LEARNING TO LEARN WITH FARMERS

A case study of
an adult learning extension project
conducted in Queensland, Australia
1990 - 1995

N.A. (Gus) Hamilton

Propositions

The training of team members in social science skills such as interviewing technique and active listening was one of the keys to the quality of information that emerged. *(This thesis).*

Balancing the status (power) between departmental staff and participants in participatory action learning activities improves the effectiveness and efficiency of learning by all participants. *(This thesis).*

Facilitation is the emergent key role for scientists in participatory learning and action research. *(This thesis).*

Understanding of participatory learning and action research (PLAR) approaches by other scientists will be more effectively achieved through PLAR than Transfer of Technology. *(This thesis).*

Constructivist approaches mean the outcomes are unknown and unknowable until they are arrived at. *(This thesis).*

PLAR is more effective and more efficient that Transfer of Technology processes in dealing with complex problem situations such as sustainability. *(This thesis).*

To a smoking, drinking, unfit, over forty Australian, who seldom rides a bike, the Netherlands is not flat. *(From experience of living in the Netherlands).*

The most valuable scientific papers are the ones you have lent someone and they haven't returned. *(Reflection on undertaking this PhD).*

The investment by QDPI in educating a small number of staff at Wageningen Agricultural University has reaped substantial benefits. *(Reflection on experience of returning to Australia from the Netherlands).*

That Dutch children are proficient in English is applaudable, but that they speak it with an American accent is less admirable. *(From experience of living in the Netherlands).*

Dutch agriculture may have a manure problem, but Dutch sidewalks have an equal problem. *(From experience of living in the Netherlands).*

Things always take longer than they take. *(Reflection on writing this thesis).*

N.A. (Gus) Hamilton

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A case study of an adult learning extension project conducted in Queensland, Australia 1990 - 1995

Promotor dr Niels G. Röling, bijzonder hoogleraar m.b.t. landbouwkennissystemen in ontwikkelingslanden

N.A. (Gus) Hamilton

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Quotes from interviewees and from personal interactions are also in *italics*, but are not acknowledged. This is to preserve the guarantee of anonymity given to respondents.

1 Aus $ is approximately equal to $ US 0.75 is approximately equal to Dfl 1.2 (1995).

Acknowledgments

This study is indebted to a wide range of colleagues and friends who have been involved in the research or have supported me while the research was being undertaken. Anyone involved in the research or reading this thesis will notice the obvious contribution of Niels Röling. He has been a major influence on my career and on me, personally. He has encouraged and supported me from afar. When we did manage to get together, he demonstrated the remarkable ability to grasp what I was attempting to do, apply his sharp mind to the situation and provide insightful comments and direction. His contribution was of immense benefit. Niels occasionally displays errors in judgement. On my recent visit to the Netherlands, he lent me his car. For a driver not used to driving on the right side of the road (for me that is the wrong side of the road), nor used to having bicycles coming from every direction, it was a brave act of faith. I thank him for his friendship and support.

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Special mention must be made of Paul Harris and John Gray for their enterprise in leading the *With and Without* and the *Making Better Decisions for your Property* activities. Their contributions to the two relevant case studies I have presented, are also gratefully acknowledged. Clive Knowles-Jackson was instrumental in many activities and particularly the Cover survey. Lew Markey, Tony Gietzel, Dave Lawrence and Scott Cawley led the way in our interactions with the Property Management Planning process and the activities that the VFSG developed to support it. Their contributions are also gratefully acknowledged. Particular mention is made of the efforts of Scott Cawley for his contribution to the development of the Rainfall Simulator case study.

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My wife, Penny, who became the project officer in the latter stages of the project was also a major contributor. She brought a woman's perspective to bear on our activities and enabled us to better interact with our non-traditional clients such as rural women. She led the

activities with the Dalby Agricultural College and the developing information products for bankers - *Is Cotton the Crop for Me*? Her contribution to the development of the associated case studies is gratefully acknowledged.

I have left our research component of the project until last. Dave Freebairn must have wondered at times what the hell he had got himself into. However, he epitomises the truly professional scientist by always adopting the attitude that it was better to find out than die wondering, and entered into the activities with an open mind and applied his remarkable skills and energy. He was also a power of support and strength when the going got tough and self-doubts began to creep in. He was innovative in his involvement in the Rainfall Simulator, *How Wet* and the *Fallow Management Game*. He proved to be a good mate and mentor.

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For the duration of the project, we have worked with an enthusiastic and knowledgable client group. They have also been instrumental in the success of the project and this research. They have been willing participants, game to try new approaches and contributing generously of their time and expertise. They have also suffered my research probings with good humour and provided insights that allowed me to develop a better understanding of what was happening from their viewpoint.

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The opportunity to complete a degree at the Wageningen Agricultural University was the result of the *SARAS* scheme, a far sighted program of the Queensland Department of Primary Industries that assists staff to undertake post graduate studies. My managers have been totally supportive of my undertaking this post-graduate study. In the early stages, John Childs was instrumental in allowing me to undertake a Msc degree which was the foundation this research was based upon. More recently, John Cutler, David Hamilton and Roly Nieper have gently pushed me and smoothed the way for me to return and complete this PhD. They have also supported me in the role and approach I took with this research. They may not always have agreed with what I was doing or with my interpretations but they always stoutly defended my right to do so.

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Glossary

AKIS	Agricultural Knowledge and Information System.
Andragogy	The art and science of helping adults learn.
APSRU	Agricultural Production Systems Research Unit. An integrated team of DPI and CSIRO researchers, DPI, Toowoomba.
BP Australia	A subsidiary of British Petroleum, a private enterprise petroleum company.
CFIC	Conservation Farmers Information Centre.
Constructivist approach	Adopts an ontological position that assumes reality is constructed by the individual, which is socially and experientially based - thus multiple constructions exist. Constructions are not more or less true, in any absolute sense, rather they are more or less informed and/or sophisticated. The epistemological basis assumes the researcher and the researched object are interactively linked.
CSIRO	Commonwealth Scientific and Industrial Research Organisation, an organisation devoted to basic and applied research, funded by the Commonwealth Government of Australia.
CU	Cattleman's' Union. A grower agri-political organisation representing the interests of Queensland cattle producers.
Double cropping	The practice of planting a crop shortly after the previous crop has been harvested. This means the fallow is usually less than three months duration.
Epistemology	The nature of the relationship between the knower or would be knower and what can be known.
Fallow	The period between harvest and planting of the next crop or pasture.
FGA	Focus Group Analysis.
Focus group	An interview conducted with a small group of people (usually four to eight).
Grainco	Grain marketing organisation in Queensland.
GRDC	Grains Research and Development Corporation funded by grower levies and Government subsidies.
Gully erosion	Gullies caused on cropping land by running water.

Landcare	Community based, local groups, comprising landholders and other stakeholders, with the main aim of undertaking more sustainable land and water management practices.
Ley pastures	The practice of resting cropping land under pastures.
Mechanical tillage	Preparation of the fallow with tillage implements.
Methodology	How the enquirer or "would be knower" goes about finding out whatever he/she believes can be known.
MEY	Maximum Economic Yield farmer discussion groups.
Minimum or reduced tillage	Certain tillage operations in the fallow are replaced with herbicides or sheep.
NLP	National Landcare Program (formerly NSCP).
NSCP	National Soil Conservation Program, funded by the Australian Government.
Ontology	Beliefs about the form and nature of reality.
Operational decisions	Operational decisions are *how to* type decisions. Their importance is immediate. They are usually relatively simple decisions and involve choosing between a range of well defined options. This supports strategic decision making. The choice of planting rate is an example of an operational decision.
Pedagogy	The art and science of teaching children.
PLAR	Participatory Learning and Action Research.
Positivist approach	Adopts an ontological position that assumes a concrete reality exists, which can be apprehended, and which is governed by 'immutable natural laws and mechanisms'. The epistemological basis assumes the researcher and the researched object are independent of each other.
QDPI	Queensland Department of Primary Industries, an organisation devoted to applied research, development and extension in primary industries, funded by the Queensland State Government.
QGGA	Queensland Grain Growers Association. A grower agri-political organisation representing the interests of grain producers.
Rapid Rural Appraisal	A series of personal interviews conducted by interviewers from a range of different backgrounds, to gain a relatively quick appreciation of a situation or problem.

RRA	A Rapid Rural Appraisal.
Reductionism	A prevailing logic of inquiry that rests on the premise that the sum of the parts equals the whole. One of the four basic premises of basic and applied science inquiry methodologies (the others are experimentation, refutation, and repeatability).
Relativism	The ontological position of constructivists that realities are apprehendable in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature, and dependent for their form and content on the individual persons or groups holding the constructions. Constructions are not more or less "true" in any absolute sense, but simply more or less informed and/or sophisticated.
Sheet erosion	The loss of topsoil from cropping paddocks through the action of rainfall and flood runoff, or wind.
Strategic decisions	Strategic decisions involve *whether to* type decisions. They involve whole farm planning rather than the individual components of the farm business. They are characterised by complexity and open-endedness. Strategic decisions have a longer term planning horizon. A rotation program required to manage a fertility restoration program is an example of a strategic decision.
Strip cropping	A method of soil erosion control. Strips of summer and winter crop are planted in alternating sequence, to ensure approximately half of the cropping land is protected from rainfall or flood runoff by a growing crop.
Stubble farming	The practice of maintaining crop stubble during the fallow to protect soil from erosion and improves infiltration of rainfall.
TAFE	Tertiary And Further Education colleges, funded by the Australian Government.
TOT	Transfer of Technology.
UGA	United Graziers Association. A grower agri-political organisation representing the interests of Queensland graziers.
VFSG	Viable Farming Systems Group. An integrated QDPI project team involving extension and research personnel in southern Queensland.
Zero tillage	Complete elimination of tillage in the fallow. Weeds are controlled by herbicides and/or sheep.

1. INTRODUCTION

This thesis explores the relationship between the use of participatory processes in the development and use of information and knowledge and their impact on change. The research is based on a major extension activity carried out in southern Queensland between 1991 and 1995. The objective of this extension activity was to facilitate change which would result in more sustainable farming systems through the development of more effective fallow management. The issue confronting the team that implemented this project was determining the most efficient and effective process of causing change to occur. The focus that emerged was on participatory processes and their impact on change.

While the project had precise start and completion dates which imply a beginning and an end, the project and this research were conducted in a situation that was already changing. The fallow management systems being addressed were changing prior to our involvement as a specific project. These fallow management systems will go on changing once we have moved onto other activities. Most of the officers working on the project were already involved in attempting to facilitate this change - this project integrated these efforts. Other actors (research and extension, public service and private enterprise, and our clients) were also involved in pursuing the same or similar missions before and during our activities - this project linked with these efforts.

1.1. FALLOW MANAGEMENT SYSTEMS IN DRYLAND AGRICULTURE IN SOUTHERN QUEENSLAND

Water is commonly the most limiting factor in dryland agriculture in Australia. Rainfall is unreliable and this coupled with high evaporative demand results in moisture stress during crop growth with subsequent reductions in yield. Few profitable crops result from growing on the basis of in-crop rainfall alone. In order to improve the water supply for crop growth, fallowing during the preceding season(s) is a tactic widely used. The combination of moisture stored prior to crop growth and in-crop rainfall improves crop yields and profits.

Fallowing is not a particularly efficient process. Research studies in southern Queensland (Littler & Marley, 1978, Freebairn & Wockner, 1986; Radford et al, 1991, Thompson & Freebairn, 1991) indicate that only 20 to 25% of incident rainfall occurring during a fallow is stored in the soil. The remainder is lost via evaporation (65 to 70%) and runoff (8 to 12%).

A key to enhancing moisture infiltration is the retention of stubble or vegetative cover which dissipates the energy of the raindrops before they hit the soil surface and prevents the soil surface from sealing and consequently reducing infiltration. Hence, manipulation of the soil surface through retention of stubble reduces the amount of runoff and increases soil moisture storage but has no significant effect on evaporation. These same studies (ibid.) have found that the impact of stubble on soil moisture storage and runoff is not significantly different until levels of stubble fall below 30% ground cover. Manipulating the soil surface configuration in the absence of stubble on the surface (rough tillage, pitting) has a similar but much reduced effect.

Fallow management systems are implemented by the use of mechanical cultivation, herbicides and livestock to remove weeds, either singly or in combination. Thus, fallow management systems are commonly categorised as zero tillage (use of herbicides or livestock only), reduced tillage (a combination of herbicides and/or livestock and mechanical tillage) and conventional tillage (use of mechanical tillage machinery only). Organic farming is seen as a sub-set of conventional tillage as only mechanical tillage is utilised, but it regarded differently from most conventional farming systems because of the different values at play when the choice amongst options for fallow management is made.

A consequence of these fallow treatments is the reduction of stubble present on the soil surface. Mechanical tillage reduces stubble levels more rapidly than herbicide treatments. Choice of the cultivating machine also determines the rate of stubble breakdown with soil inverting machinery such as disc or mouldboard plough being most destructive of stubble and soil non-inverting machines such as chisel and blade ploughs being least destructive of stubble.

Research into fallow management (Littler & Marley, 1978, Freebairn & Wockner, 1986, Radford et al, 1991, Thompson & Freebairn, 1991, Freebairn & Wockner, 1992) consistently finds that zero tillage fallow management systems store more moisture during the fallow when compared to reduced and conventional tillage fallow management systems, due to reduced runoff. This reduced runoff results in dramatically reduced soil erosion. The amount of soil erosion is correlated to the amount of stubble retained on the soil surface, and whether this stubble is anchored to the soil. Soil erosion is minimised under zero tillage as stubble levels remain high during the fallow and the stubble is anchored. Soil erosion is marginally more severe in reduced tillage and conventional tillage treatments provided adequate levels of stubble are retained and this stubble is anchored in soil clods. Once stubble levels in the reduced tillage and conventional tillage treatments fall below 30% surface cover, and this occurs concurrently with the loss of soil anchoring, the soil erosion levels climb rapidly.

However, yields are not significantly increased under zero tillage fallow management treatments compared with reduced tillage or conventional tillage fallow management systems, provided stubble levels are maintained above 30% surface cover. There is a significant positive yield response to zero tillage in drier than average fallows and a significant negative yield response to zero tillage in wetter than average fallows.

The fallow management systems in use in 1990 were causing stubble levels to fall below 30% surface cover. If the fallow management system was improved, benefits of increased yields and greatly reduced soil erosion were envisaged. These benefits were seen to most easily achieved by adoption of a zero fallow management tillage system.

To summarise, the purpose of fallow management is to improve the storage of moisture during the fallow period through reducing runoff and increasing moisture infiltration. Fallow management options currently available to farmers significantly differ from one another in their effect on soil moisture storage, runoff and consequently soil loss, but not on yield. If stubble levels are maintained above 30% surface cover, the effect of different fallow management options on soil loss is also less. Depending on the perspective, these systems have differing levels of impact on sustainability. The problem facing agriculture in southern Queensland was that many farmers were not maintaining stubble levels above 30% ground cover, thus neither optimising soil moisture storage, nor minimising soil loss.

1.2. A PROJECT TO ADDRESS THE PROBLEM

Over the past two decades, research and extension into fallow management has been fragmented. Within public sector research and extension, there was one discipline addressing the soil erosion issues while another discipline was addressing the production issue. At the same time, the private sector was addressing the problem area from similar directions. Farmers were faced with an array of advice and recommendations from these different perspectives. Sometimes this advice was in conflict with alternate advice, sometimes the advice complemented alternate advice.

In 1990, the Queensland Department of Primary Industries (QDPI) initiated a major project to address the problems of sustainability of fallow management systems. In 1991, the National Landcare Program (NLP) and the Queensland Department of Primary Industries funded the project. This project was to integrate the various efforts being made to reduce land degradation and improve productivity and aimed to promote more sustainable farming systems in the southern Queensland region of Australia.

The project was undertaken by a group of ten QDPI officers (see Appendix I) from research and extension, with differing technical expertise (field crops, soil science, soil conservation and economics). These officers were located in the major centres across the region. The formation and operation of this team could be considered to be unique in the QDPI as team approaches to extension were uncommon and a team with such diverse knowledge and skills was an exception. The team became known as the **Viable Farming Systems Group** (VFSG).

1.2.1. Linkages with other projects

The project was linked to several other projects that were also addressing problems associated with farming systems. These linkages in many cases were enhanced by members of the project team also being members of these other projects. In some cases, where concurrent membership did not exist, collaborative activities were performed. Alternatively, staff with skills required by the VFSG project team, from within the QDPI and the private sector, were co-opted to work on VFSG activities for short periods of time.

These major projects/groups included:

- The Agricultural Production Systems Research Unit (APSRU) - a joint project team with research officers from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the QDPI that was formed to generate computer models that would simulate

soil water balance, nutrient balance and the growth of the major crops of southern and central Queensland and northern New South Wales;

- Property Management Planning (PMP) - a QDPI support project for the Landcare movement that aimed to assist landholders to adopt a business planning approach to their whole property;
- Bridging the Business Gap, a QDPI project that aimed to improve the business management skills of landholders particularly through the use of computer packages for farm business accounting and management;
- Preventing land degradation in southern Queensland - a new initiative project for QDPI that (in part) utilised the findings of VFSG research to determine the position descriptions associated with this project;
- Research trials into fallow management - QDPI projects that were researching the effect of various fallow management treatments on the major soils of the south Queensland region; and,
- Conservation Farming Information Centre - (CFIC), a farmer and publicly funded, incorporated organisation that was promoting growing an increased number of crops to improve profits and reduce soil erosion.

1.3. Learning leads to a change in process

The project commenced intending to transfer the results of scientific research to farmers. The adoption of these technologies was believed to be the means to an end, that is, more sustainable farming systems. The failure to adopt these technologies were seen to be the result of unknown barriers to adoption within the farming community.

The project proposal provided for an initial market research phase that was intended to determine what the market segments were for this transfer of technology, what barriers to adoption existed in these segments, how these barriers might be overcome and how the technology might be modified and/or better marketed to these segments.

The market research produced unexpected results. Transfer of Technology was found to be an inappropriate concept. Systems thinking, Agricultural Knowledge and Information Systems and an actor oriented approach seemed more appropriate to the actual situation and the dynamic of change. Instead of focussing on the transfer of technologies and the barriers to adoption, the project evolved into a process of assisting farmers to learn about their problem situation and to explore options that might improve it.

The market research phase also identified a range of opportunities for the project team to interact with farmers and other actors. To enable these interactions to occur, the project team developed a range of activities. Some were more successful than others. This further required the project team members to develop new skills and adopt new roles in the process.

During the project, members of the project team changed their paradigm. This resulted from our interaction with a large number of actors from whom we learnt a great deal about the people we were dealing with, the problem situation they (and we) were dealing with, and how we might better assist them to improve it. Most importantly, we learnt a great deal about ourselves. This change reflects a movement from a positivist perspective to a constructivist perspective.

1.3.1. Tension in the Knowledge System

One of the most obvious effects of the change in perspective of the VFSG team members was expressed in our relationships with other actors in the knowledge system. By adopting the position that there were as many valid views on the problem situation as there were actors constructing these views, and that science had one view which we deemed no more (or less) valid than the views of other actors such a farmers, resulted in conflict between the team and (some) other scientists and QDPI management, but greater concord between the VFSG and our farmer clients. This conflict reflects the threat to their power that some scientists perceive when their view of science having a supreme and sole role in generating knowledge about "reality" is challenged. Not all scientists nor all managers were so threatened. Many were supportive. This conflict did force us to ensure that the processes we used and their underpinning methodologies and contextual frameworks were rigorous and capable of being subjected to scientific scrutiny. This, in itself, reinforced our view that the constructivist position that we had moved to was well founded.

1.3.2. A change in process leads to dramatic change in farmer practice

For the five years this project has been operational, the changes in the fallow management systems farmers are utilising have developed beyond all expectations. This project can be demonstrated to have had a significant impact in initiating this development. In 1990, a survey of south Queensland field crops extension staff (Anon, 1990) revealed that less than 30% of farmers had adopted more sustainable farming systems utilising zero or reduced tillage (see Figure 1).

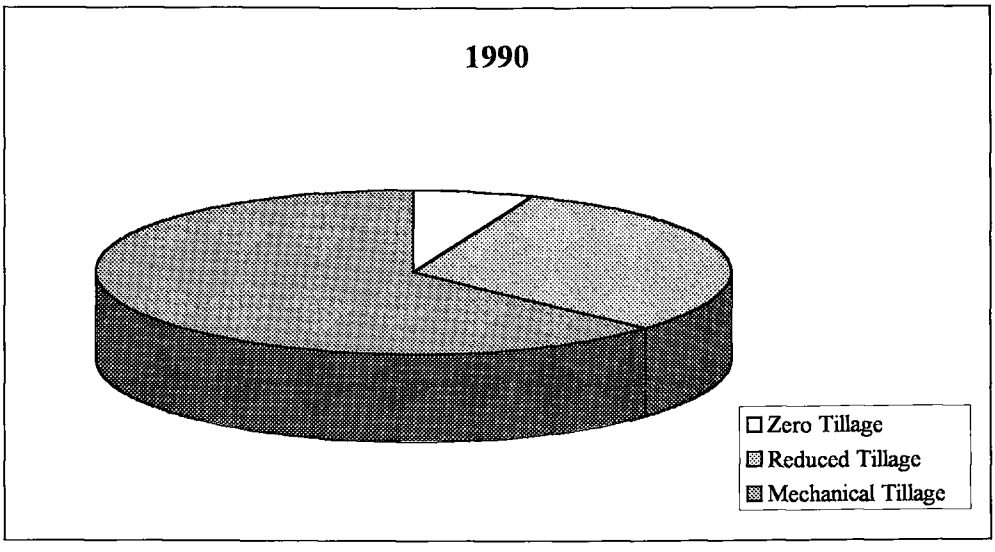


Figure 1 The relative numbers of landholders using various fallow management practices 1990
(Source: Anon, 1991, Field Crops Officers estimates, original NLP proposal)

By 1994, the intent to adopt an alternate fallow management system expressed by the farmers who had attended activities run by the VFSG demonstrate that the adoption of these more sustainable fallow management practices had risen to more than 75% (see Figure 2). These exit surveys captured the intentions of over 1600 hundred farmers (greater than 50% of the potential farmer target population) who had been involved in VFSG activities.

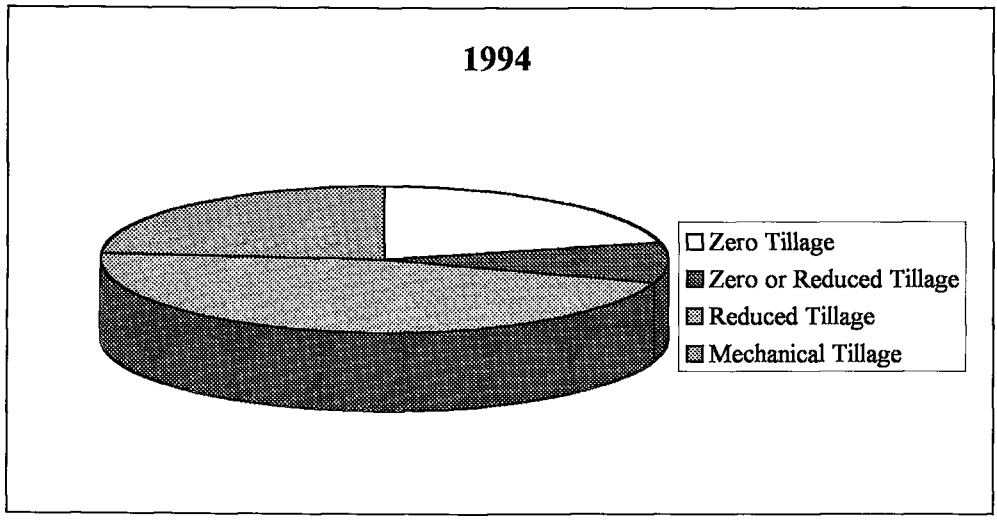


Figure 2: Relative number of farmers stated intention of using various fallow management practices - 1994
(Source: Cawley & Hamilton, 1995, Data from farmers' statements of intention - Exit surveys - VFSG activities 1991-4)

Of course, stated intention and actual implementation of practice are not the same. However, transect surveys of actual fallow management practices being utilised from 1991 to 1994 (see Figure 3), illustrate that the actual area under zero tillage shows high correspondence to the stated intention to adopt zero tillage (see Figure 2). These transect surveys are conducted by the members of the VFSG bi-annually - at the beginning and the end of the fallow period. They record the fallow management practices in use on some 1400 sites across the region. While it is not possible to accurately state the fallow management practice after one or more mechanical cultivations, as we are only recording if there has been no cultivation or if there has been cultivation (one or more), the levels of stubble remaining at the end of each fallow suggest that the proportion of reduced tillage has also dramatically risen.

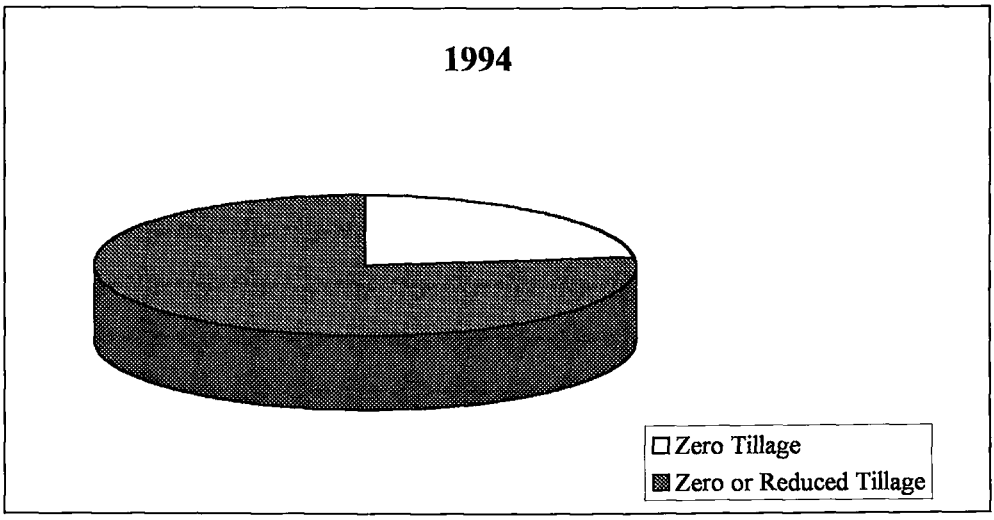


Figure 3: Relative number of farmers using various fallow management practices - 1994
(Source: Knowles-Jackson, 1995, Data from cover survey)

The question still remains - Is this change in fallow management practice related to VFSG activities? Population surveys conducted by the VFSG in 1995 indicate that more than 75% of farmers relate their change in fallow management practice to their involvement in a VFSG activity (Harris et al., 1995). A survey, independent of the VFSG, exploring the success of a QDPI/Grain industry project operating in the same region, found that more than 80% of farmers relate their change in fallow management practice to their involvement in a VFSG activity (Cahill et al, 1995) - an even more pleasing result and from an independent source.

This project was operational during the worst recorded drought on record. Comparisons of the change in fallow management between this region and neighbouring regions illustrate that this region has experienced the more rapid adoption of stubble retaining fallow management systems. Martin (pers. comm. 1994) suggested that southern Queensland was well in advance of northern New South Wales in adopting these practices, even though northern New South Wales had experienced average to above average seasons for most of the past five years. Similarly, Titmarsh (pers. comm. 1994) suggests central Queensland was well behind southern Queensland in adopting these practices although the two regions had experienced similar seasonal conditions over the past five years.

Many other groups and individuals were operating in the region at the same time as the VFSG and were pursuing similar objectives to the VFSG during this period. Their contribution to this change is acknowledged. However, from the evidence presented, it is reasonable to conclude that fallow management systems in southern Queensland have changed dramatically from 1990 to 1995 and that the activities of the VFSG have been a major force in this change process.

1.4. THE PURPOSE OF THIS STUDY

This thesis details research on successful participatory action learning operating in the real world. The purpose of this study is to better understand through participatory learning and action research two areas of discourse, and a series of questions related to each. The two areas are:

- What are the relationships between participatory processes and client decision making?
  - Who are the actors involved?
  - Who isn't involved and should be?
  - What is the nature of their interactions with each other?
  - How might these interactions be stimulated to perform better?
- What is the role of information in these processes?
  - What is the relationship between (a) meanings attributed to information, (b) information and (c) information use?
  - Can actors be stimulated to actively "create" information for themselves and is this preferable to them passively receiving information provided by somebody else?
  - What tools are suitable for stimulating information creation?
  - If information is created, is it useful to other? How useful is it? Can it be made more useful?

The purpose of the project upon which this research is based is different. The project endeavoured to:

- better understand the complex nature of
  - the farming systems of southern Queensland,
  - the interactions between decision makers and their farming system, and,
  - the interactions between change agents and clients;
- improve the interventions being applied; and,
- improve the results of these interventions, that is, more sustainable fallow management systems.

While the project purpose and my research purpose are different they are intimately and systemically linked. The pursuit of the project purpose generated the case studies that allowed the pursuit of the research purpose. The results of the research fed back into the project and modified its role and process.

