broader questioning of not just on what we do in terms of dairy farming systems RD&E using farmlets, but how we work, learn and share throughout the process of implementing a project. It seeks to make a contribution to the domain of farming systems RD&E, along with stimulating greater dialogue and thinking and subsequent practices that will better capture and utilise transformation processes across the continuum. The new age of current competitiveness and accountability against the deployment of industry funds commands this, as just the technical on farm knowledge outputs are no longer adequate.

Further participatory action research is now required to take the principles from this work and put into practical, operational guidelines that will support effective implementation of farmlets as learning platforms and more broadly farming systems RD&E. What this could include is further analysis of contradictions, including the development of a hierarchy of first order, second order and tertiary contradictions and methods to achieve effective transformation and resolution. Other options would be to utilise CHAT to assess the adequacy of the processes used to enable the project to be developed, engage stakeholders and enable a joint object to be achieved, in conjunction with an evaluation of the object itself.

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APPENDIX 1 Sample interview questions

Interview: ERDS, VMF, FF, MRF stakeholders

Describe project details

Thank you for agreeing to participate in this interview. Your information will be treated with complete anonymity. Should specific details of your information be needed for a public document, your consent for publishing will be sought . You may also wish to view a copy of the interview transcript, to which you may make any changes necessary. You are free to withdraw form this interview at any time you wish.

Under ethical rules of the University of Tasmania, I am required to collect your written consent prior to the commencement of this interview. I would like to tape this interview as a back-up for my notes. His may be turned off at any time upon your request. May I tape this interview?

Aim of this interview
This all contributes to why people are associated with the research station and the different learning processes that are represented in the Elliott set up, and demonstrates Elliott's attributes that make it a learning platform. By a learning platform, I refer to a place where people get together to learn. I am keen to explore what other people have to say about the role that Elliott plays, relative to other types of research and extension in the dairy industry. Other stakeholders e.g. shareholders, visiting farmers, broader farming community, DPIWE, who do you think are the stakeholders in ERDS?

Data will provide:

i) in sight into the different roles that the research farm plays (for them, the community), how the research farm enables synergies or more outcomes to be achieved (learning, better research questions);
ii) how do stakeholders work together and;
iii) what is their purpose for having contact with Elliott;
iv) how would you describe the research, extension and the organisational arrangement of Elliott – strengths and weaknesses

Questions
Context for your information

1. How long have you been working in the dairy industry?
2. What does your current position involve? (how does ERDS work with TIAR)
3. What type of dairy systems are typical for Tasmania?

Association with Elliott

4. What is your association with ERDS? (research site, board member, management etc)
5. In terms of farmlet research, what research projects have you been involved with at ERDS ?
6. What were the outcomes for industry from the most recent farmlet project?
7. How is there a continuous flow of information to extension throughout the duration of the project? (how often are results provided to extension and in what form?)
8. Once a research project finishes, what happens to the results ?

Role of ERDS

9. What role(s) does ERDS play for the dairy farming community in Tasmania ?
10. In what ways have farmlet projects at ERDS provided opportunities to improve dairy farm management practices in Tasmania?

Project development

11. How are project priorities determined for what happens at ERDS? (when is a project decided on?)
12. How are projects for ERDS then developed (describing the process)?
13. What are the strengths in the project development process?
14. What are the weaknesses in the project development process?

Many thanks for your time Barry, it is greatly appreciated.

Interview: Funder

The aim of this interview is to:

1. Explore the apparent mismatch between the funder and the research institute in terms determining research priorities for dairy farming systems RD&E
2. Determine the process to determine research priorities and the 'standard' project development process for farming systems projects
3. Study the flow/cycle of information from the funder to the research institute
4. Explore from the funders perspective the National farming systems project and what it originally sought to achieve and any changes in direction of objectives: what have been the challenges
5. How does DRDC measure performance of farming systems RD&E – what are the outcomes that the funders are looking for

DRDC and farmlet/farming systems projects

1. How does DRDC determine research priorities in terms of dairy farming systems RD&E?
2. How have RDPs added value or not added value to this process?
3. In terms of DRDCs perspective, what is the role of the research station and specifically farmlet projects?
4. In what way do farmlet projects help to achieve the mission of DRDC?
5. Has this role changed since their first development?
6. What is the process used to assess applications for farmlet or farming systems projects?
7. In terms of farmlet or farming systems project development, it seems that there is much effort gone into the development of projects which are submitted to DRDC and then knocked back. Why does this happen?
8. How does DRDC measure the performance of farming systems projects?

National farming systems project

9. What are the key needs that the National farming systems project is addressing?
10. Has the role evolved into something different from the original objectives? If so how?

Contextual information

11. What is your position at DRDC?
12. How many people work for you in your portfolio?

Interview: Researcher, extension practitioner

Aim of this interview

i) the learning platforms side of X farmlet
Vasse is a place where people come together to pick up learning experiences. The interview aims to get a really good insight into how you saw extension at Vasse prior to you starting, up until when you finished. – the progress made on extension, the learning experiences and barriers. It also aims to review your experiences with the national farming systems project and how it could deal with enhancing the learning processes and overcoming the barriers.

1. What was happening with dairy research/extension prior to the farmlets?
2. Then when you started your work on farmlets , what happened? (focus, aims/objectives, activities, team interaction etc)
3. What are the key physical resources (team members, research and extension tools)
4. Who to you draw on to help you set up and run the farmlets? How do you interact/communicate?
5. What were the key elements of extension that changed over that time?
6. What is the overall extension strategy in place, how was it developed, what are the challenges?
7. How do you engage with the farming community? Who comes to your events?
8. What were the key problems and issues that have occurred with the farmlets (people, tools, results)
9. How did you manage the issues and problems?
10. What do farmet approaches need in terms of overcoming the barriers?
11. What was the role of the national farming systems project for your work?
12. What is the place of the national project in accelerating the learning around farmlets and helping to overcome the barriers?

Interviews: National Dairy Farming Systems team

Thank you for agreeing to this meeting. The aim of this interview is to firstly give you a run down on my case study on national coordination and the questions I will be seeking to answer over time, then I would like to set the scene for the National Coordination process, the role of the FSEL and the expectations for the future. I will ask questions which I will seek answers for. I with your consent I would also like to tape this session. All information is confidential and will only be used if consent is provided by the interviewee. All transcripts are forwarded to interviewees for verification and then also to ask if any information can be included in publications.

Can I tape this session?
Any questions?

1. What is your background – farmlets and extension?

2. What is national coordination all about?

3. What do you see as the role of FSEL being?

4. Who are the main people being targetted to initiate national coordination?

5. How is this being achieved? Negotiated?

6.What are your expectations for this position (outcomes)– using your experience with farmlets?

7. What activities do you anticipate national coordination will initiate?

8. What are the potential benefits for national coordination (for farmlets, farmers, DRDC)?

9. What are the potential difficulties you expect to encounter with national coordination?

10. Why would you anticipate this and how do you anticipate overcoming these, if any?

11. How would you like to work in the future?

APPENDIX 2. Case study: National Dairy Farming Systems project

Preface

In Chapter 2 and across each of the case studies, there was reference to the National Dairy Farming Systems (NDFS) project. The original structure of this thesis contained four regional case studies and two national case studies. The aim was to provide additional variables and contexts to explore farmlets as learning platforms. Due to the sheer volume of data collected it was necessary to narrow the focus around the research questions and concentrate predominantly on the regional case studies, and instead, include the national case study attributes and implications as pertinent to each of those case studies. At the time this study was conducted, the national agenda for farmlets played a significant role in the operations, design, professional development and reviewing of the regional projects. As such it was critical to maintain this as part of the analysis. This case study is presented here to provide a thorough description of what constitutes the national landscape, the attempts made to building constructing a national learning platform, and what was learned from this work.

Introduction: National dairy farming systems project (NDFS)

Chapters 5-8 presented the results of individual regional farmlet research and extension projects. Between each of these case studies sit a number of common elements in the practice of farmlet research such as the stakeholders involved and many of the mediating tools that are used to broker and maintain learning relationships. Because of this commonality, an obvious step for a national organisation and cross-project investor such as DA, was to look at how better linkages and co-ordination could be achieved by building a national learning platform of farmlet projects.

The aim of The National Dairy Farming Systems project was to improve this national network of farming systems practitioners by identifying and assessing the attributes of learning and learning processes that the farmlet teams utilised, with the view to generating consistency around farmlet research and extension practices.

This case study will begin by building on the introduction of the National Dairy Farming Systems (NDFS) project provided in Chapter 2. The case study is presented chronologically using a timeline that has two key phases of the project that spanned the study period, presented in Box 1.0.

Box 1.0. Significant Events

1. Start up phase

The start up phase provided an introduction to the NDFS project initiation, and the subsequent development of a NDFS team to facilitate the development of the project.

2. Finding our feet

In the second phase the NDFS team initiated a series of activities for farmlet teams. Farmlet teams began to negotiate and adjust the position and role of the NDFS project to suit their needs. Key challenges to farmlet teams participating in the project began to emerge.

Phase 1: Start up - a new priority for farmlets.

Initiation of the NDFS project was the result of Dairy Australia exploring other grazing industry's RD&E activities in search of improving research and extension outcomes. Particular attention was paid to the red meat industry's Sustainable Grazing Systems (SGS) program, which was taking a nationally co-ordinated approach to addressing industry issues across Australia. This model had demonstrated significant value, as collective learning outcomes from the farmlets proved greater than from those operating in isolation. This direction seemed particularly appropriate, as in the Dairy industry, learning outcomes and the value proposition of farmlets were under question due to farmlets being resource hungry and the industry facing new challenges (see Chapter 2), DA then posed the question - could greater learning benefits be achieved from their collective investment into farmlets, by sponsoring a project that generates greater collaboration and coordination of outputs from farmlets delivering on agreed national goals?

This led to an investment by Dairy Australia into a series of events that engaged farmlet teams of researchers and extension practitioners with the aim of developing a national approach to farmlet design, delivery and collaboration. The start-up phase commenced in

November 1999 and spanned the time it took for the project concept to be clarified and then developed into a project.

The outline of the NDFS project provided below shows that impending learning processes involved with the initiation of the NDFS were going to occur largely at the farmlet team level (researchers and extension practitioners) and within the newly appointed NDFS team. The significant events that occurred in the initial start up phase of the project are presented here to demonstrate how farmlet teams were ‘recruited’ into the national perspective of farmlets.

Twin Waters Workshops

Farmlet teams were first introduced to the concept of nationally coordinating farmlet activities at a series of two workshops held in 1999 at the Twin Waters resort in Queensland. These were the first major events where a collective effort from all farmlet players was achieved to begin to jointly develop a national approach to farmlet RD&E. The aim of the workshops was “to establish some unifying principles and common methodologies which could improve the use of farmlets in the Australian industry”, and “to develop an agreed means for national coordination of farmlet research to enhance the aggregate return on investment” (Paine, 2001).

The two workshops were initiated and driven by Dairy Australia. Participants invited to the first workshop included representatives from all the regional development programs, regional farmlet teams (researchers and extension practitioners), funders, and farmlet scientists and extension practitioners from New Zealand.

The first workshop was held in February 1999, and focussed on clarifying the role of farmlets, defining the possibilities of farmlets and indeed challenging farmlets as the most appropriate research and extension method.

From the workshop, a farmlet was defined as a model[12] of a private commercial farm, characteristic of a region. It integrated RD&E, and studied systems relationships using decision rules. Farmlets were collectively viewed as being a multifunctional tool for the purpose of both research and extension. In terms of learning, much value was identified by

[12] The term model refers to the farmlet as being an object that is built to scale, that represents the detail of another, often larger object.

researchers, extension practitioners and farmers as well as being a central point for industry collaboration and team building. A farmlet approach was deemed appropriate for questions that effect multiple dimensions of the dairy system that required studying over a number of seasons.

A researcher highlighted the following at the first workshop:

> "The project objective will determine the methodology used. Is it about increasing farmer's awareness and understanding or is it about challenging current thinking and changing behaviour? All these things will need varying extension approaches and a different approach to using farmlets. If it is a discovery project, then science is the main objective. If it is a demonstration project then extension is the main objective. Confusing the two is dangerous; it is easy to extend bad messages. Using the "farmlets method" is a very dynamic extension tool – it is very visual. It has the ability to challenge and shape thinking of new technologies and new methods". (Twin Waters, February 1999.)

In addition to clarifying farmlets as a method, agreement was also reached between stakeholders that the opportunity recognised by DA for a national effort around farmlets would be a logical next step for enhancing farmlet research and extension.

> "[The national coordination of farmlet projects] has always been something that's been talked about but never really happened as no one has the time. We could all benefit from more contact between projects and knowing what is going on in other parts of the country. It's an obvious step really" (Farmlet researcher, 2001.)

A second Twin Waters workshop was then held by DA with the same participants, to further clarify what a national approach to farmlet research and extension may look like and to determine the content of a business plan to move the concept into action.

At this point the concept of a national approach was still an ideal, and how to make it happen was unclear. Three significant limitations (which highlighted why the concept had not been achieved to date) were used as the starting point for devising how national coordination may work. Firstly, an inclusive team approach (across regions and disciplines), that could foster a culture of sharing local knowledge needed to be found. Secondly, due to the different practices and approaches used between regions, the integration of regional project outcomes required the development of a common language for the farmlet network. And thirdly, a team and key project champion was needed to facilitate national integration through the provision of leadership and establishing a substantial communication network.

The consequence of the Twin Waters workshops was an expectation that a national approach to farmlets would be instigated. Although there was agreement in principle from the participants that there was much to be gained through a national approach to coordinating farmlet activities, it was a contentious issue as it was still unclear how the process may take shape. There were questions about how much time and resources would be required from the regional projects in order to participate, and how much regional activities would have to change to be in line with a collective national effort. The national approach required rearrangement of the way farmlet research and extension was conducted for national, as well as regional results.

In response to the workshops then, DA progressed the development of the National Dairy Farming Systems project through a business plan and a project application. The following elaborates this stage of Phase 1 of the NDFS project to demonstrate how the results of the participative Twin Waters workshops were then used to shape the new project.

Project development and positioning

> "The primary purpose of NDFS is to drive greater value (learning outcomes) out of the large investment in dairy farming systems RD&E by being smarter about the way resources are used to address the issues of relevance to Australian dairy industry" (Crawford, 2001).

After Twin Waters, the challenge and requirement remained to turn concepts of a nationally integrated network into a cohesive and workable program. As highlighted by the comment above, the intent was to value-add to projects through improved learning. This required not just collaborative activities, but a new way of thinking and conducting farmlets projects in order to respond adequately to the challenges being faced by the dairy industry[13].

The new project objectives developed to reflect this intent were:

1. To identify and provide new knowledge on key national issues by cross-site integration, through the use of collective expertise and innovative farming systems tools;

[13] The challenges being faced by the dairy industry was a key discussion point in Chapter 2

2. To test new learning resources, and use existing resources more effectively, to improve productivity and environmental outcomes through advances in the design and evaluation of learning processes that operate in farmlet projects and;
3. To test a new framework for guiding investment in farming systems RD&E by real-time comparison of empirical, modelling and systems research approaches. (Crawford *et al*. 2002:4)

The expectations of the project objectives also reflected the need for improvement in practices by ensuring research questions were addressing the environmental and economic outcomes as well as the productivity outcomes. There was also an expectation to consider options beyond the farmlet approach and recognise that there were other farming systems approaches that could potentially better address new research questions.

To achieve these objectives, three main areas of activity for the project were developed: co-ordination of activities across farmlet studies; coordination of learning activities[14]; and the development of a farming systems framework (Crawford *et al*., 2002). These are elaborated on below.

Activity Area 1: Coordination of RD&E focus across national issues

The first activity area provided a number of interfaces that would enable effective engagement of farmlet teams. Instead of regional farmlet projects using various methods for conducting research and extension, the NDFS project provided a platform for agreement and standardising approaches to farmlet activities. Coordination was dependent on agreement between players on a number of factors: the key issues and targets; shared data sets; common protocols; models that embrace the biophysical dimensions of pasture; cropping and supplementary feeding systems; and that models that allow for decision making through economic analysis were to be used to achieve coordinated learning among the stakeholders.

Activity area 2: Coordination of Learning

The second activity area was ensuring the NDFS project was correctly positioned and functioning within regional farmlet projects to provide a national link. This linkage point was

[14] Part of the learning activities incorporated tracking the learning processes associated with national coordination, and so this PhD project was initiated to extend the learning outcomes of the program.

to be achieved through each extension and communication strategy development process where regional outcomes could be made relevant to the dairy industry across Australia.

Key area 3: Framework Development

To extend the learning realm and network of the NDFS project, a collaborative sub-project was to be undertaken by Australian and New Zealand (AgResearch) research and extension officers and dairy farmers to develop, deliver, test and promote a framework for use in Australian farming systems projects (including farmlets).

The three areas of activity were created at the NDFS project development stage in response to regional projects that were not working in parallel in terms of: the methods being used for research and extension; the objectives being regionally focussed and; the opportunities for dialogue between sites not being utilised. The three activity areas also encapsulated the expectation that there would be ‘buy in’ from the players at the farmlet sites, that is, participation in the generation of a coordinated national process that was to be guided and enabled through a series of frameworks, protocols and learning tools.

The conceptual process of coordination was used to explain how the project was going to align farmlet research and extension practices and operate to deliver on both regional and national priorities. The process and development of a platform for the activities to be operationalised required a team approach.

The NDFS team incorporated and utilised input from the funding body Dairy Australia and the Regional Development Programs[15], while the overall activities and coordination process were largely enabled by the Farming Systems Extension Leader (FSEL). Activities and processes from the FSEL were informed and directed in consultation with a representative from the DA feed base team and also an expert in innovation and change management. A core team of these three players were to work and develop on-going relationships with research and extension leaders at the farmlet sites to deliver on the NDFS objectives.

The team approach represented another area where considerable coordination was also required. This largely rested with the FSEL role, in terms of maintaining relationships and expectations at the funder and regional farmlet team level. Appointment of the right person for the job was the next step in the start-up phase.

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[15] The structure and function of these funding bodies is outlined in Chapter 2.

The role of the FSEL needed to be multifunctional, and have a capacity to develop and maintain momentum within the learning network that was being created. A significant capacity for learning within the role was also needed, in terms of understanding individual requirements within farmlet teams and delivering processes and outcomes that could meet these needs on a nationally beneficial level. Subsequently, a person was appointed to the position that had previous experience working in both research and extension capacities within farmlet projects. On appointment, the FSEL began writing the project application for funding, using the first annual farming systems workshop as a key source of direction and information.

The first annual National Farming Systems Workshop was designed to set the momentum and position the NDFS project within the regional farmlet projects. Provided at the workshop was a process that enable farmlet teams to begin to generate the meaning of the project for themselves and to identify where the project would deliver benefits to their own learning through improving their projects. The following section explores the process and outcomes of the workshop.

Inaugural NDFS workshop

The first National Farming Systems workshop marked the final stage of the development phase for the NDFS project launch. Continuing with the participatory approach to developing the project, dairy farmlet leaders including scientists and extension practitioners from all Australian dairy farmlets, were invited to participate.

Expectations from invited participants at the workshop included generating strong linkages across farmlet projects, contributing to project development and sharing their own regional learning with others, and to learn themselves about what is happening across farmlet projects. Each farmlet project was at a different stage of activity and because of this some participants were looking for specific learning, particularly those who were in the new farmlet project development phase. They, in particular, were looking to capitalise on the workshop experience by learning about farmlet strategies and design and how to implement a project with limited resources.

The expectations of the NDFS team were to ascertain and acknowledge the expectations of participants and build strong foundations for the project. The matter of the sharing and appropriate management of data needed to be negotiated to establish opportunities for integrating project information. The team also wanted endorsement from the farmlet teams on a number of initiatives being developed, and for participants to demonstrate commitment to the outcomes of the workshop and the overall NDFS project.

A creative tension was used as the challenge - to provoke participant thinking and provide the focus for discussion. There needed to be outcomes realised as to 'how' to coordinate projects nationally, and also an 'identity' created.

> "For a nationally coordinated project, how do you embrace the lot (all the farmlets)? There is a lot going on at all the different farmlets so how can the project coordinate Farming Systems Research and Extension across Australian dairy farmlets? But not only how to coordinate it but also explain it (the process of coordination) to others?" (Funder, 2001).

The process of the workshop enabled players to learn from descriptive summaries about what each site was doing in terms of research and extension. The subsequent dialogue and questioning enabled further learning needs to emerge. It became evident that the issues and activities that challenged the researchers' practice across farmlet projects were similar. This was also the case for extension practitioners who also identified similar issues challenging their practice. In addition to the individual discipline needs there were issues common across farmlet disciplines that needed addressing.

Both science and extension were looking for standardisation of processes and practices around farmlets to aid the construction of a common language between sites and build a stronger network. For science, this meant looking at how to take various measurements (including social factors) and consider realistically the scale effects associated with the small herds of farmlets. Other major issues included clarification and better positioning of farmer management committees within farmlet projects and the development of consistent research protocols for farmlet research and demonstration. On the other hand extension practitioners were looking to standardise protocols for best practice farmlet extension, including evaluation, farm needs analysis and communication strategies. A key difficulty around extension was the engagement of private providers, which became a major issue as identified in both the Vasse and Flaxley case studies (see Chapters 6 and 7, respectively).

Jointly owned issues centred on the question of how to open up the store of learning held within each region and develop processes to enable access to the information and data sets.

One common, problem shared between farmlets (that remained largely unsolved) was how to develop alternative learning relationships for a variety of learning styles, and ensure that the team learning was applied in the farming community as well.

One strategy used to get activities for NDFS happening and demonstrate opportunities for collaborative efforts was to take national learning packages already developed by DA, and implement them on farmlet projects as part of best practice demonstration. A national dairy intervention program called InCalf[16] was flagged at the workshop and the suggestion made that participants volunteer their farmlet project and implement the strategies within the program. Three farmlets decided to engage in the program workshop enabling a planning process on how to implement the program. This brought value-added, and also mutually beneficial, learning outcomes for the farmlet and the national intervention program. Implementation of such programs within farmlet projects aimed to address the identified requirement that farmlets should be demonstrating best management practices across the dimensions of the farming system.

Critical issues

The start up phase of NDFS required a transition within the farmlet project teams from being a manager of a regional project to becoming a client of NDFS. By becoming a client, the project teams were to be a learner in a different capacity to what they had been within their own farmlet projects. NDFS learning was primarily about focussing on their practice and the practice of others, rather than focussing on learning about dairy farming systems management.

However, the lack of clarity of the concept of NDFS in the early stages of the project development made it difficult for the clients to be clear about what they were a client of. This was part of the learning process - to be involved, to generate clarity and have ownership of the concept and understanding of the project that emerged.

The involvement of farmlet teams within the NDFS highlighted the heterogeneity within the clientele that the NDFS team were working with. Key differences and classification of clients was needed to be able to manage and differentiate the way in which NDFS interacted and

[16] InCalf is an intervention program developed by Dairy Australia to improve the reproductive performance of Australian dairy herds though the use of proven, best management reproductive principles.

commenced building learning relationships with each individual farmlet team. Key attributes of the farmlet teams that affected their learning behaviour as clients included: the stage of the farmlet project; the length of time farmlets had been used within a dairy region; who the key actors were who interacted and participated in NDFS events; and, the level of certainty that the farmlet team members had in their practice and positions. Later on in this chapter, it becomes apparent that the different classes of farmlet teams had an impact on learning behaviour and resistance to partnering in the learning process being created by NDFS and investors.

Taking the role of critical friend and supporter to farmlet teams

In providing the alternative perspective on farmlets by introducing a concept of farming systems, a key role emerged for the NDFS project to become a critical friend to farmlet teams in a supportive environment. This role was to incorporate ways of questioning the adequacy of practices in line with national, rather than regional, dairy industry goals. This approach aimed to change the focus from learning about dairy farming systems to learning about themselves.

The question, then, was what was gained or lost with the introduction of a national approach to farmlets from the closing perspective of the start-up phase? Gained, as already highlighted, was the increased capacity to more rigorously reflect, debate and question the utility of farmlets for addressing national issues of importance. Such questions would never have been asked otherwise, for reasons that will become apparent when there is discussion on the learning culture around farmlets. Also gained was the opportunity to capitalise on the enthusiasm within the majority of farmlet teams keen to make a concerted effort to communicate and value-add to project outputs through creating application to more than one region in Australia. NDFS was to provide an enabling framework to achieve structure and boundaries for deciding what projects were to be included or excluded in the farming systems approach. Potential losses included the potential for interference in project autonomy, and restrictions on activities created by the independence of governing rules. Where a farmlet team sat within the heterogeneous classification affected the perceptions of gains or losses as a result of the project initiation.

Conceptual intangibility and “muddling through”.

Apart from the obvious gains and losses, a concept of national coordination was difficult for all teams (NDFS, farmlets, DA) to comprehend, as when it came to explaining how it may transpire, considerable complexities would emerge due to the intangible benefits and potential losses. Composing an action plan was also made difficult due to the variation in project teams as already highlighted.

In a sense, it was a learning process that all teams needed to go through. It enabled each team to freely contribute to the concept development, while at the same time provide some structure to the “muddling through”[17] process that was required to ensure an end point and future directions to the project were achieved. There is a tension and risk associated with providing structure to a participative approach, in terms of balancing the level of prescription and control over the learning process and guiding the outcomes to suit an alternative agenda. At the same time, the intangibility around the concept created an additional risk that it was thrown into the “too hard basket” and abandoned.

The approach required a balancing act by the NDFS team to manage the structure and encourage participation, as the development process was critical to the evolution of learning relationships with the farmlet teams. It was paramount to get this right, and this was achieved at the first annual farming systems workshop. This isevidenced by the significant dialogue and negotiation processes around the concepts that were presented to farmlet teams in order to generate approval and a direction forward.

Standardisation and coordination

A first step to giving some tangibility to the process of enacting the national approach was to introduce standardisation of farmlet research and extension practice. By generating uniformity across projects an immediate avenue was created that would assist the coordination process central to a national approach. Standardisation would enable greater comparison between project outputs (i.e. “comparing apples with apples”), and reduce the barriers to farmlets using data that had been collected and analysed in a different region in Australia.

The multitude of practices as exemplified by the variations in the kinds of measurements taken, units of analysis and approaches to analysing outputs, was considered to be one of the major limiting factors to inter-farmlet collaborations in the past.

[17] “Muddling through” is a trial and error way of making progress on topics that does not have some well-established routine for problem solving (Lindbloom, 1959).

Identity and benchmarking of the learning culture around farmlets

The Twin Waters workshops highlighted the culture of farmlets as represented by stakeholder behaviour.

In the early stages of the NDFS project, the farmlet teams seemed to have a narrow view of what constituted farmlets in terms of “the farmlet team” and “a farmlet project”. There was a trend in perceptions across the participating groups that suggested the learning focus for farmlets tended to be internal (i.e. learning occurs within the project team), with localised routines and traditional ways of operating and conducting their practices. This was particularly evident within older farmlet project regions such as ERDS. The younger regions however, were looking outside their region to learn about concepts of farmlet research and extension. The difference was the high appetite of the younger farmlet teams to learn about farmlet activities and practices compared to the older teams who had a history of practice and learning to draw on.

Establishing elements of the learning culture within each farmlet team, demonstrated how the methodology around farmlets was developed to address the challenges being faced by the dairy industry. Understanding these processes in the beginning of the NDFS project enabled direction setting for a national approach and the assessment of the various levels of receptivity within farmlet teams to alternative ways of thinking.

Creating a national agenda – fragmentation to cohesion

Farmlet teams had always been encouraged to work towards addressing local dairy system learning needs (Paine, 1999). Funding arrangements like the regional development programs were used to assess the relevancy of proposed project to the region, which in turn was meant to be linked into addressing an overall national agenda. The initiation of the NDFS aimed to develop stronger linkages between regional and national agendas, through a joint performance between farmlet teams.

In simple terms, such an activity seemed logical. However in real terms, the proposal consisted of a rearrangement of the way research and extension around farmlets was conducted. Within the regions, farmlets were working towards the regional goals using their own previously learned approaches to farmlet research and extension. On a regional scale, different disciplines had their own ways of interacting and working harmoniously to develop farmlet learning platforms.

Introducing a national scale with the NDFS project, added another layer of disciplinary interaction. With this additional layer came the potential of further differences in philosophies from which research and extension teams were working from, variations in the roles they played within the farmlet program of activities, and different audiences (regional farming communities) for which they were working. How could the farmlet teams then be working towards the same goal of a nationally coordinated approach?

In addition to the regional fragmentation of project objectives, fragmentation was also created through the short-term approach (generally three-year funding) to farmlet research and extension projects. A national goal of coordination required a long-term approach, which was conflicting with the typical modus operandi of projects. Many teams were reliant on external funding to employ team members and as such it was difficult to be committed to a long-term national objective.

Dairy Australia initiative

The question then remained that if the national approach seemed so logical, why had the project teams themselves not previously initiated it? These critical issues all formed a response to this question. If a national approach and culture was to be fostered, the construction of a new relationship between DA, NDFS team and the farmlet teams was required as part of the rearrangement of dairy farming systems RD&E.

Significant tension was associated with the national approach being a DA initiative. The motive behind farmlet teams participating in NDFS activities during the start-up phase was unclear. It appeared that there was a degree of attendance because teams anticipated potential value, but also because it was perceived that a demonstration of a commitment to the bigger picture of farmlet research and extension may put them in a favourable position to receive funding.

Commitment and support from within the farmlet project within the start-up phase was the key to a project being developed. After the first annual workshop at the end of the start-up phase, participants enjoyed the interaction that encouraged voluntary participation in the second stage activities. It was here that the project began to ‘find its feet’.

Emergent learning

Initiation of the NDFS extended the learning platform attributes of farmlets, by encouraging and promoting multiple learning dimensions for the farmlet teams themselves. This process of creating multiple learning avenues acted to challenge existing thinking, and trigger a new focus for the teams.

Learning, encouraged by the NDFS program development, was to open the perspective of farmlets to farming systems by questioning and trying to position farmlets as an RD&E tool. The Twin Waters experience was the first step in defining and clarifying farmlets and the need to take the approach to a national level. The difficulty from there was to create a concept of a national approach, and how it could be enacted. This was done by highlighting the positioning of farmlets in a different light - as being one approach to farming systems RD&E. Providing this step through multiple learning dimensions was a key concept in the development of learning platforms.

To take advantage and embrace the multiple learning dimensions, farmlet teams required substantial time to understand the position they were in by becoming a client and contributor to the concept of NDFS. Much of the time and activities that participants were involved in worked to provide a vehicle that enabled farmlet teams to ‘change their hats’ from being a provider and developer of farmlet learning to being a client and contributor to a program that intended to improve their practice and open their perspective on farming systems. Making sense of the role that each individual farmlet team would play within the process, and to make a connection with the NDFS team, required a transition phase into the learning process and the NDFS program.