2. RESEARCH METHODOLOGY AND APPROACH

2.1. THE EXTENSION ENVIRONMENT

2.1.1. Improving the effectiveness of extension - the debate in Australia

Agricultural extension in Australia during the past decade has been debating and reflecting upon its effectiveness. For example, Vanclay (1994:10), argued that in the Australian context, public extension, as well as facing a fiscal crisis, was facing an effectiveness crisis (*...extension practices are not working...farmers fail to adopt many recommended practices, particularly in the area of environmental management),* and a theoretical crisis (*...agencies have had to reject the traditional extensional model, but have no cohesive, coherent or widely accepted alternative*). Central to this debate was an examination of the paradigms in use, the underlying assumptions and principles these paradigms are built upon, and the attendant processes attached to the various paradigms. Historically, the QDPI has taken a Transfer of Technology approach. I shall examine this briefly, as framing the background to the reaction to what emerged in the VFSG project as a participatory learning and action research approach.

2.1.2. Improving the effectiveness of extension - the debate in QDPI

Since its beginnings over 100 years ago, the activities of the QDPI have been firmly within (and have been served well by) the Transfer of Technology paradigm. Over the last decade, the effectiveness of extension has been questioned and the existing extension methodology has been extensively reviewed. Until the mid eighties, these reviews have been to examine failures of the existing paradigm. In 1987, Niels Röling and Janice Jiggins reviewed the QDPI's extension service and for the first time the underlying paradigm was questioned (Röling and Jiggins, 1987).

This was a watershed event for many QDPI extension staff and QDPI management. It resulted in them beginning to explore alternate approaches to extension. From this key event can be traced the formation of extension science discussion groups such as the Systems Study Group (Van Beek, 1993), the review of QDPI extension policy (Wythes et al., 1990) and the development and introduction of a formal extension policy for QDPI (Coutts, 1994).

2.1.3. Contrasting approaches within QDPI

Bloome (1991) classified extension under four paradigms: technology transfer, problem solving, informal education and human development. Coutts (1994) briefly outlined these classifications as:

Technology Transfer. Extension is a means of pro-actively changing voluntary behaviour in the form of the adoption of new (externally developed, already available and tested) technology or management practice by providing information, opportunity, and persuasion. The assumption is that the scientists or experts have developed solutions to problems or new ways of doing things that, if adopted by farmers or "users", will improve farm output and living standards. The manner of achieving this change is mainly persuasive by nature, that is, convincing people of the value of adoption by use of extension material, presentations, demonstrations, discussion groups, etc.

Problem Solving. Extension is a reactive expert (advisory/consultancy) function which is a means of assisting individuals to find solutions to technological or management problems which arise and are inhibiting their desired unit performance. The adoption of a new technology/management practices (or the purchase of goods and services provided by the agency) are an indirect, though "inevitable" consequence of this process.

Education. Extension is a means of pro-active informal education which seeks to assist individuals to better understand their situation, and so enable them to make choices and take action to improve their situation. The assumption is that an adult education approach (action learning) both assists people to make better choices, and results in better choices being made.

Human Development. Extension is a means to facilitate and stimulate individuals and communities to take the initiative in problem definition and seeking solutions to individual and societal concerns/opportunities. The assumption is that given the opportunity and interactive framework, individuals and communities will and can best improve their situation. It encourages people to govern themselves.

When proposing these categories, Bloome (1991) saw these differing paradigms as complementary rather than in conflict - each relevant to different needs and situations. Van Beek and Coutts (1992) conceptualised this complementarity (see Figure 4) by using the level of (social) complexity to distinguish between appropriate extension categories, with the *style* of extension being regarded as forming a continuum from persuasive to facilitative (The persuasive/facilitate continuum could be thought of as bisecting the axes in Figure 4).

Van Beek and Coutts supported Bloome's assertion that it was not an "either/or" choice of paradigm, but rather that:

...the range of required people-oriented skills expands when the (public sector) department becomes involved in more complex situations with multiple perspectives and goals....it is not a matter of substituting skills in technology transfer by people skills....more complex situations required both: more technology transfer from disciplines and sciences and more education and human development. The full range of intellectual skills and tools must be present in the Knowledge System as a whole, if effective development is to take place.

However not all need to reside within (the public sector organisation), provided they can work together. (Van Beek & Coutts, 1992:4).

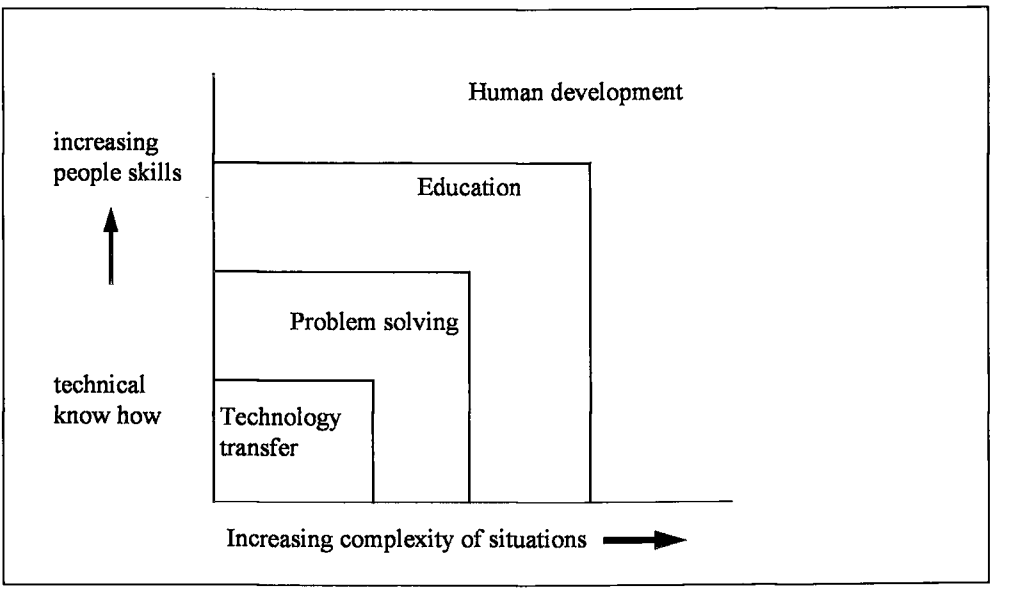


Figure 4 Complementarity of differing extension paradigms
Source: Van Beek & Coutts (1992).

As the internal debate within the QDPI progressed, a growing understanding emerged of where what paradigm(s) is/(are) effective and where what paradigm(s) may be effective in the future. It became increasingly obvious that exploration of the options would be a continuing process and that the outputs of the debate could not and should not be used prescriptively. Rather the understanding gained should be used to purposefully make decisions about what is appropriate for each individual (unique) situation.

2.1.4. TOT as the dominant paradigm within QDPI

Nonetheless, TOT has remained the dominant paradigm. Its characteristics and the processes used are well documented by Rogers (1983) and Röling (1988).

Briefly, under a transfer of technology paradigm, the role of "discovering" and developing innovations is assumed to be mainly the province of research. Extension transfers these innovations, usually to the so called "innovative" farmers and these innovations diffuse to the remainder of the farming population. Farmers are assumed to make a simple, rational decision - whether to adopt or not. The process is linear and may be one-way, or two-way with research receiving feedback from innovative farmers and extension. Farmers who are late adopters are regarded as laggards and farmers who "fail" to adopt were regarded as being irrational in their decision making.

Engel and van den Bor (1995) regard this approach as having negative consequences. It positions farmers as passive receivers of technological developments and of the goods and services developed by others. This results in the failure adequately to value the *innovative strength and dynamism inherent in farming itself.* Engel and van den Bor (1995) further state that this paradigm *led us to believe that extension and education are institutions which merely channel knowledge without adding new value to it.*

The focus of research and extension under the TOT paradigm is on the relationships between technical variables of the biological system. The human elements of creativity, experimentation and autonomy are excluded or ignored. In the main, TOT also excludes the additional relationships that occur when economic and social variables and their interactions are considered. The approach used under this paradigm is to focus on the component parts of farm systems and ecologies. The sum of these parts are regarded as being representative of reality. This has been characterised as being reductionist in nature.

In some parts of the QDPI, there remains a belief that innovations are adopted in a set sequence within the TOT paradigm. Obviously there is some truth in this belief as some innovations are dependent upon earlier innovations. Thus an improved pasture cannot be planted unless the existing vegetation is modified through timber clearing and ploughing to remove native pasture. Similarly, higher stocking rates are dependent upon the introduction of improved pasture. However, in many cases this sequential relationship is derived from normative and empirical analysis of the practice of innovators; the causality between one innovation and the next is not predetermined by science nor inherent in the technology. Empirical studies show that people may adopt innovations in varying sequences rather than a predetermined sequence. Alternatively, they may adopt part of the sequence and then adopt alternate technologies and have a different end point in their farming system than that envisaged by the QDPI.

I, together with other colleagues in the QDPI and CSIRO, had been exploring alternative paradigms and approaches for a number of years prior to the initiation of the VFSG project. Systemic approaches in particular were investigated. Some systemic approaches were realist and positivist in nature, while other explored the theoretical and methodological components of constructivist approaches (Clark et al. 1993, Cox, 1993, Coffey, 1995).

A major criticism of the Transfer of Technology paradigm which emerged from these explorations was the failure to recognise the normative basis of adoption studies. There are implicit assumptions that innovation is good in itself and that adoption in time will be total. The paradigm ignores those people who dis-adopt, who refuse to adopt (because they do not find the technology appropriate), and who do not adopt because they do not know about the existence of the technology.

Although the VFSG project was conceptualised squarely in the TOT tradition, I and a few other colleagues already were searching for alternative approaches and paradigms, which we hoped to explore and test within the VFSG project. In particular, we were drawn to the Participatory Learning and Action Research approach as a result of our own previous studies (for example, Hamilton, 1990a, Van Beek, 1992) and the ongoing debate within QDPI and other parts of Australia.

2.2. OVERVIEW OF RESEARCH METHODOLOGY

This research was emergent in design. It proceeded on the basis of a series of eleven interventions, a mix of pre-planned, opportunistic and serendipitious activities. Each experience threw up new perspectives, triggering further development of the team's thinking, action, and research. These activities are presented in chapter 5 as the first learning experience and chapters 8 to 10 as ten case studies. The research was mainly qualitative in nature even though it generated and used some quantitative data and positivist research, due to the complex nature of the social phenomena being inquired into.

A graphic overview of the research methodology is given in Figure 5.

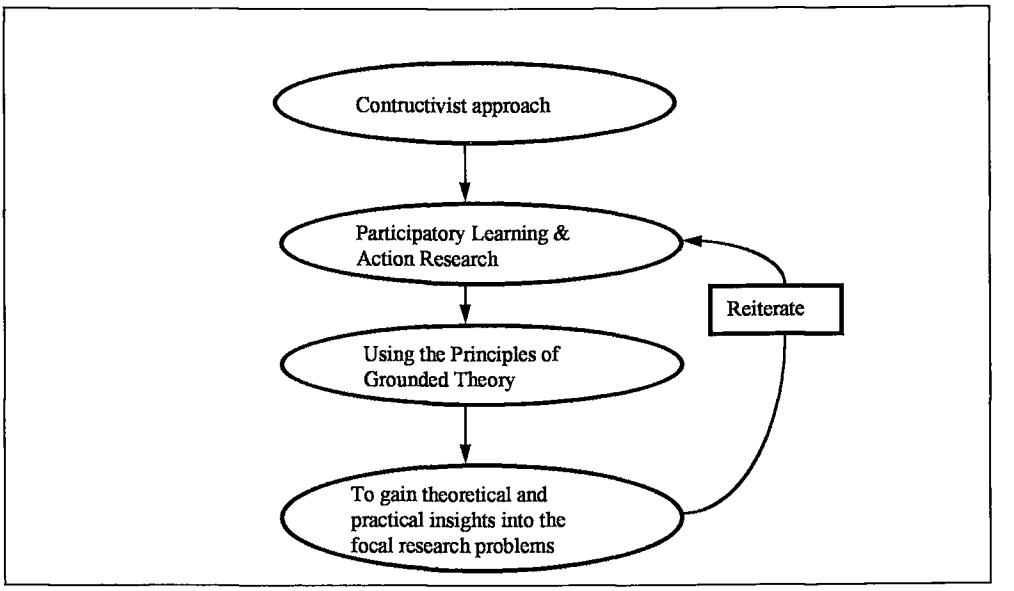


Figure 5 Graphic representation of overview of research methodologies used in this study

2.3. A CONSTRUCTIVIST APPROACH

To understand my reasons for choosing a constructivist stance, constructivism is compared with positivism under three criteria, as related by Guba and Lincoln (1994:108-111).

(i) the ontological question - the form and nature of reality and hence what is it that can be known about it?
(ii) the epistemological question - the nature of the relationship between the knower (or would be knower) and what can be known.
(iii) the methodological question - how can the enquirer (or would be knower) go about finding whatever they believe can be known.

Positivists adopt an ontological position that assumes that a concrete reality exists, which can be apprehended, and which is governed by "immutable natural laws and mechanisms". These

laws and mechanisms can be discovered through research and then used to predict and control the behaviour of natural phenomena.

The epistemological basis of positivism assumes that the researcher is objective and independent from the researched object. The researcher is neither influenced by nor influences the researched object. If either form of influence is recognised, strategies are put in place to reduce or eliminate it. By following prescribed procedures, values and biases are prevented from influencing the outcomes. Findings are replicable and are in fact "true".

The methodology of positivism is experimental and manipulative. Research questions and hypotheses are empirically tested to verify them. Control (manipulation) of confounding conditions must be exercised to prevent (improper) influence on the outcomes. The tools of positivist are commonly quantitative and reductionist.

Constructivists in contrast adopt an ontological position that assumes that reality is constructed by the individual. The individual's construction is socially and experientially based and thus multiple constructions exist. Constructions are local and specific in nature although elements are often shared among many individuals.

Constructions are not more or less true, in any absolute sense; rather, they are simply more or less informed and/or sophisticated.

The epistemological basis of constructivism assumes that the researcher and the researched object are linked as they interact. The "findings" are literally created as the investigation and learning process proceeds.

The methodology of constructivism is to elicit and refine individual constructions through interactions between and among the researcher and the respondents as they observe and interact with material phenomena. Conventional hermeneutical techniques are used to interpret the various constructions and these are compared and contrasted through dialectical debate. The final aim is to distil a more informed construction. This construction may be a joint or consensus construction.

Thus, constructivism adopts a relativist ontology which assumes that *multiple, apprehendable and sometimes conflicting social realities that are the products of human intellects, but that may change as their constructors become more informed and sophisticated* (Guba & Lincoln, 1994).

2.4. PARTICIPATORY LEARNING AND ACTION RESEARCH: A CLOSER LOOK

McTaggart (1992) credits Lewin (1946, 1952) as the first advocate of "action research" in the English language. Lewin described action research as proceeding in a spiral of steps, each of which is composed of planning, action, observation and reflection on the result of the action.

McTaggart describes action research as *beginning with an imperfectly understood felt concern and a desire to take action ... a general idea that some kind of improvement or change is desirable*. Action research begins with the participating group identifying the

cluster of situations of mutual concern, and agreeing to work together to improve the situation.

Participatory Learning and Action Research (PLAR) is more than action research and action learning alone, although the two exist on the same continuum. Action learning is often described as learning by doing. Unfortunately, thus described it is often passive, with the learning process incorporating tools and information invented by others, to solve problems determined by others, which incorporate the values and meet the aspirations of these others. PLAR introduces the notion of, and a methodology for, adults as active co-experimenters engaged in joint learning with researchers. It is contrasted with technology development as a design process; the end state is not pre-determined. The learning process is guided by collaborative determination of multiple goals and values (Cornwall, in Scoones & Thompson, 1994:98-116). PLAR is about knowledge production (McTaggart, 1992) and use in practice.

Reason (in Denzin & Lincoln, 1994:328) claims that participatory learning and action research is probably the most widely practiced participative research approach. PLAR is a form of inquiry into practice which utilises the knowledge gained from the inquiry to take effective action that may contribute to transforming individuals, organisations and society. It seeks transformations in ways which contribute towards greater effectiveness and justice in action. PLAR researchers and other participants change themselves as they endeavour to facilitate change and to understand change.

PLAR reflects the work of Argyris and Schön (1974) who distinguish between single loop learning and double loop learning. Reason (in Denzin & Lincoln, 1994:330) states that the governing variables of *single loop learning* are

(i) to achieve the purpose as the actor defines it;
(ii) to win not lose;
(iii) to suppress negative feelings; and,
(iv) to emphasise rationality.

In *double loop learning*, the governing variables include
(i) valid information;
(ii) free and informed choice; and,
(iii) internal commitment.

These very different governing principles lead to strategies that actively seek information and increased participation of others. PLAR combines action research and participatory learning.

Pretty & Chambers (in Scoones & Thompson, 1994:184) nominate six criteria underpinning the reliability of participatory approaches:

- *a defined methodology and systemic learning process* - the emphasis is on the cumulative learning of all participants and hence the use of these approaches must be participative;
- *Multiple perspectives* - a central objective is to seek diversity; but this diversity reflects that there are multiple possible descriptions of any real-world activity;
- *Group inquiry process* - recognition that the complexity of the situation will only be revealed through group inquiry;

- *Context specific* - approaches must be flexible enough to be adapted to suit each new set of conditions and actors, and so there are multiple variants;
- *Facilitating experts and stakeholders* - the role of the expert is to assist the stakeholders in their own situation, carry out their own study and so achieve a desired outcome;
- *Leading to sustained action* - the inquiry process follows a path of (i) debate about change, (ii) the debate changes the actors' perceptions and their readiness to contemplate action, (iii) action is agreed, and (iv) implementable changes will therefore represent an accommodation between different conflicting views. The analysis both defines changes that would bring about an improvement and seeks to motivate people to take action to implement the defined changes.

These criteria will be used in Chapter 10.6 to analyse the experiences described in the case studies.

2.5. GROUNDED THEORY

The theoretical approach taken was that of grounded theory. Strauss and Corbin (1994:273) define grounded theory as *a general methodology for developing theory that is grounded in data systematically gathered and analysed.* This methodology may be used to

(i) create theory from the data collected and analysed; and/or,
(ii) confirm, elaborate and modify theories that are currently in existence (grounded) by comparing the "goodness of fit" with data as it is collected and analysed.

They further state that *researchers can also carry into current studies any theory based on their previous research provided it seems relevant to these - but again the matching of theory against data must be rigorously carried out.* (273)

Strauss and Corbin (1990:9) assert that *formulating theoretical interpretations of data grounded in reality provides a powerful means both for understanding the world "out there" and for developing action strategies that will allow some measure of control over it.*

This approach argues that multiple perspectives must be systematically sought during the research inquiry. The perspectives of those actors who sooner or later are judged to be significantly relevant must be incorporated in the emerging theory.

Coutts (1994:37) reports three important guidelines for researchers developing grounded theory:

(i) periodically step back and ask "what is going on here? Does what I think I see fit the reality of the data?"
(ii) Maintain an attitude of scepticism; and,
(iii) Follow the research procedures - the data collection and analytical procedures are designed to give rigour - break through the biases.

2.6. EXPERIENTIAL LEARNING; TESTING SEQUENTIALLY; NEW PERSPECTIVES

The concept of grounded theory is graphically captured by Checkland (1985). He reminds us that *all practical action is theory laden, in the sense that if we observe any apparently purposeful human action, we can always ask of it: "What intellectual framework would in logic make this particular action meaningful?.* This concept of grounded theory, depicted with a simple illustration (see Figure **6**), is used as a framework for this research, to organise it and as a basis for analysis.

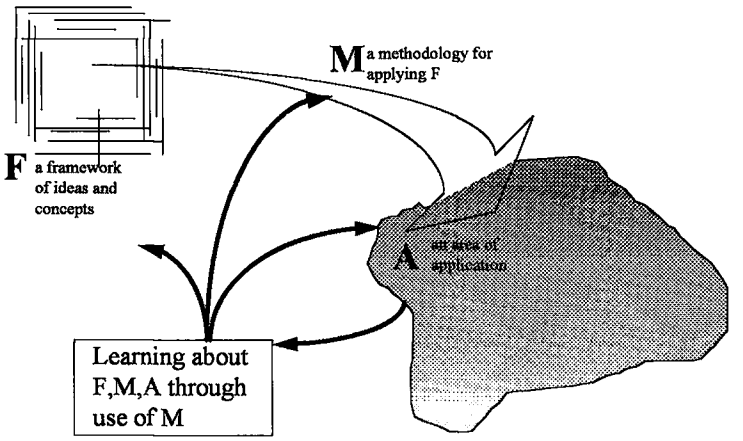


Figure 6. The general research framework
Source: modified from Checkland, 1985.

In this general research framework, F is a framework of ideas and concepts; M is a methodology - the way of applying these ideas and concepts; and A is the area they are applied to. Checkland suggests that *A is indicated without sharp boundaries to remind us that when A is about human affairs, the application of F through M may lead us into byways not initially expected.*

The application of M, the methodology results in learning. This learning relates not just to A the area of application; but also about F, the framework of ideas and concepts, and M the methodology applied. This general research framework is conducted iteratively, with each sequence testing and providing insights into the framework of concepts and ideas, the methodology applied and the area of application so that new frameworks of ideas and concepts emerge, new methodologies appear to further the testing, and new insights and perspectives on the complexity of the area of application emerge.

2.7. ENSURING RIGOUR IN THE PROCESS

The major criticism of qualitative research relates to the rigour associated with the processes used. In positivist, realist research, the issue of rigour relates to four criteria:

- internal validity - isomorphism of findings (being identical or similar) to reality;
- external validity - generalisability;
- reliability, - able to be repeated; and,
- objectivity - the observer is distanced and neutral.

Rigour in the constructivist style of research conducted in this study is judged on two sets of criteria (Guba and Lincoln 1994:114), trustworthiness and authenticity.

- Trustworthiness is further defined in terms of:
  - credibility, (paralleling internal validity), that the reconstruction of the many co-operators' "constructions" are deemed acceptable by the co-operators;
  - transferability, (paralleling external validity), that readers of the reports have the capacity to transfer its findings to new situations;
  - dependability, (paralleling reliability), results from diverse research methods and multiple sources (similar to triangulation); and,
  - conformability, (paralleling objectivity), the quality of the data.
- Authenticity is further defined in terms of:
  - fairness;
  - ontological authenticity, (enlarges personal constructions);
  - educative authenticity, (leads to improved understanding of constructions of others);
  - catalytic authenticity, (stimulates to action); and,
  - tactical authenticity (empowers action).

These criteria will be used in Chapter 10.6 to analyse the experiences described in the case studies.

2.8. QUALITY ASSURANCE OF THE RESEARCH METHOD

Jiggins (in Scoones & Thompson, 1994:140) nominates criteria for quality assurance. She states *there are three ways in which a method may fail to meet tests of quality.* These are:

- efficacy: choosing the wrong tool for a given task;
- efficiency: failing to use the minimum or constrained resource; and.
- effectiveness: the approach may not be the right thing to be doing.

These criteria will also be used in Chapter 10.6 to analyse the experiences described in the case studies.

2.9. THE RESEARCH PATHWAY

The methodology of the research undertaken on the VFSG project's experiences belongs to the family of Participatory Learning and Action Research methodologies. It pursued two desired outcomes. The action outcome was to change the situation in which the research was carried out (the research activity of the project). The research outcome was to develop

greater knowledge of the relationship between process and outcome (the research activity of this study). Because the work was contracted from the National Landcare Program to the VFSG and promised to deliver outcomes irrespective of process, it could be viewed as participatory learning and ACTION research rather than participatory learning and action RESEARCH. The two aspects of the research worked synergetically, with one contributing to and strengthening the other.

The research process follows the principles of grounded theory (see Section 2.5) The process began with the identification of focal questions. These were refined during Phase 1 & 2 of the market research process, and explored during the case studies. The theoretical insights generated by the research are analysed in chapter 10 and the theoretical and practical implications discussed in chapter 11.

The research followed a path (see Figure 7) of utilising a framework of ideas and concepts, experiencing the problem situation through multiple perspectives, determining a relevant method to apply to the problem situation, applying it, observing the outcomes (improvement in the problem situation) and reflecting on the success and appropriateness of the method and framework of ideas and concepts. The reflection process resulted in the methods applied being modified and tested again if they were found to be inadequate. The reflection also continually reinforced the learning process associated with the research.

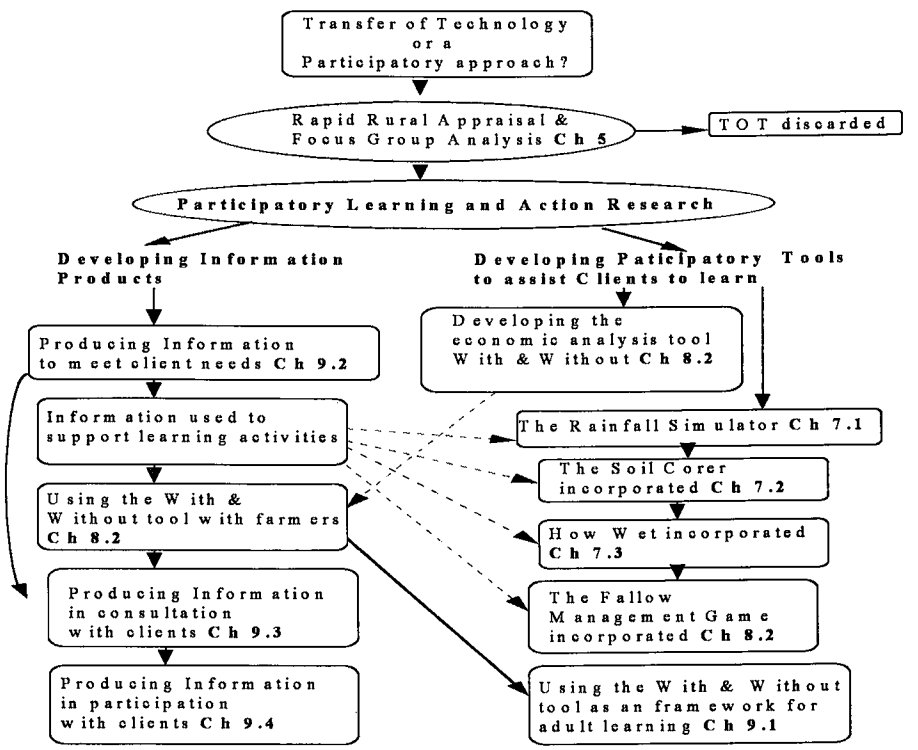


Figure 7: Overview of the research pathway with location of where each method is discussed.

3. THE PROBLEM SITUATION DESCRIBED

3.1. INTRODUCTION

The area covered by the project was large being approximately 400 kilometres from north to south and 450 kilometres from east to west (see Map 1).

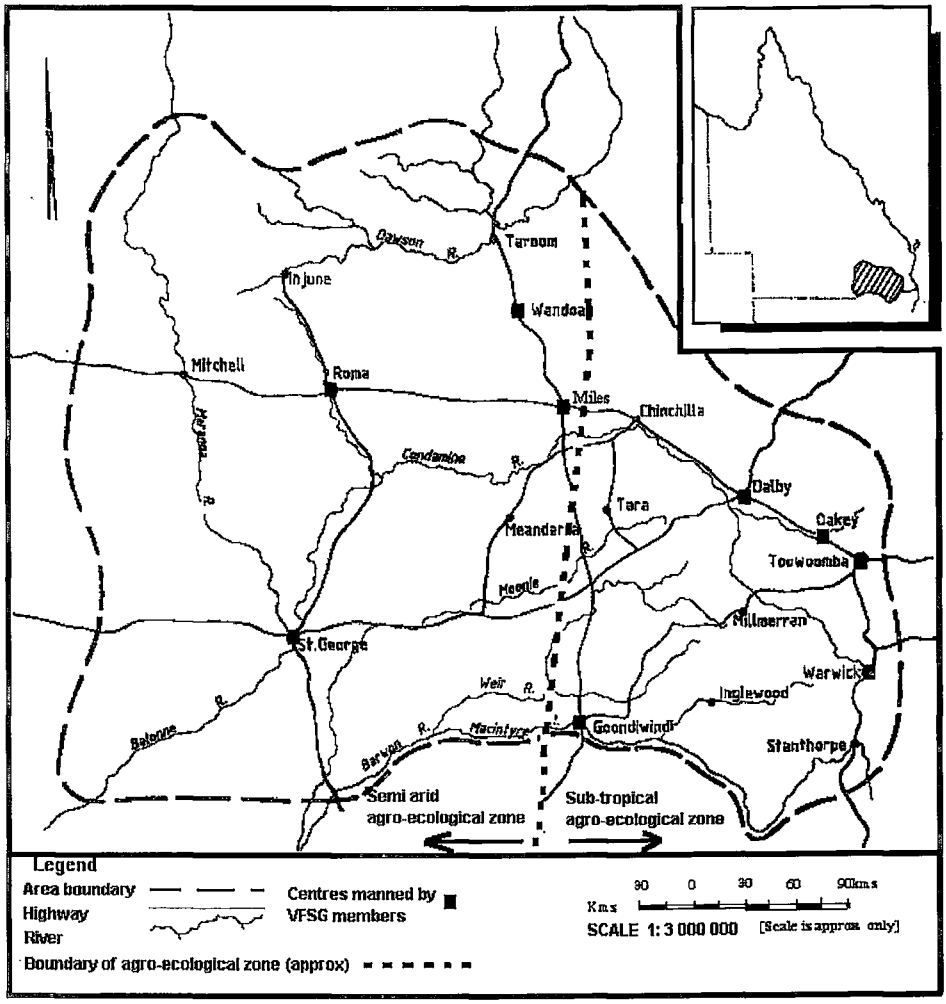
This area is in excess of 150,000 square kilometres with approximately 6,000 landholders and their families (Australian Bureau of Statistics: 1990) engaged in agricultural production. In comparison, the Netherlands has a land area of less than 40,000 square kilometres (Röling & Jiggins, 1994). The focus of the project was on farming systems that incorporated cropping. There are approximately 3000 farmers in this region who manage these types of farming systems and are thus potential clients of the project.