The heterogeneity within the farmlet teams was an attribute that had considerable influence over the learning behaviour exhibited by actors in the start-up phase. This brought both challenges and considerable value to the learning platform in two distinct ways. Challenges took the form of power plays, and the assertiveness of the ‘larger’ more experienced teams in voicing their perspective and dominating the direction of dialogue and outputs from activities. On the other hand, the heterogeneity provided a multitude of experiences that could enrich the learning value of the platform being created. Just as each regional project was different in terms of resourcing, team players etc, to the NDFS team, the contrasts within their new clientele represented a series of variable learning relationships that could be constructed and maintained using the rules for engagement determined by the farmlet teams themselves. For some teams this would be easy, and for others it was to be met with considerable resistance (this emerges further in the case study). Managing heterogeneity within clients was a key part of constructing a national learning platform and learning how to work together.

Differences between and within teams meant there wasn't an instant collective understanding of the operational activities that constructed regional farmlet activities. Twin Waters produced the underlying principles of farmlets, but lacked any further detail. The first annual workshop initiated the opportunity for farmlets to present their projects and own concept of farmlet research and extension. Presentations were descriptive of the aims of projects, with more detailed attributes provided through questioning, and informal sessions such as tea breaks. This was a continuation of the recruiting process into NDFS, using familiarisation-learning processes to enable connections to begin between projects.

While description enabled familiarity and connection, another important step in the start up phase and gaining membership was to create some tangibility and meaning around the concept of national dairy farming systems. This was to be a learning process in itself for all teams. As indicated already, this was the commencement of project development and new learning relationships, so there were all kinds of uncertainties around participation. A complex process of structuring a "muddling through" approach while using participative processes was used to facilitate the learning process, using mutual decision-making and boundary setting tactics.

The importance of boundary setting in the start-up phase was crucial, as there needed to be rules that governed what activities would fall within the realm of NDFS, and what wouldn't. Boundaries were set as part of the mutual decision making process.

Boundaries were set within NDFS by looking at ways to standardise farmlet research through the development of protocols. Providing guidelines was a way to efficiently coordinate activities and bring researchers together on a joint project. Evidence of learning relationships emerged when there was a process of analysing the decision rules and tools that guided their practice, which acted to deconstruct farmlet research practice, and reconstruct it in a form that would be consistent for all projects. This process of deconstructing and reconstructing was a useful learning process for research teams to build relationships through better connecting with each other's practice. This approach strengthened the foundations on which learning relationships were constructed between researchers[18], and initiated a new learning culture for them. It continued a culture of focussing on the project operational aspects and output attributed (as revealed by the results

[18] Researchers were able to develop protocols as science already has predetermined rules that dictate practices. Further analysis and discussion on this activity is provided further down the chapter.

from Twin Waters workshops), however it introduced a new dimension of joint performances and cross-site interaction.

Assessment of the learning culture and generating a benchmark of thinking around farmlets were concepts critical to the learning process in developing a national approach. This was a revelation to the NDFS team in terms of how project teams were perceiving farmlets, and the degree of openness they had to a new way of operating. A large part of NDFS was to focus on changing the learning culture around farmlets, which in the first approach was to assist with rearranging responsibilities from being regionally focussed to incorporating the national focus. Farmlets already had multiple objectives they were working towards, and so a national agenda needed to complement these, not be additional.

Related to the learning culture are the historical relationships that farmlets required to maintain, such as those within their regional institutions (State Department of Agriculture) and also DA. The national approach meant that the RD&E continuum, incorporating primarily farmlet teams, NDFS and DA were to work together towards a common goal. Historical working relationships however, had implications for the development of a cohesive team within the national approach. New stakeholders to the team meant relationships required development, particularly with funders, for a national approach to be achieved. Historical baggage, generated through negative experiences of the project development phase (an example was presented in the ERDS case study, Chapter 5), could reduce motivation within farmlet teams to participate and create a barrier to learning processes.

This concluded the analysis of the start-up phase of the NDFS project. Revealed are a number of converging processes that were going on, that aimed to foster the development of relationships, learning about each other and putting some clarity around the concept of a national approach. The discussion now moves to study the second phase on NDFS, where project teams began to ‘find their feet’, with the official start of NDFS activities.

Phase 2: “Finding our feet”

By this stage there had been a shift in the thinking of the NDFS, as indicated by the naming of the project – it was no longer the farmlet project, it was about national dairy farming systems which suggested the scope of the project was to be more broad. Dairy research in Australia was moving to encompass farmlets as an approach that fits into the scope of farming systems RD&E.

The second 'phase' of the NDFS project commenced after the first workshop. At this point, it was apparent that farmlet stakeholders were agreeable to contributing to the project by participating in NDFS events and engaging with the NDFS team for relevant activities. The implications of this involvement for individual projects were unclear at this point. Farmlet workers and funding stakeholders had to move through a process of 'finding their feet', to position the NDFS project within their existing projects and their individual professional needs. It was also a matter for the NDFS team themselves; identifying the project utility for the farmlet projects, and clearly locating where the project would provide the greatest impact on achieving the objectives that were developed in the initiation phase.

This phase was dominated by a study tour to develop linkages with the New Zealand research and extension dairy sector. From this event a joint project was initiated to develop guidelines for dairy farming systems RD&E. Other key activities during this phase consisted of working with farmlet teams to develop extension strategies; the second annual dairy farming systems workshop; and, a joint workshop with the managers of a farming systems program that was in operation for the red meat industry. These activities were all part of a process to create a clear identity for NDFS.

Significant events

NZ study tour and workshop

This workshop was an attempt to build a new collaborative future for dairy farming systems RD&E between Australia and New Zealand, so that research and extension teams could plan on the basis of a mutually agreed platform, instead of simply reacting to the forces impacting on the dairy industry. The rationale behind the NDFS initiating this project was to respond to the demand from investors and other stakeholders for a more holistic approach to research and extension that included environmental and social outcomes along with the more traditional technical and economic outcomes.

It was also recognised that collaboration seemed a logical approach by the Australian NDFS team:

> "… no one organisation had the full bottle on dairy farming systems RD&E and between us, there was a full complement of modelling, experimentation and social research capabilities that are being applied to environment, production and social problems" (NDFS team, 2001.)

Sufficient similarities across farming systems existed to foster collaboration and sharing in the learning process operating between projects. These similarities included the dependence on pasture base, low cost dairy systems and issues of high experimental costs and demonstration of a high standard of scientific rigour respectively. Along with the similarities, there were considerable differences also between the two countries, for example the variations in farming systems within Australia due to climate whereas in New Zealand farming systems were comparably similar. Also the institutional structures servicing New Zealand farmers (processors, research and extension institutions) were considerably different to the way Australia's was operating.

For NDFS team, two outcomes were sought from this project (Barlow *et. al*, 2002:3):

1. A framework for guiding the design, conduct and evaluation of dairy farming systems RD&E projects that copes with the challenges of triple bottom line investment criteria;
2. A strategy that will extend the disciplinary basis of dairy farming systems research in Australasia.

Planning how to make rapid advances in the area of farming systems RD&E was initiated with the NDFS team, beginning with appointing a team of two New Zealand farming systems RD&E leaders. Informally, the team were motivated by a set of questions that drove their activities and thinking. Was it possible to work in collaboration to advance current knowledge beyond individual capacity? Were the benefits of working together greater than the costs of a trans-Tasman exchange and; could the collective input be formulated into a useful framework? Two days of planning and working through these questions established that a field orientation program around New Zealand, followed by a multi-stakeholder workshop, would be the most appropriate course of action.

Study tour of New Zealand

An Australian delegation of 25 dairy farming systems stakeholders was invited by the NDFS team to participate in the event. Seven researchers, two extension practitioners, three Dairy Australia representatives (funders), five farmers (representing the regional development programs), two State Department representatives, one Natural Resource Management representative, one social researcher and the four NDFS team members made up the group.

The learning process, designed by the NDFS team for the delegation, aimed to present an insight into New Zealand dairy farming and the RD&E system set up. The two-day study tour commenced with a visit to a leading dairy farmer, who was considered by his peers and extension staff to be well ahead of research technology with his dairy farming system management and in control of his own extension requirements. This farmer was used as a critical thinker, and held equal status and voice to that of any other industry leaders, researchers or extension practitioners. This leading farmer had a clear perspective on research needs and how to best prepare industry for challenges of the next 20 years. As pointed out by a New Zealand farmlet researcher:

> “It is the top 10% [of farmers] that have the real research questions. They know what they need and the rest [farmers below the top 10%] will do it in 20 years.” (Scientist, Ruakura Research Station, 2000.)

He had been farming for seven years, and started with a farm that was totally run down, with low soil fertility and stocking rate, and an old rotary dairy that was old and mechanically defunct. His first activity was to design a new dairy so that he would only have to rebuild it once. He thought about what it was he wanted with his dairy and the system. The design got bigger and busier and eventually he decided he wanted the Westfalia milk system technology, which included a Ruakura milk harvester and metre.

The farmer bought the high tech milk harvester before he designed the shed. The technology that was installed in the dairy recorded individual cow records at the time of milking and provided a ‘Dairyplan system’. Information included the amount expected milk (standard deviation determined from previous milkings), the amount that was provided, and warnings provided if milk production was low and, if the cow was down on two consecutive milkings, another warning was provided to draw attention to potential issues such as that the cow being on heat or developing mastitis. All this information was recorded on a calendar with the cow’s activity and used as a key management tool by the farmer.

He also moved into feeding grain and maize and lifted the soil fertility using a strategic fertiliser plan. Over seven years he managed to double his herd size to 300 cows and also the size of his farm.

The farmer had strong ideas on research and extension activities in NZ and tended to use outcomes where they were relevant to his system.

> "Research in New Zealand is too short-sighted. I went to a brainstorming workshop that was looking at the direction that research should go. I think it should be looking towards the big herd situation and also major studies on individual cow performance. We need to know where and when the cows are performing at 100%".

The farmer's perceptions on the extension system and paying a levy were also strong, with the farmer having a clear opinion on the kind of extension service he was looking for. Instead of extension being the responsibility of an institution, he believed it was the responsibility of the farmer to manage the information and knowledge services he required. These perceptions were an alternative approach to that which was encountered in Australia, and a real challenge to the way in which the delegation were used to thinking about the way they approach their own practice. As he elaborated:

> "I don't believe that a farmers levy should be used to cross subsidise extension as I haven't got any value out of what I have had to pay for. If I want a consultant then I will pay for it. It is my choice of who the consultant is. Extension is an individual's responsibility and not an industry responsibility. Extension should be left up to the individual. The current system allows for there to be no accountability in extension either, it should be up to the good consultants to excel and the others to fall by the wayside".

From challenging the thinking and adequacy of current RD&E to manage the direction of future research and extension services, the study tour then moved to explore the research stations, the major milk processor and the contribution the company made to research and extension efforts, and also paid a visit to the 'farming systems' research group. Key attributes of the New Zealand approach to dairy farming systems RD&E were revealed through various presentations, with some notable key differences to the Australian perspective.

Farming systems framework workshop

The Australian delegation combined with a New Zealand group of 23 delegates on arrival at the workshop. The New Zealand delegates included ten researchers representing New Zealand's contingent from AgResearch (consisting of six researchers from the farming systems team and four dairy component researchers), six Dexel researchers, two Dexel extension managers, and one representative from a wool extension program, a meat extension program, NRM catchment management and an animal health institute representative.

A system of facilitation and provocation of thinking between Australia and NZ was shared between Australian and New Zealand presenters, using a program that was pre-determined by the workshop planning group.

Two documents emerged as the major outcomes from the workshop. Firstly, a report summarising the study tour and a presentation of the outcomes from the workshop activities. This document was subsequently used to develop guidelines for informing farming systems RD&E programs. It was the task of the study tour and workshop planning group to maintain the momentum gained by the workshop outcomes, and turn the report into a useable set of guidelines for the purpose of informing farming systems RD&E project development and operation. As highlighted at the conclusion of the workshop:

> "The workshop planning group will take the information generated to a point where a set of protocols are developed for use as a framework. This is the total planning group (i.e. Australian and New Zealand stakeholders) and then bring it back to the full workshop group over time to create appropriate model. A final step will be to approach investors to then develop a credible framework". (Australian facilitator, workshop 2001.)

Six key elements to farming systems RD&E projects emerged as the major points to consider for a framework on farming systems project development and operation. Around each key area, important principles and considerations for these elements were debated and recorded.

In the day after the workshop, the entire Australian contingent and some of the New Zealand workshop participants travelled to the Whatawhata research station site to work through two case studies of existing farming systems projects to test the principles of farming systems RD&E projects developed throughout the workshop. Each participant was asked to work through each principle, and provide an analysis of project strengths or weaknesses in line with the new framework principles. This was the final point of the learning process of the study tour and workshop, assisting participants to gain confidence in the process, generate validity to a framework and enhance system thinking processes. As summarised by the NDFS team (2004:23):

> "Undertaking the field testing process increased participants' understanding and confidence in the approach that had emerged during the workshop. The critique of the two case studies allowed participants to develop their thinking in terms of

> farming systems RD&E, and elucidated the key elements that contributed to a comprehensive approach. The systemic analysis of the projects demonstrated that it was possible to provide validity, think beyond the traditional scientific processes, and understand the importance of the human dimension within farming systems RD&E. Furthermore it encouraged participants to critically reassess the approach undertaken within their own projects. The participatory approach to building the framework developed an appreciation amongst the participants for the benefits and importance of a multi-disciplinary approach to farming systems RD&E".

The principles that emerged from the workshop were taken back to Australia and worked into the farming systems RD&E framework through workshop activities. It was the Australian NDFS team that largely developed the framework, with limited input from the New Zealand members of the planning group. Input was difficult to achieve, and communications between the planning team members after the workshop became limited with lack of responses to requests for feedback. Despite this, the NDFS team persisted and sent out a draft document to the entire workshop delegation, to seek their comments and initial responses to the emergent framework.

Feedback was received from only 20 (11 Australian, 9 New Zealand) of the 48 participants at the workshop. Overall, the feedback was positive with the balance between explanatory discussion and succinctness commended. Feedback indicated that the framework was viewed as having utility within existing projects and also in the development of new projects as a checklist for quality assurance. Common concerns of the framework were in terms of the risk of becoming too prescriptive, and the need to draft the document in line with different actors perceptions of farming systems RD&E concepts. Delivering the guidelines acted to prompt participants to reflect on their own worldview of the farming systems concept. As this research suggested:

> "My understanding of FSR is quite different to much of what we saw in NZ, and I don't see it as necessarily being large and expensive. The key elements for me are relevance (often achieved by working on farm), participative (including an action learning base), and multidisciplinary (as needed to address the problem). The message I get from the guidelines is that experts should think of all possibilities, manage thoroughly and communicate professionally. Isn't this just professional research management?" (Researcher, 2001.)

Seeking feedback was useful for revealing whose systems thinking had developed as a result of participation, compared to those who were no further ahead in their thinking. For example, this extension practitioner was taking his thinking to a higher level, after already embracing the systems thinking concept within their existing farmlets project:

> "Looks good to me (guidelines) but while that success of systems trials is determined by the level of interactions from the different streams contained in the project i.e. using our project as an example. It's no good if production reaches 100% of its goals if sustainability is only achieving 20% and social achieving 50%. A better result would be all achieving 60% over all areas. It would represent the ability of the project to achieve or address a systems outcome". (Extension practitioner, 2001.)