The region is effectively bisected into two agroecological zones (Gentilli, 1972:33): to the west, a semi-arid zone, commonly referred to as the Western Downs and Maranoa, and to the east, a sub-tropical zone, commonly referred to as the Darling Downs. These agroecological zones reflect differing climatic patterns (rainfall and temperature) and differing soils (their water holding capacity and consequent crop growth).

The annual rainfall increases from approximately 550 mm in the west to more than 700 mm in the east. The rainfall is predominantly summer rain (65% of total rainfall being summer rainfall in the east and 55% of total rainfall being summer rainfall in the west).

Temperatures are cooler in the east resulting in pan evaporation levels of below 1.5 metres per annum as opposed to more than 2 metres per annum in the west. The climate is characterised by drought which occur on average 1 year in 5 in the west and 1 year in 10 in the east. A drought is defined as a period (twelve months or more) of extended dry weather where less than 30% of annual mean rainfall falls.

The rainfall is also often intense with rainfall intensities of greater than 75 mm/hr not being uncommon. Most cropping soils in the region have high infiltration capacity (greater than 100 mm/hr) until rainfall in a single event exceeds 30 to 50 mm when infiltration rates fall to below 5 mm/hr. Rainfall above this amount usually results in significant runoff events.



Map 1 Location of the research area

The soils used for cropping are mainly cracking clays. The clay type is montmorillonite which swells and shrinks as water moves in and out of the soil. With swelling and shrinking, cracks appear and disappear. Cracks are an important feature to allow rapid water entry into the soil. The percentage of this clay type in the soil in combination with effective soil depth also determines the relative water holding capacity of the soil. In the west, the soils are shallower (average effective rooting depth of 60 cm) than in the east (average effective rooting depth of 1.1 metres). The soils in the west have a lower clay percentage resulting in their having a plant available water holding capacity (average of 110 mm of stored soil moisture per metre of soil depth). In the east, the plant available water holding capacity is significantly higher (average of 150 mm of stored soil moisture per metre of soil depth).

Agriculture and cropping patterns reflect the agroecological zones. In the west, agriculture is usually a mixed livestock/cropping enterprise with the cropping being predominantly winter cereals. Wheat is the major crop grown with smaller areas of barley, oats and sorghum. The cropping sequences are mainly monoculture wheat. In the east, agriculture is usually solely a cropping enterprise with cropping being predominantly summer crops in rotation with winter crops. Over seventy different types of crop are grown in the east ranging from dryland cotton and sorghum, through a range of summer and winter pulses to a range of summer and winter cereals. Farm sizes are significantly larger in the west (average farm size approximately 2000 hectares) than in the east (average farm size approximately 400 hectares).

The majority of farming enterprises are family farms. Chamala et al. (1983) found that most farmers were raised on their present farm or nearby farms. Most farmers have at least seven years schooling with 75% having less than 10 years. Schooling to age fifteen has been compulsory since 1961.

3.2. AGRICULTURE IN CRISIS

3.2.1. Land degradation - a crisis occurring

Australian Bureau of Statistics (1990) figures indicate that there are 2 million hectares of land cultivated in southern Queensland, supporting approximately 3000 farmers and their families. This region's agriculture is based mainly on continuous cultivation and cereal cropping, leading to declining fertility (Dalal et al. 1991), deteriorating soil structure (So et al 1988), lower beneficial biological activity (Haas et al. 1957; Dalal & Mayer 1986a), increased incidence of disease and weeds, and increased soil erosion (Lal 1989).

Soil erosion/storing runoff water in the soil is the major concern. Of the cultivated area, 1.8 million hectares (90%) require protection from soil erosion by earthworks and agronomic practices (Chamala et al 1983:1). Soil erosion is a result of rainfall running off the soil surface, taking topsoil with it. Soil loss from soil erosion on cultivated lands has been estimated to be minimal (less than 5 t/ha/yr) on the landscapes of low slope and/or low rainfall but rising to 20 to 50 t/ha/yr on much of the sloping cultivated land of southern inland Queensland. Of the designated "needs protection" area, only 0.5 million hectares were protected by soil conservation earthworks in 1990 and less than 40% was adequately protected by agronomic measures such as maintaining stubble to combat soil erosion.

The other impact of rainfall runoff is the failure to maximise the stored water in the soil for use by subsequent crops.

Soil fertility is the emerging concern. Soil fertility decline is also regarded as a growing problem facing agriculture in southern Queensland. Dalal et al (1991) estimate that in this region, 1.2 million hectares (60%) are affected by soil fertility decline, with a subsequent reduction in crop yield and grain quality valued at an output loss of $AUS 324M[1]/year.

Organic matter decline is also regarded as a growing problem in this region. It results in lower nutrient supplying capacity and increased bulk density, that is, the soil becomes compacted.

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[1] $ AUS 1 is approximately equivalent to $ US 0.75 is approximately equal to Dfl 1.20 (1995)

Soil organic N declines with cultivation and cereal cropping (Dalal et al. 1986b) and as a result cereal yield and protein content also decline.

3.2.2. Declining profitability of agriculture

Bowman (pers. comm. 1995) reports that the economic viability of farming in the region declined dramatically over the past twenty years, reflecting the trend Australia wide (see Figure 8).

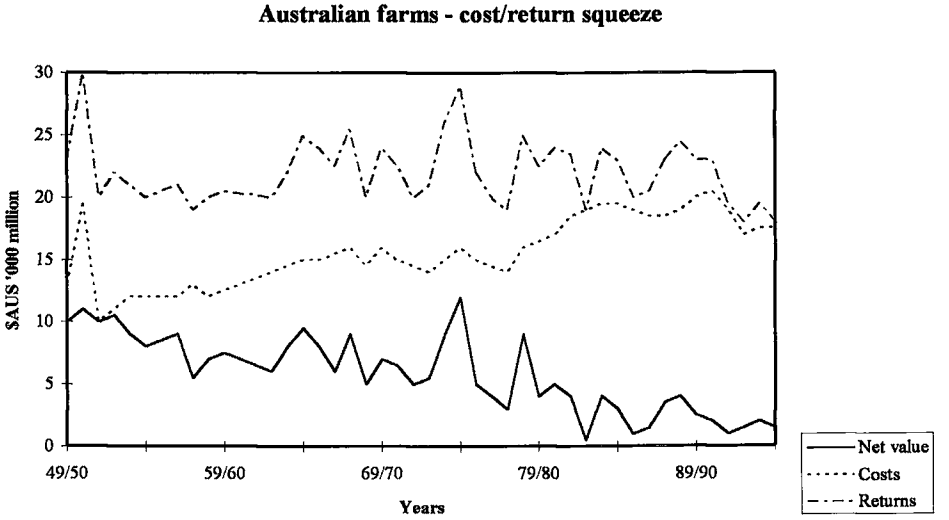

Figure 8. Declining returns from Australian agriculture
Source: Bowman, 1995, data derived from Australian Bureau of Statistics (1994) figures.

Similarly, Bowman (1995) reports that the contribution of agriculture to productivity, employment and export earnings of the region reflect the national contribution of agriculture to productivity, employment and export earnings and are declining rapidly (see Table 1).

Table 1 Contribution (%) of Australian rural sector

	GDP	Employment	Exports
1956-57	14	10.8	80
1966-67	10	8.3	68
1976-77	5	6.2	46
1985-86	4	5.8	35
1989-90	4	5.0	24

Source: Roberts, B. (1995:49)

3.2.3. The farming population is declining in numbers and ageing

The number of farms and farmers has declined by an estimated 25% over the past decade (Cribb, 1994). He links this decline in rural population to environmental degradation. *National environment decline in rural areas (*is a result of) *depopulation, absentee management and the pressure to extract too much from the land* (which) *are the mainspring of land and water degradation.*

The farming population has also been ageing, both in the south Queensland region (Bowman, 1995) and nationally (ABS, 1994), indicating a failure of younger farmers to become involved in agriculture (see Figure 9).

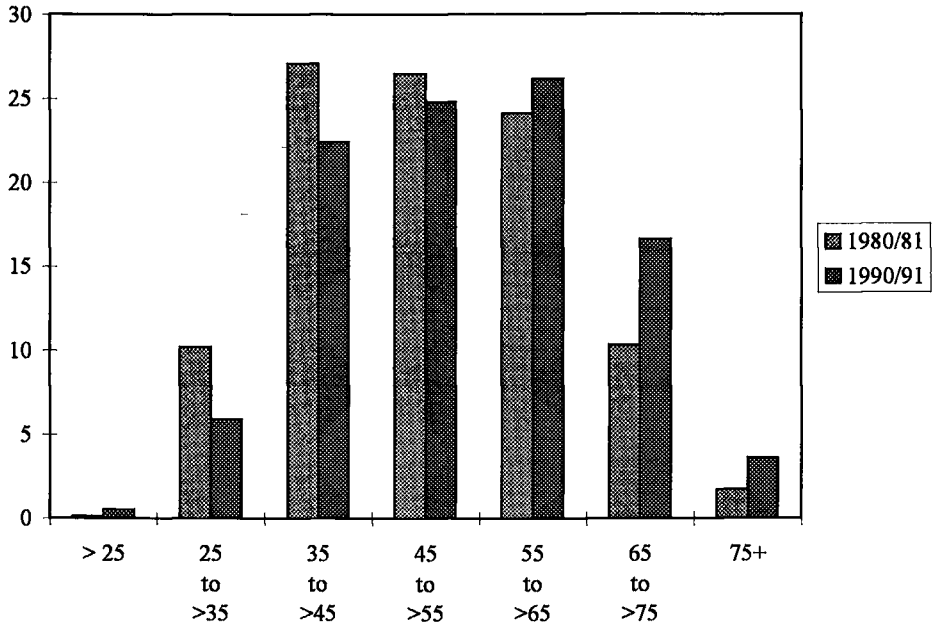

Figure 9. The ageing of the Australian farming population
Source: Bowman, 1995, data derived from Australian Bureau of Statistics (1994) figures

So, Australian agriculture and the agriculture of this region is characterised by declining profitability, declining contribution to the Australian economy (and consequently, declining political lobbying capacity), and declining numbers of farmers, growing progressively older.

3.3. CRISIS STIMULATES CRITICAL REVIEW OF RESEARCH, DEVELOPMENT AND EXTENSION

In 1993, Jim Miller, then Director-General of the Queensland Department of Primary Industries, stated that *we are living in a period of unprecedented change* (Miller, 1993). He further hypothesised that *Historians will look back on the 1990's as representing a 'paradigm shift' in terms of institutional and attitudinal change. For, extension, and for science more*

generally, change is everywhere. Our clients are changing; our clients are experiencing great change themselves, and their demands on science are presenting a major opportunity (or posing a major threat). How science copes with these changes will determine whether the opportunity is realised (Ibid, 1993).

The clients of publicly funded science are changing. The debate relating to the nature of science as producing a public or private good has waxed and waned in Queensland, in Australia and internationally (eg Wythes et al. 1990). In Queensland, the outcome of the debate has been the recognition that the general community is the client of publicly funded science and the products are public goods. Farmers may be the target of publicly funded R, D & E, but the community is the ultimate beneficiary (Coutts, 1994).

Public funding for scientific research and extension is being restricted while the relative input of private funds is increasing. Sources of private funding include grower levies (matched dollar for dollar by government subsidy) such as the Grains Research and Development Corporation (GRDC), corporate sponsorship such as BP Australia's contribution to the National Landcare Program and commercialisation of the products of public sector scientific research and extension such as the sale of QDPI bred insect resistant parent lines. With this input in funds comes a demand for an increased role in deciding how and where the monies will be spent.

Our clients are also experiencing great change. Environmental issues, and the interest that urban communities have in what farmers do with their farms and the impact this has on the environment, have caused an often painful review of agricultural practice.

Our clients are experiencing changing social needs. They are wanting to or are being required to, become more self-reliant. They are demanding a bigger say in decision making, an input into policy making, and accountability of government departments and staff. In Australia, this is exemplified by the emergence in 1988, of Landcare, a community driven movement pursuing sustainable land use and management (Campbell, 1994).

This era of change is also reflected in the debate within science, at the abstract and the practical level, as to the appropriateness of the dominant scientific paradigm in use (Gamble, 1993), and the appropriateness of the various agricultural extension approaches (Coutts, 1994).

3.3.1. The need for more effective change processes

In recent times, technology has proven less and less able to provide the quick fixes that agriculture required and had been delivered in the past. As a QDPI manager stated at the time this project and research process commenced "*the easy fruit have been harvested - we now have to pursue the higher more difficult fruit if agriculture is to continue to advance*". His rather cryptic metaphor suggests that, in the past, the simple problems of agriculture had been solved by technological innovations that addressed simple cause and effect relationships, and by management, improvements that in themselves led quickly to improved profitability. Increasingly, problems being addressed were becoming more complex, moving from simple cause and effect relationships to multiple cause, multiple effect relationships. Further, there was a growing understanding the many of the solutions being implemented brought with them new problems or detrimental effects, at a technical, economic, social and environmental level,

both within the boundaries of the farm and external to the farm. The solutions required to advance agriculture at all these levels were becoming increasingly complex. While the approaches of the past would continue to contribute, this contribution would be relatively less.

It was becoming increasingly difficult to gain agreement upon the definition of the problem itself. Scientific-based and management innovation was less capable of providing a single "one solution fixes all" applicable to most situations. Similar problems in a diverse range of situations demanded diverse solutions, each compatible with its specific situation, that is, multiple outcomes. As agriculture was developed and matured, the problems it faces and the solutions being sought are in a state of flux, major change and upheaval. Solutions must not only be technically sound but must also address the increasing social, economic and environment imperatives being placed upon agriculture by both farmers and the wider community.

3.3.2. The evolving nature of agricultural development

Since the turn of the century, Queensland agriculture as an industry has been very successful in meeting the challenges that national and international political imperatives have placed on it, while satisfying individual farmer goals. Policy imperatives have changed over time from increasing production through increasing productivity to, most recently, sustainable productivity, human resource development and community development.

Throughout this evolution, it was not a case of one imperative replacing another - all were being addressed but it was their relative importance and the subsequent focus that changed. Thus production did not cease to be an issue when the focus moved to productivity; productivity did not cease to be an issue when the focus changed to sustainable productivity.

Agricultural research and extension have been major contributors to agriculture's success through this evolution. While many collective and individual benefits[2] have been derived from agricultural development, these benefits have also been attended by (hidden) costs, many of which have emerged only over time.

The paradigms and processes employed by agricultural research and extension have been developed and evolved to allow these disciplines to fulfil their role. In hindsight, many of these processes have themselves contributed to the costs associated with agricultural development.

3.3.3. The effect of competing goals.

In current agricultural development in Australia where there is an emphasis on both sustainability and productivity, these two goals or outcomes are often seen as antagonistic to one another. Land degradation is perceived, to a large degree, as an environmental impact of a farmer and his farming system. As the external community is increasingly aware of the unsustainable nature of many of our current farming systems and farming practices, it has played a role in changing the political imperative to include its concerns about sustainability.

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[2] Benefits and costs are defined in broad terms to include values such as (social) equity, access to resources and services, aethetic values, health, well being etc., as well as the more common monetary value

While many farmers also share these concerns with the wider community, the farmer is left with the difficulty of balancing productivity and sustainability with viability. Often, he experiences a reality in which that the pursuit of sustainability is at the expense of viability and seeks government intervention in the forms of subsidies to compensate for the loss of viability. Thus the agricultural sector becomes unbalanced and this form of intervention brings with it unforeseen consequences. For example, in Queensland farmers receive drought subsidies often in times when the "drought" has been man made. Because drought subsidies are available, farmers include this expectation in their decision making processes and this exacerbates the situation. It can be clearly demonstrated that drought as defined by farmers is becoming more frequent and bears less and less relationship to drought as defined by environmental variables that are measured (Daly, 1993, *pers. comm.*)

3.3.4. Changing paradigms lead to change

In Australian agriculture, the issues of ecological sustainability, rural community sustainability, and viability of agricultural production are symptomatic of the emergence of complex problems that apparently have defied solution (and may have been exacerbated by) traditional scientific approaches under a traditional scientific paradigm. This dilemma has caused a re-examination of the paradigms in use, particularly by agricultural extension.

Albert Einstein observed, "The significant problems we face cannot be solved at the same level of thinking we were at when we created them" (quoted in Covey 1989::42). Kuhn (1962) illustrates how almost every significant breakthrough in the field of scientific endeavour is linked with what he termed "a paradigm shift". A paradigm shift is a new way of looking at or thinking about old problems. Barker (1990:27) states that a paradigm shift occurs when the *established "rules of the game" fail to provide effective solutions to our problems.*

Barker (1990:25-27) also provided several definitions relating to paradigms and paradigm shift:

- Paradigm Effect - paradigms filter incoming experience. The way we view the world is dependant on our paradigm which causes us to select data that best fits our paradigm and try to ignore the rest;
- Paradigm Paralysis - the belief that there is only one way (our way) to do things, and there are no better or alternative ways; and,
- Paradigm Flexibility - the opposite of paradigm paralysis - an active behaviour that constantly challenges our paradigms on a regular basis.

The paradigm shift experienced during this project is reflected in the activities and the processes used by the project team and which impacted on the project outcomes.

3.4. COMPLEMENTARY EFFORTS TO ADDRESS THE PROBLEM

3.4.1. Landcare

The Landcare movement in Australia had its beginnings in a joint agreement between the National Farmers Federation (the major farmer's lobby group) and the Australia Conservation Foundation, supported by the Australian Government (Chamala & Keith, 1994). Campbell

(1994) describes Landcare as a grassroots revolution that has turned land conservation extension on its head. Landcare groups are voluntary local groups, comprising landholders and other stakeholders, with the main aim of *undertaking more sustainable land and water management practices, to rehabilitate degraded resources, and to prevent further deterioration of land and water resources* (Chamala & Keith, 1994). They further state that *this is a genuine example of participative action management where stakeholders are empowered to identify the issues, select workable solutions, implement projects and programs, and monitor them to fine tune future planning programs. All these activities are conducted in a participative way.*

In 1990, the Australian Government declared the 1990's the "Decade of Landcare" and contributed significant funding under the National Landcare Program - NLP (formerly the National Soil Conservation Program - NSCP). These funds are used to fund State Government Agency projects (with the State Governments contributing at least dollar for dollar), and community projects such as the employment of a local Landcare group facilitator. The project this thesis is based upon is an example of a State Government Agency project. The Landcare community has a significant say in which projects receive funding through Regional Advisory Panels which have more than 50% membership of local landholders.

Campbell (1992) reports the phenomenal growth in these community Landcare groups: in 1985, there were less than 100 groups in a few States (of Australia). By 1993, there were 1600 Landcare groups nationwide and by mid 1994 there were more than 2000 Landcare groups established across the nation.

3.4.2. Public sector research and extension

Public sector research and extension into land degradation and sustainability of cropping has, until recently, involved two branches of the QDPI, focussing on two aspects of the problem and operating relatively independently of each other. The Soil Conservation Services Branch focussed on the implementation of earthworks to control soil erosion, while Agriculture Branch focussed on the agronomic aspects of crops growth and its ameliorating effect on soil erosion.

Earthworks for soil conservation were first commenced in the mid 1930's but it was not until the mid 1950's that the Soil Conservation Services Branch expanded and spent considerable effort on protecting the landscape through the use of contour banks (Pauli, 1978) More recently, strip cropping has been extended on the low sloping floodplains.

The agronomic thrust can be traced from the mid to late 1960's to the present time with research efforts concentrating on major research trials looking at the long term effects of various tillage practices. These are exemplified by four major trials across the region located at:

- Warwick in the south-east (Littler & Marley, 1978, Thompson & Freebairn, (1991);
- Greenmount, near Toowoomba, in the north east (Freebairn & Wockner, (1986);
- Wallumbilla, near Roma in the north west, (Freebairn & Wockner, (1986); and,
- near Goondiwindi in the south west (Radford et al, 1991).

The extension efforts gathered momentum from the late 1970's with projects focussing on what became known as conservation cropping: the use of plant materials to protect the soil surface from raindrop impact. Initially, these projects focussed on the machinery aspects of conservation cropping. This was technology and machinery such as blade ploughs imported from the Great Plains of the USA. The technology was pursuing machinery that didn't invert the soil and its stubble, but left it lying anchored on the surface. Until this period, the disc plough had held prime place in the early cultivations of a fallow. This machine inverted the soil and its stubble and left the soil bare and exposed.

The agronomic efforts gathered momentum in the mid 1970's with the introduction of glyphosate, a broad spectrum herbicide for fallow weed control. In many situations, this product rivalled mechanical tillage in terms of cost and effectiveness.

Integration of the QDPIs' efforts was not accomplished until the mid to late 80's. The aggregation of these efforts is reflected in the VFSG's project and in the formation of groups such as APSRU which focused on computer simulation and modelling of the water relationships, soil erosion and crop growth.

The focus of public sector research and extension for this entire period was on the development of superior technologies for adoption by farmers to reduce soil erosion, improve moisture storage, and subsequent crop growth, yield and profit. It was firmly rooted in the TOT paradigm.

3.4.3. The private sector

The private sector focus on the problem of land degradation was minimal until the introduction of glyphosate. This product represented an opportunity to radically change fallow management systems through the input of cost effective chemical alternatives to mechanical tillage. The private company who owned the patent to glyphosate spent considerable effort in researching the niche of the product and marketing this product to farmers. Many of these efforts were undertaken in conjunction with QDPI's research and extension staff.

More recently, glyphosate has come off patent and the product is now marketed by a range of companies. While, this has resulted in the original company reducing its efforts into marketing the product, this role has been assumed by the companies that distribute the product. The interaction between the QDPI and these private companies has waned in recent years. It was increasingly seen that the marketing and use of this product was a private good and as such should be firmly in the realm of private sector agriculture and not public sector agriculture.

3.4.4. A combined public sector private sector initiative

The other entity that is of interest in conservation farming in southern Queensland, is the emergence in the mid 1980's of the Conservation Farming Information Centre (CFIC). This is an autonomous organisation that was initiated by the QDPI, but was developed to occupy an independent role in the provision of extension and research to conservation farming.

It is funded by grower contributions, by QDPI funds and by projects funded by the major research and development corporation funding bodies. The CFIC is overseen by a board of

directors which consists of 3 representatives from QDPI, 3 representatives from agri-business and 3 farmers. One of the QDPI representatives is also (but is not compulsorily) a member of the VFSG project team. During 1991-92, I was also a member of the board of the CFIC.

To date, the CFIC only employs a single project officer. The project officer is employed to deliver QDPI projects. For example, the project officer occupied a role in the VFSG as well as within the CFIC during 1991-92. More recently, in 1995, the CFIC's project officer in conjunction with QDPI staff, has been contracted to deliver a QDPI project, that had its roots in the market research of the VFSG.

3.5. QDPI'S PERCEPTION OF THE PROBLEM.

3.5.1. The influence of a declining budget and reduced staff numbers

From the late 1980's the budget of QDPI has steadily declined in real terms due to increasing pressures upon government to reduce its expenditure. This has resulted in a significant reduction in the number of field extension research staff.

The focus of public sector research extension has also changed from provision of *private goods* to provision of *public goods*. This has resulted in a move away from the provision of one-to-one reactive advice and information to individual farmers upon request. This role is now determined to be more rightly the role of private sector agronomy. It has been superseded by proactive projects that aim to operated within farmer groups. Instead, the public sector is aiming to research and extend public goods by becoming more focussed and by working with groups. The public sector now aims to provide information on problems that have impact on the community, rather than on individual farmers only.

In response to this reduction in State Government funding, there has also been an increased effort to attract external funding from Federal Government funding organisations, such as the Grains Research and Development Corporation (GRDC) and the National Landcare Program (NLP). It was under the NLP funding arrangements that the VFSG project was funded. The integration of the fragmented approach to conservation farming into a co-ordinated larger project may also be seen as a response to the reduction of field staff. Again, the VFSG project reflects this.

3.5.2. The technology is available, it is now an extension problem

Resulting from the extensive research efforts into improved fallow management systems, their effect of yield and on soil erosion and soil loss, the QDPI held a belief that the technology to improve the sustainability of cropping in southern Queensland was available but had been poorly adopted. It was deemed to be a failure in the extension process that was now the problem. By co-ordinating the previously fragmented approach to extend the researched technologies of fallow management systems through a major extension project, adoption of preferred fallow management systems would be accelerated.

3.5.3. The Nature of the Problem being addressed

The substitution of land, labour or capital with information is a process of decision making. Decisions that result in change primarily occur on an individual's farm. The original project intent was to enhance the flow of relevant information to farmers so they would make informed decisions to adopt improved fallow management practices.

The fact that the VFSG project did bring about substitution of land, labour or capital by provision of information and enhancement of knowledge, is not the central issue of this thesis. The focus here is with the processes by which these substitutions were accomplished.

3.6. MY ROLE IN THE PROJECT

My entry into the region where the research was conducted began 15 years ago. I was an extension agronomist, specialising in crop and pasture management, with a positivist worldview, operating in a traditional "Transfer of Technology" mode. I was regarded by many as being "technically proficient" (read this as sharing a positivist view of reality).

In 1990, I returned to the field after completing a M.Sc. in Management of Agricultural Knowledge Systems, full of new theory to test out on my unsuspecting clients. I was seconded to the project as a full time project officer and later was to assume the role of project leader. Under these two positions, I further was expected to fulfil additional roles.

Role of a "plant". In a team building exercise for the project based on the Belbin team building exercises (Belbin, 1989), my role in the project was identified by the other project team members as that of a "plant". A "plant" is regarded as being a creative force within a project, looking for innovative new options and mechanisms to make the project function more efficiently and effectively. This is a role that I adopted with alacrity. Belbin (1989) also suggests that "Plants" are commonly poor "completer/finishers" because they are more interested in the future than the present. The project team members nominated "completer/finisher" as a characteristic that I was weak in.

Facilitator of team skill development. I was also the only member of the project team that had formal skills in social sciences. I was also linked to an extensive network of social science professionals. As this project developed, the need for social science skills emerged. To fulfil this need I adopted a role of trainer and mentor to project staff. I assisted in the training of these staff to acquire social science skills (both personally and by drawing upon my social science network). As the staff implemented their newly acquired skills, I played a role in overseeing their application, and assisted in their interpretation.

Facilitator of reflection by the team. As the project evolved, the project team became a learning team. I played a significant role in assisting the project team members to become reflective about their work. The visible output of this reflective activity is the publication of project reports and scientific papers that record the activities and the underlying principals that the project team undertook. Writing project reports and scientific publications had not been a task that most team members had previously undertaken. Again, new skills were required and I acted as a mentor in this skilling process. These projects reports and scientific publications

have been utilised in this thesis as a basis for the case studies. An unintended benefit of the project staff publishing has been the meeting of an important performance indicator required for promotion and advancement within QDPI - the criteria of publications ("publish or perish" is still the norm).

Facilitator of linkages with other projects and with management. I spent considerable time over the duration of the project liaising and ensuring that the linkages between this project, other projects operating in the same technical and/or process area, and management were maintained and enhanced. These linkages operated within QDPI, with other state organisations around Australia and between this project and the private sector.

Administrator. As project leader I also was required to fulfil the administrative role required within the project in terms of maintaining the budget and fulfilling the reporting requirements.

Social researcher. To fulfil my own ambitions for higher education, I also occupied a role as a social researcher. This role was not a prerequisite of the project. My role as a researcher of social science situations complemented the project activity roles. I spent considerable effort being a participant observer of situations that project staff were involved in. I interviewed clients of the project to determine the effectiveness, efficiency and efficacy of the project activities. The information I gleaned from this research role was fed back into the project team and its project activities to enhance its performance. In effect, project team members were clients of my research activities as much as the clients of the project activities were clients of my research activities.

3.6.1. My positionality within the research area

Ceglowski and Marcovitz (1994:6) state that "*positionality is more than a conventional list of the researcher's and field site worker's characteristics, biases and sensitivities: it is a fluid interplay between their positions in multiple and sometimes contradictory discourses*". I interpret this as suggesting that positionality is not an objective measure of an individual. This raises several questions about positionality. Is positionality constant over time? Can there be a commonly agreed definition of a researcher's positionality? Can positionality be controlled?,

The constructivist posits that the researcher creates "realities" through social interactions among and between other actors. It assumes the researcher and the object of investigation are interactively linked so that the findings are literally created as the investigation proceeds. These constructed realities are shaped by the participant's worldviews, which have been developed through the participant's history, knowledge and experience.

As I entered into the research process, I brought with me my own set of attributes, status, values and beliefs. The research processes I utilised were designed to place my impact within the positionality of others through mechanisms such as feedback of my "constructed reality" to the participants.