Compared to this researchers thinking after the framework was developed:

> "A system can have 2 variables in one experiment (height and interval of grazing), it can be very complex without getting human involvement in the system, but stakeholder input may always guide and direct research into the system, systems research surely can also be a computer model which does not have social interaction. I guess this exercise started off as national coordination of farmlets research and perhaps we should continue to focus more on down to earth things like that. After all, farmlets are supposed to represent the ultimate system - the farm". (Researcher, 2001.)

After nearly 12 months of maintaining the participatory approach to developing the guidelines through seeking feedback (extensive emailing, reminders for feedback and deadlines for comment) and input from the planning team members and the workshop delegates, the "Guidelines for Farming Systems Research, Development and Learning" were eventually published and distributed. Considerable effort was made to develop distribution lists across industries and institutions, where both electronic and hard copies were made available. The following is a discussion of the critical issues encountered within the learning process and the process of developing the framework that impacted on the development and maintenance of learning relationships around farmlet projects.

Critical issues

Connecting to develop a learning relationship with New Zealand – different views of farming systems RD&E

The Australian farming systems team initiated the contact and development of the NZ study tour and workshop. This suggested there was significant energy and enthusiasm within Australia to strengthen the collaboration with New Zealand. In the area of farmlet research, New Zealand had historically been the leaders in this area, ahead of Australia, with an extensive history of using farmlets since the 1960s (see Chapter 2). Between the two countries there was a clear distinction in experience, and as such New Zealand tended to take on a mentoring role for the Australian delegation.

The questioning process of the planning group provided the initial motivation for the parties to engage and determine if the country's had sufficient in common around farming systems to engage. This approach in itself demonstrated that although from Australia's point of view there was sufficient to engage in the first place, the NZ contingent were some what reluctant and unclear as to the benefits of interaction. After all, on the surface New Zealand seemed clearly further advanced. This was certainly the case with farmlets, however with the agenda shifting to focus on farming systems, Australia was using the national infrastructure, and had planned and initiated a more coordinated and participatory approach to developing an appropriate construct that was effective for the RD&E continuum. Australia had taken the lead as the initiators of the activity, and was open to learning and building a concept of farming systems RD&E. Australia was keen to co-develop a new concept of farming systems RD&E.

In contrast, New Zealand had the Agricultural Systems group, an R&D resource, however the extent to which the group was truly a systems research group came into question. There were elements of a "systems team", including social research, farm expert and modeling capability. However, the Australian delegation weren't given a lot of exposure to how they were working together or using systems theory and methodology. The implication for the development of learning relationships was the potential of limiting a two-way exchange of learning. The significance of this limitation meant the full innovation potential was not realised until the opportunity had passed.

Different learning approach of Australians compared to the New Zealanders

New Zealand had a completely different approach to Australia in terms of learning around farming systems, and this led to another lost opportunity. Australia brought along a large delegation of multiple stakeholders, but of particular note was the inclusion of farmers. Incorporation of farmers was critical to generating industry 'buy in' and creating a sense of ownership of the farming systems RD&E approach. Doing this added richness to the learning process around the key similarities and differences in thinking, RD&E approach and farming systems. Farmers from Australia were critical to include as co-developers of the framework (this was not the case from the New Zealand perspective.)

The large multi-disciplined Australian delegation was critical to the development of learning relationships amongst the Australian team, in particular with regard to developing learning relationships between research and extension. This was a significant opportunity for New Zealand gain, given the separation between the disciplines in terms of geography and methodology was a common issue. Researchers and extension practitioners traditionally work independently from each other, and as such a learning relationship is absent. Both Australia (farmlets and NDFS) and New Zealand (Ag systems group) approaches to farming systems RD&E were dominated by technology transfer approaches and a science culture. The creation of NDFS in Australia and also the initiation of the study tour and workshop was an attempt to deal with this issue and strengthen such relationships. It was a chance that could have been better utilised by New Zealand.

Reinforcing a national approach through a large delegation

A large delegation from Australia (as opposed to Australia sending five participants) was critical to promoting a national sense around dairy farming systems projects, and building the Australian networked learning relationship. Adequate representation from each State aimed to contribute multiple perspectives on Australian and New Zealand farming systems. There was sufficient common ground between the two countries to enable an in-depth discussion around farming systems.

For Australia, the process was designed to develop thinking and reinforce the national approach. It worked because they were a large group, they covered extensive ground in a short time, and because there were sufficient NZ numbers to interact with.

The approach used at the workshop, using constant review and adaptation of the process as it went along, helped maintain a clear distinct purpose despite having such a large group. Adequate representation from the groups meant the workshop wasn't dominated by any one group. Regular provision of feedback was used as a management tool to convey a sense of progress over time.

Taking stakeholders out of Australia also helped to formulate the national perspective by expanding the state-based focus they were used to. Geographical separation and the provision of an outside view on the role of farmlet projects relative to other farming systems projects forced the national team to emerge, and players to focus on adequacy of their own activities and performance.

Co-construction of a new approach – why it worked, why it didn't

Collaboration with NZ around development of farming systems RD&E seemed an obvious activity, providing natural progression to adapt existing thinking and practices into a new approach. The use of a project management framework to guide activities provided an instant connection point for all players to relate to, and a forum to share their experiences to take that project management approach into a new way of guiding farming systems RD&E projects.

The workshop and study tour was set up as a trial collaborative activity, rather than the starting point for a long-term learning relationship. This was demonstrated by the conclusion that emerged from the planning session, which stated that they were "… *to use the impending workshop as a key determinant as to whether ongoing interaction (and hence a learning relationship) would develop into the future*" (Barlow *et al*. 2001). In this time, an assessment of true collaborative behavior was being made in terms of the input of time, physical resources and enthusiasm within the planning team. Determination of what was a fair and reasonable measure of true collaboration had not been achieved and required negotiation. With the NDFS team playing a dominating role in driving the activity and constantly seeking input from NZ, it meant the expectation grew from the farmlet teams that the NDFS team would drive collaborative events. With limited engagement of the farmlet teams after the workshop finished, no significant collaborative arrangements for joint activity emerged.

Managing and maintaining participatory processes across the large group provided the opportunity for workshop delegates to remain part of the guidelines development and learning and ensured a valid document was being produced. However the time delays created by waiting for feedback after the workshop meant momentum tended to be lost, and the nature of the relationship become unclear. Being responsive to feedback helped to maintain some stakeholder interest and continue to build new collaborative relationships. However with almost a year in between the workshop and the final document being released, much of the new thinking and enthusiasm created by the workshop had dissipated and much of the potential for learning relationships to develop was lost.

Emergent learning

Considerable learning around farmlets and learning relationships emerged as a result this activity being planned and followed through. This activity was built around co-construction of a shared view, and teams working to draw on the learning and experiences of others to create a new approach to farming systems RD&E, and positioning farmlets in a broader more meaningful approach to research and extension.

One of the first learning processes that the Australian contingent was exposed to was that of the innovative farmer, who had control and total management of his own learning. He also had clear expectations of research and extension. This prompted the Australian contingent to reflect and assess their own methods, using this farmer as a benchmark of a potential future direction of the industry. This farmer was a practical, living example of the possibilities for dairy farming systems and demonstrated how inadequate current research and extension thinking was for addressing the questions that leading farmers had.

Taking a large Australian delegation out of the country and providing a contextualised perspective from New Zealand's, fostered critical reflection on their activities and practices relative to the New Zealand context. This out of situ learning process allowed for the consolidation of ideas and practices, relative to others. Taking them out of the context they normally operated within, to position their work relative to others, facilitated the emergence of a national perspective on dairy farming systems. Taking the team outside of their own context to expand their thinking and demonstrate the national identity and approach was critical to developing further the national learning relationship around the farmlets.

However the intellectual development of participants was variable, with those already open to farming systems concepts and working within the paradigm more willing to engage and provide feedback to developing a new perspective on farming systems RD&E compared with those who were content to remain working solely within farmlets. Other grazing industries looking to move towards a farming systems approach were also keen to engage.

Observation of the behaviour and contributions within the workshop process indicated confidence among the New Zealanders about their position on farming systems. We can think we are clear on our position on farming systems RD&E, but it is opportunities to re-think this position and give it clarity that can often be missed due to narrow-mindedness. Ambiguity surrounding the farming system concept leaves it open for manipulation in changing contexts, therefore its definition and key points of emphasis can vary across industries, countries and questions. This creates a situation for a valuable learning exchange that we've seen emerge from farmlet projects in Australia , that's been turned into a re-conceptualising of farming systems RD&E by the NDFS team. With the significant learning exchange opportunity, a trans-Tasman joint exercise was justified.

A key issue within the learning exchange is the capacity and initiation of self reflection on an individual level about how you as a researcher, extension practitioner, farmer or funder use constructs such as farming systems RD&E. Being able to reflect and then articulate a particular approach or position on farming systems RD&E can be difficult, and this in turn affects the development of learning relationships and the influence the learning exchange may have on learning itself. The production of guidelines has gone some way to addressing the articulation issue. It's provided a benchmark for the key elements within projects, processes to build boundaries, and a starting point to initiate and maintain stakeholders in a learning relationship.

Learning exchanges tend to have a time limit attached, along with expectations for engagement which if not recognised, opportunities for learning can be missed. This time limitation was demonstrated by the approach of the New Zealanders towards the activity, where in the initial stages a learning relationship was being generated in the planning stages. It was during the workshop event and afterwards where the New Zealand contribution tended to be in response to requests from the NDFS team for their participation rather than a pro-active level of participation that suggested NZ were not recognising the learning and partnership potential of the event. For learning relationships to develop and advance, mutual contributions from players need to be achieved. For example, if the workshop outcomes were to be further analysed collectively by the project planning team, the job needed the whole planning team to be active in this process.

A learning relationship can develop if one party is left with the responsibility, and spends copious amounts of time seeking feedback and input from others who had committed to the process but not followed through. However the outcome of this in this case was discontentment within the planning team, and once the final outcome of the guidelines was achieved, no further joint activities were organised. This suggests that in building learning relationships, there is a time-framed 'trial period' built around joint performance contributions that either makes or breaks relationships.

A key barrier to the trial period being successful is the perceptions of how players are positioned within the relationship, and what they view as being the learning benefits to being a participant. Where a player views themselves as being a leader and “ahead of the game”, this acts to limit their participation, and see the learning benefits that may be incurred as a result of interaction for the long term.

We now head back to Australia to investigate the next key activity that had implications for the development of learning relationships around farmlets. We will explore how the NDFS team worked with different farmlet projects to build extension and communication strategies.

Extension strategy development

In the second phase of NDFS project evolution the NDFS team engaged with willing farmlet teams to contribute to the development of their extension strategies. This process enabled significant learning to occur between both the NDFS and farmlet teams. For the NDFS team, they learned about individual projects and team members, generated an understand of the learning environment that teams were operating within, and in turn transferred the learning from one site to another. For the farmlet teams, engagement with NDFS around their extension strategies provided a systematic process to develop and implement their extension strategies, an outsider’s perspective and critical review on extension, and the exposure to extension learning outcomes from other farmlet sites.

The extension component of farmlets provided significant challenges to developing a nationally coordinated approach due to a number of variables between regional sites. For extension, there weren’t particularly recipes, methodologies or guidelines of best practice as there were for research. Regional extension strategies were developed ‘in-house’ with little variations in the types of extension methods used. Extension teams were restricted by the level of existing resources (human and financial capital). They were also restricted in the amount of professional development they were exposed to, which in turn contributed to team cultures of working in isolation, and working within their own traditional paradigm of extension. Engaging with an ‘outside’ team from the NDFS to work on their extension strategy was a new concept requiring adjustment in thinking and practice for the farmlet teams.

The VMF, M5 and FF farmlets were the three projects elected to represent and demonstrate the common issues and variations between projects, as they were the dominant extension projects that NDFS were involved with. Attributes included in the analysis were the key farmlet messages that extension had to work with, resources, history of extension planning, and methods implemented, barriers to extension and, outcomes from the farmlet team engaging with the NDFS team.

Key messages that emerged from the projects suggested that significant extension planning was required and a substantial extension effort was needed if change was to occur at the farm level as a result of the farmlet work. Key extension messages related to the relationship between production and profitability, with additional environmental messages incorporated in the M5 and Flaxley projects.

Among the attributes creating variation between farmlet extension projects was the size of the extension teams and experience in their extension roles. Other teams such as Vasse faced ongoing uncertainty with extension staff leaving, and also with the appointment of new staff. Different extension experience was introduced with new staff, which acted to enrich the extension activities, but also caused disruption to the activities already in place.

Reputations of the farmlet projects were considered by project extension teams to have implications on extension. Each team had their own idea of how well regarded the farmlets were, based on either formal evaluation or informal feedback received from farmers. The Queensland team considered that the farmlets were well thought of, the West Australians perceived their reputation was poor particularly with farmers who use irrigation (see Chapter 7), and the South Australians had the most negative perception of their reputation within the farming community (see Chapter 6) due to the complete absence of extension in their project. These were the types of issues the NDFS team needed to learn about and that required regionally constructed extension strategies to account for local challenges.

Common to all farmlet extension teams was the challenge to re-build confidence in the dairy industry at a regional level, in response to industry deregulation. The uncertainty created by deregulation meant that the learning environment within farming communities required the farmlets to provide management strategies that assisted their survival in the industry for the long term.

All projects had to cope with insufficient operating funds to conduct activities beyond what had been specified other than complimentary industry projects that the extension team were allocated to. The number of members within extension teams and their time allocation to farmlet extension varied across sites. For example Queensland had two full time extension officers and Flaxley didn’t have any. This had a profound effect on the number and types of extension activities each site was able to deliver to the farming community directly from the farmlets.

Also common to the farmlet extension projects were the methods of extension implemented. These were typically the use of on site field days, updates of farmlet performance in local newsletters, and using companion farms as the next step to implementing farmlet outputs on a commercial farm (see preceding farmlet case studies in Chapter 5). This commonality between projects meant that there were significant opportunities for learning experiences around extension methodology to be shared across projects. It also highlighted that extension around farmlet projects had become conditioned to implementing certain methods and there was a lack of evidence to support any move to go beyond these traditional methods and thinking.

The final common element between farmlet extension teams was that extension practitioners at the farmlets undertook limited reflection on their extension practice, with little active sharing of their learning around extension with others within their profession. Extension as a profession in general doesn't have the professional culture of actively publishing their technology and new approaches. Such issues represented key opportunities for the NDFS project to facilitate capacity building of farmlet extension teams.

The intention and objective of the NDFS team to work with farmlet teams on their extension strategy was to "… *facilitate the development of capacity for extension and learning within farmlet projects*" (Crawford, 2002:4). The challenge for the NDFS team was to be accepted 'into' the extension teams and be engaged willingly by the farmlet teams. Part of their approach was to develop a plan and process to be used with each regional extension team that provided these teams with a comprehensive strategy for implementation over the life of the regional project. A joint process was used, whereby the NDFS acted in a facilitating role to explore the possibilities for extension in each region. .

A consistent process was used between projects, which allowed for regional variations to be explored and accounted for. Strategies were developed in conjunction with the project teams using a common semi-structured 2-day workshop process, which allowed the strategy to be tailored to individual project needs. The facilitated workshop process included obtaining an overview of investors' expectations, challenges to success, development of key messages, identifying resources, planning strategy, and specifying actions, milestones and work plan.