Social constructions are made "visible" through interactions which implies that the emergent construction is further determined by other's perceptions of my positionality. People I interacted with held a view on what they perceived as my set of values and beliefs. Their perceptions influenced the way they interacted with me, and consequently on the constructions of reality that ensued. Where I could not be sure how other's perceptions of my positionality

would influence the shared interpretations, I utilised a third party to assist in the construction. For example, I used a third party to help us determine the team's perceptions on the impact of the project in changing the members' worldviews.

My positionality is intimately linked to the research area. I was born and bred on the Darling Downs, the eastern ago-ecological zone. My father's family had, and continue to have, agricultural interests in the Western zone. My family have farmed on the Darling Downs since the mid 1940's. I have worked extensively in the Western Downs and Maranoa for the entire span of my career until recently. More recently I have transferred back to the Darling Downs to my home town. I, myself had, and continue to have farming interests in the region. From a farmer's perspective, this background allowed them to regard me as being empathetic to their situation.

I will attempt in the remainder of this text, to illuminate and interpret the factors I believe had a bearing on the construction of my positionality and the evolution of the project. It is a story of change and an emergent positionality.

3.7. A CHRONOLOGY OF PROJECT ACTIVITIES

A chronology of the project activities is illustrated in Table 2 (see next page). This table illustrates the periods of key activity within these project activities. For most of these activities, the chronology extends from the timing illustrated in Table 2 until the present time. However, for clarification I have included only the periods of key activity.

Table 2 Chronology of the key periods of the major activities of the VFSG project

1990	1991	1992	1993	1994	1995
Project proposal written and submitted to National Landcare Program for funding					
Funding application approved and project team selected					
I was seconded to the project team as the full time project officer					
Rainfall Simulator used as a research tool at Roma					
Farmer "discovers" an extension tool					
Market research - phase I - Rapid Rural Appraisal					
Market research phase II - Focus Group Analysis					
Value adding to research information - a top down approach					
1st round of Rainfall Simulator demonstrations					
Development of and training in With & Without economic analysis tool					
Development of With & Without case studies with farmer groups					
Team training in using Rainfall Simulator as an action learning tool					
Subsequent rounds of Rainfall Simulator action learning activities					
Redevelopment of Soil Corer as an action learning tool					
Incorporation of Soil Corer in Rainfall Simulator action learning activities					
Using With & Without as an adult education framework					
Development of *How Wet* - a tool for farmers to estimate soil water and nitrogen					
Development of *Fallow Management Game* - a tool to support group learning					
Producing information for strategic decision making - a consultative approach					
Producing information for strategic decision making - a participative approach					

4. INITIAL CONCEPTS

4.1. MY BACKGROUND PERSPECTIVES AS THE RESEARCHER.

Between 1988 and 1990, I studied at the Wageningen Agricultural University to gain a M.Sc. in Management of Agricultural Knowledge Systems. It was whilst undertaking these studies that I was to become acquainted with new and exciting concepts to assist in understanding and gaining insights into the complex "messy" world I am involved in my work as an extension officer. These concepts, Soft Systems Thinking, Agricultural Knowledge and Information Systems (AKIS) and an Actor Oriented Approach, were concepts that I immediately developed empathy for. They allowed me to systematically interact with a problem situation; they allowed me to improve the clarity with which I saw the situation; and they assisted me to make sense of the complicated and complex situations I was involved with (Hamilton, 1990a).

4.1.1. Soft Systems thinking

Littlejohn (1992:41) defines a system as a set of objects or entities that interrelate with one another to form a whole. The fundamental question of systems thinking is Do systems exist or are they creations of the mind? As Checkland and Scholes (1990:22) point out, a 'system' can be taken as something which actually exists, an ontological entity, or as a perspective, a concept or theoretical construct we use to study real life situations. Wilson and Morren (1990:360) define systems thinking as conceptualising the complexity and dynamism of the world in terms of holism, means of measurement and control, emergent properties, hierarchical structure, and communication processes. My position reflects the view that systems are theoretical constructs that we use to study real life situations. I use systems thinking to assist me to understand and make sense of the "real world". In this form of systems thinking, models of the "real world" are created as tools to gain insights into and to test notions about the "real world" but do not suppose to actually represent the "real world". I do not believe it is possible to capture the "real world" in a model; it is too complex, too dependent on time and space and too dependent on who is looking at it.

Checkland (1981) and Checkland and Scholes (1990) distinguish between "hard systems" and "soft systems". The distinction between the two relates to the epistemological basis of the researcher or would be knower.

Hard systems thinking is based in the positivist paradigm in which the system is assumed to exist objectively and independently of the researcher. It is characterised by the problem being defined by the researcher; the goals or desired end states being defined by the researcher; quantitative models are employed by the researcher to describe the system, and these models

using optimisation or maximisation assumptions are utilised to develop solutions. Hard systems approaches assume that the variables under study are measurable and that the relationships between cause and effect are consistent and may be discovered by empirical, analytical and experimental methods.

Soft systems thinking is based in the constuctivist paradigm in which the system is constructed by the researcher or other actors. Soft systems thinkers do not take the world to be systemic. They do not presume that their constructs can actually represent the "real world". For Soft systems thinkers *a system is a construct with arbitrary boundaries for discourse about complex phenomena to emphasise wholeness, inter-relationships and emergent properties* (Röling, 1994:387).

People are at the heart of soft systems thinking. *The objective of soft science is not to predict and control, but to stimulate self-reflection, discourse and learning* (Röling, 1994:388). Wilson and Morren (1990:105) state *the object of soft systems analysis is the Human Activity System*. These human activity systems must be looked at as complex wholes with the actors internalised into the system. Röling (1994:387) suggests that the actors in the human activity system *actively construct their own realities through learning in social processes. Reality is assumed to be constructed in social interaction through language.* As Röling (1994:387) further points out *hard science can, of course, be seen as one specific way of constructing reality*.

Whereas hard systems science has a wealth of approaches and methodologies to design and construct their models, soft systems science has relatively few. An example of a soft systems approach that I found useful in dealing with the complexities I faced was Röling's Agricultural Knowledge and Information Systems approach (Röling, 1988).

4.1.2. Agricultural Knowledge and Information Systems

A knowledge system's perspective allows an overview of the actors involved, their roles, their linkages with other actors; and analysis of how this influenced the final decisions made. It is a framework to assist in diagnosis of the constraining and enabling conditions for the application of knowledge processes.

Röling (1990) articulates two interdependent definitions of an Agricultural Knowledge and Information System (AKIS):

(i) as sets of organisations and people, and the links and interactions between them, engaged in such processes as the generation, transformation, transmission, storage, retrieval, integration, diffusion and utilisation of knowledge and information, with the purpose of working synergetically to support decision making, problem solving and innovation in a given country's agriculture or a domain thereof; and,
(ii) as sets of coherent cognitions that have evolved among members of organisations, communities or societies.

At the lowest level of a knowledge system is the individual possessing discrete knowledge and information about a subject and applying this to make decisions, solve problems and move towards their goals. It is assumed that each actor in an AKIS may generate, exchange and use information. Röling further emphasises that both the cognitive processes taking place in

people's minds, and the communication processes taking place between them and within/between institutions, are essential for understanding an AKIS. *Humans are sense making beings* (Röling, 1994). Everyone tries to makes sense out of their own experience. People assign meaning to what is going on and in and around them. Sometimes meanings are shared, sometimes they are not. How people assign meaning, and how these meanings are shared or not shared is based on information they receive from other people and their environment, and the knowledge they possess. People's knowledge shapes the information they receive, so for the same piece of information, different people will assign different meanings and arrive at different knowledge.

4.1.3. A coupled system's approach to managing ecosystems

Röling (1994:385) suggests that a coupled system comprising a 'hard' ecosystem' and a 'soft' platform for decision making about that ecosystem provides a better model and tool for integrating agricultural knowledge for natural resource management than interactive multiple goal planning models alone.

Walters and Hilborn (1978) have identified three approaches to the management of ecosystems, an example of complex systems. The first approach, called 'deferred action', implies that management should not proceed until the ecosystems are fully understood - a hard systems approach. In the second method, termed the 'passive adaptive approach', management proceeds on a basis of the best understanding of the system, but using strategies that are counter-active given that mistakes can be expected. Experience gained from the mistakes can be used to improve the model of the system - also a hard systems approach. The third method, called the 'active adaptive approach', treats management actions as deliberate experiments designed to both manage effectively and generate better information for long-term management, with the goal being sustainability.

This third approach, a coupled systems approach to managing an ecosystem becomes a process of 'learning by doing' (Walters and Holling, 1990), analogous to the systemic action learning approach recommended for research into dryland farming systems (Bawden and Packham 1991). Because there will never be perfect knowledge of ecological processes, the concept of sustainable land use will change as knowledge expands. Varying economic and social demands on management will also contribute to a changing definition of sustainability. Therefore, an active adaptive approach is preferred to match the dynamism of a bio-physical, economic and social system that continually requires the setting of new management targets (Lefroy et al. 1992). An essential ingredient of this approach to management is a monitoring capability.

4.1.4. Actor oriented approach

While an AKIS perspective is useful in modelling the system, to gain appreciation of the interactions between individual actors requires a more detailed analysis. An actor oriented approach was found to be useful in providing this. With participatory approaches, the understanding emerged that agricultural innovation should be regarded as a continuous learning process between social actors from different relevant agricultural and non-agricultural practices (Engel, 1994). Long and Long (1992) outline the concept of humans as social actors. They may act individually or collectively. They are intentional and pursue their own goals through learning, experimenting, formulating and carrying out decisions. Sometimes,

the pursuit of their goals causes clashes with other seeking competing goals. When these clashes occur, progression is achieved through social discourse and interaction, that is, participation.

Long (1989) also expounded the importance of hidden attributes such as power (status, control and authority), in relationships. Long (1992:22) defines agency as the *capacity of individual actors to process social experience and devise ways of coping with life*. Power is commonly defined as the capacity of an individual to impose his or her will upon others. Villareal (1992) expands the definition of power beyond Weber's definition of *"the probability that one actor within a social relationship will be in a position to carry out his own will despite resistance, regardless of the basis on which this probability rests"* (1957:152) to include the *probability of achieving only part of one's own project, of accepting compromises, but then pressing home one's moderate gains in an attempt to dominate as big a part of a situation as possible so that one can consider one's aspirations consummated.*

4.2. THE ORIGINAL PROJECT PROPOSAL AND ITS ASSUMPTIONS

The original project proposal (Anon, 1990) visualised the problem in terms of a transfer of technology paradigm. The inference was that science was knowledge rich while most farmers were knowledge poor. The farmers were able to be categorised into adopter categories and that each of the categories could be targeted to progress towards a more "innovative" state. The failure to adopt rested with the farmers. The adoption process could be accelerated by the input of more extension resources.

While the project proposal also included activities such as a market research exercise to better determine the direction of the project, the underpinning beliefs had a major influence on how these activities would be utilised. These beliefs were:

Science had the answers and was able to *provide specialist technical support on fallow management to QDPI extension personnel, agribusiness advisers, farmer groups and farmers.*

All the necessary innovations were known and available to be adopted. The project proposal stated that stable farming systems involve a combination of fallow management practices that *involve the complete replacement of mechanical tillage with herbicides and/or strategic grazing during the fallow to preserve protective stubble, and soil structure, opportunity no-till planting of rotation crops, especially legumes, when suitable stored soil water levels permit rotation with perennial legumes and/or grass pasture leys on soils not suited to continuous farming and for restoration of structurally/fertility degraded country, crop rotation to break disease and weed cycles and maximise ground cover, and, balancing nutrient supply with soil water availability.*

The innovations were determined as being practices that innovative farmers already had adopted and met the criteria of increasing profitability while improving sustainability. *The conservation farming systems which have been developed, largely by innovative farmers fitting individual components together.* The inference was that these innovations, once adopted by the rest of the farming community would largely solve sustainability problems.

The adoption of innovations had been inadequately achieved. *Progress towards this objective...*(of implementing sustainable farming practices)*...has been variable in different regions of southern Queensland* (with) *advanced land protection technologies...being widely applied in some districts,* (but) *these technologies* (are) *not being well utilised elsewhere.*

It was possible to group clients into adopter categories and the adoption of the available innovations was seen as a step-wise activity from one adopter category to the next. Included in the project's objectives was the statement that *by the end of the project* (the aim was) *to have:*

(i) 20 to 25% of farmers using sustainable farming systems (defined as including zero tillage systems);

(ii) 40% of farmers using herbicides as regular substitution for cultivation; and,

(iii) 20% of farmers to make an initial step into conservation farming.

The adoption process could be speeded up by the input of extension expertise. *The primary aim of the project will be to hasten the evolution of more stable farming practices over all parts of southern Queensland by co-ordinating the activities of extension officers". "This project represents an escalation of current QDPI development and extension activities on fallow management and stable farming systems".*

The failure to adopt the available innovations was blamed on the farmers. *One of the major features of the project will be the role of the local Landcare Committee members, in helping to overcome attitudinal and sociological blocks impeding the adoption of conservation farming",* and, *"conservation farming requires a change in farmer attitudes".*

4.3. ALTERNATIVE PERSPECTIVES ARE BROUGHT TO BEAR ON THE PROJECT.

The debate within extension science was beginning to question whether a TOT approach was an appropriate paradigm. The members of the team were also beginning to recognise that the technologies that were being recommended were not necessarily the "best bet" for all farmers in all situations. Landcare was starting to expand its influence rapidly and was exerting pressure to be included in the decision making of projects such as these. They were also demanding that the activities being delivered from projects such as this, should assist them to pursue their philosophy reflected by Chamala & Keith, (1994).:

Telling adults provokes reaction.
Showing them triggers imagination.
Involving them gives them understanding.
Empowering them leads to commitment and action.

Questions were raised from the start of the project within the team about the assumptions of the project and its methodology. Are farmers our only clients? What does constitute a sustainable farming system? Will a questionnaire inform us about groups of farmers that can be targeted by the project? What other forms of market research are there, and which may be suitable? Is qualitative or quantitative market research more likely to yield the results we require? These represented the initial questions the project team wished to address.

The team eventually determined to undertake a two phase market research activity. A Rapid Rural Appraisal to determine the breadth of the problem situation we were dealing with; and a Focus Group Analysis to add depth to and validate the findings of the RRA. QDPI staff, external to the project team but with relevant qualitative methodology skills were seconded to assist with these phases.

4.3.1. The initial focal research questions

The initial focal questions for my action research were in part a response to the project team's initial questions. Additionally, they addressed questions such as: Can a team of technically proficient staff be trained to adequately undertake social science methodologies? Will the involvement of these staff in a participatory process empower them to use participatory processes in later stages of the project? In effect, the project team members were equally my clients as the actors in the rural community. To prevent confusion, I reserve in this thesis the use of the term client to refer to members of the Knowledge System other than the project team and its members.

The initial focal questions were generated on the basis of the previous studies (Hamilton, 1990, Van Beek, 1988) and the internal debate within the QDPI described in section 2.1. Each question was analysed in turn in order to design a systematic and coherent research process.

The following initial focal questions were formulated.

Focal research question 1:

Does the use of participatory processes improve client decision making compared to Transfer of Technology processes?

Focal research question 2:

Does formatting information to meet market requirements improve client decision making?

Focal research question 3:

Does the use of participatory processes improve team skills and empower them to use these processes in future activities?

As the research progressed, insights into and understandings about these initial focus questions allowed them to be modified, developed and refined (see Chapter 6.2).

4.4. MY ROLE / THE TEAM'S ROLE IN THIS COMPONENT OF THE RESEARCH

With the PLAR approach (see chapter 2), the project team members were as equally involved in the research as I was. At another level, other participants (for example, farmers, rural women, agribusiness) were also equal participants in the research. Hence, at various times with this approach, I occupied different roles. My own role related to three domains of learning (see Figure 10).

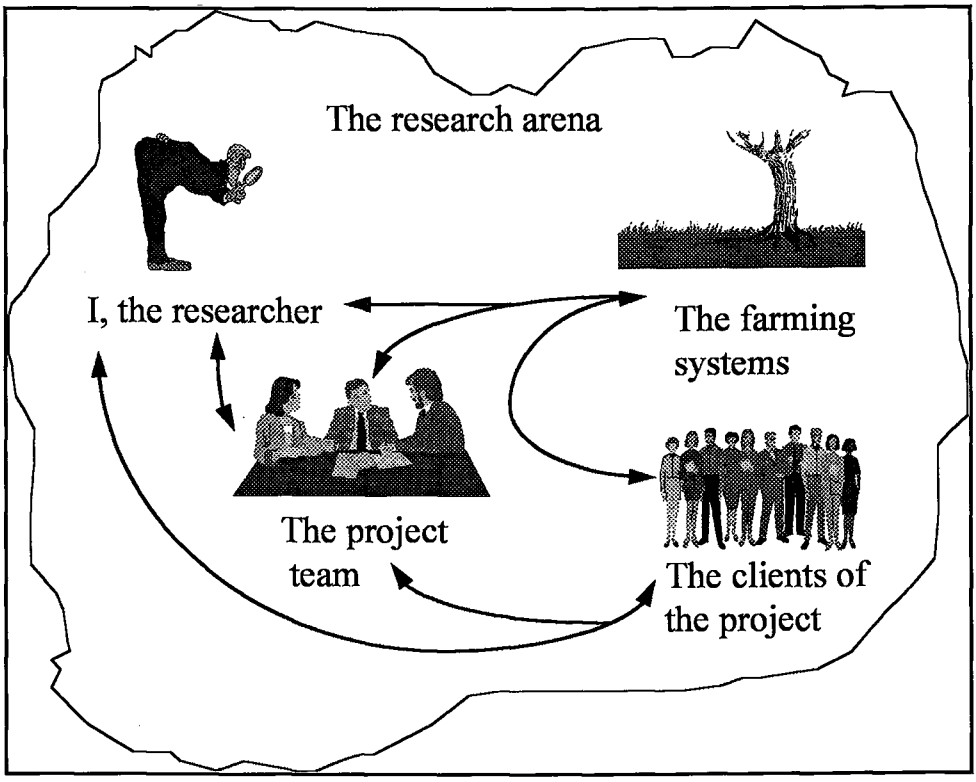

Figure 10: The multiplicity of research roles involved

With the project team as the co-learners, I conducted the research using participant research/observation, interviews, textual analysis of their written products, and a focus group at the end of the project. For this final focus group, to avoid biasing the output by being personally present (the project team was aware of my dual role as a researcher of them and a participant researcher with them), I utilised a facilitator from outside, who was aware of the project team's activities but was regarded as being independent of the project and my research.

With the clients of the project as the co-learners, I shared with the project team members a joint role as co-researcher, but undertook it more formally and systematically. I also directed/oversaw the research of my colleagues. We utilised a RRA and Focus Group Analysis at the commencement of the project. We also used participant research/observation,

interviews, and quantitative methods. We returned to the original focus groups for a second Focus Group Analysis at the end of the project. I further used textual analysis of the written products of the team.

Taking the farming as the domain of co-learning, I again shared with the project team members and project clients a joint role as co-researcher. We expanded on the research techniques used above to include innovative tools for data collection and analysis, and transect surveys to capture changes in the landscape.

4.5. RADICAL CHANGES OCCUR IN THE EXTENSION PERSPECTIVE AND APPROACH

The most immediate impact of the market research phases occurred in the project team. These are dealt with more fully in Chapter 5.7.3. In brief, this first learning exercise caused radical changes to occur in the extension perspective and approach.

The market research phase determined all subsequent activities of the project. It also gave the project new perspectives on what we were trying to achieve and how this might be most effectively undertaken. The TOT paradigm was abandoned as being inappropriate. The Knowledge System we were targeting was expanded. The team adopted a participatory learning and action research approach.

Our technical skills became less important and we had to develop new skills, particularly facilitation skills. We became participants with our clients in learning about the problem situation we were involved in. We developed tools to assist us and our fellow participants to understand and gain insights into the complex and messy problem situation of pursuing sustainable agriculture. We tested innovative approaches and methodologies, not always with success, but we jointly learnt in the process.

The impact of these new perspectives and approaches exceeded all our ambitions. Although we had experienced some criticism of our approach, these outcomes demonstrate that these approaches are powerful mechanisms for initiating change. They are more efficient and more effective. In effect, a significant paradigm shift occurred in the project team as it conducted this project.

5. THE FIRST LEARNING EXPERIENCES

5.1. OVERVIEW OF THE MARKET RESEARCH PHASE

To ensure that the efforts of the project team were optimised in terms of effectiveness and efficiency, to identify potential client groups and to align project activities with the needs of these clients, a structured effort to "research the market" was the first priority of the project. This was a consultative process conducted over two phases. The first used a rapid rural appraisal (RRA) to produce a wide overview of the problem situation. The second phase used a focus group analysis to validate and probe in depth priority issues emerging from the RRA, and to verify or legitimatise project assumptions.

The RRA was conducted within the two major agro-ecological zones (see Map 1).

5.2. PHASE ONE: THE RAPID RURAL APPRAISAL

There are many versions of Rapid Rural Appraisal (RRA). These are known under various names (Beebe, 1985). The version used by the VFSG was constructed by Peter van Beek and myself to suit the needs of the VFSG (see Van Beek & Hamilton, 1992). Our version was based on the RRA literature and on six appraisals with which Van Beek and I had been involved in, in the Netherlands and Australia. Most of these had addressed the complexities of land management.

Our version of RRA was based on the following assumptions:

- An RRA is a method to obtain a broadly-based overview of a *complex situation* about which we know very little, or about which we have very fixed ideas. It aims to make full and immediate use of the knowledge, experiences and insights of the widest possible range of people from inside and outside the situation.

- Situations are complex when:

  - there are many different and often independent people and groups;
  - there are many physical, economic, social and psychological processes; and
  - there are a large number of interdependent interactions between these.

- Being aware of the main interactions is as important as knowing and understanding individual groups and processes in the situation.

- Each individual sees reality from a unique perspective, which is strongly influenced by personal characteristics, history, background, education and position. While this restricts peoples' views and creates biases, it also gives them unique insights into parts of the complex situation. (The word bias therefore used in a positive sense).

- The insights of people from similar backgrounds, education and positions are likely to be roughly similar; for instance, farmers, bankers or researchers are more likely to agree with their peers than with other groups.

- It is unlikely that an important aspect will be overlooked when a situation is approached from a wide range of perspectives and experiences and when the insights gained from these are brought together.

- It is not possible or necessary to seek an optimum solution before taking action, or one which will satisfy all stakeholders.

- Improving any aspect seen as important from a wide range of perspectives is likely to lead to an improvement in the situation as a whole and satisfy many stakeholders.

- Any RRA will change the situation it is trying to understand simply by being carried out, hence:
  - the participants are a dynamic part of the situation and cannot be objective outsiders; and,
  - the RRA needs to produce both immediate results and follow up actions in order to deal with the expectations created by it.

5.2.1. Mission

The mission[3] for this RRA was:

- to produce, within strictly limited time, the widest possible overview of aspects, people and processes which could be relevant to a situation;

- to indicate how these aspects related to and interacted with each other.

- to indicate which aspects were seen as important from different points of view and which could be acted upon immediately; and,

- to widen the views participants had about the situation and provide a common basis for understanding and future cooperation.

The mission of the RRA was not to provide statistical analysis or quantified measurements. The RRA was heuristic, in that it reported on what is there and provided leads for further

[3] Mission is a term commonly used in the QDPI which is equivalent to an overall major goal.

questioning. It was not diagnostic in the positivist sense, in that it did not report on what is wrong, provide solutions to the determined wrongs or determine how issues rank. It is diagnostic in the constructivist sense in that it did assist problem situations to emerge, and assisted in determining possible interactions to assist improving these situations. Analysis and priority setting were tasks left for follow up activities.

This RRA tried to identify the widest possible range of relevant information in current cropping systems in southern Queensland by:

- reaching a wide cross-section of the relevant community,
- adjusting the definition of what was relevant during the exercise, and,
- not excluding any related material from the report.

The conduct of an RRA was seen in the QDPI to be justified if it significantly increased confidence in the choice of consecutive projects. It would not be justified if the report was seen as an end product in itself. Furthermore, in our view an RRA by itself would not be very useful. It needed to be part of a larger set of methods, which must include repeated structured contacts with the main stakeholders within the two zones. Such structured contacts were seen to be necessary to prevent vested interests from again redirecting follow-up activities to their ends.

5.2.2. Preparation

The concepts of an RRA first were introduced to the VFSG itself during a two day workshop. The introduction given above was used to open a discussion about what an RRA could do and how an RRA relates to other specific methods. Expectations of outcomes were discussed to ensure that they were realistic and reasonably consistent for the major participants and stakeholders that were expected to be included. The VFSG then determined the size, the objectives, the geographic boundaries and the land uses to be included. It was decided to utilise two teams to conduct the RRA in order to try and capture the agro-ecological diversity, across the geographic scale in which future activities would take place.

A number of *focal points* were decided after small group brainstorming sessions:

- current management of farming systems;
- reasons for the current system;
- past and future changes of the system;
- how well the system fits family and social patterns; and,
- which information sources are used when contemplating changes.

A number of opening questions were determined and tried out for use with different groups of interviewees.

Skills were introduced, discussed and practised, including:

- Role plays of interviews and discussions of findings and feelings;
- Interviewing skills;
- active listening;
- asking semi-structured open ended questions;
- reflective questioning and probing; and,
- using of value neutral gestures and comments.

5.2.3. Setting up the RRA team

The RRA team consisted of VFSG members and external participants seconded to jointly conduct the research. The focal points were used to generate a list of "desirable" biases. The "biases" of the VFSG members were listed and placed in a matrix. These "biases" were then counterbalanced by placing in the matrix names of people potentially interested in collaborating in this exercise and listing their biases. The overall matrix was analysed to select the most useful biases, based on the criterion, "to have as wide a range as possible". The range included as many opposites as were deemed relevant: male and female, young and older, practical and theoretical. A range of desirable disciplines was also considered: social, biological and other relevant sciences. Other characteristics related to peoples' backgrounds, for instance if they were producers, conservationists or researchers. The final selection included a veterinary surgeon, a business woman, a forestry officer, a female PhD student from Zambia, a rural woman, a forestry extension officer, and a beef cattle research officer. The VFSG project staff and the selected participants were equally divided into two teams. Each team was also served by a process manager and a logistics manager.

5.2.4. Selecting the interviewees

The situation in which the VFSG was operating was terra incognita with respect to the identity of stakeholders and how they interacted. Sampling in a statistical sense was not conducted. RRA's do not comprise statistically representative samples. The aim was to interact with reasonably typical respondents as key informants with respect to the diversity among the unknown population and reduce spatial, agroecological, gender and socio-economic bias, that is, purposeful sampling (Bernard, 1988). The first stage thus was to divide the region into its two agro-ecological zones, and to select a typical district from each zone. Within these zones, the VFSG brainstormed the widest possible range of potential interviewees (types not individuals) and selected key groups from which to draw the first day's interviewees. The resulting list was divided into primary respondents and informed persons. Primary respondents are people who make decisions within the situation, such as farmers. Informed persons are those who have a valuable outsider's view based on their daily activities. These included stock and station agents, bankers and extension officers. Lists of people in each category were formed and the visits for the first day decided, with the major criterion being the need for diversity.

Using information gained from the first round of interviews, future interviewees were selected by *peer referral*. When determining respondents by this method faltered, we returned to the original list to gain further perspectives while still pursuing diversity.

Overall, interviewees included farmers from a variety of circumstances, their wives and sons, agribusiness managers, bank managers, accountants, consultants, public servants, machinery manufacturers, a school bus operator, and a minister of religion.

5.2.5. Team building and task clarification

The VFSG introduced the RRA concepts to all interviewers, gave an overview of the area and explained administrative procedures and working arrangements. Interviewers were then trained in semistructured interviewing. One trial interview outside the area was arranged, followed by a trial debriefing. The purpose of the final report was discussed and arrangements were made to record and capture the rich detail which would not be included in the final report, in the form of attachments, notes, tapes and supplementary reports.

5.2.6. The interview period

During the interview period, pairs of participants conducted as many interviews as logistics and time allowed. The interviews were about one hour each. One member concentrated on recording (eg notes and tapes, where the interviewee agreed), while the other led the discussion. These roles were reversed between interviews. The interview was followed by a reflection as soon as the interviewers were out of sight of the interviewee. This aimed to capture the essence of what people had said in note form using a debriefing sheet listing the main foci of the RRA. The interviewers were warned against reinterpreting, selecting or commenting upon what people said. The pairs were changed daily to give participants maximum exposure to different ways of seeing the world.

Debriefing at night was led by the process manager. During the debriefing, the day's findings were listed on flip charts. These included suggestions for further interviews with people who appear to be influential or different which were given to the logistics manager. Each pair in turn mentioned two notes at a time from their debriefing sheets until all notes taken during the reflection periods had been listed. Each item was given a sequential number, and an identification of the perspective from which it was raised, for instance owner of a large farm, teacher, or bank manager. Confidentiality was respected at all times. Space was left for later identification of clusters of related aspects of issues. The focal points and opening questions were reviewed after all findings had been recorded.

During the second day the managers looked at the notes to identify clusters of aspects or issues of similar nature. During the second day's debriefing these groups were suggested to the whole team as potential clusters around which to structure the report.

5.2.7. Reporting

The clusters formed the basic sections of the report. Each cluster was allocated to one pair on the final interviewing day. The pairs for the last day of interviews were also composed towards this end, to allow them to follow leads of special interest to their cluster. The draft report was written, discussed and approved by all team members on the last day.

The report aimed to be more than a "wish-list" or a list of generalities. It aimed to illustrate the diversity in the situation and indicate which of the findings were likely to be the important ones as seen from different perspectives. Recommendations were made about immediate

follow-up, as well as about longer-term opportunities and more detailed projects. The report aimed to fulfil the requirements of the paymasters and the people interviewed. The completed report was sent to all participants and feed back was received and noted.

5.2.8. Follow-up

Follow-up was planned by the local team members as part of the reporting session in order to capitalise on the expectations and local energy created by the RRA. In the final analysis, we were overwhelmed by the data we had gathered and did not anticipate the energy we created. We instigated the follow up using the Rainfall Simulator, which although already conceptualised prior to the RRA, fulfilled the needs of the RRA and was true to the direction suggested by the RRA (see Chapter 8.1)

5.2.9. Pitfalls

We learned there are a number of pitfalls in conducting an RRA. Awareness of these pitfalls assists in avoiding them and lends rigour to the process. The pitfalls included:

- domination by one or a few biases through poor selection of the team;
- using the RRA to justify current projects and staff;
- using it as a sightseeing tour;
- trying to be complete and thus superficial in each individual interview, rather than exploring in depth those aspects which the interviewee regards as important;
- failing to adjust focal points when these are shown to be inappropriate;
- making it analytical or diagnostic instead of reporting what is there;
- failing to keep details about the methodology and application, names, dates, roles and functions of the people interviewed;
- failing to record and use existing data, observations, casual remarks or impressions;
- dismissing qualitative data, because of the lack of statistical confirmation; and,
- taking the result itself as baseline data, rather than as a guide for the development of baseline data.

5.2.10. Findings

The RRA revealed:

(i) **important elements** (and hence linkages) of the knowledge system that were not encompassed by the original proposal, including farmers, rural women, banks and accountants, farmers' sons (and daughters), agribusiness, agricultural colleges, Landcare groups, and machinery researchers, developers, salesmen and extension staff and users, and some indications of preferred communication methods;

(ii) **areas of knowledge deficit that required further investigation** during the subsequent phases of the market research in order to allow action to be planned and implemented, including, the economic aspects of farming systems and the role of economics in decision making, farm succession, the uneasiness about farm chemicals, the problems of farm machinery, the potential of organic farming; and,

(iii) **areas of knowledge deficit that required action** (to be planned and implemented in conjunction with clients) to develop or capture the required knowledge, including the potential

role of farming system alternatives such as cotton and ley pastures, the accumulation and loss of soil moisture and how to optimise the process, and the relative importance placed on the relationship between soil erosion and soil moisture accumulation.

These revelations were explored in greater depth in the Focus Group Analysis and are reported in section 5.5.

The RRA made one major mistake. While farmers nominated information that we knew had emanated from research, they did not nominate research *per se* as a key respondent. Hence, we did not include research officers as a stakeholder group that required involvement in the RRA. This proved to be an obstacle to the wider acceptance of results and undoubtedly we failed to capture the richer picture that their input would have given us.

5.3. PHASE TWO: THE FOCUS GROUP ANALYSIS

Focus group analysis comprised the second phase of the market research. Six focus groups were conducted across the region. The groups repeated the agroecological zoning used in the RRA and the major fallow management strategies being conducted within these zones. The resulting discussions were recorded, transcribed and analysed using a computer aided textual analysis program - *Ethnograph.* Data were analysed under three categories - factors affecting decision making, information sources, and preferred communication methods.

The **primary objective** of the focus group interviews was to cross-check with *farmer's* and *rural women's* issues raised in the RRA exercise and pursue these issues in more depth.

Although the RRA demonstrated that farmers are linked to a wider knowledge system, the Focus Group Analysis included only farmers and rural women. They ultimately are the decision makers with respect to change in farming systems and have to bear the consequences of these decisions. It was determined that gaining insights into the complexities these primary decision makers were facing warranted utilising the Focus Group Analysis solely with farmers and rural women.

The **secondary objective** was to strengthen study design through *triangulation.*

Triangulation involves the use of different methods to study the same problem or situation (Patton, 1990:187). It provides a way of cross-checking qualitative data. The term triangulation has been taken from land surveying. Fielding and Fielding (1986:23) explain that knowing a single landmark only locates you somewhere along a line in a direction from the landmark. Whereas with two landmarks, you can take bearings in two directions and locate yourself at their intersection. Studies that use only one method are more vulnerable to errors linked to that particular method, than studies that use multiple methods.

5.3.1. Focus groups

The origin, purpose and conduct of focus groups is widely documented (Burns and Grove, 1987; Krueger, 1989; Patton, 1990; Stewart and Shamdasani, 1990). Focus groups involve an interview with a small group of people. Although focus group interviews can produce quantitative data, they are almost always conducted for the purpose of collecting qualitative data (Stewart and Shamdasani, 1990:12). Focus groups can also provide a means of exploring the ways potential

survey respondents talk about objects and events, identifying alternatives for closed-ended survey items, and determining the suitability of various types of scaling approaches.

5.3.2. Selecting the focus groups and their participants

Six focus groups were conducted. The focus groups aimed to reflect:

- the two agro-ecological zones:
  - sub-tropical and
  - semi-arid; and,
- the three major fallow management systems being used within them
  - zero tillage (complete elimination of tillage in the fallow);
  - reduced tillage (certain tillage operations replaced with herbicides or sheep);
  - mechanical tillage (complete preparation of the fallow with tillage implements).

Local VFSG members organised and moderated five of the groups. An experienced moderator independent of the QDPI, was contracted to conduct a group in one district as a cross check on our process and bias (further triangulation).

5.3.3. Selecting farmers and rural women

Farmers were defined to be potential candidates if they were:

- cropping more than 50 ha on the eastern Downs, and 200 ha on the western Downs;
- participants had to be located within 60 minutes travel time from focus group venues;
- not respondents interviewed in the RRA exercise.

Participants were selected from existing mailing lists and Election Rolls. If the person selected met the respective selection criteria, they were included on the focus group list. If not, they were skipped. If a person's details were not known, either the person or an associate was contacted to assess eligibility for group selection. The process was continued until eight prospective participants and six reserves were chosen per group. If prospective participants could not be contacted after three attempts, reserves were then contacted.

5.3.4. Inviting respondents

Moderators initially contacted prospective respondents by telephone. Following an introduction, moderators informed respondents that they would like to seek their views on how to increase the viability of their farming operations. They were invited to attend a small discussion group with other farmers to talk about the issue in detail.

The advantages for them were stressed. These were:

- the opportunity to have input into QDPI programs on farming systems, to ensure future programs were relevant to them;
- the opportunity to exchange ideas with other farmers; and,
- to enjoy a free outing.

Over 90% of respondents initially invited to participate in groups accepted the invitation. The main reason for not accepting invitations was inconvenient timing of the focus group.

Respondents who accepted the invitation were advised of details and that the focus groups were expected to run for up to two hours. It was stressed that input would remain confidential outside the group and that individual identities would not be revealed. Invitations were reinforced with a follow-up letter which confirm necessary details. Venues were selected close to the farmers' own environment. Focus groups were conducted at a time suitable to participants. Food and refreshments were provided.

5.3.5. Moderators' role

The main functions of the moderators as detailed in Krueger (1989), Patton (1990) and Stewart and Shamdasani (1990), were to:

- focus the interview on the relevant subject area in a non-directional manner;
- establish rapport (empathy and understanding without judgement), make participants feel relaxed, and promote free interaction;
- ask open-ended, neutral, singular and clear questions to ensure quality answers;
- suppress dominating respondents by encouraging passive group members to participate; and,
- record and analyse the interview with assistance from field notes and tape recordings.

VFSG moderators were given training in group interviewing skills at workshops with QDPI and external specialists.

5.3.6. Running the focus groups

Focus group discussions were recorded on tape (with permission) to assist analysis. The focus group discussion was conducted in two parts.

Part A of the focus group interviews aimed to check and probe issues raised in the RRA exercise through *unaided recall*. By discussing how the viability of their farming operations could be improved, it was anticipated that many of the issues raised by other farmers in the RRA exercise would be re-established in an unprompted way.

Part B was aimed to cross-check and further investigate issues raised in the RRA exercise, but not previously raised in part A or the introduction to the focus group. This involved prompting comment on the issues which were not previously discussed. It also involved probing for further information on important issues that were inadequately covered in part A.

5.3.7. Capturing the information

Brief notes were recorded during interviews to: check the interview direction; confirm earlier statements; summarise the interview; pace the interview; and analyse it. The act of note-taking also served as a form of active listening. Notes could be used as a backup in case tapes failed. However, moderators were warned to avoid becoming distracted from their primary functions of directing the group interview and interpreting output by taking too many notes.

Analysis was done by the moderators of the focus groups and by an independent detailed analysis using the *Ethnograph* software package. *Ethnograph* allowed multiple perspectives to be documented, contextual information to be captured, and the exact record of the discussions to be analysed rigorously.

5.3.8. Ethnograph

Ethnograph (Seidel, Kjolseth and Seymour, 1988) is a computer software package. It assisted us in the management and analysis of data, and the search for patterns and themes. Text databases can be used to test and re-build tentative theories by searching for data that challenges such tentative theories (Patton, 1990). It allowed us to isolate issues from a large dataset and study these from different angles. It did not however, remove from the us the interpretative duties associated with analysing text data.

Wordperfect text transcripts of our recorded interviews were loaded into the *Ethnograph* database. These were coded (and recoded), and sorted into categories. This enabled us to review text, mark segments, and then display, sort and print segments in any order or sequence. This made it easier to interpret and compare segments either with each other, or with segments in other categories. The process was reiterative, which allowed continual data recoding to smaller, more precise categories.

The database and codes used in *Ethnograph* were maintained as an ongoing process and reinterpreted or added to over time. *Ethnograph* allows additional data to be collected and interpreted, and the original data to be analysed and interpreted from different perspectives. It is also in a format that was used by other researchers.

The coding process is the most crucial stage of the analytical process as it has the potential for the introduction of bias. To reduce bias, the coding was done jointly by a VFSG member and an outside person.

Written text used in *Ethnograph* and oral dialogue can be interpreted differently. Written text contains greater detail but does not allow the user to detect non-verbal communication and variation in verbal meaning, feeling and colour. Using either written text or vocal text alone could reduce the total data set. To avoid loss of data, we used written text from *Ethnograph* in conjunction with the moderators' interpretations of focus groups.

Data were analysed under three major headings:
(i) *factors affecting decision making*,
(ii) *information sources*, and,
(iii) *communication methods*.

Data in *Ethnograph* and the moderators' reports were searched iteratively for themes, patterns, and overt and underlying messages. Key points were listed under the headings of:

(i) *problem,*
(ii) *solutions offered by farmers,* and,
(iii) blockages to these solutions,

and listed in tabular format for ease of use. The issues validated in the focus groups were used to assist in designing quantitative processes to evaluate project progress and impact.

Features of the process are:

i) needs analysis, implementation and evaluation stages were inbuilt into project design;
ii) potential users of VFSG programs and products are actively involved in all stages;
iii) both qualitative and quantitative research techniques are used;
iv) design is *emergent* and *reiterative*. Each step is contingent on the knowledge gathered from the preceding step. After each cycle, the process starts again. Products and programs are developed and continually refined with input from users, and,
v) issues were raised that were beyond the competence of the VFSG.

5.3.9. Findings

The Focus Group Analysis revealed that:

- the situation we were intervening into was complex, with an associated extended Knowledge System;
- actors had preferred communication channels;
- decision makers required information supporting strategic decision making rather than operational decision making; they already possessed information for operational decision making;
- decision makers required understanding of the fundamental causes of land degradation rather than prescriptions of solutions; and,
- the information requirement extended beyond technical information to economic and social information and the interactions between these.

5.4. COMPLEXITY OF THE SITUATION EMERGES

The market research phases illustrated that we were dealing with a complex situation with a wider "Knowledge System" (Röling, 1988) than just the traditional client group of farmers. It also demonstrated that what science saw as the "best bet" options was only part of a wider array of options being implemented, often for very good, rational reasons. This expansion of information on factors influencing the decision making process illustrated that the decision making process is complex and factors include far more than just biological and economic factors; and even these factors have different interpretations for different individuals in the knowledge system.

The original project proposal focused on the linkage between **extension** and **farmers**. The RRA and the focus group analysis revealed stakeholders and linkages that were not originally targeted or which had insufficient emphasis placed upon them.

The main stakeholders revealed were:

Rural women who were found to have a major impact on decision making, especially "whether to" type of decisions;

Banks and Accountants who could have an impact on implementation of decisions yet lacked the information to make informed judgements; which possibly results in conservative reactions and works against change;

Farmers' sons (and daughters) who have been to agricultural colleges. These people were seen have potential to create change on their family's farm and on surrounding farms and should be targeted for knowledge maintenance and for their potential to act as agents of change;

Agricultural colleges, integral in the early farming knowledge transfer to farmers' children and consequently has the potential to establish the foundations for change;

Landcare groups, who were potentially important factors in creating change. Reaction to Landcare amongst the interviewees was diverse, ranging from enthusiastic support and involvement in the concept to regarding Landcare as a fad that lacked direction and was only addressing superficial problems;

Machinery researchers, developers, exchangers and users. The role of machinery in restricting change was nominated as a major issue and there existed the potential for the VFSG to facilitate the linkages between relevant components of the knowledge system to address the problem.

The main linkages revealed to be of importance were the linkages:

- within the family decision making unit;
- between the farm family and neighbouring farm families;
- between Dalby Agricultural College graduates and surrounding farmers;
- within Landcare groups; and,
- between private and public sector extension and the farmer.

The main missing linkages were:

- between the QDPI and Dalby Agricultural College graduates, the QDPI and the Dalby Agricultural College, and between the Dalby Agricultural College and their graduates;
- between the QDPI and members of the family decision making unit other than the farmer; and,
- between machinery manufacturers, machinery extension staff and farmers.

The VFSG revisited its initial concepts and activities in the light of these findings. The VFSG came to the view that they could increase the outputs and the impact of the knowledge system by strengthening direct linkages among main stakeholders, and ensuring that other linkages were facilitated to operate optimally, that is, by assisting people to communicate better.

5.5. THE MAJOR ISSUES THAT EMERGED

5.5.1. Economic survival

The immediate priority of economic survival was found to override all other strategic decisions affecting longer term management of farming land. Morale amongst farmers was low and linked to uncertainty about the economic future.

The economic viability of the various farming systems was unknown and/or poorly understood by all stakeholders. This topic was seen to require a major effort by the VFSG, both in terms of which parameters are important and how these parameters interact.

5.5.2. Unviable farm size

Insufficient area of land leading to unviable farm size was raised as a significant issue in most groups. *`I saw it ... all my life, fellows with small blocks, they pushed every inch of their land.'*

5.5.3. Uneasiness about farm chemicals

Concern about herbicides proved to be a major consideration in evaluating reduced and zero tillage systems. *`...zero till farming, what is going to be the long term effect of using all these chemicals instead of cultivating?'* Concerns related to: cost, buildup of chemicals in the soil, health, off site impact of chemical drift associated particularly with aerial spraying, unreliability of chemicals to control weeds, and unreliability of information.

Farmers' uneasiness about chemicals was differentiated. They were more concerned about more toxic chemicals, such as crop insecticides and veterinary products, than herbicides. Fertilisers were not considered to be as hazardous as herbicides or crop and animal insecticides.

Some farmers viewed the QDPI as being biased towards chemicals. The issue of the position of the QDPI and its perceived alignment with chemicals was seen to need further evaluation. This was to be done internally or externally and include project officers from related projects such as the QDPI focal program on chemicals in agriculture. Similarly, and perhaps concurrently, the attitudes of users towards chemicals was resolved to be further investigated.

5.5.4. Soil erosion

Soil erosion was mentioned as a concern in all focus groups. Farmers' concerns related more to the highly visible gully erosion than the less obvious sheet erosion. The implication was that farmers assess the severity of erosion on the incidence of gullies, rather than on how much soil is actually lost. This suggested farmers are not aware of, or do not believe, research data on the severity of sheet erosion. Farmers acknowledged that soil loss was lower (but still existed) on zero tilled country. Farmers were concerned that organic farming increased the risk of soil erosion.

5.5.5. Planting machinery

Machinery suitable for planting through high levels of stubble was raised as a limitation. It was also raised as an issue by eastern Downs farmers in the RRA exercise. On the western Downs, the preference was to modify stubble to suit existing planters.

5.5.6. Soil fertility

Most farmers felt that soil fertility was declining. They observed this decline in soil fertility as being related mainly to declining soil nitrogen and linked declining grain protein with the declining soil nitrogen. Phosphorus application was mentioned by western Downs farmers as a way of supplementing phosphorus deficient soils. Concerns with nitrogen and phosphorus fertilisers related to the cost, unreliable responses and extra down time at, or prior to, planting were raised. Declining organic matter levels were also mentioned.

5.5.7. Integration of livestock into the farming system

Diversification into both cropping and livestock enterprises was seen as the best way to survive industry cycles. In this respect, most farmers were already well diversified on the western Downs. Diversification options mentioned on the eastern Downs included livestock, silage and feedlotting.

Farmers acknowledged that sheep grazing fallows reduced chemical and fuel bills. Concerns with using sheep in the fallow were: poor wool returns; dingoes (a native predatory dog), the need for high stocking rates, need to move and feed the sheep elsewhere after weeds were grazed, and compaction around watering points and pad creation in paddocks. While it was common practice to graze cattle on fallows after harvest, especially sorghum stubble, this was largely for the benefit of the cattle rather than the fallow. Cattle seen to cause excessive compaction on wet or damp fallows and were regarded as less effective for controlling weeds than sheep. Tillage was usually necessary following grazing of fallows with cattle.

Farmers have traditionally made more money out of cropping than livestock on better quality soils. Some farmers *do not like livestock.* Many eastern Downs farmers do not have the necessary yards, fencing and water facilities.

There was divergence in opinion regarding the degree of diversification necessary. Some farmers believed diversification into more than two industries[4] was desirable. Others felt that participation in too many industries resulted in none being properly managed and variable costs increased excessively.

5.5.8. A change in information focus

The RRA and focus groups revealed that the VFSG's perceptions relating to the development and transfer of information were inaccurate. Farmers' information needs regarding management of farming land were found to be for information supporting *strategic* decisions rather than

[4] In Queensland, the term industry refers to the commodity produced as in the grains industry or the livestock industry.

operational decisions. Strategic decisions, (for example, the purchase of more land or changing livestock/cropping mix), were further seen potentially to have a much greater impact on farm viability than operational decisions, (for example, variety selection and choice of spray rates).

Current technology (which encapsulates information for operational decision making) already was in the possession of farmers and was well understood. This finding suggested a change in emphasis in the information the VFSG was developing and transferring. Transfer of operational type information could be reduced to maintenance extension, based on knowledge believed to be already in the possession of the QDPI but needing to be collected and formalised.

It was found in addition that there was a need to develop common definitions so that misunderstandings could be reduced, particularly with regard to the requirements necessary for the enhancement of sustainability.

5.5.9. Farmers' information needs for better decision making

Farmers required information that addressed the *fundamental causes* of land degradation, for example, managing soil types within their production capability, fertility restoration programs, and coping with unviable property sizes.

We found groups of farmers that collectively possessed the knowledge to overcome many of their land use problems. However, they also had genuine reasons for not applying many of the solutions offered by the QDPI to manage these problems. This raised important new questions for the VFSG: in what sense were technologies and information offered by extension truly appropriate? How well had research and development defined the nature of the problems for which they were offering solutions?

5.6. SPECIFIC INFORMATION NEEDS

Specific information needs also emerged from the market research.

5.6.1. Alternative farming systems and fallow management systems

The market research phases 1 and 2 suggested it was necessary to define the full range of farming systems and fallow management options, and to package information relevant to each, for example, zero tillage, mechanical stubble retention, partial herbicide replacement, organic, etc. It was also determined to be important that a balanced presentation of options be undertaken, and care taken not to appear to be promoting one system over another. This finding challenged the assumption that zero tillage was the best option.

5.6.2. New components of the farming system

Two fairly recent components of farming systems - cotton in the eastern region and ley pastures in the western region - were found to need specific attention to ensure that their incorporation into existing farming systems maximised the benefits and minimised the costs, both in terms of economics and sustainability

5.6.3. Machinery

The role of machinery in the range of farming systems was unknown and/or poorly understood. As the VFSG had no skills in machinery technology, it was resolved that the VFSG would attempt to "manage the knowledge system", by creating and optimising linkages between farmers and relevant people with machinery technology skills, for example, machinery companies and research.

5.6.4. Farm business management skills

Economics was an issue that the RRA appraisal indicated was chaotic in the view of the participants. Economists were criticised by participants as providing tools and information that was irrelevant to farmers.

Farmers felt they lacked farm business management skills. The RRA and focus groups revealed a wide range of knowledge about, and use of, standard economic tools. Opinion varied on the appropriate method, and the importance, for example, of budgeting. Farmers who did written budgets primarily did so for their bank manager or tax accountant, rather than for the purpose of assisting with on-farm decision making. Several farmers felt that improved skills in budgeting and farm business management would contribute to better long term planning and risk management. However, others felt that the major variables effecting profitability were obvious without the hassle of having to do a formal budget.

Methods of budgeting varied widely. Written or computer budgets were one way; however, variation in season and returns often rendered the projections inaccurate. Some farmers felt that budgets done mentally or '*...on the back of a newspaper over breakfast*', were just as useful and accurate as detailed written budgets.

Many husbands avoided bookkeeping, and their wives took this role on the farm. Most farms kept a cashbook and some worked out gross margins. All farmers keep rainfall records but there was no indication that these records are used in decision making.

5.6.5. Passing on the family farm

Most farmers interviewed wished to pass on the family farm to their sons. Daughters were not mentioned as potential heirs. However, some farmers interviewed on the eastern Downs saw little future in the land for their sons. Communication on transferring the farm was often avoided. The mechanics of farm transfer were not discussed nor were the goals of the inheriting generation adequately determined or accounted for in the farm transfer decision. An inappropriate transfer process was seen as contributing to management instability and rundown in property.

5.6.6. Maintaining a rural lifestyle

The preference for maintaining a rural lifestyle, once thought to be a major motivation for farmers to farm, was found to be under review. A better rural quality of life is nowadays expected than in the past. Selling out was raised quite frequently by respondents; however, a preference for a rural lifestyle, maintaining family tradition, poor land prices and no alternative job prospects were reasons cited for not selling.

5.6.7. Farmers' information sources

Farmers' own experiences and the experiences of other farmers were stated as having the most influence on both strategic and operational decision making. Spouse and children had significant influence at the strategic level of decision making. This suggests farmers learnt best from their own experiences, their spouse and children, and other farmers.

5.6.8. QDPI's role as an information source

Most farmers saw the QDPI as a source of operational information, rather than a provider of strategic information. Even when information influential to strategic decision making originated from the QDPI, it was often not credited as such. This suggested a need for stronger identification and marketing of QDPI personnel, programs and products.

The QDPI was valued for its impartiality and ability to confirm information gained from oral sources or previous experiences. The QDPI was also valued for being local. Farmers did not wish to be charged for QDPI advice. However, the QDPI was seen as less timely in supplying information than agribusiness agronomists. The impression gained by the independent moderator of one of the focus groups was that `*...the QDPI did not play an important or focal role in their (the farmer's) lives. The QDPI was seen as an important part of the background resources and infrastructure that the industry required.*'

The status of the QDPI was found to be directly related to individual officers continuing to be, and being seen to be unbiased, local and credible. The RRA itself was seen as an important event in confirming this identity. Farmers requested that the activities of the VFSG should be high profile with emphasis being placed on the involvement of farmers in the development and transfer of information.

5.6.9. The Dalby Agricultural College and its graduates

It was determined that the VFSG should create and/or strengthen linkages with the agricultural colleges, as their students were seen to be an important channel for information transfer, and that the VFSG should target ex-students of agricultural colleges in order to upgrade their knowledge. It was suggested that this group of ex-students, with the benefit of appropriate training, had the potential to become "agents of change".

5.6.10. Agribusiness

Agribusiness agronomists were frequently mentioned as sources of timely operational information.

5.6.11. Mass media

Rural radio programs were well respected sources of information. Conversely, farmers expressed anger that city based media were damaging their credibility through sensational and inaccurate reporting. Rural newspapers were widely read. TV was not well regarded, because of poor content and inappropriate program timing.

5.6.12. Bankers and Accountants

Accountants were mentioned as potential providers of information on farm business management. Banks were seen to have a major influence on the adoption of various farming practices but many farmers were nervous about these organisations being targeted for information input. Farmers felt that this would increase the capacity of bankers to obstruct the farmer's plans without the bankers having sufficient knowledge to make adequate judgements about those plans.

5.6.13. Landcare

Landcare was not seen as influential with regard to land management strategy by most non-members. Several farmers felt that Landcare had improved wider community awareness on land management issues. Most farmers interviewed saw the function of Landcare as keeping the *greenies* and government legislators out. The reaction to Landcare was dichotomous. There were farmers who embraced the landcare concept and were actively involved in landcare groups, but there were also farmers who regarded landcare as being irrelevant and of not much use to them. Officers employed by Landcare reacted fairly strongly the VFSG's report of these comments and spent considerable effort trying to convince the team that they were incorrect comments, or that the VFSG had misrepresented what respondents had said.

5.6.14. Organic farmers

Organic farmers were found to be a marginalised group within the rural community. The acceptance by the VFSG of organic farming as a valid world view lead to increased and improved communication between the VFSG and organic farmers. Resultant from this was a chapter in *Crop Management Notes* (Mills, 1993) specifically aimed at assisting farmers to make decisions about getting into organic farming and what the requirements were to become an organic farmer. The *Crop Management Notes* are produced and distributed to all farmers every two years, with separate editions for winter crops and summer crops. They contain ready reckoner information and information for supporting (mainly operational) decision making.

5.6.15. Communication methods

Farmers indicated that they were receptive to a variety of communication methods. No single method emerged as a general preference. Among those mentioned, the following comments were offered:

- **Discussion groups** - Farmers learnt best from other farmers and their spouse and were receptive to the use of discussion groups. Farmers emphasised a facilitator role for QDPI personnel working with producer groups rather than its more traditional teaching role. Farmers preferred small discussion groups with invited, like-minded peers, to larger and more impersonal farm walks or open days.

- **On-farm visits** - On-farm visits by QDPI extension and research officers, and by agribusiness agronomists, were highly valued. Farm visits were important because they provided first hand information and helped maintain QDPI status.

- **Written information** - Operational information, and ready reckoner information such as in the QDPI *Crop Management Notes* were highly respected by farmers. Newsletters were also mentioned as credible sources of information. Written material was regarded as being useful mainly to reinforce or confirm information gained orally or from experience. Some written material was too highly powered in parts and difficult for many farmers to understand and used too much jargon. Some farmers don't like reading written information.

- **Computer packages** - One group viewed computer packages as *interesting,* however, they felt that those available had not helped in decision making. Time spent developing such packages should not be at the expense of more hands-on extension activities.

5.7. DIGESTING AND REACTING TO THE FINDINGS

While the VFSG is the primary user of the findings of the RRA and focus group analysis, the information gathered had wider implications for a wider audience. Phase 1 & 2 had several outcomes:

- Two reports which presented and discussed the observations provided by the respondents (Hamilton, 1991a, and Blacket & Hamilton, 1992);
- Analysis of the implications that these reports raised for the VFSG and QDPI; and
- Recommendations that were made for action.

5.7.1. Critical reaction from within the scientific community

The extension assumptions associated with the RRA itself were explained and published (Van Beek & Hamilton, 1992), and were subject to considerable critical comment (see also Chapter 10.3). In particular, scientists tended to dismiss the findings as unrigorous because they were not statistically based, while those working in the farming community tended to discuss the findings as already being common knowledge.

The reaction of some areas of management and some of our peers in the QDPI was also negative. Generally, they received information from the reports and via seminars. They were extremely critical of the process and extremely critical of the results. At one (VFSG Seminar, Brisbane, 1992) an extremely heated debate arose about the validity and rigour associated with qualitative research methods and with the RRA in particular.

5.7.2. Positive reaction amongst farmers

Interestingly, farmers were also in the audience at the main seminar at which the results were presented. Towards the end of the seminar the farmers were asked for their reaction and one farmer stood up and said *that in his opinion the RRA, was one of the best exercises the Department had conducted and that they should continue to conduct more*. Unfortunately he delivered this congratulatory piece of information *sotto voce* (in a very soft voice) and not many heard it. He would have been drowned out by the volume of cat calls from the research officers in any case.

Clients' reaction to the RRA in particular indicated that they preferred this style of market research to surveys. The common comment they made about surveys was that they couldn't

express themselves fully in response to the questions and that surveys were extremely impersonal. As one farmer commented in an unsolicited response to the report on the RRA, he felt *that this was the first time that the QDPI had listened to what I had had to say.*

Over time the failure by the VFSG to reinforce the impact of the RRA and to link this explicitly to the activities that emerged from the RRA, or to report this process back to the clients, was a *failure in process.* Farmers could not make the link between what the RRA suggested should be done and the activities that aimed to improve on what should be and was done.