In addition to providing a supportive process to extension strategy development, the NDFS team were also attempting to play the role of a 'critical friend', providing alternative perspectives, and questioning why certain approaches were used and not others. Interestingly, there was a difference between teams in how open they were to this role, or indeed having any involvement with the NDFS team at all with extension strategy development. While some teams embraced the support, critical review and involvement of the NDFS team, for other teams it was considered more as interference and the assistance unnecessary (see Chapters 5 and 6). For some farmlet teams, the NDFS team had to work considerably harder to 'win them over' to work together and did not necessarily having any success despite considerable effort to engage. As the NDFS extension leader explained below:

> "We were explaining the other day it's not about getting up their noses, but seeing our involvement as being a really good thing for them and adding value…(and) a new way of looking at things, a fresh perspective whilst still being able to put into context what they're trying to achieve". (NDFS extension leader, 2002.)

Attributes of the teams that resisted engagement with NDFS on extension strategy development were those farmlets that had a long history of dairy extension within their region around the farmlet project or those that had extension processes in place that they considered were adequate and it wasn't critical to engage additional expertise to develop the concept of extension any further.

In failing to engage with all farmlet teams, a hole was created in the process of building capacity across the sites. Part of the beneficial role that the NDFS team were able to play was to transfer learning within one farmlet extension team to another. The sites the NDFS team work provided the NDFS team with an opportunity to collate lessons from different regions and apply these in new situations. As highlighted here:

> "… when we were working with the Vasse stuff… it was like -- OK well here's some ideas from Flaxley -- here's the outcomes of our working with them – we further developed the presentations, helped them with their writing, tried to, I guess simplify the language and the style of the science writing from the researcher. And to pull out the key messages so that the development of the story that they were telling, fitted together and also building their profile a little bit in that". (NDFS extension leader, 2002.)

So for the teams that NDFS were able to work with, significant learning relationships were formed, however this was only a partial performance in the development of a network at the national level. Those teams that had limited resources and experience found the support from NDFS project most valuable compared to other teams who had more experience and were looking for other activities from the project which they would choose to be involved with. The discussion now moves to exploring the critical issues affecting learning relationships around farmlets through the NDFS involvement in developing extension strategies.

Critical issues

Building learning relationships with farmlet extension teams – initiation and previous history

NDFS moved to engage with the extension component of farmlet projects using a strategic development process that provided a platform for dialogue around extension practice. Strategies were developed to look forward and plan a learning pathway that would support the development of a collaborative approach to national extension. It was the intent of the NDFS team to work with the teams, providing an exploratory process that enabled a regionally relevant extension strategy to emerge. Critical to this process was to ensure the strategy was jointly constructed, and not perceived to be 'top down', with the NDFS team telling the regions what their extension strategy would be.

For the teams who were willing to participate, engagement around the extension strategy tended to reveal further opportunities for NDFS to contribute to the farmlets activities, and also be involved in the implementation of parts of the strategy. Box 6 provides an example of other activities that emerged as a result of NDFS team involvement in extension strategy development and implementation. As a result of the development of the on-going relationship around extension at Vasse, the NDFS team were able to be external advocates of the program and support the project in getting a new extension leader appointed.

> New facilitator at Vasse Milk Farmlets
>
> "I was at Vasse in February/March because I was talking at a field day and then it was suggested "You should write it up. Do a bit of a review on what they're (Vasse teams) are doing - write it up." And that led to sort of a whole chain of events, a lot of discussion, between NDFS team and funders about the progress of where they were at Vasse which contributed to the Vasse team beginning themselves to think about where they were going to go with the project because funding was coming. We all identified that there was a real problem with the project 'cause they hadn't had their extension officer replaced then, the funds were there Everyone was saying "Look the project's good, but no extension is happening". But with out involvement and discussions, within two weeks they had an extension officer. And, , the researcher (at Vasse) was just delighted because there's only so much he could say and it was just falling on deaf ears, but it took people from outside for once 'cause that's not always the case that people from outside claim this is an issue, and something actually changed". (NDFS extension leader, 2002.)

There was considerable variability in the strength of relationships that emerged with the farmlet teams that participated with the NDFS team. Evidence suggested that the strength of relationship was dependent on who initiated the engagement. As highlighted below:

> "… if groups come to us and are actively engaging us in something, well I'm all for that … because then by us being engaged they can see the value of what we're doing and … they see the value of it and then it develops that relationship…Vasse is asking for a lot more support in a number of areas. Because they see that it's important. Flaxley, is, well, hasn't in fact asked for any involvement -- and we have offered—we were involved in the extension strategy, but that was driven by the RDP, it wasn't driven by the project team…….and Mutdapilly I think we have a really good relationship. There's a good team up there. They've got people to do a lot of the stuff. They are good value, and I think, they are a valuable support in terms of their learning and extension strategies and are interacting in a number of ways. And it's like everywhere, there's a diverse group of personalities and, so, they respond differently" (NDFS extension leader, 2002.)

Although some farmlet teams were more amenable to NDFS assistance and support than others, there was considerable variation between regions on how they utilised the NDFS team on regional level activities. For example, Vasse embraced the NDFS team in on-going interaction and support for various local extension activities, while the M5 project engaged the NDFS team for reviewing and evaluation processes of research and extension. Despite the variety in on-going interaction in extension activities, each engagement led to the development of a more relevant learning relationship with the NDFS team.

Previous history and interactions with NDFS also partly determined whether or not farmlet teams engaged or rejected the NDFS team working on their extension strategy. The teams that had a positive experience in general across the NDFS (i.e. support to develop strategies, knowledge sharing at national workshops etc.) were more likely to embrace the extension strategy development process, compared with those who had (from their perspective) a negative experience e.g. ERDS new farmlet project development. Extension practitioners in the farmlet teams resistant to assistance considered the standard approach offered little to add to their own processes for strategy development. The resistance was expressed as attitudes such as this extension practitioner.

> "… we don't really look for input into our extension as we have a long history of developing programs that have been endorsed by our RDP and been successful and we don't want to be going back to

> square one all the time……. they don't really know the issues facing our region and they also don't have the background of why we take the approaches we take…..". (Extension , 2002.)

This farmlet extension team was unable to see any beneficial additions to their extension strategy by engaging with the NDFS team and in fact considered it to be adding to their workload. This particular team already had their own system established for developing the farmlet extension strategy, and worked within the RDP system that DA had put in place with consistent successful program outcomes. Rejection of the NDFS team participation then prompted questions of what they needed to learn in order to work effectively with extension teams to build on-going learning relationships across regions and a national approach to farming systems RD&E. This is now explored.

Staging NDFS team learning

In much of their activities, the NDFS team were themselves looking for support and learning opportunities to increase their own understanding of farmlet projects, the farmlet teams and issues of national relevance. By participating in extension development NDFS went through a process of their own, learning about the contextual issues and systems, and getting to know how the teams and individuals within the teams operated. Understanding the regional teams and their activities was critical to developing cohesion between projects and an overall national approach to farmlet extension. As stated by the NDFS extension leader:

> "One of the roles that I have now is I understand what they're all doing and I know where they're coming from and so I can talk to them about stuff without having to have them explained. I have a history of what they're doing and so I know where it fits in and so they can show me stuff. I go "Oh yeah, OK, this is what you're doing now" and, "Yeah, that's a good approach or that's not on or think about this, that and the other". (NDFS extension leader, 2002.)

Each engagement with farmlet teams accrued further knowledge and capacity of the NDFS team, better equipping it to build the capacity of the farmlet extension teams they were working with. For this NDFS team member, involvement with the extension strategy development enabled an accumulation of stories at a national level, and learning of the strengths and weaknesses within regional teams to get an idea of the level of thinking teams were operating at:

> "Extension strategies, well, that is part of the process of getting the regions to deliver integrated strategies, collate the various stories, and put it together nationally. A story can be bought in from anywhere, to

> spark learning in another area. We can become more aware of the strengths and weaknesses of who has been invested in and get a sense of how well people are thinking in the planning exercises. We get a sense going into a planning exercise how well people are thinking about designing clear outcomes and outputs and the resources that they need. Its about how to position the issues, and have a tight rope of being challenging on one hand but nurturing on the other and how to play the roles between the three of them". (NDFS team member, 2002.)

So there was considerable learning for the NDFS team in order to effectively engaging with extension strategies. The interactions that the NDFS team had with farmlet project teams increased the NDFS teams own capacity, furthered their legitimacy in contributing to farmlet research and extension practices, and provided a better case to put to those farmlets that rejected input and support at this level. The more interactions that NDFS team had with extension teams, the further the relationship progressed to the point where the farmlet teams were initiating contact and seeking the input of the NDFS team on various extension activities. As highlighted by the NDFS extension leader:

> "They wanted help with extension strategies – and implementation. They were keen to I guess get feedback on a lot of what they're doing and whether they're heading down the right way. They've been interested in how other people approach things. Usually you get to a site and get "Have a look at this. What do you think?" (NDFS extension leader, 2002.)

This leads to the next critical issue, which explores how the NDFS 'collected' learning outcomes from their engagements with farmlets and how they used this learning to increase their capacity to assist farmlet extension teams.

Collecting learning outputs from regional sites

By making a contribution to extension strategies and their implementation, the NDFS team collected learning outcomes along their journey around the sites. This learning was to do with extension planning processes, implementation and picking up new ways to approach these activities. As demonstrated by the NDFS extension leader:

> "There's so many opportunities and when I hear of new projects and extension coming along -- and we think "Oh God we've really been down this track. We could really help." And we've got some good tools and some good approaches and, there's been a lot to reflect and one of the biggest things is there's a number of things that will impact on the sort of extension you have and it's going to be things

> like money, who is doing what. Within small groups you don't always necessarily have the best ideas and there's sort of that continuous improvement process. But we've got a number of examples where projects have changed".

This reveals the NDFS team were in a unique position. They were exposed to learning that had occurred within teams around extension activities and were then able to use to use this knowledge to benefit other extension teams developing strategies. This position allowed the NDFS team to expand their own capacity and contribution to extension strategies using relevant tools and examples developed around farmlet projects.

Making strategies accountable and resilient – gaining momentum with activity and thinking and maintaining it.

In addition to tracking the learning within projects, the contact with extension teams allowed for a more rigorous approach to extension planning, and gave more accountability to the farmlet teams to deliver on the work plan developed. Part of NDFS engagement in the planning process was to follow up periodically to ascertain how implementation of the plan was occurring and any issues that had arisen. Sporadic informal discussions were used by NDFS to maintain contact with regional extension teams that helped the teams ensure their plan was being followed through.

> "One of the key issues was that many local projects have some extension strategies in place, but really following through in quality work (was a problem). I mean their hearts are in the right place, so making sure that things are happening -- and it's not just the plans going in the cupboard and that's something that we can all be pretty guilty of. We sit there and have some great ideas and then mentally in your mind you work out what you need to do next, but unless you're checking back, things slip by or they just don't happen". (NDFS extension leader, 2002.)

Periodical follow-ups initiated by the NDFS extension leader also demonstrated continued commitment to the learning relationship, and in the process each team was continually updated on recent events that were relevant to their practices.

Restrictions in extension creativity

While the standard process the NDFS team used to develop extension strategies worked for the engaged farmlets, it also acted to restrict any creativity [19] emerging in extension strategies. The approach ensured the immediate need of the extension team was being addressed in terms of developing a new extension strategy, however the approach didn't allow for scoping how extension may be done differently or assessing the alternative social theories, learning theories and extension methods that could have been implemented. Extension teams tended to work within their comfort zone and not experiment or explore different ways to improve their practices. There were differing reasons for this. The more established teams wanted to maintain the continuity of the learning processes they were providing the farming community. The teams that were relatively new to farmlet research tended to follow the activities of the more established teams using tried and tested extension strategies.

The lack of creativity in extension was a gap that the NDFS team were trying to fill, however the learning relationship with extension teams was not advanced enough to cope with such a challenge. The process used to develop strategies locked in a focus on the operational aspects of extension and was intentionally not challenging to facilitate establishing a relationship. But the effect of this was a restriction on the possibilities for innovative approaches and a reinforcing of the conditioned extension approach already embedded within the thinking of farmlet extension teams.

Emergent learning

This study of extension strategy development revealed a number of concepts around learning relationship building and the processes that teams went through to finding a foundation on which to build it. There was a multitude of learning outcomes emerging as a result of NDFS teams engaging with regional farmlet teams to develop their extension strategies. These included learning about the sites and regional issues, how they operate, and different ways of dealing with extension challenges.

However the apparent large variation in the way farmlets either accepted or rejected NDFS support and contributed to NDFS extension strategy suggested that different issues impacted on whether they were to be players or not in building a learning relationship around

[19] Creativity in extension is describing the opportunity at the beginning of extension strategy development to review all the alternative social and learning theories, approaches and methods that may be implemented beyond the previous extension program.

extension. Interestingly though, those not interested in engaging with NDFS activities on a regional level did however participate at national level in activities such as the workshops. This attribute is further explored in the proceeding section. The buy-in of farmlets on the regional level tended to be affected by the perceived benefits to their practice. Where teams had a system of developing and implementing extension programs that was successful[20] it was difficult for NDFS to engage with the teams on extension, because it was difficult for the farmlet team to see there was any real advantage to having NDFS involved.

Along with this, the previous interactions that farmlet teams had had with the NDFS team also influenced local level interactions. Where the previous relationships had been burdened by unresolved opposition and a mismatch in expectations (see Chapter 5) with DA, confusion was created in the relationship and subsequent interactions. This highlights the complexity in the role of NDFS, as it was the farmlets who controlled the development of learning relationships. The success of NDFS building capacity within farmlet teams (and meeting their own objectives) was dependent on NDFS engaging with farmlet teams, however the success of farmlet extension was not dependent entirely on engaging with NDFS in strategy development and implementation, it was merely seen as a potential , but optional, activity.

For the teams that did engage, certain characteristics emerged as NDFS and farmlet teams worked to establish their own learning around their projects. For NDFS, their learning process was to create a knowledge bank on the regions that would help to determine how to effectively work together. This would then form the basis of understanding how a productive national team could be created. The farmlet teams worked on the principle of first working with the NDFS team and seeing what emerged as a result. This backgrounding approach provided a foundation for forming a learning relationship that could maintained over time. This needed to be a two way process, where both teams learned more about each other.

Exploring the processes NDFS used to assist extension strategy development revealed that there was a gateway NDFS was required to negotiate before any backgrounding process could commence. Once through the gateway, different kinds of learning relationships developed on an individual basis with extension teams, in addition to the relationship that had been formed with researchers and project development. Affecting the ability to get through the gateway was the perceived benefits to interaction and the immediate needs of

[20] Success here refers to an extension project meeting all the specified milestones and also passing evaluations that assessed how well the program met the objectives.

the extension team as well as previous relationships and previous interactions the team had had with the NDFS program. Learning around farmlets is affected by the prior relationships developed, and the experiences people have had as a result of these interactions.

For an external team such as the NDFS a key to the gateway was needed for a relationship to emerge. For some farmlets, participating in extension strategy development was the key. But for those that didn't engage with that activity the NDFS team needed an alternative (see section on SGS program and the third annual workshop).

Learning between farmlets was transferred by the NDFS team working as a knowledge archive. Learning was recorded in report writing and meeting minutes by the NDFS team. Learning across the regions, particularly in the variation of approaches to extension activities, and understanding the capacity within extension teams (i.e. where certain skills were), was carried by the NDFS extension leader and used as a way of linking and networking farmlets in a national activity.