5.7.3. Reaction within the VFSG

The criticism at first threatened the cohesion of the team and its members lost confidence and morale. But in intensive team discussions of these adverse reactions, they realised that the criticism was basically unfounded, based on a misunderstanding of the process. Appreciation that the VFSG was involved in discovering or creating a complementary paradigm began to develop within the VFSG and cohesion and confidence increased once more.

Phases 1 & 2 had given the team increased confidence that they were on an exciting and important learning path. Team cohesion, and empathy with the range of people involved directly or indirectly with farming were created. As a result, attitudes of team members' changed.

In this respect, undoubtedly the biggest impact was brought about by the greater understanding of the multiple "world views" concerning viable farming systems. By communicating and interacting with respondents the world views of the team members themselves changed. This was particularly evident as some members of the team were not direct participants in the process, and their world views in the short term remained unaltered.

5.7.4. Lessons from the market research and changes in project direction

Balancing status empowers the respondents. The hidden attributes associated with the RRA and focus groups change the status between the interviewer and the person being interviewed. By utilising skills such as active listening, probing questioning and body language, the status of the interviewee is enhanced as their knowledge is the only knowledge that is being discussed. At no stage does the QDPI officer contribute his technical knowledge or contradict or provide alternate world views to the interviewee's world view. By balancing the status between departmental staff and the interviewee, better information emerged. This change in status was reinforced and enhanced by utilising interviewers who had little or no technical knowledge and had no status as a technical expert.

The value of alternate worldviews. The use of third party interviewers was important as this contributed to developing an expanded set of world views and uncovered issues that wouldn't have been uncovered if only departmental staff were involved. This added to the breadth and intensity of the data which in turn added clarity and breadth to the respondents' perception of their own world and world views of their fellow farmers. Non-departmental staff directly participating in RRA were less embarrassed about asking the naive question. This resulted in some of the best information being uncovered. Without these non-QDPI participants this information would have remained buried.

Developing enduring social research skills. The team members of the VFSG acquired some skills which proved valuable, indeed essential throughout the duration of the project. These skills included active listening and semi-structured interviewing. The use of probing questions and body language were skills that could normally be expected to be helpful to extension officers. These skills are rarely professionally taught to extension officers and what skills extension officers do possess, they have developed themselves over time or developed intuitively.

The development of these skills impacted strongly on the subsequent activities and the results of the project. As one extension officer with over 15 year's field experience commented *until he was involved in the RRA he felt (in hindsight) that he rarely listened to farmers. (He) went out and told them what (he) thought they needed to know and if they didn't accept that, it wasn't (his) fault (*Coutts, 1995).

In addition, the RRA demonstrated that the skills possessed by the members of the VFSG were not aligned with the needs of their target audience. This would be addressed by retraining VFSG members in the necessary skills, for example, skills in machinery selection and manufacture, skills in methods to handle complex situations, and/or by appointing officers that already have the necessary skills

Qualitative process or quantitative process? The RRA developed a range of emergent issues and a breadth of data that was not evident from a review of quantitative surveys that had been conducted in the area over the previous 10 years. The subsequent focus group analysis didn't alter these findings markedly, but had an impact on the critics' perceptions of what was important. Qualitative data provided contextual details and insights that wouldn't have been available through quantitative processes. The resultant focuses and activities of the VFSG were independent of numbers such that a quantitative survey would normally produce, the situation was so complex that the simple numerical data generated by statistical surveys are irrelevant or even misinforming. By allowing clients to determine who was to be interviewed, unknown elements were uncovered.

Which stakeholders are important? Further this process altered the importance which had been placed on various stakeholders. For example, the Dalby Agricultural College, a post secondary college for people returning to the land, and the Dalby agricultural graduates, were an element of the knowledge system that was unrecognised by the QDPI. Rural women became seen as an important element in their own right. The position of agribusiness was also changed or the perception of agribusiness was also changed. The QDPI was forced to consider that agribusiness occupied much the same role and position as Departmental staff. Moreover, farmers perceived agribusiness as being extremely good in providing operational information for operational decision making. They saw the QDPI's role in operational decision making as "being a check and balance", and the provision of information for operational decision-making in areas that generated no financial gain for agribusiness. The respondents also saw the QDPI as a duality: The "local bloke" was regarded as locally credible and unbiased while QDPI management in the regional centres and head office were regarded as being out-of-touch and driving the Department in directions that were less and less relevant to farmers needs.

Changing project management objectives. Phase 1 & 2 indeed changed the extension *management objectives* of the project. It demonstrated that *innovativeness*, a variable that we had utilised in the research proposal, was no longer a useful variable for characterising knowledge systems or farming systems. We found farmers who utilise zero till, which we had previously equated as being the most innovative practice, also used reduced tillage in combination with chemical and mechanical farming (which we regarded as being moderately innovative), or used no chemicals and all mechanical tillage (which we had previously regarded as being less than innovative). Also, organic farmers were found to be an important category among stakeholders, albeit a small one, and in terms of innovativeness as we had originally defined, they did not fit at all.

Challenging long standing assumptions. Phase 1 & 2 also challenged long standing QDPI assumptions about accountability. Team members developed new feelings and attitudes towards those who had previously been marginalised, trivialised or ignored, including organic farmers but also others such banks and agribusiness and machinery dealers. Members of the VFSG championed these groups and their causes to the QDPI and to the broader community. There was some countervailing reaction to this championing process.

Learning preferences. Phase 1 & 2 also provided information on how farmers preferred to learn. For example, they expressed no strong preference for written material, which unfortunately is a major output of departmental projects. They would prefer written material to be a backup to other alternate activities. Farmers especially preferred hands-on-learning. Women or rural women preferred to be targeted separately. While we recognised that all family members are involved in important decision making, our interaction or linkage with rural women in the past had been minimal, to say the least. It came as a surprise that they felt that they would prefer to be targeted separately. The reason one woman gave for separate targeting was that when she and her husband were involved in group activities with departmental staff, she felt that she could not express herself adequately as she had to be tactful in deference to husband's feelings. Conversely, a farmer suggested that he didn't like having his wife at meetings and activities because he was always expecting that she would make a comment that would embarrass him or expose information that he felt was too sensitive.

Information for strategic decision making. Phase 1 & 2 also discovered that information for strategic decisions was a major issue that was not being adequately addressed. The strategic decisions were the decisions that farmers felt that information was lacking on. The strategic decisions were also the decisions that had the potential to have big impacts on the variables that farmers felt were important, especially financial viability, sustainability of the land resource, health and happiness.

Creating demand, meeting demand. The literature about RRA indicates that a RRA will create a demand amongst participants for follow up activities to. While we were expecting this demand, the strength of it caught us quite by surprise. We did not at the time have any particular activities that were directly emergent from Phases 1 & 2, so we utilised the *Rainfall Simulator*. While the simulator was "discovered" as an extension tool 12 months prior to the RRA, it was a suitable activity that fitted with the demands for activities that the RRA in particular created (see also Chapter 7.1).

6. REVISITING THE INITIAL CONCEPTS - THE MAIN RESEARCH QUESTIONS AND RESEARCH DESIGN

6.1. THE ORIGINAL PROJECT PROPOSAL AND ITS ASSUMPTIONS

The market research phases had major ramifications upon the project team, the project as we now envisaged it and the interventions that we planned and implemented. The original project proposal, its assumptions and TOT approach were discarded. The proposed outcomes of our interventions remained but the proposed path (the research approach) to achieving these outcomes was radically different. The market research phases demonstrated that participatory approaches were promising mechanisms for initiating and facilitating change. Our technical skills (previously regarded as our strength) were shown to be of less relevance in pursuing the changes we were seeking (farmers were either well catered for in this technical expertise, or they already possessed it and it was readily available from a variety of known sources). We would have to acquire new skills and new roles if we were to remain important components of the knowledge system in seeking to create change. These skills were based in the social sciences rather than the technical sciences. We would have to become facilitators of change, facilitators of discovering and uncovering knowledge in diverse locations, facilitators of communication of this knowledge to a wider and more diverse target audience.

6.2. REVISITING AND REFINING THE FOCAL RESEARCH QUESTIONS

The initial focal questions (see chapter 4.3.1) were refined and expanded in the light of the results of the RRA and the FGA's (discussed in chapters 5.2 and 5.3). I initially started with three focal research questions. The third focal question "Does the use of participatory processes improve team skills and empower them to use these processes in future activities?" was relegated a lower priority in this research, not because it became less important for the project to achieve its desired outcomes but because for this research study, the acquisition and application of social science skills was of less interest. The market research phases and later PLAR activities showed that the project team had exceptional capacity to acquire new social science skills and apply them. When they did default (on occasions) to being technical experts and adopting a TOT approach, the performance of the activities diminished. Through reflection upon why the activities' performance diminished, team members returned to being facilitators and pursuit of a participatory approach. Hence, whist I started with three focal research questions, I now had two.

These two focal questions were:

Focal research question 1:

Does the use of participatory processes improve client decision making compared to Transfer of Technology processes.

Focal research question 2:

Does formatting information to meet market requirements improve client decision making.

Question 1 was refined and expanded to include:-

- identification of hitherto overlooked "actors" & stakeholders in the community;
- identification and clarification of the linkages (or lack of) among them;
- identification and amelioration of hidden attributes associated with these linkages that effect their performance;
- adaptation or creation of developing tools for co-learning;
- the role of tools to "discover" information, the role of providing information itself, and ways to link the two; and,
- creation of forums and opportunities for communication and problem solving.

Question 2 was refined and expanded to include:-

- the relationship between hidden attributes, information and information use, and ways to improve these relationships;
- the systemic relationships between types of information, particularly between information for strategic decision making and information for operational decision making; and,
- the relationship between information for the biological component of the farming system, and information for the socio-economic component of the farming system.

Utilising a modified format for research planning proposed by Gleason and Hursh-César (1992), tables 3 and 4 were developed (see next two pages).

Table 3: Research plan for Focal Research Question 1:

Does the use of participatory learning and action research processes improve client decision making compared to Transfer of Technology processes.

What data is available	For what purpose?	In what form?	Methods used	Reliability	Precision (ie low bias)	Accuracy (ie low error)	How analysed
(a) Client decision making before/after VFSG	(a) Compare and contrast client decision making before/after VFSG	Rapid Rural Appraisal before and Focus Group Analysis before & after	RRA before FGA before and after	low but appropriate fitness for function	RRA - medium-whole population FGA - medium	Low but triangu-lation	RRA is participatory analysis with return data flow. FGA by *Ethnograph* and return data flow
(b) Information available/produced - (format, access)- before/after each case	(b) Compare and contrast information available/produced - (format, access) - before/after	Information on practice change	Transect surveys Secondary information from other evaluations	High	High for primary target population	High	Statistically analysed using - SPSSX
(c) Effect of TOT on decision making	(c) Baseline data on the effect of TOT on decision making	Information on fallow management *& Crop Management Notes*	Textual analysis	low	low	low	Cross-sectional case study of activities
KAP surveys and Population surveys - post project	Post project evaluation	Reports	Statistical sampling	medium	medium	high	SPSSX

Table 4: Research plan for Focal Research Question 2:
Does formatting information to meet market requirements improve client decision making

What data is available	For what purpose?	In what form?	Method	Reliability	Precision ie low bias	Accuracy ie low error	How analysed
Research information Extension information Producer information	Identification and analysis of information set	Written information	Textual analysis. Participant observation	Medium	Medium	Medium	Textual analysis. Participant observation.
Making Better Decisions for your Property. Is Cotton the Crop for Me? Fallow Management Game and other tools	Identification and analysis of information set	Written information	Textual analysis. Participant observation Farmer/ researcher co-learning Joint development and application of tools	Medium Low	Medium Low	Medium Medium	Textual analysis. Participant observation.

6.3. INTRODUCTION TO THE CASE STUDIES

The case studies are the market research phases 1 and 2 and the activities that were developed to meet clients' needs delineated by the market research phases. They represent varying degrees of success and acceptance but they each provided insights into and understanding of the problem situation we were involved with. A brief overview of each of the case studies is presented below and they are fully described in chapter 5 (market research phases 1 and 2), and consequent activities, chapters 7 to 9.

Rapid Rural Appraisal - first phase of the market research which aimed to produce a wide overview of the problem situation.

Focus Group Analysis - second phase of the market research which aimed to validate and probe in depth priority issues emerging from the RRA.

Rainfall Simulator - already used as a research tool and had been used as a demonstration tool during the year prior to the start of the VFSG project. The VFSG developed a suitable process to make it a PLAR tool. The VFSG promoted its dissemination as an extension and farmer-controlled tool.

Soil Corer - prototype had been developed many years previously and used sporadically in the community and by researchers as a demonstration tool on an *ad hoc* basis. The VFSG developed a suitable process to make it a PLAR tool. Mike Foale, senior research officer from APSRU elaborated its design, and arranged for its manufacture. Mike Foale and the VFSG promoted its dissemination as an extension and farmer-controlled tool.

How Wet - was developed as a pen an paper exercise and later computerised to calculate stored moisture in the soil using farmer's rainfall records.

Fallow Management Game - was developed in reaction to and as a by-product of ongoing development of APSRU's work on a crop process simulation model.

With and Without - a user friendly comparative economic analysis tool - is a tool also already in use by research and extension but emerged with a refined process to be used directly in participation with farmers in reaction to what was seen as, paradoxically, both the weakness of the economic analysis of the computer simulations and the over-sophistication of the simulations as a tool for economic decision making at the farm level.

DAC course: Investing in Young Farmers - is an example of a targeted application of the experiences generated in the community when using these tools.

Producing information for farmers with farmers is an example of an effort to structure a process to the formatting of information that responded to farmer's stated needs, initially from a research context and evolved to formatting of information that responded to farmer's stated needs, from a farmer's context.

Collaborative experience of writing Strategic Decision Support Information - is an example of an effort to structure another kind of process to the formatting of information in collaboration with clients.

Participative experience of writing Strategic Decision Support Information - is an example of an effort to structure a process for the formatting of information in participation with clients.

Note: This is the order in which they are presented in the text. It is not the order they were introduced in the project. The order they were introduced in the project is detailed in Table 5.

Table 5: The introduction, occurrence and number of participants involved with the interventions in the project.

Intervention	Date of 1st Introduction	Approx. No of times occurring in project	Approx. Total no. of participants
Rapid Rural Appraisal	April, 1991	once	150 +
Focus Group Analysis	June, 1991	Twice	50 +
Rainfall Simulator	November, 1991	Numerous	1600+
Soil Corer	July, 1992	Numerous	1300+
How Wet	January, 1993	10 plus	30+
Fallow Management Game	January, 1994	5	23
***With and Without*: a user friendly comparative economic analysis tool**	July, 1992	3	10 (actively) and mass distribution
DAC course: Investing in Young Farmers	June, 1993	once	35
Producing information for farmers with farmers	November, 1991	on going	none (actively) and 2000+ mass distribution
Collaborative experience of writing Strategic Decision Support Information	November, 1992	once	150+ (actively) and 100+ mass distribution
Participative experience of writing Strategic Decision Support Information	July, 1994	once	17 (actively) and 1500+ mass distribution

Woven throughout the case studies are instances of interest such as the clash between the positivist and constructivist paradigms that could be developed in case studies in their own right. I have chosen to leave these in the case studies of the interventions where they occurred but they are discussed in chapter 10.

6.4. TYPES OF DATA COLLECTION

A variety of both quantitative and qualitative data collection methods were employed during the course of this research. Data was collected for the specific purposes of the project as well as for this research study. These two forms of data collection complemented each other - the data for the project was of use to the research study and the data for the research study was valuable to the project.

6.4.1. RRA

The RRA is a qualitative research methodology and was conducted to provide insights into the problem situation we were attempting to intervene in. We utilised researchers external to the VFSG to maximise the bias of worldview in interpreting the problem situation. We used semi-structured open ended questioning to allow the respondents to present the information they wanted rather than pre-determining the information structure and asking respondents to fit their information into our structure. The respondents were chosen by targeting the two agro-ecological zones independently and interacting with a wide range of reasonably typical respondents. These respondents were regarded as key informants who reflected the diversity of the population and allowed us to reduce spatial, agro-ecological, gender and socio-economic bias. Data was collected by detailed notes made during the interviews, tape recordings of the interviews, reflection upon the interview immediately after the interview and distillation of the key points at the end of each day. Interviewing continued until little new information was emerging. The distilled key points were presented in a report written by the interviewers at the end of the interview period. Reference was made to the tapes and notes to gain clarification where required. An abridged copy of the report was sent to all respondents. A more detailed description of the data collection for the RRA is given in chapter 5.2.2 to 5.2.8.

6.4.2. Focus Groups

Six focus groups were conducted across the region. Each focus group involved eight to ten farmers and rural women. Each focus group represented an agro-ecological zone (one of two) and a major fallow management system in use (one of three). A researcher external to the VFSG conducted one focus group to cross check on our process and bias.

The focus groups also utilised semi-structured open ended questions with members of the group discussing their views and through this communication, the richness of the different worldviews emerged. The discussions were taped and the facilitators also took notes. The tapes were transcribed and a textual analysis package *Ethnograph* was used to assist in analysing the discussions. The moderators also analysed the discussions and the two analyses were used to seek the key issues that emerged. The focus group analysis was presented in a report which was sent to all respondents.

Focus groups were also conducted with new target groups (see below) and a focus group was conducted with the project team as the subject to determine their reactions to and changes resulting from being involved in the project. A more detailed description of the data collection for the RRA is given in chapter 5.3.2 to 5.3.7.

6.4.3. Purposive surveys

Purposive surveys, utilising focus groups and/or one to one interviews were conducted with each new group we targeted. These surveys were initially used to ensure that the information derived from the RRA and Focus Group Analysis remained valid.

Purposive surveys were also used to gain insights into the changes that were occurring as a result of individuals being involved in or respondents to our activities, and why these changes were occurring. Particular interest was devoted to what we perceived to be incongruities to determine if what we were observing was as we perceived it to be or if there was a logical explanation (usually the latter).

6.4.4. Population surveys

Population surveys were conducted to quantitatively measure the changes that were occurring in the farming system and to assist in determining the causes of these changes. While these population surveys were primarily for the purpose of the demonstrating the project's outcomes, they did provide some insights into the research outcomes as well. We also utilised population surveys conducted by other groups that yielded information that was relevant to the project.

6.4.5. Exit surveys

Exit surveys were conducted with all attendees at most of the major activities associated with the project. These were quantitative surveys utilising numeric, ordinal and nominal responses and allowing respondents to provide additional comments if they wished. These exit surveys concentrated on the usefulness and effectiveness of the process associated with the activity, the current practices the respondent was utilising and the intended changes in practice the respondents would make as a result of being involved in the activity.

6.4.6. Transect surveys

Ten transects (ongoing) were laid out across the eastern and western Downs, with 100 observation points in each transect. These transects are surveyed bi-annually at the beginning and end of the summer fallow period - the period of high erosion potential. The surveys are conducted by VFSG members. Data are collected on:

- slope;
- orientation of cultivation;
- fallow management practice;
- percentage ground cover and type (growing crop, stubble from crop, weeds);
- surface roughness;
- presence or absence of cracks; and,
- prevailing climatic conditions.

To date we have 4 years of data with both summer and winter crop seasons. The aim is provide objective data to verify claims made for changes in farming practices. The transect surveys were also used to identify areas with low stubble cover for targeting with VFSG

activities. An unintended benefit of mapping crop rotations and farming systems in use over time has also resulted.

6.5. METHODS OF ANALYSIS

As with the data collection, a range of analyses was conducted on the data that were gathered.

6.5.1. Participatory analysis: FGA/RRA

As a researcher, I was conscious of the biases my worldview introduces to any analysis of data and whilst this awareness reduces the impact of worldview bias, it cannot entirely eliminate it. Consequently, the use of participatory analysis was employed to further reduce this source of bias.

In the RRA, the team of researchers who gathered the data also analysed and interpreted the data (see also chapter 5.2.6 and 5.2.7). By bringing this breadth of worldviews to bear on the data, a richer analysis of the data and the interpretation of the data emerged. Difficulties were encountered in capturing these interpretations into the report. With so many authors, writing a consistent report also proved difficult. We used this experience to structure our data analysis and interpretation in the Focal Group Analysis.

We also sought to gain divergent worldviews in the Focal Group Analysis by employing an external researcher to moderate one of the focus groups. As with the RRA, the analysis and interpretation of the data was conducted by the team who collected the data (see also chapter 5.3.7). Additionally, we used textual analysis software *Ethnograph* to analyse the data. This also proved useful in manipulating the massive amount of data we were working with. Again, the data was analysed and interpreted using *Ethnograph* by an internal member of the VFSG and an independent external researcher.

The data and codes applied to it were kept for use with a second round of the Focus Group Analysis conducted with the same focus groups in 1995. This gave us before and after information with respect to the work we had done and provided direction for the possible next phase of a new project.

6.5.2. Participant researcher/observer

As a member of the VFSG project team and as a researcher for this study I played the dual role of participant researcher/observer. I was directly involved in most of the activities of the project and depending on the circumstances, my role changed. For many of the activities, I was a major participant. In these situations, I was a participant researcher and a participant observer. In other situations, a team member from the VFSG led the activity and was the major participant. In these situations, whilst I was still a participant, I was primarily an observer.

In all situations, the VFSG team members also occupied the role of participant researcher/observer. All activities of the project were reflected upon by the team members and their learnings presented in reports on the project. I collaborated in these reflective activities with the project team. They formed an important resource for this research study.

In some situations, an external participant researcher/observer was brought in to provide an alternate perspective and insight (for example, the Dalby Agricultural College course). This added to the insights we gained from these activities and were an important cross check on our insights.

6.5.3. *Ethnograph* - textual

Ethnograph is a computer software package that assisted in managing and analysing the massive amount of data that was generated from the focus groups (see also chapter 5.3.8). The transcribed texts from the discussion groups were coded and recoded and the coded segments sorted into categories and themes. With the assistance of *Ethnograph*, searches were conducted for themes and patterns in the dialogue. The use of *Ethnograph* allows a more structured approach to the textual analysis. The coding process is the stage where there is greatest potential for the introduction of bias, so this was done by myself co-jointly with an external researcher. Analysis and interpretation using *Ethnograph* was also undertaken by myself and another member of the VFSG to further reduce bias in the interpretation.

6.5.4. SPSSX

SPSSX is the Statistical Package for the Social Sciences. It is computer based and allows a rapid statistical analysis of quantitative data. It was used to analyse the data generated from the exit surveys and the population surveys.

6.5.5. Feedback from clients: normative analysis & evaluation

During the course of the project, we actively sought and received feedback from our clients. In many instances, we also received unsolicited feedback. This feedback was important for the project as it provided a monitoring tool for the project's activities. It was also important for this research study as it provided insights from the client's perspective regarding the area of discourse and the methodologies we were applying.

6.5.6. Textual Analysis

During the course of the project, written products relating to the fallow management systems were produced, by the members of the VFSG, by other QDPI staff and by private enterprise extensionists. These texts were collected and analysed to determine changes in the perceptions of research and extension personnel over the course of the project. Particular emphasis was devoted to written texts that were updated during the course of the project such as the *Crop Management Notes* as these gave an excellent overview of the changes in perceptions over time as opposed to a single piece of written text that is time specific.

6.6. INNOVATIVE TOOLS FOR DATA COLLECTION AND ANALYSIS

The nine main interventions used in the course of the project also can be seen as innovative tools for data collection and analysis. In cases such as the Rainfall Simulator and the Soil Corer, the **farm** is the primary point at which data are collected and analysed, and the **farmer** is the main 'researcher'. In cases such as the production of *Making Better Decisions for your Property* and *Is Cotton the Crop for me*? data collection and analysis takes on the character of a collaborative activity, with the farmer and researcher engaging in iterative cycles of investigation and interpretation.

6.7. LIMITATIONS AND STRENGTHS

This research study and the project relied heavily on qualitative data. Amongst some of our scientific peers this was regarded as a limitation. They felt we were drawing conclusions and interpretations from non - statistical samples and that this was invalid. However, what some see as a limitation, I see as a strength. We were not interested so much in the how many and the what. We were interested in the why and the why not. By pursuing a qualitative approach, we were continually able to probe the issues over time and space from the respondent's perspective rather than ours, rather than capturing a snapshot in time of a situation from our perspective. The latter often gives a misleading view of a situation, especially when strategic decisions are involved. For example, to measure how many farmers were using each category of fallow management practice does not allow the respondent to adequately state his position that these are the results of decisions purposively made. They are time and space dependent. It is only through qualitative data collection and analysis that these rich insights and meanings can be captured.

A limitation of qualitative data is the time and cost of collection and analysis. Compared to many quantitative methods, a qualitative method such as a Rapid Rural Appraisal is not rapid. However, the cost in time and resources needs to be balanced against the quality of the data that is collected. The volume and richness of the data from the qualitative methods we used guaranteed that the cost was greatly outweighed by the benefit.

For much qualitative data, the bias of the researcher's worldview is always present to a degree and the detail of the method is not easily captured and described for external review. We attempted to reduce the bias of our worldview through triangulation techniques such as the use of external researchers and multiple methods.

Similarly, the interpretation of qualitative data presents the same limitation. For example, we perceived that in general farmers and the rural community were uneasy about the use of chemicals. This finding was criticised in some circles as being wrong because farmers were using vast amounts of chemicals so they couldn't be uneasy about them. While this demonstrated the poor correlation between attitude and practice, this did not change the interpretation we had arrived at. It reinforced our belief in qualitative data and cautioned us against using one variable to make inferences about another.

A major limitation of qualitative data is the reporting of process and outcomes. Because the process is flexible and dynamic, moulded to fit the situation it is being used in, there is no set prescription of process as there is for quantitative data collection. Similarly, the relationship

between the data and the interpretation is a flexible and dynamic process with no mechanistic tools available as there are for quantitative data and its interpretation. Hence, the reproducability of the process is not exactly possible as it is time and space dependent. This is perceived to be a limitation in some circles but a strength if one acknowledges that the real world is constantly changing and evolving.

7. NEW APPLICATIONS FOR OLD TOOLS

7.1. THE RAINFALL SIMULATOR

Rainfall Simulators of various kinds have been used as research and demonstration tools for many years. Our initial interest was to pursue improved farming systems' methods to optimise rainfall capture and minimise rainfall runoff and the accompanying soil loss. The twin-plot Rainfall Simulator, initially developed as a research tool, could play a useful demonstration role in achieving this objective. It soon became evident to the VFSG that it had the power as a participatory learning and action research tool to influence people's behaviour. This power soon became evident.

Prior to the commencement of the project and the attendant research process, a minor activity[5] with a farmer occurred that was later to have major implications for the project (Hamilton, 1990b). In 1990, David Freebairn, Principal Research Officer, QDPI, Toowoomba, contacted me and invited me to inspect his new research toy - a Rainfall Simulator. Rainfall Simulators had been used by scientists in Queensland for nearly thirty years as a research tool to study the impact of rainfall on soil water relations and as a demonstration tool to teach farmers how rainfall could be captured and stored rather than running off and causing soil erosion. At the time, their use with farmers was minimal because they had had little impact.

David tried to explain to me about this marvellous piece of equipment was a new improved version, and asked for some input into parameters they should research with it. At the time, I was unable to conceptualise the machinery or understand how it would work and I was sceptical about the output they would gain. Consequently, I was unable to offer too many suggestions about what would be useful to be done to improve its impact.

When it finally arrived in my district, I looked at the gadget on the top of its trailer and all the associated vehicles, staff and equipment, and I raised my eyebrows and shook my head (very discretely of course). The associated staff were also predicting teething problems which didn't add to my enthusiasm, but when they finally got the gadget up and running, I must admit that this was one cynic who was highly impressed.

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[5] This section is an edited version of a memorandum that I circulated after the exercise trying unsuccessfully, at the time, to develop interest in developing and repeating the exercise. (see Hamilton, 1990b).

7.1.1. What is a Rainfall Simulator?

The Rainfall Simulator (see Figure 11) is a transportable machine that produces 'rain fall' with drop size and energy similar to natural rain (Loch, 1991). 'Rainfall' is applied to two adjacent plots allowing two treatments to be applied and compared (see Photo 1) . The plots are separated by barriers to maintain independence between the treatments. Rainfall is usually applied at a constant known rate but is also measured for the duration of the activity. Runoff collected at the bottom of each plot is vacuumed into measuring tanks where it is easily seen and measured.