Extension at each site however, was dependent on the local industry perception of what was needed (in terms of an extension strategy) which was one area that restricted creativity and potential for finding alternative ways of doing things. This suggested that learning within farmlets teams began by dealing with the immediate need of developing an extension strategy. But by dealing with the immediate need, there was often not enough time to explore other potential ways to approach extension practice and thinking. So in one sense, NDFS managed to build a relationship and achieve a strategy, however by the time this was achieved there was little time for innovative extension to be encouraged. Taking the next step in thinking, that is incorporating social research outcomes and innovations in extension approaches, was yet to occur. It was a tension that built momentum and restricted the NDFS to build capacity within the extension teams. This highlighted how the systems and processes that NDFS used to build learning relationships needed to be reviewed and adapted in line with how the relationships was progressing.

The more the NDFS team were able to engage with the regions in extension activities, the more capacity they had to legitimise the NDFS program and to formulate a project relevant to the regions specifically. In effect, where the NDFS team were able to engage with extension teams, both teams were building capacity, each able to be more effective in their role as a result of the emergent learning relationship.

The discussion now moves from studying the attributes of extension strategies for building learning relationships around farmlets, to exploring the development of experimental protocols for farmlet research. In comparison to extension strategies, farmlet research lent itself to standardisation and the development of clear rules for practice and is another avenue through which learning relationships were developed around the farmlets.

Experimental protocols for dairy farmlet projects in Australia

Farmlet scientists and an agricultural economist developed protocols for dairy farmlet research that became a published document in June 2002. The activity of developing protocols was one that had been in progress since the Twin Waters workshop in 1999 (see Chapter 2) before the NDFS project officially commenced. It engaging committed researchers from various farmlets to write different aspects of the protocols. The aim of the protocols was to provide guidance on the variety of measurements considered minimal and optimal for collection within farmlet projects (Crawford, Paine and Barlow, 2004:15) but overall to generate consistency in approaches/practices and develop a common language .

The benefits of this for farmlet researchers was to ensure information from one region was able to be translated to another region, creating a common language between projects to encourage further interaction. Encouragement to interact was required because at times regional differences in data collection and analysis made data exchange difficult. This frustrated research practitioners as they were unable to compare management results and overall performance, for examples some farmlets measured milk solids per hectare whereas others measured production as litres per cow, and some measured pasture utilisation whereas others didn't, and each farmlet had their own methods for analysing the economics of the farmlet treatments.

For the NDFS project and the farmlet teams, the development of protocols was seen to be a way of developing a coordinated approach to farmlet research. As presented in the final protocol document, "…*the protocols have been developed to ensure there is a uniform approach to undertaking farming systems RD&E within a dairy farmlet study context*" (Crawford and van Houtert, 2002:4).

Within the farmlet protocol document, there were a series of definitions and descriptions on minimal and optimal measurements that should be followed for Australian dairy farmlet projects. They include rules for sharing data, experimental description, site and meteorological measurements, pasture, fodder crops and animal measurements and additional studies that can be added to the farmlet study including nutrient movement, enhancing biodiversity and measuring the economics of making changes in line with the management farmlets were advocating.

The protocols were developed in a coordinated effort by the researchers and the Farming Systems Extension Leader (Crawford, Paine and Barlow, 2004:15). Prior to printing the document, feedback was sought from other researchers. It was the NDFS leader that collated the work on the protocols and made the document available to those farmlet players that had not been involved in their development. Finalisation of the protocols was completed by the NDFS extension leader sending a printed and electronic copy of the document to all farmlet projects and RDPs. It was considered to be a working document, and was designed to be reviewed and added to over time as part of the NDFS project activities.

Critical issues

Utility of the experimental protocols

In the first instance, the activity of developing experimental protocols brought different researchers from around Australia together into a group for a specific purpose. The significance of this was the facilitation of dialogue across farmlet sites around a common concern to develop agreed research procedures and new methodology for farmlets. Each researcher within the development group was committed to the activity, and saw the protocols as a way to guide their practice and foster learning relationships built on data comparisons across regions. As highlighted by the NDFS extension leader below:

> "They recognised that they had a commitment to doing things the same way that involved some give and take. For some it meant changing from how they were doing it locally and that's quite a big thing because often what they do locally is grounded in, ten, twenty, thirty years of experience and calibration of results. So there was that commitment -- they wanted an opportunity to be able to compare data and so they moved to measure things the same way". (NDFS extension leader, 2002.)

For the NDFS team, generating uniformity in the way farmlet measurements were taken was a way to begin coordinating farmlet project outputs. As a starting point, the protocols would create a level playing field for farmlets to enable exchange of data. Commitment and enthusiasm to developing protocols suggested that farmlet teams were looking for the opportunity to work together to extend outputs from the projects, and that a core barrier to cross-site comparison of results was the variation in measurement techniques.

On the completion of the protocols, it was assumed by the protocol developers that farmlet teams would then work together on shared projects., however this did not occur. The protocols were mainly used to guide new and existing projects working on measurements within their own region. No data sets were exchanged as a result of the protocols being published. As a result, the coordination role that NDFS were hoping for was only achieved at the protocol development level and not at the point of application. Teams involved in the protocol development were still not taking the next step of data exchange and extrapolation for the benefit of other regions. Lack of time and low priority were the explanations given by interviewed researchers as to why this activity didn't take place.

Farmlet teams not involved in the development of the protocols were not nearly as enthusiastic to use them within their project activities. This particular researcher considered the protocols as good, however not a lot of value at that time:

> "…we were given some experimental protocols which are sitting on the shelf. I've had a flick through and looks good, but I haven't had to use it yet". (Researcher, 2002.)

By developing protocol the complexities of collaboration between farmlets were brought to light. One in particular issue was the definition of data ownership. The strong need to clarify who owns data, how it could be used and in what context suggested that this was a significant barrier to data sharing across farmlet projects. Defining agreed rules on data ownership helped clarify the dilemma, helped by the NDFS extension leader acting as a negotiator in the process when ownership was not clear. While the NDFS extension leader took the role of negotiator, there were no significant events around the protocols.

The protocols were an important tangible output that emerged from the NDFS project. Tangible products were a major requirement of the funders, because they made it easy for funders to demonstrate to the industry what their money was been spent on. As highlighted by this member of the NDFS team:

> "… when [the funders] say they want products or tangible things they like things that they can show off (where they have put there funding into. Things like the protocols. You can hold it up and say "Look this is what they've done". (NDFS team member, 2002.)

Positioning farmlets in farming systems RD&E

The second critical issue around the development of the protocols was the way in which the protocols positioned farmlets within the paradigm of farming systems RD&E. In essence, the protocol document demonstrated how the authors defined the farmlet methodology and related the farmlet approach to farming systems RD&E without any real clarification of the linkage. This issue is now explored.

Using the protocol document, farmlets were defined using the minimum set of production system measurements (i.e. pasture and fodder crop, animal production, site description etc.) along with optional measurements that added value to the experiment. These measurements were all related to the production system and created a boundary around farmlet research, making it focussed on the production system. These constructed boundaries then make farmlets as a methodology, incomplete to be positioned as farming systems RD&E. The umbrella term of farming systems RD&E lends itself to have multiple meanings (see Chapter 3), however consistent within the definitions of the paradigm is the need for multidisciplinary teams. The farmlet protocols were advocating a multidisciplinary team, however the team was designed to focus on the production system, whereas for farming systems the focus not only includes the production system, but broader economic, environmental measurements, and substantial social research that encompassed 'the system'.

While the intent was to move towards farming systems RD&E approaches, the publication of the protocols was inconsistent with this intent. This is indicative of the timing of when the farmlet protocols were published: after significant effort was put towards the development and publication of the guidelines for farming systems research, development and learning. Within the farmlet protocol document, there is no reference or linkage to the guidelines, yet the guidelines were intended to be a significant step to shifting farmlet thinking into a broader framework beyond farmlet research and extension. It is also apparent that within the guidelines document also there is no reference to the farmlet protocols.

Farming systems RD&E was compatible with the new goals and dairy industry mandate given to address the triple bottom line (see Chapter 2), and the flexibility and ambiguity surrounding the farming systems paradigm made it easy to position farmlets there. Fellow farmlet researchers reviewed the protocols yet little challenge and critiquing of the use of farmlets and farming systems RD&E language was achieved. This failure to explore the meanings behind concepts and find meaningful connections between them (even though this was possible through the existence of both the farmlet research protocols and guidelines) meant that considerable confusion was being created amongst farmlet teams. As it was put by one farmlet extension practitioner:

> "This whole NDFS project started out with a focus on farmlets and how to make farmlets more effective. Now we are talking in terms of farming systems RD&E and so I'm not really sure what it's all about now". (Extension practitioner, 2002.)

This highlights the pointlessness of connecting the terms when there is a lack of continuity and linkage between concepts and activities. Connection of the two concepts was difficult for those not involved in making the original connection between farmlets and farming systems RD&E and as such difficulties were created for future attempts by NDFS to introduce concepts beyond the boundaries of farmlets. This will become more apparent in the next significant event - the second annual farming systems workshop.

Dominance of science culture in farmlets

The development of protocols demonstrated the dominance and reinforcement of the importance of research and practice of production science within farmlet projects. It also highlighted the marginalisation and complexities of farmlet extension. If the published protocols were to define what constitutes an adequate farmlet project, it would suggest that getting the research component right was the first imperative. Extension methods did rate a small mention within the economic analysis recommendations, providing guidance on presentation of results. However it was interesting to explore why science was so dominant around farmlets and the NDFS project, when research and extension are processes which go hand in hand around farmlet projects[21].

Research methodologies including farmlets can relatively easily be organised into protocols because they rely on rules derived from the scientific method to govern appropriate practice. In the development of protocols the learning sits within the process of researchers negotiating which rules and measurements are the most appropriate to be documented as best practice for farmlet research. Such a debate is easily had between the researchers who

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[21] The connection between research and extension within farmlet projects was demonstrated through the case studies presented in chapter 5, in particular ERDS, MRF and VMF. The case on Flaxley demonstrated the deficiencies within a farmlet project when an extension project is not linked into the farmlet activities.

developed the protocols, as there wasn't a large variation in the types of measurements they would take in their own projects.

Extension, on the other hand, encompasses the complexities of the contextual climate within a region. This can largely determine the receptivity that target audiences will have to new farmlet production technology, and there are few, if any, set recipes or rules that guide extension in various contexts. There is also a variation within the way extension projects are funded. Even if a farmlet project is funded for three years, it is not a given that an extension project will be funded in association with the farmlet research. The development of farmlet protocols was an opportunity to demonstrate the equal imperative for an extension project to be initiated in association with the research project, not to develop rules for extension, but rather principles of working with extension practitioners in the farmlet environment (e.g. recording and analysing data, highlighting the role that extension practitioners have taken in the past within the research process). However this opportunity was missed due to the protocol development team consisting of farmlet researchers and the key purpose of the activity being focused on the farmlet research methodology. The development of experimental protocols did initiate dialogue on the development of extension protocols (see in proceeding significant event) and it was determined that the complexities around extension meant that strategies needed to be dealt with on a case by case basis.

Encouraging the dominance of research and science within NDFS activities such as the farmlet protocols was the portfolio manager and funder at DA. As he was funding the development of protocols through the NDFS project and looking for tangible outcomes, the protocols were progressed with little scrutiny and critiquing of the concept. Being funded from this portfolio and being driven by a person solely focussed on the research side of farmlets, meant the development team of the emergent protocol document was created within the boundaries of farmlet production experimentation.

The following is an analysis of the emergent learning from these critical issues.

Emergent learning

Several concepts around learning platforms emerged around the development and distribution of the experimental protocols. Firstly, the development of experimental protocols was essentially a tool that provided an assessment of players' thinking and perceptions of farmlets at that time. The tool used the coordination of agreeable and voluntary efforts by researchers who were able to work through a process of negotiation to document the rules. This subsequently provided a ‘stock take’ of how developed the thinking of researchers was at that time. For NDFS, the lack of critiquing and reviewing of the protocols beyond the farmlet research teams indicated that the emergent document was providing the utility it was designed for, and as such it was not recognised that the protocols could be used for their own learning. Using the protocol development process for reviewing practice and documenting practice rules could have been a learning process and assessment of the level of development associated with a concept such as farmlets. Activities that aim to address a need around farmlet projects can also be viewed as a learning tool to assess current thinking and then determine the next step required to meet objectives of programs such as NDFS.

In supporting and coordinating the development of protocols, the NDFS project team were being responsive to overcoming the barriers faced by farmlet teams who were committed to engaging with other farmlet projects. Protocols were also seen as a tangible product that would clearly demonstrate to industry where investment had been made. In addressing these needs, it demonstrated to teams and funders that NDFS valued commitment and took action where it was demonstrated. However this came at the expense of broader learning objectives the NDFS project, in particular where they were trying to get teams to think and develop projects beyond traditional farmlet projects. The development of protocols acted to develop boundaries in thinking and also created instability within the learning platform. These two concepts are now explained.

Boundaries were created in the protocol document by the same team used to develop the emergent document. With the team consisting of traditional farmlet researchers, the rules generated for farmlets were based on tradition and were a combination of traditional rules that made for an adequate farmlet project. Also the direction and input from the funder acted to limit the scope of the protocols and maintain the dominant science flavour of farmlet projects. Such boundaries limited the learning platform that was created around the activity of developing protocols.

While creating boundaries narrowed the field of possibilities for farmlet experimentation, it also meant the task was clear and easily achieved. However simplifying the task created instability within the learning platform that NDFS had begun to build through other preceding activities (e.g. development of guidelines for farming systems research, development and learning). Such instability was created by a number of factors. Firstly, removing the consistency in the promotion of thinking beyond farmlets (i.e. farmlets to farming systems).

Secondly, through promoting farmlets as being positioned within the realms of farming systems when the focus for farmlets remained with production. And thirdly, through not adequately linking concepts to demonstrate relationships (i.e. farmlets and farming systems, research and extension) and linkage. The instability created by these factors added ambiguity and confusion around both the use of the protocols and the NDFS project.

The second farming systems workshop followed the development and publication of the experimental protocols and was the final event in the second phase of the NDFS case study. This event provided an opportunity to further analyse at what stage farmlet teams were at with their thinking beyond farmlet boundaries. It also provided an opportunity to analyse the areas where learning relationships within farmlet teams had developed further, if at all.