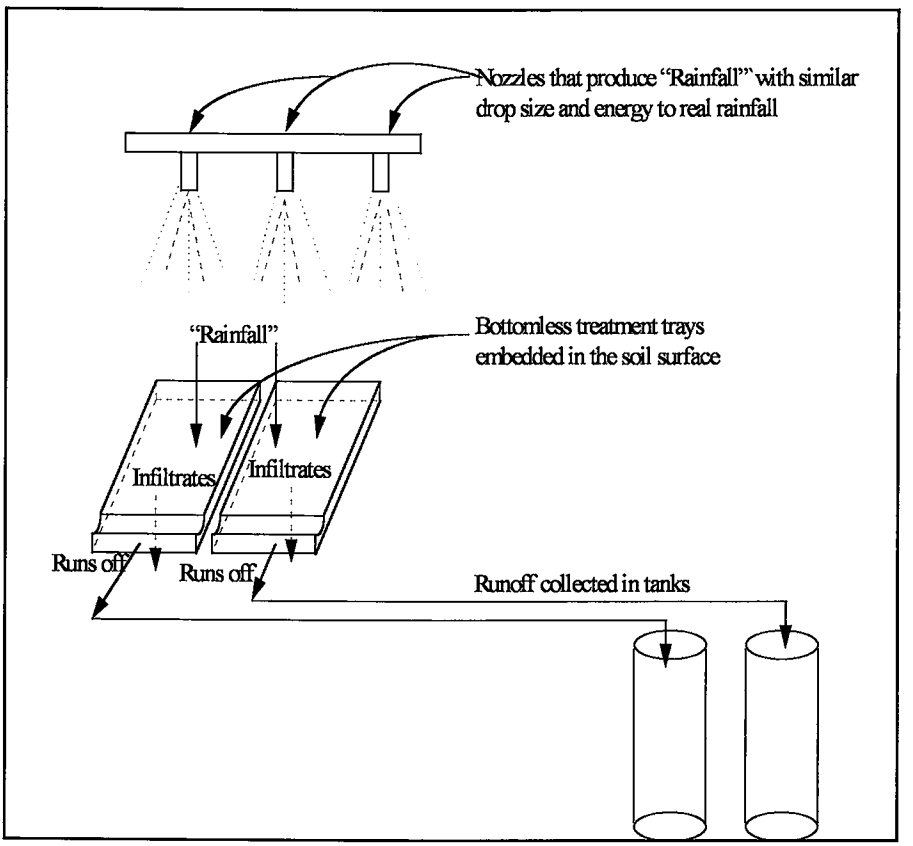

Figure 11 Schematic diagram of the Rainfall Simulator

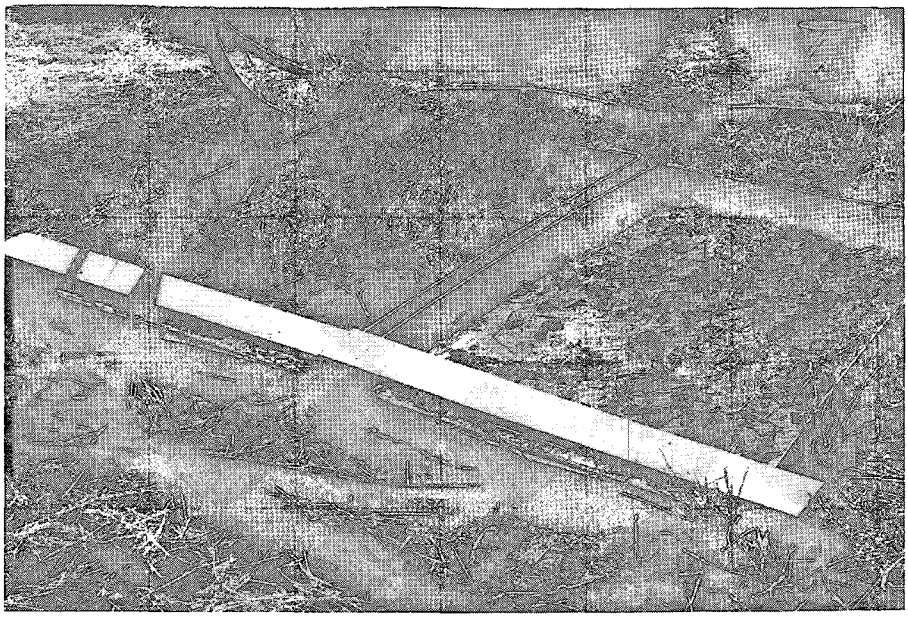

Photo 1: Two treatments are applied to allow comparative analysis

7.1.2 A Farmer "discovers" the simulator as an on-farm learning tool

Once the Rainfall Simulator was up and running, David posed the question - "What treatments do you think it would be useful to have good data on?" Given the very dry conditions prevailing at the time, and stage of the fallow, I could only offer the obvious ones that were already being covered. I suggested to the research officer that his question would be better answered if farmers told him what parameters they would like to get some data on. It should be possible to gather a handful of farmers at one of their sites and let them decide on the treatments and then observe the results. It was research officer's turn to be sceptical. He was worried about the negative impact on farmers of seeing up to ten QDPI personnel standing around apparently doing nothing, unless scribbling in little notebooks with "world wise" facial expressions and sage nods of the head could be described by farmers as work.

The next day, in spite of our uncertainty, we took the Rainfall Simulator onto a local farm and ran it on an area that the farmer had been having difficulty in managing for some time. Our opinions quickly changed due to the reaction of the farmer who came to see what was going on in his paddock. He spent a considerable amount of time peering into the tent that covered the simulator, looking at the runoff coming out of the bottom of the trays and checking the water levels and sediment loads in the collection tanks, followed by much shaking of the head and a few expletives, a determined walk around the immediate area and then a repeat of the process all over again. He then threatened to come back next day with a probe to see what had happened below the surface. The general impressions of this farmer's observations of the Rainfall Simulator travelled several hundred kilometres in the space of two days and several

more farmers contacted me as they wanted to see the machine in action for themselves. Although we attempted to generate some support to reproduce this activity on a wider scale, at the time there were no funds available and we couldn't convince anyone that this was a useful extension tool that deserved wider exposure. It wasn't until twelve months after I was seconded to the VFSG team (which included the research officer) that we were able to follow our instincts and make the Rainfall Simulator a key component of the project.

This incident provides a glimpse of the intellectual dilemma that agriculture, and particularly extension, was facing at the time and pointed to a possible direction to pursue.

7.1.3 Process

The Rainfall Simulator activities, in the context of the VFSG, were intended to be action learning processes used with small groups of up to twenty landholders. These activities were underpinned by several key components: (i) multi-channel publicity for awareness prior to the event; (ii) farmers nominate treatments and put the treatments in place (see Photo 2); (iii) farmers monitor treatment effects; (iv) farmers participate in small group discussions; (v) scientists facilitate the process of self-learning among participants; and (vi) scientists adopt the role of an expert and contribute their knowledge only when the clients are obviously drawing incorrect inferences from their observations or where the input of scientific knowledge would energise the clients to pursue further discussion and knowledge sharing.

Photo 2: Participants nominate treatments and apply the treatments themselves

Site selection was based upon (i) need derived from land use/stubble cover surveys which located areas with less than adequate stubble cover to protect the soil from erosion and lower potential to optimise water infiltration; and, (ii) requests from interested groups.

Publicity for the field days was handled at two levels: (a) regional using of radio and articles in regional rural newspapers; and, (b) local using local radio stations and local newspapers, and publicity flyers posted out to individual landholders. A publicity plan was drawn up prior to the commencement of the activities and the assistance of local and regional media was negotiated to co-opt these important elements of the knowledge system to assist in driving the process.

7.1.4. Effectiveness of the Rainfall Simulator

The Rainfall Simulator has proved to be an effective participatory learning and action research tool because: (a) it has two plots, with different treatments in each, which can be compared simultaneously; (b) results are immediately available throughout the simulation; (c) it is a visually active demonstration technique with a degree of novelty; and (d) the simulator is simple and flexible, allowing quick modifications to the treatments specified by producers.

The Rainfall Simulator allows different participants to arrive at different decisions from the same activity (see Box 1).

Box 1: An influential farmer's involvement in a Rainfall Simulator PLAR activity.

The Rainfall Simulator allows for multiple outcomes. An influential farmer, who was a member of a major funding body, had expressed doubts about the effectiveness of activities like the Rainfall Simulator to assist farmers make better decisions and change their farming practice. This made him a prime target to host a Rainfall Simulator activity. This farmer, with a small group of his peers, tested a range of options with the Rainfall Simulator. Their fallows were generally had fine tilth with no stubble cover due to the drought conditions preventing them from growing stubble, and excessive cultivation. This group tested a range of options including stubble cover (provided by hay), rough tillage, and fine tillage.

At the end of the simulator demonstration one farmer went home, got his machinery out and roughened the surface up. A result he interpreted from the action learning exercise.

Our targeted influential farmer said, *'Well, you've convinced me.'* He went out that afternoon and bought himself a zero till planter. A result he interpreted from the action learning exercise. This farmer became a strong advocate of these types of PLAR tools.

This example demonstrates that these tools allow participants to reach very different outcomes from the same event.

The Rainfall Simulator also allows participants to discover a their own version of reality rather than accept someone else's version of reality (see Box 2).

Box 2: A machinery dealer's sales spiel fails

One private enterprise machinery salesman, who invited himself to a series of Rainfall Simulator days wanting to push a particular machine that he believed would improve the infiltration of rainfall and the reduction of runoff. This machine dug pits in the soil surface to create mini dams. Rather than excluding this individual we included him in the action learning situation. He was quite vocal and persuasive in getting farmers to implement a treatment that reflected the treatment that his machine would impart. Over 5 days, in every situation, he was allowed to put the treatment in and he exaggerated this by digging the pits larger and deeper than they would occur in reality. In no situation did this treatment prove to be any more effective than any other treatments that were tested. Farmers recognised the exaggeration as a deliberate attempt to bias the outcomes. The end result was that he did more damage to his cause than good.

7.1.5. Effectiveness of method

Exit surveys, (Cawley et al., 1992, Hamilton, 1994, Cawley & Hamilton 1995), showed that the Rainfall Simulator and the associated action learning process proved to be a highly successful and effective PLAR tool (see Box 3).

Box 3 Exit surveys indicate that the Rainfall Simulator is effective.

Exit surveys, completed by participants at the conclusion of each activity, indicate that:

85% of participants found the activity useful to very useful;
91% of participants said the activity was effective in showing the relationships between rainfall, infiltration, runoff and soil erosion;
86% of participants reported the site selection and results were relevant to their farm; and,
81% of participants reported that the Rainfall Simulator activity would influence their fallow management decisions in the future.

Source: Cawley et al., (1992), Hamilton, (1994), Cawley & Hamilton (1995).

The Rainfall Simulator PLAR activities are able to be easily reproduced with many small groups at a large number of locations. Consequently, a large percentage of the target population is rapidly reached (see Box 4).

Box 4 The Rainfall Simulator hits hard and hits often.

In the four years, the Rainfall Simulator has been used in this region, over 1600 farmers have attended one or more days (Cawley & Hamilton, 1995). This represents more than 50% of the total number of farmers who farm in the south Queensland region. One farmer admitted *'I get so much out of these days that I have been to seven of them, even when they are not in my district.'*

Producer involvement in the whole process, the novelty of the simulator capturing and maintaining the producer's attention for the duration of the message sharing period and the follow up with specific written information were the keys to its effectiveness.

The simulator's effectiveness is enhanced by structuring the information (knowledge and process) in such a way that the farmer can integrate it in his/her present pattern of thinking and decision making. This pattern of thinking is often based on concrete experience as most of our learning occurs when analysing our own actions or experiences of others. The simulator allows farmers to implement their experiences and test options with fallow management (through the selection of treatments) and review them (via the results of the simulations). It is uniquely valuable in that farmers usually seek shelter during actual rainfall events and therefore do not observe the effects the simulator demonstrates.

The effectiveness of the process was further enhanced by the openness of discussions and questions that occurred. These discussions were facilitated by extension staff. But they only provided expert input when the farmer group could not provide the information they desired or if information from farmers was in conflict with scientific knowledge. In this latter case, the extension facilitators did not draw conclusions but concentrated on providing information that allowed farmers to draw their own conclusions.

7.1.6. Interest from other extension practitioners

The impact of the Rainfall Simulator in this region has attracted interest from other extension practitioners. The report detailing the process (Cawley et al., 1992) has been distributed to over 400 extension and research staff, in Queensland, in Australia, and internationally. Rainfall Simulators based on our "Tool" and process are now used in every State in Australia and in India. They (and the process) have been used in the remainder of the regions in Queensland and in grazing locations as well as cropping locations.

7.1.7. Influencing management decisions

Exit surveys (see Box 3 above) indicated that the impact of the Rainfall Simulator on influencing future management decisions was highly significant (Cawley et al, 1992, Cawley & Hamilton, 1995). The majority of attendees said it would influence future decisions on soil surface management. A follow up survey of knowledge and practice change confirmed that positive change occurred (Harris et al. 1995). Another survey, external to and independent from the VFSG confirmed these findings with marginally more impressive results (Cahill et al, 1995).

The size of the response, and the fact that the Rainfall Simulator positively influences future management decisions were initially regarded by me with suspicion, especially when farmers who were already implementing zero tillage in their fallow management suggested that their future management decisions would be influenced also. Interviews with some of these farmers found that these farmers had a fixed concept of why and how to implement zero tillage and were led to believe that any deviation from the prescription would be detrimental. After being involved in the Rainfall Simulator exercise, their perceptions changed to enable them to be more flexible in their decision making.

7.1.8. The simulator and its role in decision making.

The Rainfall Simulator PLAR program was aimed at improving the quality of farmer decision making in fallow management. This centred on decisions to maximise infiltration and minimise soil erosion.

A problem-solving decision in the PLAR constructivist and multiple perspective approach goes through 4 major phases (Kolb, 1984, Fell, 1988):

(i) a clear analysis of the problem and of its causes;
(ii) identification of possible solutions to the problem;
(iii) trying out and testing options, and,
(iv) a control system which shows whether the problem is solved by applying these solutions.

The Rainfall Simulator is influential in improving decision making on fallow management because it reflects these phases:

(i) a clear analysis of the problem and of its causes as the group discussions prior to implementing treatments helped participants to expand their understanding of the underlying causality of the problem of fallow management and what contributes to it;
(ii) identification of possible solutions to the problem as the group participants discuss proposed treatments to implement;
(iii) trying out and testing options - the Rainfall Simulator shows visually, and the group discussions allow explanation and interpretation of, the processes that occur and contribute to the problem; and,
(iv) a control system which shows whether the problem is solved by applying these solutions. The participants discuss the outcomes of the various treatments.

For making decisions farmers have to know which options may be used and what consequences they can expect from following each of these options. Impact is enhanced if producers offer what they perceive to be their solutions to their problems from their own terms of reference. The flexibility of the simulator allows farmers to nominate what treatments they see as the options and to investigate their outcomes in their own context.

The measurement of the effects of the implemented treatments on water infiltration and runoff provides a focus for the group to discuss and evaluate the merits of each treatment. The VFSG's experience in using the Rainfall Simulator with farmers thus demonstrates that tools which allow farmers to engage in on-farm learning and action research processes, to solve problems which occur in a specific context, is an essential component in bringing about

changes in understanding, and in practices which typically involve complex changes in farm system management.

7.1.9. Why is the Rainfall Simulator PLAR successful?

Part of the success of the Rainfall Simulator as a decision support tool was due to farmers' and team members' reaction to it. As one team member said, *The Rainfall Simulator and the underlying process is the most powerful tool I have seen for creating change amongst farmers. At no stage do we tell farmers what to do, rather they work it out for themselves and this seems to be very powerful.*

7.1.10. Participatory Learning and Action Research is not teaching

When the Rainfall Simulator was first used by the team members, their natural inclination was to revert to the default extension process, that is, to use it as a demonstration tool to teach farmers improved fallow management techniques. We instituted specific training to assist team members to learn to use the Rainfall Simulator as an action learning tool with farmer participation. Through this training, team members gain the confidence to utilise this process, to allow understanding to emerge amongst farmers, and to allow multiple outcomes to emerge, rather than try to control the situation and drive it towards the extentionists' predetermined outcomes. Participatory Learning and Action Research became the preferred approach and the activities performed better because of it.

For similar reasons, at the request of the farmers, we selectively excluded private enterprise extensionists as participants in the process when it was used with farmer groups. This was due to the clash between the VFSG's style of participatory learning as opposed to private enterprise's style of information transfer. Private enterprise, who were involved in the early stages of the development and use of the Rainfall Simulator, interacted with farmers by telling them what they thought farmers needed to know and by selling an outcome that they (private enterprise) desired. Farmers quickly rejected this method and asked us to exclude private enterprise from future activities.

7.1.11. There is knowledge and then there is knowledge

Group discussion arising through the use of the Rainfall Simulator exhibited four types of knowledge:

(i) Fact, where understandings converge;
(ii) Fiction, where the deduced outcomes from the observation were obviously incorrect;
(iii) Myth, beliefs by individuals or groups about a situation that are not based upon comparative analysis; and
(iv) Faction (a term of my own invention) where the linkage between two facts lead to a third fact, but the deduction has been made incorrectly.

Within the groups, these different types of knowledge were exposed, disputed and discussed. Through group discussion, common understandings were generally arrived at. Care had to be exercised by the scientists to remain equal participants in the group and not impose their understandings upon the group. The scientists had to facilitate the group arriving at agreement where knowledge conflicted. Often, these differences of opinion were due to

legitimate experiences that altered individuals' worldviews (for example, zero tillage invariably fails on hard setting or surface sealing soils but works well on soils with friable surfaces leading to differences in perspective on the effectiveness of zero tillage). In these situations, the different worldviews were explored to determine why the differences existed. Through these explorations, the total knowledge about options was increased.

In some situations, it was not possible to arrive at an agreement, usually because of some deeply held values (for example, the safety in using chemicals was often disputed). Again, rather than imposing the scientific understanding upon the group, the issue was discussed and if agreement could not be reached, the members of the group were left to agree to disagree.

The precision that farmers require of data and information also differed from the expectations of science. Farmers involved in the Rainfall Simulator activities appear to be more interested in relative relationships rather than absolute relationships. For example, they are not interested in one treatment allowing 10 millimetres more infiltration compared to an alternate treatment (an absolute measure of difference), rather that one treatment allows more infiltration than an alternate treatment (a relative difference). This is considered to be due to a single variable being only one of a range of variables that farmers consider in their decision making. How they value these variables is a personal measure and defined in relative terms rather than absolute terms. By this approach, farmers can include diverse variable such as infiltration (usually measured in mm of rainfall) and soil loss (usually measured in kgs/ha) in their decision making processes.

7.1.12. Facilitation - a key role

Team skills needed to be enhanced at beginning of the Rainfall Simulator activities. Whereas the VFSG members had previously played a role of technical expert, they were now required to play a role of facilitator. These skills can be learnt and the use of facilitation enhances the outcome of the exercise.

Facilitation is not always an easy task. In a group setting, by playing the role of the facilitator rather than the technical expert, the extension agent opened the door to individuals who had a particular perspective on the situation and wanted to dominate the group, and to try and convert the other members. The handling of this self-appointed farmer expert is difficult and must be handled tactfully. The VFSG helped group members to develop skills to assist them in handling these farmers without putting them down and to enhance the group functioning.

7.1.13. Exit surveying - part of the process

The Rainfall Simulator exercises included an exit survey (Cawley et al., 1992, Hamilton, 1994, Cawley & Hamilton, 1995). These surveys fulfilled several roles:

- They measure the effectiveness of the Rainfall Simulator;
- They assist the project team to understand the interactions between the participants and the Rainfall Simulator; and,
- They allow participants to maintain their participation in the future development of the process.

7.1.14. Other effects

1. Evaluation data from the cover survey (Knowles-Jackson, 1995), and from the quantitative survey implemented after the activity (Harris et al., 1995) reveal other effects and impacts. A big advantage that farmers see in the Rainfall Simulator is that it allows them to play with their environment, to test various options, to gather information, to gain knowledge without any direct risk, that is, the Rainfall Simulator has a major impact on strategic decision making and tactical decision making. During most activities there is very little input from QDPI concerning operational information although farmers do exchange this sort of information when they are discussing the strategic and tactical decisions.

2. Although good facilitation skills enhances the Rainfall Simulator's use as a learning tool, one of the good features of the Rainfall Simulator is the reproducability of the process. The Rainfall Simulator can be moved rapidly from site to site for a range of soil types, a range of climates, a range of stubble covers, a range of soil moistures. The Rainfall Simulator and the process have been reproduced and exported to most other states in Australia and even to India, and is not facilitator dependent.

3. The Rainfall Simulator had a significant impact on management objectives within QDPI in the region. There has been a general move towards action learning and adult education since the Rainfall Simulator has been utilised and proved so successful.

4. We used the Rainfall Simulator mainly with farmers, but we have also used it with rural women. Rural women were far more interested in the social implications of the various treatments tested by the Rainfall Simulator such as the use of chemicals in a zero tillage system, the effect of soil erosion and the issue of improved economics. Conversely, farmers were more interested in the technical issues and the economic issues and did not pay much relevance to the social issues.

5. Trustworthiness is a significant hidden attribute of the Rainfall Simulator exercise. A major effect of facilitating the Rainfall Simulator was to remove the status of expert from the QDPI personnel and to lift the status of growers by demonstrating that their knowledge was valuable and useful. It proved important that the facilitation allow these interactions to occur and allowed the process to emerge of its own free will or via the group's will. Facilitation rather than control became the preferred method.

6. We observed some farmers digging into the bottom of the plots to see if we'd inserted some impermeable sheet. Once they had discovered that the trays were only side barriers and had no bottoms, they believed in the process and conferred trustworthiness to the process. We incorporated this into the process, by asking farmers to dig into the treatments which demonstrated that the trays were bottomless.

7. The activity gained status as it was operating throughout the districts. The demand for the Rainfall Simulator soon grew beyond what was feasible and often we had groups arriving at Rainfall Simulator days far in excess of the numbers that we'd invited. The use of rural radio was also very important to the Rainfall Simulator's success. The radio agricultural commentator with an extremely high reputation in the region, became an avid supporter of the Rainfall Simulator. The interaction between the VFSG team and this commentator enhanced

the impact of the Rainfall Simulator. He actively followed the Rainfall Simulator's progress through the districts and sought interviews and advertised the activity for us.

8. Central to the success of the activities of the Viable Farming Systems Group in creating change, was the development of tools that allowed farmers to interrogate the ecosystem within which they were farming. Most farmers have little experience of the intricate cause and effect relationships that occur during a rainfall event. During a rainfall event, farmers are usually safe and warm inside their houses or sheds, feeling good about the rain that is falling. They are rarely out in the paddock observing at close quarters what is happening when rain hits the soil, how it infiltrates and becomes an important resource for crop growth, how it runs off and is lost and how it runs off and causes soil erosion. A tool like the Rainfall Simulator allows farmers to study these relationships in close proximity while remaining comfortable. To be able to stand in the sun, watch rain fall on the ground, infiltrate or runoff, cause soil erosion or be captured for use by future crops, is a new experience for most farmers. The utilisation of these tools by farmers to interrogate their ecosystem allows them to build new constructs as to cause and effect relationships and how they may use this information in their decision making for improving the sustainability of their farming system.

9. One change in practice towards more sustainable farming system practice in fallow management over the period of the Viable Farming Systems Group project was the change from mechanical tillage and stubble destruction, to increased chemical use in the fallow and stubble retention. While it is not possible to allocate these change wholly to activities such as the Rainfall Simulator, the Rainfall Simulator can be demonstrated to have had significant impact (see Cawley et al., 1992, Hamilton, 1994b, Cawley & Hamilton, 1995). Other factors such as a reduction in the price of input items such as Glyphosate reducing in price, also significantly influenced the choice farmers were making.

10. By being a participatory process, the scientists involved were also able to build new constructions of how they perceive sustainability of farming systems. For example, most scientists involved had technical expertise in the cropping areas but not in the animal industries. Yet the majority of farmers we deal with have both crops and animals on their farms. To a person with just cropping expertise and a cropping perspective, runoff is a lost resource and has a cost in terms of soil erosion attached to it. To a landholder that has both crops and animals, runoff is a lost resource to the cropping enterprise but they require runoff to store water for their animals in dams and in creeks and from this perspective the capture of runoff is a gained resource. While most farmers and scientists would agree that soil erosion and soil loss is a cost that must be reduced, there is some payoff against reducing soil erosion to nil in that stock water supplies will be adversely effected.

7.2. THE SOIL CORER

7.2.1. Introduction

The Soil Corer was initially introduced to the VFSG by Mike Foale, Senior Research Scientist with APSRU, a project team pursuing complementary activities (Foale et al., 1994). We invited him to address the Rainfall Simulator groups. From this interaction, we modified the approach from a demonstration of the Soil Corer to a PLAR approach using the Soil Corer as a tool for action learning.

7.2.2. What is a Soil Corer?

A Soil Corer, is a thin tube usually 2 cm to 2.5 cm in diameter, that is driven into the soil and removes a complete core of soil up to 2 meters. Mike Foale's Soil Corer design was made available to a commercial firm for manufacture. The Soil Corer kit comprises two tubes, a driver to hammer the tube into the ground, and a simple jack to pull the tube out. This kit retails for approximately $ AUS 80[6]. Alternatively, dies to make the tubes are available.

Soil corers have been used by research and extension for many years. Yet, most farmers have little knowledge of what exists in their paddocks below about 15 cm, the normal depth of planting. Yet, the full profile that crop roots can access has huge implications on yield and quality: the amount of water and nutrients in the total profile is of paramount importance. Although some farmers pay for commercial analysis of soil samples, operators normally do not sample the soil below planting depth, and provide no information which would enhance farmers' understanding of what is really happening below the soil surfaces.

Most farmers estimate their soil moisture capacity by utilising a soil probe - a thin metal rod that will penetrate through moist soil, but not dry. When the rod is pushed into wet soil, it penetrates to the bottom of the wetting layer. While this gives a good indication of depth of wet soil, it gives little indication as to the degree of wetness of the soil. Therefore a soil that has moisture slightly above wilting capacity (which means little available plant water) as opposed to a soil that is fully wet, will still allow a soil probe to penetrate. Use of the Soil Corer allows farmers to see and feel exactly how wet the soil is (see Photo 3). As clay based soils become wet to field capacity, their texture becomes like plasticine. Conversely, when they are close to wilting point, they become hard and crumbly. By removing a complete core, the farmers can see and feel the moisture.

The depth to which plant roots will penetrate a soil is not only dependant upon soil moisture but other constraints like structural faults (such as hard pans) and chemical faults (such as salt layers), which prevent plant roots penetrating. Again, the Soil Corer allows farmers to see where plant roots are throughout their profile and to get a good estimate of the effective soil depth they have available in their paddocks. This is done by finding plant roots down through the core and interpreting where they stop as the effective depth. Often this effective depth is also characterised by layers of salt deposits such as calcium carbonate and gypsum.

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[6] $ AUS 1 is approximately equivalent to $ US 0.76 is approximately equivalent to DFl 1.20.

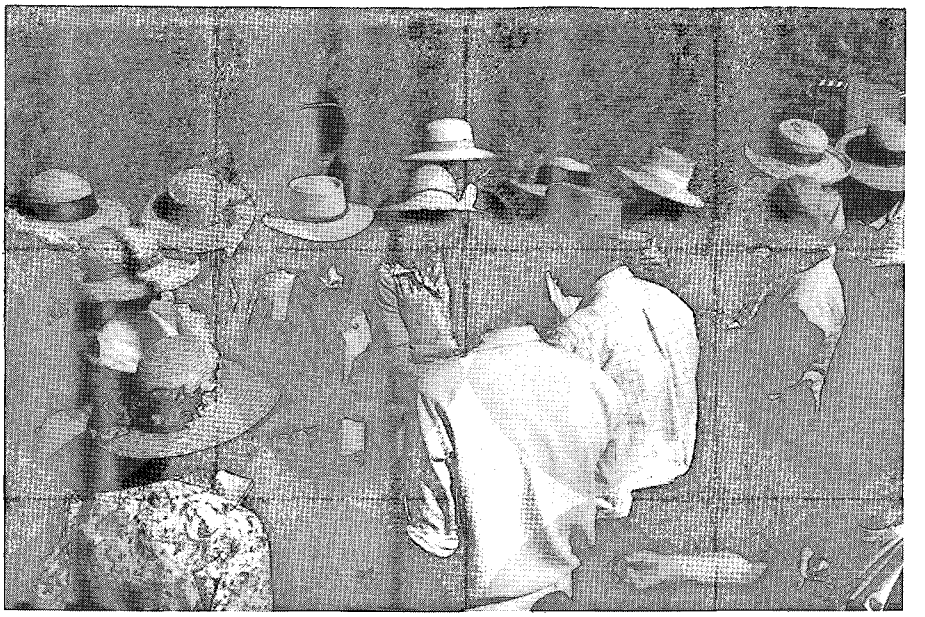


Photo 3: Rural women seeing and feeling the "wetness" of a soil core.

The simplicity of the Soil Corer and its relatively cheap cost provided farmers with a tool with which to explore their own soil profiles. A manual, 'Exploring the Soil on Your Farm' was published by Mike Foale to guide farmers in using the Soil Corer on their own (Foale et al., 1994).

Foale (1995, pers. comm.) reports that from November 1992 until March, 1994, the following sales occurred:

- 60 complete kits of the Soil Corer;
- 15 jacks;
- 6 dies; and,
- 12 templates (for groups to produce the kit).

He also reports the distribution of approximately 600 manuals.

7.2.3 Application

The Soil Corer was introduced in conjunction with the Rainfall Simulator. It was usually used to assist farmers to develop better understanding of their soil profile between the first run of the simulator and the second run of the simulator when it was being set up on a new treatment area. Farmers could determine the total water holding capacity of their profile by taking soil cores when the profile was fully wet and drying it down and comparing this to soil profiles when the soil was fully dry (such as after a crop). By having better knowledge of their soil water holding capacity, farmers had access to science produced information that was presented in terms of soil water holding capacity and it made this information meaningful. The alternative was to present the information in a way that would relate to depth of soil water

which was commonly a known feature by farmers from their work with the soil probe. However, because soil depths vary considerably across the region, and the effective water holding capacity of soils vary considerably, the depth of wet soil (determined by a soil probe) is not a useful variable to relate to information being transmitted by science.