APPENDIX 3: SUMMARY OF CONCEPTS ACROSS FARMLET ACTIVITY SYSTEMS

Object

Alignment of objectives and rational for collaboration	Outcome	Connecting and disconnecting drivers and motivations		ERDS
Principles driving actions within the activity system	Object/task and rules	Old rules	Old rules	ERDS
Criteria of subjects within the activity system	Object/task, subjects and rules	New rules	New rules	ERDS
How individuals responded to changes in rules	Object/task, subjects and rules	Independent rule development	IRD	ERDS
Consequences of engaging new subjects with different skills	Object/task and subjects as mediating tools	Shifting ownership	⊗	ERDS
Differences in worldviews, paradigms and approaches to activity	Object/task and subjects as mediating tools	Degrees of separation	⟷	ERDS
Leading, initiating and managing actions in farmlet activity	Object/actions/ outcome	Outcome driver	OD	VMF
Project development and stakeholder engagement	Object / outcome / subjects / tools	Activity system division		FF

Mediating tools

Perceptions of the role and form of tools used to carry out actions	Tools and mediating artefacts	Cultural definition of tools	CDT	ERDS
Adaptive tool usage and alignment of perceptions	Tools and mediating artefacts	Tool reinvention	TR	ERDS
How innovative approaches were incorporated into the activity system	Tools and mediating artefacts	Infusing innovative interventions	- · - · ->	ERDS
Communication and farmlet key messages	Tools/rules	Contextual learning	CL	VMF

Farming community connecting with the farmlets	Tools/rules/ community	Identity points	IP	VMF
Points in time where communication and linkage with the farming community were made	Tools	Significant incremental learning events	◎	VMF
Activity system linkages and collective action.	Tools/rules/subject/ division of labour	Learning relationship strategy	RS	FF
Utility of learning outputs	Mediating tools / rules / subjects	Tracking system	TS	MRF
Participation in industry learning programs	Mediating tools / rules	Centralisation of learning	C	MRF
Developing and using decision rules	Mediating tools/rules/subjects/ community	Convergent decision rules	DR_c	MRF
Multiple roles within farmer learning	Mediating tools / rules / community	Risk manager	Rm	MRF

Division of labour

Allocation of tasks	Division of labour, rules	Activity leadership	AL	ERDS
Blending and integrating tasks on farmlets	Division of labour, rules	Hybridisation of roles	Hr	MRF
Allocation of tasks between farmlet team	Division of labour	Role definition and boundaries	RD	VMF
Role definition and delineation of responsibilities towards achieving the joint outcome	Division of labour	Rules for engagement	RE	FF

Subject

Addressing learning needs of farmlet team – contact with others	Subject/mediating tools/objective/ community/rules	Learning relationship - peers	LRP	VMF
Antagonistic factors to building relationships around the farmlets	Subjects, community, tools, rules	Obstructions to learning relationships	⊘	VMF

Extension strategy reviewing	Subjects/tools/rules/ division of labour	Responsiveness		VMF
Evaluation and assessment of performance	Subjects/tools	Affirmation of practice		VMF
Addressing learning needs	Subject/rules	Differentiation of decision rules	DR	FF
Farmlet linkages with industry	Subjects / mediating tools / community	Learning relationships constraints	R👎	FF
Information / content conveyed from the farmlets	Subjects/community/ tools	Information gate keeper	GK	FF

Rules

Building relationships between activity systems	Rules / subjects / division of labour	Relationship enabler	R👍	FF
Points in time where linkages occurred between activity systems	Rules/community/ subject	Learning relationship momentum	RM	FF
Interaction with the Board	Rules/subject/ division of labour	Formal relationships	Fr	MRF
Information requirements/format	Rules/mediating tools	Information transparency	It	MRF
Local learning needs and farmlet responsiveness/focus	Rules/community/ mediating tools	Regionality of learning	R	MRF
Criteria that makes or breaks negotiations for a new farmlet project	Rules / Division of labour, rules	Deal breakers	DB	ERDS

Community

Linking with farming community	Community/subjects/ tools	Learning relationship - industry	LRI	VMF
Engagement of farming community	Community / Mediating tools / rules	Informal learning relationships	Ir	MRF

APPENDIX 4. DairyMod Case study

Negotiating the role of modelling for Australian dairy farming systems research, development and learning (FSRD&L) projects

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Abstract

Modelling brings a holistic approach to the study of farming systems by focussing on the interactions between system components. Models can be used as research tools that push the boundaries of research questioning and increase understanding of the behaviour of the system.

A biophysical dairy systems model called DairyMod is currently being integrated into Australian dairy farming systems RD&L projects (principally farmlet experiments) for these purposes. A negotiated process is being used to refine the model and its utility. A series of workshops have been conducted with project team members, to instigate the learning process of using the model and to define where the utility lies for each individual farmlet project.

This paper presents the findings of research that tracked the learning process associated with integrating the model with the farmlet experiments. Semi-structured interviews and participant observation techniques were used to gather data on; issues relating to what players were looking for in the model; the learning process that was necessary for enabling user competency and determining utility of the model for farming systems RD&L projects; the role of a national project in coordinating this process; and how the learning from the model development team has been extended onto the end users.

Integrating the use of the model within the projects enhanced the systems understanding of the researchers and extension workers. The complexity of the model challenged the

knowledge systems (science/extension) of the team members by revealing the depth of information behind the numerous parameters and decision rules required to manage the system. People were challenged to move outside their own knowledge 'comfort zone' in order to fully exploit the utility of the model. This process resulted in building greater knowledge and understanding about the farming systems experiments and their outcomes, with greater systems questioning than what would have been possible without the use of the model.

Introduction

Australian dairy industry and the challenge for farming systems RD&E

The dairy sector is one of Australia's leading rural industries, with an annual farm gate value of approximately AUD$3.7 billion (ADC, 2002). The production system is predominantly based on the use of improved pastures, although supplementary feeding with cereal grain or other supplements is common. The sector is a cost-effective producer of high quality milk, with Australian dairy farmers constantly increasing on-farm productivity through improved pasture, feed and herd management techniques (ADC, 2002). Productivity, measured as litres of milk produced per grazed hectare has increased by 31% from 1991 – 1998 (Riley, 1999).

Australian dairy farming systems are in a continual process of intensification. Australian farms have generally become larger and more efficient in response to competitive pressures. Farm numbers have rationalised from 22000 in 1980 to just over 11000 currently, average herd size increased from 80 cows, to an estimated 215 over the same period, and milk production has steadily increased, with an average annual yield per cow increase from 2850 to 4760 litres over the last two decades (ADC, 2002).

Across Australia, each dairying region has put in place a strategic plan that identify production increases, providing additional pressure. The push to increase dairy production capacity across Australia is clear from these statements:

"the dairy industry aims to double production by 2010 to 800 million litres"
Department of Agriculture, Western Australia (2002)

"growing the dairy industry to 1.5 billion litres (from 700 million) annually by 2010 – achieving the highest added value per litre of milk in the Australasian region – and earning $1 billion."
Dairy Industry Development Board, South Australia (2002)

For the dairy industry to respond to the challenge, the increases in production will need to be married with innovation and learning. Dairy farming systems will need to be pushed to the boundaries of resource capacity and efficiency and farmers will be required to take greater risks. Within this journey, is the complexity of making a profit while maintaining the environment and the social well being of players. This is a collective challenge, which will require a collaborative effort between farmers, researchers and extension workers to ensure the journey to doubling production is as successful and efficient as possible. The next section outlines how Australian dairy farming systems research and extension has been arranged in response to this challenge.

Rising to the challenge: Dairy Farming systems RD&E

To date, Australian dairy farming systems RD&E has generally been undertaken on a state-by-state basis, often within a farmlet study context (although this is just one experimental approach for farming systems RD&E). Farmlet projects, as they are colloquially known, are traditionally led by the project leader (also known as the farmlet leader), together with a team of scientists, often extension practioners, technical staff and farm workers. These projects usually have a consultative or reference committee who provide guidance, technical advice, and an industry perspective to the project.

A series of nationally-coordinated technical, environmental and extension research projects have been initiated to build on regional and state achievements (DRDC 2001). Agreement by independent state agencies to contribute to the national project depends in part on the benefits or value the project can create for that state or region. The process of coordination for farming systems RD&E, including farmlet projects, is being led by the National Dairy Farming Systems (NDFS) project. This project was created in response to recognition by project stakeholders that the opportunity for coordination needed to be captured and developed.

The seven current farmlet projects (corresponding with the major dairy regions) are at various stages of development and have differing aims and objectives. This provides both opportunities and challenges for national coordination. Opportunities include:

- sharing of experience and data to learn from others;
- sharing resources (particularly extension materials) to minimise development costs;
- questioning and investigating *'triple bottom line'* issues at a different level;
- an ability to develop comprehensive exchanges with the New Zealand dairy sector; and,
- a capacity to coordinate dairy sector responses to national directives.

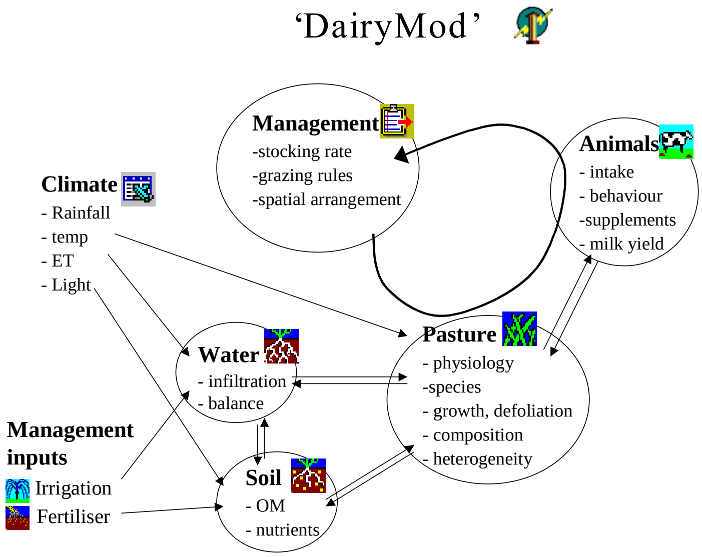
Modelling has been proposed to play a more significant role in future dairy farming systems RD&E. The opportunities include improving learning processes and capacity for farming systems RD&E, assistance with design, implementation and analysis of farming systems projects, improving the cost-effectiveness of systems experiments and enhancing the predictive capacity and utility of research results (Crawford et al. 2003, *this conference*). Modelling brings a holistic approach to the study of farming systems by focussing on the interactions between system components. Models can be used as research tools to push the boundaries of research questioning and increase understanding of the behaviour of the system. Wilson and Morren (1990:75) state that models are used to amplify the human process of learning and, in the context of systems thinking and practice, have four practical uses:

i) to communicate complex interrelationships
ii) to communicator concepts about the meaning of something
iii) as a novel construct for the search for new insights about how a system might be, might work, or might behave
iv) as a test bed or simulation for the evaluation of alternative strategies

This utility of models in farming systems research provides some indication of different roles it might play for a research project. However, these are generic applications and do not necessarily provide a detailed insight as to other roles that modelling may provide in particular contextual settings such as dairy farming systems RD&L projects.

The development of the National Dairy Farming Systems has occurred concurrently with the development of a new model for dairy farming systems called DairyMod. Phase 2 of the model development (Johnson et al. 2003, *this conference*), provided an opportunity to integrate the use of modelling into existing Farmlet projects. DairyMod was originally developed as a model that could be used to explore the principles of grazing management as applied to dairy pastures (Chapman et al., 2001). The researchers' aim was to develop a tool for research [22] that could be used to look at the effect of manipulating grazing management inputs such as stocking rate, pre- and post-grazing pasture mass, rotation length and level of subdivision on the amount of pasture consumed, and the interactions between these inputs and factors such as variation in climatic conditions and pasture species (ibid). The various dimensions of the model are demonstrated in Figure 1.

[22] It is important to note the purpose of the model was a tool for research and not as a decision support tool



Source: Chapman, et al (2001)

Figure 1. Overview of the structure of the dairy pasture system model 'DairyMod'. The icons alongside each component are used on the interface of the model to access parameters within that part of the model.

Positioning of this research

This research is part of a case study within a PhD project[23] that is studying learning processes in Australian dairy farming systems projects. The introduction of DairyMod into the dairy farming systems projects, or those using a farmlet[24] framework for their projects, was an exciting opportunity to study learning processes in such a context. Anecdotal evidence suggested that players within these project recognise that there is a role for modelling in farming systems RD&E projects, however exactly what that role is has yet to be clarified.

This research positions itself in four ways. Firstly, it is positioned as a case study for the PhD project mentioned and is a context for studying learning processes in Australian dairy farming systems projects. Secondly, it aims to assist the National Dairy Farming Systems team in terms of tracking and recording the outcomes of the learning process. Thirdly, it aims to assist the DairyMod team by following the learning outcomes from the introduction to the integration of their model into farming systems projects, at a different level to what is possible for the team themselves to achieve. And lastly, the farmlet project players

[23] The PhD is funded by the Dairy Research and Development Corporation and is titled "Farmlets as learning platforms for the Australian dairy industry".

[24] A farmlet is a research method used in Australian dairy farming systems projects to study production system issues. A farmlet is a small grazing unit that simulates production conditions on commercial dairy farms.

themselves, whereby this research aims to help clarify the role of modelling for their projects, through following the negotiation process that they were all involved in.

Method

A systematic approach to this research was used. This included building relationships with all the teams and players, participating in workshops, interviewing key players, developing a method for tracking the learning processes, and collection of any relevant secondary data that was an outcome for any of the teams involved. The way each of these steps to the project was conducted is outlined in more detail below.

1. Building a relationship with all the players and teams

The first stage was to develop a relationship with the DairyMod team to ensure that they could see the benefit of this research to their work and so were comfortable to allow the researcher to participate and observe events. This required discussions with the DairyMod chief investigator and the NDFS extension leader at the early stages of the each project's commencement. Benefits to participation were to be reciprocal, in terms of the researcher generating data for studying learning processes and the role of modelling, while both the NDFS project and the DairyMod project benefited through having detailed records kept of events, and a person to contribute to evaluating the role of modelling for farmlet projects. The next stage was to determine an appropriate process for tracking and recording the learning and negotiation process for integrating DairyMod into the farmlet projects.

2. Process for tracking and recording

The process employed involved using three techniques for data capturing. These were participant observation at relevant events; semi-structured interviews with farmlet stakeholders; and collection of any relevant reports associated with the integration of DairyMod into the farmlet projects. The techniques used are outlined below.

Participant observation opportunities – meetings and workshops

The researcher attended all meetings that brought together the NDFS project team, the DairyMod team and farmlet project researchers. The purpose of this technique was to generate data in situ and in real time rather than getting a retrospective account from a stakeholder involved. The benefit of being involved in the workshops was to capture the collective learning processes in the group setting. It also enabled independent observation of the integration process. At each meeting, the researcher would take detailed notes using the following framework as a guide for recording:

- How are the NDFS team and DairyMod teams representing the model?

- How are the farmlet teams receiving the model?
- What is the learning process being used for integrating the model into farmlets?
- What are the roles each stakeholder is playing in the learning processes?
- How do the farmlet stakeholders go about learning how to use the model – what are they looking for from the model?
- What difference is DairyMod making in terms of how the farmlet stakeholders conduct their work?

Interviews with key end users of DairyMod

A two staged interview process was used as a way of tracking on an individual basis, the learning processes that farmlet stakeholders went through to determine the utility of DairyMod for their purposes. Interviews were conducted with eight farmlet scientists who had already been introduced to the model. The key questions used to guide the semi-structured interviews can be seen in Table 2. The first stage interviews aimed to generate background information on perceptions of modelling, use of models in general, and anticipated use of DairyMod. The second stage of the interview process aimed to establish any changes that had occurred as a result of further training and interaction with others at a workshop.

Table 1. Summary of interview process used at stages one and two of the research

Stage 1. Interviews	**Stage 2. Interviews**
1. What did you considered a model as being and how have you used models in the past? 2. After the last workshop in 2001, what was your intended use for DairyMod? 3. Did you take it back to their farmlet project and use it? Why/why not? 4. What did you use DairyMod for? (How did it add value to what you do) 5. What were the key problems or decisions that were supported by the model? 6. Were you able to do what you wanted to with DairyMod? Why/why not? 7. Have you linked with any other farmlet projects using DairyMod? 8. Did you require any support after the workshop for using the model? If so what kind of support? Profile of user 9. What is your current role? 10. How many years have you been involved with research/extension? 11. What is your age approx? (optional)	1. What did you learn at the workshop? 2. How often have you used DairyMod since the workshop? What have you been doing with it? 3. Are you confident with using the model since the workshop? 4. Since the workshop, what do you consider to be the role of DairyMod in your work? 5. What kind of support do you require now with using DairyMod? 6. Have you had any discussions with other farmlet projects about DairyMod use?

i. Collection of secondary data

All relevant reports were collected over the duration of the project. Key documents included milestone reports from the NDFS project and the DairyMod project, and emails that were exchanged.

ii. Analysis of the data

All data was analysed using QSR's NVivo™ Version 1.3 (Richards, 2002) Qualitative data analysis software. The analysis of the data consisted of using constant comparative methods and coding. The coding process used was a two step process; firstly using descriptive coding and; secondly thematic analysis, where emergent themes became the points for discussion.

Results

The results from all activities are summarised here to provide the focus for a discussion on the role of modelling in dairy farming systems RD&L projects. A brief overview of the process used to negotiate the integration of DairyMod is presented initially and then the concepts that emerged from the interview process that highlighted the role of modelling for dairy farming systems projects, as viewed by the farmlet teams after the most recent DairyMod activity.

i) Process for negotiation

The results of the process for negotiating the role and utility of DairyMod is presented below in terms of the key events that were conducted. The purpose and outcomes of each event are provided in a timeline, along with a scale of when each stakeholder (DairyMod team, NDFS team and farmlet teams) learning process began and continued throughout the negotiation process. The focus for learning is highlighted along the scale.

From the results (next section), it can be seen that a series of meetings and workshops were used as the platform for negotiating a role in the dairy farming systems projects. There were three teams involved in the negotiation process, all with different learning requirements and expectations: firstly for the DairyMod team, the utility of the model was yet to be determined and a process of model refinement with the end users was required; secondly, the National Dairy Farming Systems team needed to identify opportunities for coordinating farmlet outputs, but clarification of what this would mean was yet to be determined; and thirdly, farmlet teams all have some knowledge of the role that modelling can play for farming systems work, however this role is not clear.

Much of the learning in terms of model development remained with the DairyMod team up until the completion of the first phase of their project. With the establishment of the National Dairy Farming Systems project came an opportunity for the utility of the model to be explored. And so the negotiation process commenced through both projects recognising the opportunity. This began through an initial meeting, where the two projects met to compare objectives and desired outcomes from projects. This was an ideal opportunity for mutually beneficial outcomes to be achieved. For DairyMod, the time had come for the model to be utilised by others beyond the immediate project team and for the NDFS project, DairyMod provided a tool that could be implemented nationally across farmlet projects to improve research outcomes and capacity for farming systems RD&L. It was an ideal common linkage point for coordinating outputs from the projects and an area for generating cross site dialogue.

The farmlet teams were introduced to DairyMod after the model was largely developed, and the NDFS project recognised the opportunity for the tool to have utility in dairy farming systems projects. The first exposure to the model was through a presentation by the DairyMod team, which provided farmlet teams with an introductory overview, and an opportunity to generate their first ideas for model utility.

Timeline of events – negotiation and learning processes

April, 1999

First DairyMod project commences.

DairyMod model development begins. A multidisciplinary team of dairy farming systems specialists and a professional model developer come together with the aim of creating a model that could be used to explore the principles of grazing management as applied to dairy pastures.

April, 2001

Dairy farming systems project and DairyMod team come together to explore the opportunities for the two projects to work together. Negotiation process for model integration begins. The process is initiated by both teams introducing their projects objectives and opportunities for project integration with the farmlets identified. The model is presented at this stage as a research tool.

June, 2001

First DairyMod project completed – model up and running. The model is at a stage where it needs to be used beyond the project team to indicate utility and ensure relevance, whilst also value-adding to existing farming systems projects. The first National Dairy Farming Systems workshop is held– DairyMod presented as a possible tool for farmlets. All stakeholders are now in the negotiation process and are all learning about DairyMod and its capabilities.

October, 2001

First workshop with farmlet stakeholders to introduce the model and begin determining the role it might play for their projects. Farmlets have the opportunity to use the model and begin working with farmlet data. DairyMod team provides support and obtains feedback on further requirements of the model.

June, 2002

Second National Dairy Farming Systems workshop – DairyMod developments presented. DairyMod team presents to the farmlets how the model has been amended in response to feedback from the researchers.

September, 2002

Stage 1 interviews conducted with farmlet participants

October, 2002

Second DairyMod workshop with farmlet stakeholders, specialist groups for animals and pastures developed. Farmlet teams that are interested in using the model participate in the workshop and can run simulations.

December, 2002

Meeting with the Mutdapilly Research farm team as a case study to assist with implementing DairyMod into their

Learning objectives for stakeholders

DairyMod team	NDFS team	Farmlet
Learning process begins for DairyMod team in terms of model building requirements	No exposure to DairyMod at this stage as the NDFS project is in development phase	No exposure to DairyMod. Modelling tools are being used in some farmlet projects
Building almost complete. Team now looking for utility of the model. And areas to transfer their learning. Opportunity	NDFS project looking for opportunities for national coordination & modelling and DairyMod explored.	No exposure to DairyMod. Modelling being used in some farmlets
Model utility and refinement stage. Basic model capabilities presented to the teams	Workshop used as a platform for launching the opportunity of DairyMod	Farmlets teams first introduction to DairyMod. Agreement to explore at another
Learning for DairyMod team remains largely in the area for refining the model	Learning for NDFS team is how the model can be used to link farming systems	Learning begins on how to use the model, utility requirements and where it
Model refinement process continues. Support to teams	Linkage opportunities being sought with individual farmlet	Limited use of DairyMod though interest regenerated at the
Model refinement continues, using expert specialist	Assessing key modelling capacity in farmlets	Learning is in terms of gaining confidence in model output
Specific integration requirements	An example for other projects	Full utility of DairyMod explored

project. What role was DairyMod going to play for this project

ii) Model utility – the roles it can play for farming systems research

It was apparent that the role of the model for the DairyMod team and the NDFS team lay in the area of model development and having a tool as part of the alignment coordination of farmlet activities. However, for the farmlet teams the role was not as apparent. The two stage interview process was used to follow changes that occurred as a result of their interaction with DairyMod. Table 2 demonstrates part of the results from these interviews.

In the first instance, the term models and the meaning they attribute to it was explored. There was considerable variation with perceptions, ranging from basic Excel spreadsheets that used simple equations (where some considered to be models whereas others didn't), to complex systems models based on hundreds of algorithms and equations.

Participants were also asked to discuss the models they have used in their current work. There was much variation between farmlet players as to the types of models used, and how often a model was used. Both these points highlight the lack of consistency with which models are viewed in terms of their meaning, their value and their utility for regular use.

After farmlet teams had participated in a number of DairyMod activities, the second stage of interviews was carried out. This stage revealed the teams' use of the DairyMod, the frequency of use and the roles that they now perceived the model as having in their work. Participants were asked to rank the following used of models in terms of 1) this would be a primary role of DairyMod for their work, 2) this would be a secondary role for DairyMod in their work, and 3) DairyMod would not be used for this purpose. The list was derived from the preliminary interviews with participants and also reviewing the literature.

The shaded areas indicate the key roles that the farmlet teams view DairyMod as playing for their work. This demonstrates that at this point in time, with the level of exposure they have had to the model, it is seen as primarily a tool for exploration of possibilities within the dairy farming systems context and also the implications of change. The pasture component in the context of the whole dairy farming system was also seen to be of primary use.

	Participants							
Roles for modelling in dairy farming systems RD&L projects	**P. 1**	**P. 2**	**P. 3**	**P. 4**	**P. 5**	**P. 6**	**P. 7**	**Total (mean)**
Determining knowledge gaps	2	2	1	1	1	2	2	1.4
Prediction of practice change outcomes	1	2	2-3	1	1	1	1	1.2
Estimate animal nutrition requirements	2	3	2	3	2	2	2	2.2
Estimate pasture growth	1	1	1	1	2	1	1-2	1.2
Explore the impact of different treatments/interactions on the system	1	1-2	1	1	1	1	1	1
Develop management strategies	3	2	1-2	2	1	1	1	1.6
Measure parts of the system hard to get measurements on e.g. nutrient flows	1	3	1	2	1	2	2	1.9
Developing Decision Support Systems	1	2	1-2	3	1	3	2	1.9
Analysing/interpreting data	3	3	1-2	1	1	2	2	1.9
Asking/answering more questions within an existing project	2	2	2	1	1	1	2	1.5
Developing new decision rules	2	3	2	3	2	2	2	2.5
Developing/assisting new research projects	2	1	1-2	2	1	2	2	1.6
Confirmation/reassurance of what you are doing	1	2	1-2	2	2	1	2	1.6
Developing other models	1	2	3	3	3	3	3	2.5
Using it as a systems thinking tool	2	1	1-2	1	1	2	1	1.2

Table 2. The role of DairyMod in Australian dairy farming systems RD&L projects

Discussion

i) Impact on stakeholder learning

Each of the three stakeholders had different learning objectives, which lead to different learning outcomes. The approach to initial model development and utilisation was a linear process, comparable to the top down transfer of technology approach used for some research and extension projects today. The implications of this for learning processes has meant that much of the learning that was achieved through the developmental phase of the model, remained largely with the model development team. The full range of possibilities for the model utility were explored at the end of the project rather than at the beginning.

However, significant learning opportunities and processes commenced with the two project teams converging to take the utility of DairyMod out to researchers of dairy farmlets. Transferring the learning from the development team to the farmlet teams was facilitated by the platform created by the NDFS project. The synergistic outcome of the relationship meant the role of the model was beyond just creating a tool for systems exploration and prediction. It was also a tool for aligning farmlet project activities and dialogue.

The learning for farmlet teams in the model integration process, occurred largely through questioning and comparing model outputs to what is already known to be true[25] in the users existing knowledge base. The learning process used to generate understanding of how to 'drive' the model, began with gaining confidence in the model parameters and outputs. Confidence is the term used by modellers themselves as opposed to using words such as model 'validation'. The farmlet teams began to model their own farmlet system and get a close match to measurements and results that have been achieved in the farming systems experiments. This process of comparison of model outputs to what is known is an interesting process, when considering that the role of the model is not about seeking truth, it is about questioning and exploring interactions in the farming system.

The model provides a learning process for discovering more indepth understanding of the systems concept. Use of the systems based model tends to encourage individuals to becoming multidisciplinary in their knowledge and thinking. The many parameters of DairyMod require a high level of expertise on a scientific level, and using the model highlights for individuals their own learning requirements of the system, beyond their own specialisation. Where there is a multidisciplinary team, the model creates a further purpose and opportunity for working together.

The negotiation process for farmlet teams highlighted different factors necessary for learning and model implementation to be achieved. These were: getting to a stage where farmlet teams developed confidence in the model; a user friendly model interface; assistance and support to deal with the high level of complexity that the model entails (beyond just a help menu); and a multidisciplinary team approach.

[25] This issue raises a debate on the philosophical debate of what is truth? This discussion, however, is beyond the aims of this paper.

ii) Impact of model use on farming systems approaches

The level of impact that the implementation of DairyMod into the farmlet project teams has had on the operationalisation of dairy farming systems project has been a moderately high, relative to current use of models in general.

A number of factors need to be taken into account which affect the impact of the integration process. The interviews revealed that the majority of teams were only using the model at DairyMod activities and had only allocated small blocks of time in their normal work to use DairyMod. Some had used the model since to continue trying to get their farmlet simulations up and running, whereas others had not used it at all. Reasons for this were due to time constraints and teams were unable to do work that was beyond what their current projects required. DairyMod activity was seen as an extra task as opposed to being integrated into their current work.

This was the case with most of the teams that did not have a modelling component to their projects. For the farmlet project that does have modelling written into it, DairyMod was embraced and a concerted effort was made to continue learning about the model and integrating it into the project. This highlights that modelling in most farmlet projects was not a priority and as such, meant the culture for using models was secondary (hence the original research focus “we know there is a role for modelling, we’re just not sure what it is).

The complexity of DairyMod gives it the requirement that for new operators, time is necessary to work with the model. This means that further training may be required for the project teams. The complexity of DairyMod also means that users tend to need a specific question/scenario to run through. So a clear purpose is needed for teams to have the intent to use the model. It is not a matter of just sitting down and playing around with the model for an hour, you need a couple of days to work with it. When running a simulation, questions are the result: why is this happening? Time is required for analysing this. This is why time was used as a barrier to farmlet teams using the model in between workshops. Despite this, farmlet teams value DairyMod as a useful tool and all have intention to use it in their future work.

The resource demands for using DairyMod are considerable, more than just learning to drive the model. This is amplified due to the systems knowledge requirement, and when an individual (who is usually an expert in a component of the system, not the entire system), rather than a team is trying to use the model and integrate it into an already full research agenda. This is made considerably more difficult through the process of model refinement and infrequent use, which requires a certain amount of ‘refamiliarisation’ of the model by the model user. In an ideal world where resources were not a limitation, specialist teams who work specifically with the model would have the capacity to cope with this.

The farmlet teams perceptions of the different roles DairyMod could play in their work provided insight into whether the utility of the model is seen as widely versatile or required only for specific use. From the first stage if the interview process, farmlet teams were viewing the model as being primarily a research tool for their own area of expertise (e.g. pasture agronomy, or nutrient flows), and not beyond this utility. This may be due to the stage they are in the research cycle, where modelling is not a priority. It could also be because the farmlet teams are still ‘finding their feet’ with how to use the model. By the second stage interview, there was some change in the farmlet teams perception of the role that modelling could play within farmlet projects. With more interaction (with the model and other teams using it) and further opportunities for familiarisation with the model, came more ideas of how the model might be used. It is the reinforcement, re familiarisation and interaction with other farmlet teams the enables the emergence of further utility of the model.

It is in the longer term that impact of the model should really be assessed. The process of integration of the model is still in progress, with the NDFS and DairyMod teams still conducting training activities for the farmlet teams. With the development of new projects, and the use of modelling incorporated into new, overall research strategies, the impact of implementing DairyMod will be seen to be much higher. A significant impact in the perception of models and the vast potential that DairyMod is seen as having by all the teams, demonstrates a significant paradigm shift in terms of the way the farmlet teams will embrace modelling in the future.

Conclusion

This paper began by highlighting the challenges faced by the Australian dairy industry and how dairy RD&E has been rearranged to assist in coping with the challenges the industry faces. The NDFS project developed a number of strategies for extending the learning outcomes from farmlet projects, one of those being the implementation of DairyMod across farming systems projects. This represented an opportunity to study learning processes and the role of modelling for dairy farming systems RD&L projects. Through tracking this process, it can be concluded that the role of modelling in these projects is multifaceted, in that the stakeholders involved in the integration process all have a number of roles for it. The learning process involved with negotiating the role of DairyMod revealed that the roles is multifunctional, at different levels of the research continuum: from the model developers

(DairyMod team) where the model was the interface as they developed and modelled a high level dairy grazing system; to the platform for extending its utility (NDFS project), where the model was to be used as a linkage point for farmlet teams: to the end users (farmlet teams), where the model was seen as a tool for questioning, exploration and prediction of system changes. For the farmlet teams, factors which influence the role of the model were time, clear purpose for use, the multidisciplinary knowledge requirement and the perceived role within their own work. The full impacts of the model integration will be seen in the next round of project development, where there is an opportunity to integrate the model more fully into projects, and to also explore other areas where the model has further utility.

Finally, in terms of this research process, it can be concluded that the learning benefits from the integration of DairyMod into farming systems RD&L projects is proportional to the level of questioning given to the integration process itself. An embedded social research process such as this contributes to questioning of the process, resulting in the creation of more knowledge and contributes to the developmental process so that learning outcomes go well beyond the immediate learning objectives.

After this paper was presented, further one to one meetings with the farmlet teams occurred with the model development team, which meant that the negotiation process required a significant learning relationship to be built between the modellers and the model users – this required the platform for learning that the NDFS project provided.

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