Another benefit of the Soil Corer was that it allowed soil samples to be taken for soil fertility analysis. Hence farmers could undertake two operations at once for two outcomes.

Utilising the Soil Corer to its full capacity across the paddock or farm is a time consuming business. We found that many farmers are unwilling to invest this time so the process was modified to reduce the amount of soil coring required and to combine the corer with the soil probe. By utilising this less time consuming method farmers developed knowledge of their soil moisture profiles across the challenging scale of large paddocks or farms [an indication of the success of the Soil Corer was the number of microwaves that were blown up around the region as farmers dried their soils down without following the instructions adequately!].

The Soil Corer in itself delivered little information but it allowed farmers access to a range of scientific information which previously would have been meaningless to them because it was based upon soil water holding capacity usually measured in millimetres per hectare. This sort of information could be utilised in decision making about whether to plant or not (see Box 5), the probability of success as determined from crop models and the alternative decisions that may be made such as continuing the fallowing process to accumulate more soil moisture and planting at a later date where the probability of growing a viable crop was enhanced.

Box 5: A grower's experience using the Soil Corer

A grower bought himself a Soil Corer after being introduced to it at a Rainfall Simulator activity. He reported (in an unsolicited response) that the Soil Corer had allowed him to extensively test his soil profiles in paddocks across his farm. The moisture profiles of the various paddocks were not what he expected from the varying lengths of fallow each had had. A paddock with a short fallow that he thought would have had less moisture stored was found to actually have more moisture when he took soil cores. Conversely, a paddock with a long fallow that he had expected to have more moisture, was demonstrated by the Soil Corer to actually have less moisture than the short fallow paddock. Consequently, he altered his planned decision to plant the long fallow paddock and planted the short fallow paddock instead.

His son further reported that if his father didn't stop taking soil cores, they would not have a farm left to farm. The farmer's wife also reported that her husband had blown up the microwave oven, he had dried so many soil cores.

7.3. HOW WET

How Wet is a decision support tool which aims to give farmers a better understanding of their soil-water relationships from rainfall records (Freebairn, 1995). Rainfall records are the one set of data that the vast majority of farmers collect on a routine basis. In an attempt to make this information more useful for farmers in their decision making, and to couple this information with information generated by the Rainfall Simulator and the Soil Corer, a research scientist (David Freebairn, Principal Research Officer, QDPI, Toowoomba) developed a process which took daily rainfall figures and converted them to stored soil moisture, evaporative loss, and runoff and soil loss.

The initial calculations were done on pen and paper; and these were converted subsequently to a computer program. However, when we started to use the computer software with farmers, the "black box" nature of how the rainfall records were converted to soil water storage, runoff and evaporation, meant this information was not trusted well by farmers. We altered the process so that farmers went through the pen and paper process and understood what happened to individual rainfall events, how much was stored in the surface and lost to evaporation, and how much ran off. We then moved on to entering this same information into the computer program. By this process we opened up the black box and allowed farmers to understand how the final figures were arrived at. When presented thus, farmers then trusted the computer program and were willing to use it.

The pen and paper process also allowed farmers without computers, to participate. Such farmers are still in the majority, so access to the information by simple means is important to extension impact, although it is more time consuming to generate insights in this way. The insights created allowed farmers to access to a range of scientific information, presented in terms that farmers couldn't easily generate on their own farms. *How Wet* has the same capacity to assist farmers in decision making as the information derived by the Soil Corer, but adds an in-time understanding of sequence. Whereas the Soil Corer gives a picture at a specific point in time, *How Wet* gives a picture across time.

7.4. THE CHALLENGE TO THE DOMINANT RESEARCH, DEVELOPMENT AND EXTENSION PARADIGMS

The Rainfall Simulator, Soil Corer and *How Wet* together raised a fierce debate within the VFSG's intellectual community. By providing tools for farmers to observe and learn basic ecological principles, and to understand how manipulation of these related to management practices, the VFSG at one and the same time removed from scientists the claim to be the sole source of expertise, and from extension the role of 'transferring' information on appropriate management options.

Their use on-farm, by farmers, also raised questions concerning investment in highly sophisticated computer-based simulation modelling. If significant returns to investment, as measured in terms of changes in management practice and consequent improvements in productivity, profitability, and environmental sustainability, could be gained by the introduction of simple, cheap, easy to use and interpretable tools such as the Rainfall Simulator, Soil Corer, and *How Wet*, then the research, development and extension establishment would be forced to reconsider its whole approach to publicly-funded agricultural

support. It would be challenged also to reconsider the processes by which it sought to bring about changes at the farm level.

In particular, although in scientific terms the three tools considered here have coarse resolution and low precision, they have the advantage of being context-specific learning tools which enable farmers:

(i) to keep pace in their decision making with changes in seasonal and inter-annual changes in their farm and economic environment; and,
(ii) to know and manage the diversity of conditions across their (very large) paddocks and whole farm systems.

7.5. LEARNINGS FROM THESE NEW APPLICATIONS OF OLD TOOLS

These tools were the most powerful enhancers of our and the client's understanding of the problem situation and the most powerful initiators of change. They were highly reproducible processes for a range of facilitators, client groups, and situations in time and space. Their impact was enhanced by science facilitating the process and the client becoming the researcher as opposed to the scientists adopting the role of researcher and relegating the client to an observer. This change in roles enhances the clients' self perception of their status, and their perception of their ability to generate knowledge and the value of that knowledge. In turn, this enhances their trust in the research and its results and their understanding of the situation. This enhanced perception by the clients of the value of the process and outcomes of the research is the driving force that makes these tools and their associated processes powerful agents in creating change.

The use of the tools in group situations was also important in their success. Through dialectic discourse and joint observation, understanding is enhanced and consequently, more purposeful decision making is made by the clients. Often, but not always, convergent agreement and convergent understanding were achieved. Irrespectively of whether this convergence occurred or not, there was no judgements made about the correctness of the final position. This allowed each individual to arrive at their own position and maintain control over their own decisions.

Facilitating the process rather than driving the process as a technical expert caused some problems with the use of these tools and their associated processes initially. Adopting the role of facilitators rather than technical experts required the scientists involved to acquire new skills. They also had to accept the change in their status in the exercise that this new role implied. In this learning experience, scientists had to confront their fears about losing status by not performing the role of technical expert. Fear of perceived loss of status associated with being a facilitator was a barrier for some scientists to adopting this role. Once they had adopted the role and perceived that their status was enhanced because of it, their fears were resolved

We also learnt that these tools and processes contained "black boxes" that were not visible to the participants. For example, with the Rainfall Simulator it was not immediately apparent that the trays were bottomless, that they did not have a sheet of metal underneath them. The speed with which runoff commenced was unexpected to most clients and led to a perception amongst them that there was an artificial barrier under the soil surface that was producing an

atypical effect. When they dug into the trays and discovered no artificial barrier, their understanding immediately changed and they believed what they saw. Similarly, with the computer software version of *How Wet*, participants could not see the calculations that the computer was crunching. The relationship between rainfall figures and a calculated stored soil moisture figure remained unknown and the faith clients placed in the calculated figure was diminished. By taking them through the calculations with pen and paper, the relationship became visible and the calculations of the computer were then trusted. By opening up the "black box", clients trust in the tool was enhances as was the belief they had in the results.

The status attached to these tools was also an important agent in their impact. Status was attached to the tools by farmers as they used them. This conferred status was communicated to other clients which made these clients more amenable to becoming involved in the activities associated with the tools and through being involved and confirming the status of the tools, more amenable to change. Status was also conferred on the tools by independent and respected individuals such as the regional rural broadcaster.

We also learnt that the power of these tools in initiating change was related to the tools being compatible with the clients' preferred learning style. Farmers like to experience tangible exercises. They are less enamoured with abstract exercises like reading written accounts or computer outputs. Tools such as the Rainfall Simulator and the Soil Corer are iconic models that are tangible rather than abstract. As such they are more compatible with the learning styles most of our clients possess. Abstract models such as the *How Wet* computer program can be made more tangible by incorporating exercises such as pen and paper calculations that make the process more tangible. Their status may also be enhanced by linking them to tools that have acquired status or had status conferred upon them such as the Rainfall Simulator.

□ 8. CREATING NEW TOOLS FOR SPECIFIC PURPOSES AND CLIENTS

8.1. THE *FALLOW MANAGEMENT GAME*

8.1.1. Overview of the tool

The *Fallow Management Game* was developed by the VFSG to sequentially build on and expands the learning activities associated with the Rainfall Simulator, the Soil Corer and *How Wet*. The intention was to add to the understanding gained with one tool by incorporating the next tool into the learning process.

The Rainfall Simulator enhanced understanding of the relationship between fallow management technique, rainfall, infiltration, runoff and soil erosion. The Soil Corer value adds to the Rainfall Simulator through enhanced understanding of the soil profile, soil moisture storage and total amount of plant available moisture. *How Wet*, further enhanced understanding of the relationship between fallow management technique, rainfall, soil moisture evaporative losses after rainfall, and moisture accumulation over the fallow period. It also incorporated accumulation of nitrogen, the major problem nutrient of southern Queensland agriculture. *How Wet* utilises a farmer's existing rainfall records.

The *Fallow Management Game* incorporated the software from *How Wet* and turned it into a game that is run on a computer. It further enhances understanding of the farming system through demonstrating the relationships between fallow management and: (a) stubble and stubble cover; (b) infiltration, runoff, evaporation and soil loss using actual rainfall records; (c) nitrogen and moisture accumulation over the fallow period; (d) the costs of accumulating this moisture; (e) the crop growth as a result of moisture accumulation and subsequent rainfall; and, (f) the returns from crop yields.

The *Fallow Management Game* is still in its infancy as a game and the process are an evolving development with farmers involved in the development process. This participation from farmers will enhance the impact of the game because they are basically determining the framework and the content of the game. For example, we initially utilised very simple economic analysis. We had economic costs that were associated with the various treatments or cultivations or practices that farmers implemented. The cost of these practices could be altered by the farmers and thus the variable costs could be altered. We didn't include any costs apart from the fallow costs. Farmers felt that the resultant cash flow relationships were not reflective of reality and asked that we include the variable costs of planting, in crop husbandry and harvesting.

Unlike most computer decision support software, the *Fallow Management Game* is designed to be "played" within a group with the interaction between players being as important as the interaction between players and the game. An example of how the *Fallow Management Game* is "played" is detailed in Box 6.

Box 6: The *Fallow Management Game* in action - an example.

The players include three generations from one family/two farms and a neighbouring couple with their own farm. So the participants are:
Farm A: owned and operated by Grandfather and Grandmother aged above sixty;
Farm B: owned and operated by Father (son of above), Mother (both aged in their forties), and their teenage children; and,
Farm C: owned and operated by a husband and wife aged in their sixties. This couple are neighbours but are not related to the families of Farms A & B.
The playing of the game is facilitated by an extension officer and a research officer. The local extension officer is also present to learn how to run the process.

The day starts with the group being introduced to *How Wet*, first as a pen and pencil exercise, then as a computer exercise. The players use their own rainfall records and determine the characteristics of their own soil. This lays the foundations for playing the *Fallow Management Game*. The players are then introduced to the *Fallow Management Game*. They commence playing the game. The game starts at a determined date, for example, November at the end of a winter crop. Starting soil moisture and stubble cover are calculated by the game. The game generates daily rainfall events, one month at a time. These rainfall events are historical rainfall records for the local town, but the year is randomly selected and the players don't know which year it is. This year may be any one of the past hundred years. As a rainfall event occurs, the players discuss the effect of this rainfall on weed germination and determine if they have to implement control measures. They determine the costs of the alternate control measures on a "look up" table and modify these costs as they believe them to be. This sequence continues until the players judge that sufficient moisture has been stored and a planting rain occurs. They then plant a crop of their choice. The game then "grows" the crop and generates a yield. The players can nominate the sale price of the grain and the game determines the returns.

As the game evolves month by month, it graphically tracks soil moisture accumulation and loss, the decline of surface cover (stubble) and the partial cash flow. Also, at each decision point, the players discuss the options they see as being viable (within each family and between families). At the end of one run of the game (harvest to harvest) the players review the options they implemented and make judgements about whether they were the best options that could have been chosen.

Observations of interest arising from this exercise include:
- the willingness to play the game is inversely proportional to the age of the players but in a relatively short period of time, all players are involved;
- the wives and the children operate the computer - it is difficult for farmers with their battered fingers and thumbs to manipulate a mouse or keyboard; and,
- the players choose options that are not their usual options in real life although these options are tested.

8.1.2. Lessons learnt

The *Fallow Management Game*, when it was used by groups, facilitates learning between group members. There is an added dimension compared to most decision support software. The *Fallow Management Game* provides information to users as a normal decision support program, but it also facilitates discussion and information exchange between producers within groups. We learnt important lessons from the development and production of the game.

Our intention was to use the game to enhance our own understanding of farmers' decision making. By watching farmers simulate their farming activities in the computer game we thought we would develop an understanding of why (in their existing practice), they took up certain options, why they didn't take other options, what impact these options had on water storage, crop yield and profitability and how farmers judged the value of these variables. However, when we utilised the game with farmers, they (of course) thwarted our intentions by using the game to test options they did not (as yet) normally implement on their farms. The farmer's need for learning in a situation that didn't carry threats from failure proved to be of great benefit to them. Our understanding of existing decision making processes thus could be drawn only from our understanding of farmers' decision making processes as they tested alternative options beyond the range of those 'normally' used.

Farmers also enjoyed playing the game and expressed the impact of "farming in a fun sense" had an impact on how they responded in practice. There was initially some concern amongst scientific staff about calling the computer software "a game". The scientists felt that the term "game" gave an inferior status to the software, that farmers would react to the name "game" by treating it as a game and not a serious tool and as a consequence, not learn from it. When we went to the farmers, they had no problems with the term "game". They understood that it was a piece of software to be utilised to try to maximise what they had regarded as being a valid outcome, that is winning the game, but also thereby learning through the process how to manage "reality" more effectively.

Our original intentions were to incorporate a limited number of economic inputs and outcomes in relation to farming processes that stored moisture and the crops that utilised it. We determined that by playing the game the farmers would identify which economic variables would be useful to their decision making and we would incorporate these variables in updated versions. Similarly, other variables that farmers wished to be included would also be incorporated in updated versions. In effect, the farmers determined the framework and variables of the game rather than science. Farmers were very forthcoming in suggesting what variables could be incorporated and how the game could be made to more useful. For example, the farmers wanted the game to generate a realistic fallow weed spectrum so their decisions about control measures would be more realistic. Unfortunately, the existing research into crop modelling and simulation has not reached the capacity to model some of these variables. These variables therefore will be incorporated into the game by using "scenario cards" relevant to the local area and determined by extension staff and farmers from the locality.

8.1.3. Limitations and Strengths

A limitation of the *Fallow Management Game* (and *How Wet*) is the graphic displays used to represent the various variables such as soil water, deep soil water and cash flow. Scientists are used to graphical representations, whereas farmers are not. Efforts will now be made to transform these graphical representations into a form that is more appealing and understandable by farmers.

A limitation, as perceived by scientists in QDPI and CSIRO, is the loss of precision when the relationships generated by their simulation models are transferred to the game and simplified to reduce the computing power needed to run them. Simplification of the algorithms also considerably reduces the time a computer needs to 'crunch the numbers'. While some absolute precision is lost, the relative relationships remain adequately precise. Users of the game did not regard the outputs from the game as being atypical of their experience of reality.

This perception by the QDPI and CSIRO scientists of a weakness may also be viewed as a strength. It demonstrates that the output from a computer is only one construction of reality. My experience with another piece of QDPI software *Wheatman* (Hamilton, 1990a) indicates that when the computer delivers a result that is disputed by the users, the discussions comparing the validity of the computer's output with the user's experience are very beneficial.

Another limitation is the need to use a computer. Computers are felt to be necessary to rapidly handle the computations and deliver output, but most farmers do not own computers and/or are not comfortable with using computers. But the act of playing the game can also increase people's degree of comfort. For example, our Grandfather farmer in Box 6 spent the first 30 to 40 minutes glancing suspiciously at the computer as his wife worked it. As he gained confidence that it wouldn't break if he touched it and the results it was generating became interesting to him, he gradually took over the computer and became involved

A major strength is that the *Fallow Management Game* is able to be played by some or all members of a family (the decision making unit). It allows all members of the decision making unit to input information into the game and the discussions. Because it is "risk free" playing, this information is not given a higher or lower status depending on who it comes from but accepted equally and tested. Women gain from this relationship as they acquire technical information that is usually the province of their husband. They introduce this technical information via the computer and the husband attributes the information as having the status of coming from a computer not his wife. This avoids disruption of the power relationships within the decision making unit but allows valuable alternate perspectives to be introduced and discussed. This strength has also been observed by users of the "Wheatman" software (D. Woodruff, pers. comm.).

Although the *Fallow Management Game* is still being developed, it shows enough promise as a Participatory Learning and Action Research tool to be continued with.

8.2. *WITH AND WITHOUT*: A USER FRIENDLY COMPARATIVE ECONOMIC ANALYSIS TOOL

8.2.1. Introduction

The RRA and the Focus Group Analysis showed that the issues of farm economics and declining farm profitability were of major importance to farmers (Hamilton, 1991, Blacket & Hamilton, 1992). They also have shown that farmers are interested in, and respect the ideas, information and techniques that Dalby Agricultural College (DAC) graduates bring back to the property. The *With and Without* tool attempted to build on and combine these two findings.

In an effort to lower costs of production and improve farm viability, many farmers are investigating or adopting practices that minimise inputs such as chemicals, fertilisers and fuel while pursuing sustainability goals (Blacket and Hamilton, 1992). On the other hand, some farmers are keen to investigate more dramatic changes in an attempt to improve farm profitability. Discussions with landholders consistently highlighted three topics of interest:

1. The economics of various fallow management strategies.

2. The attractive gross margins in dryland cotton.

3. The financial impact of ley pastures.

During the RRA and the Focus Group Analysis discussions, farmers revealed that they had a reasonable understanding of all the factors involved but were unable to complete a formal evaluation for their own situation. In many cases they relied on intuition or gut feeling to make a decision. A consequence of this is that the financial comparisons between different farming systems often leave different farmers with markedly different assessments of the same problem.

The RRA and the Focus Group Analysis also revealed a need for a deeper appreciation by extension officers of the issues involved; and, the lack of skill and understanding on the part of producers to evaluate the problems confidently (Hamilton, 1991, Blacket & Hamilton, 1992).

Standard economic tools did not appear to offer the methods to fully address this situation. In an effort to create applied information from existing knowledge (amongst farmers and extension officers), we turned to a research economist from the QDPI (J. Gaffney, Principal Research Economist). He had developed a comparative analysis tool known as the *With and Without* (Gaffney, 1992). *With and Without* is a comparative analysis tool designed to analyse and test options on a whole farm basis. The total costs and benefits associated with an option were compared with the total costs and benefits associated without the option (usually the existing situation). Its main use had been within the QDPI, to improve extension officer's understanding, with only the results being transferred to farmers, that is, a classic TOT approach.

We tested the use of the tool in two situations:
(i) a co-learning situation within a PLAR framework (between the VFSG team and farmers) to test the implications of major changes in strategy on a whole farm basis, and,
(ii) as a framework for delivering a semi-formal education course for DAC graduates.

In the first situation, the farmers involved learnt the procedure associated with the tool and how to apply it, as well as investigating options that they were interested in (described in sections 8.2.2 to 8.2.6). We learnt about the strengths and weaknesses of the tool and about how farmers thought about farm economics and the various strategies they themselves investigated. These were, of necessity, labour intensive exercises. The information generated was published to the wider farming audience via the mass media.

In the second situation, the tool was used in a more formal setting with the dual audience of the DAC graduates and the DAC staff (described in chapter 9.1). The tool was used to analyse a range of situations. Scientific information relevant to strategic issues associated with these situations was presented to the students and they incorporated it into their own situation using the *With and Without* tool.

8.2.2. Using *With and Without* - first attempts

The use of the tool in the absence of farmers could not provide the detailed knowledge of actual farming operations, performance levels and likely market prospects relating to the issues the group (on behalf of farmers in the region) wanted analysed. Although much of this knowledge possibly existed in diverse QDPI circles, it was the farmers in the region who fully understood the complexity of the issues.

To address this deficiency, the idea of forming a partnership between a project team member and a knowledgeable farmer to address a particular set of farm economics and extension issues was pursued. Farmers had the knowledge of their farming systems but lacked the skill to organise the information in a systematic way. Through the training, VFSG members knew how to analyse the problems but lacked the intimate knowledge of farming systems that only practising farmers had. Both groups have a keen interest in investigating the economics of the three topics of interest (see section 8.2.1, above). This common interest, plus the need for knowledge that only the other partner could supply, led to a joint approach to information creation and interpretation.

8.2.3. Group workshops made up of farmers and officers

The VFSG held a joint farmer/officer workshop to address the three topics of fallow management, dryland cotton and ley pastures. The workshop was run over two full days.

The aim of the workshop was to develop a hypothetical whole farm 'with' and 'without' analysis for each of the 3 topics. The hypothetical farm depersonalised the farmer's information which put them at ease when sharing this personal economic data and experience with the group. It further encouraged them to discuss the development of each other's case study as they didn't feel they were telling anyone how to farm their own property. Preserving the anonymity of individual's financial data also meant that the final information product would be suitable for mass publication.

A considerable amount of preparation was completed prior to the workshops. Individual officers spent time with selected landholders completing whole farm analyses for their current situations. In this way, both parties shared their economic insights while becoming co-learners

in the application of the model. This process also developed the confidence of the landholder to participate in a group workshop process.

Involving landholders as partners in the preparation phase ensured that the farming systems and data used in the workshop analysis sessions were realistic and represented those used by experienced growers.

8.2.4. Results

The following immediate results were obtained:

- The analysis yielded information that would otherwise be difficult to attain. The information and data have been used to prepare a series of discussion papers and the case studies have subsequently been used to illustrate written decision support material.

- Extension officers developed their ability as 'farming systems analysts' by developing a better grasp both of how different variables fit together in a farming system and of the possible effects of change. Officers were forced to deepen their grasp of the 'with' and 'without' whole farm approach by explaining to the farmers how the analysis proceeds. Farmers learnt their economics in a powerful way by investigating a change or solving a current problem.

- The participative approach meant that the landholders and extension staff worked as co-learners in the process, and developed considerable ownership of the knowledge they had developed together. This ownership created trust between the participants and credibility in the information. This helped to ensure application. The impact of the workshop process on the participants was evidenced in the groups becoming so engrossed in the tasks that they continued working long past the end of each day.

8.2.5. A useful tool?

The group experienced no real problems with the co-learning partnership approach. An unknown factor prior to undertaking the workshop was how well the farmers would grasp and accept the 'with' and 'without' comparison. This problem failed to eventuate.

The only difficulties encountered by the group related to the adequacy of the economic technique. The analysis can provide only a quick guide to profitability but cannot adequately account for every aspect of the change. Participants at the workshop were able to identify a number of benefits and costs not accounted for by the whole farm approach, along with some limitations. In the main, these are intangible factors difficult to define in an economic analysis. For example:

- the time saving encountered when substituting herbicides for tillage in reduced till farming;
- the health concerns over the high use of pesticides in dryland cotton; and,
- the potentially increased value of land and complementary increase in farm profits from improved soil structure under reduced till farming.

Further, the analytic tool uses fairly rigid economic definitions for some variables; we discovered that many farmers use different definitions. For example, machinery depreciation is defined by economists as the price of a new piece of machinery less the trade in price divided by the age of the trade price of machinery. Farmers define depreciation in several ways. For example, they may define depreciation as:

- a capital cost incurred only when a new piece of machinery is purchased. This accurately reflects cash flow but it not useful in associating costs on a per hectare basis; or as,

- a tax deduction which reflects an opportunity benefit calculated on depreciation percentages set by the Taxation department.

These limitations reduce the flexibility of the tool and hence its usefulness. But as Whynes (1983) commented, when pressed for a distinction between good economics and bad economics; 'good economics is aware of its limitations, while bad economics is not'.

Farmers believe that the information and knowledge generated by the approach will lead to a more informed decision because it has expanded their knowledge base. This was seen to be a better outcome than relying purely on gut feeling and gross margins.

Team members developed greater insights into the intricacies of farmer decision making This assisted them to become more critical of the information they were producing which was believed to add to its effectiveness.

8.2.6. Useful information?

The usefulness of the information produced in these workshops can be judged from three perspectives:

(i) from the perspective of the participants who were involved in the workshops;
(ii) from the perspective of the recipients of this information as it was published; and
(ii) from the perspective of the competing information providers.

For the workshop participants, the information produced was found to be extremely useful. The format allowed them to clarify variables and to put values upon the variables that were meaningful to them. In effect, the process allowed them to construct meaningful information for their own use.

The information derived from these workshops was published to the wider farming community as case study reports. Farmers who were not involved in the workshops, but who had read the reports, were interviewed and said they found the information useful (Harris & Gaffney, 1993). However, they didn't regard the information a complete information set and didn't agree with all the costs used nor all the benefits gained. Rather, instead of regarding it as the one and the only model, they saw it for what it was, an example, that is, a construction from one view point, highly applicable to the individual case, and that has some implications and application for other users as it provides a different view point on a common problem theme.

However, scientific staff viewed it completely differently. The questions they raised caused a great deal of tension and created wide debate. These scientific staff questioned the expertise of the people involved, and, consequently the results.

How expert were the farmers? The farmers who participated in the workshops were not what are commonly termed innovative farmers according to the TOT paradigm, but from the constructivist perspective, their real life experience constitutes expertise because they have lived the problem. Because they were not considered innovative farmers by scientists, and some of the expertise that they applied would not be regarded as "expert", the farmers' experiences were down-played by scientific staff.

How expert were the officers involved in the process? In crops like cotton, none of the officers were regarded within the QDPI as technical experts, but their technical expertise wasn't what was needed in the workshop. They played a facilitating role appropriate to a PLAR approach, rather than a technical expert role. This distinction was lost amongst many of the scientific staff.

Consequently there was much criticism as to the accuracy and the usefulness of the case study reports. The scientific staff failed to understand that these reports were not an end in themselves but a means to an end. They are constructions put together by individuals for their individual situation, in a format that allows comparison amongst alternatives by others as well as by themselves. They are a starting point to stimulate communication, to assist farmers to seek information to enhance their decision making. For other users, they provide a model of a relevant situation alternate to the scientific model. By enlarging the perspectives brought to bear on a problem situation, the understanding of the problem situation is improved. The scientific staff failed to grasp this concept and the impact of *With and Without* was diminished because of it.

8.3. LEARNINGS FROM THESE ACTIVITIES AND PROCESSES

The *Fallow Management Game* and *With and Without* were innovative new tools created for specific purposes and clients, to enhance participatory learning by engaging in a form of "risk-free" action research based on formal representations of real farm situations.

Although both were developed initially by researchers/extensionists, their application was pioneered together with farmers, who made considerable input to their development and refinement.

Their use brought home to professional agriculturalists and farmers the need for such tools in order to understand and explore "reality" from differing perspectives. The discovery, for example, that farmers were using differing definitions (or interpretations of) supposedly standard, objective phenomena, was in itself a powerful discovery that would not have been learned otherwise. Moreover, the tools provided a forum in which scientists', extensionists', and farmers' experience and knowledge were placed on a more equal footing than is the case in the TOT approach. Information and data were shared, not transferred.

Finally, both farmers' and agricultural professionals' understandings were enriched by the exchange and the opportunity for dialogue. The fact that team members (highly educated,

using a jargon-loaded and abstract language) and farmers (mostly with only limited schooling, using a practical colloquial language) could sit down together and engage in mutually meaningful interaction, was a surprising and rewarding discovery for both parties. The tools, as it were, allowed the manipulation of impersonal-but-contextualised "reality" which could be interrogated at will. In the process, deeper insight into the nature of technology as a social construct was gained.

The use of participatory processes to develop information either as an information product for mass distribution or internalised by the participating farmers as personal constructs, demonstrates the power of participation as opposed to the reception of information that the user had not input or participation in. The *With and Without* exercises were of great value to those farmers who participated in them, but to farmers who received the information as hard copy and had not participated in developing the information, the information was less valuable and useful. This insight raised the challenge of replication: how possible is it, in practical terms, to reproduce participatory learning opportunities across the target farming population?

9. INNOVATIVE APPROACHES TO WORKING WITH TARGET CLIENTS

9.1. *INVESTING IN YOUNG FARMERS* - WORKING WITH GRADUATES OF THE DALBY AGRICULTURAL COLLEGE.

9.1.1. Why target the Dalby Agricultural Graduates?

Farmers were found during the market research phase to be interested in, and to respect the ideas, information and techniques that Dalby Agricultural College (DAC) graduates bring back to the property (Hamilton, 1991, Blacket & Hamilton, 1992). College graduates were also seen to represent an opportunity for more quickly assimilating and implementing information and to have the potential to become significant agents of changes. They already possess a sound basis in agricultural management, coupled with practical experience in farm management. During their post secondary education, they have been exposed to a learning style which couples formal classroom learning with applied action learning. This is different from most other farmers' school-based learning experiences.

9.1.2. The opportunity to create a partnership with farmers

In response to the opportunity, the VFSG and the DAC worked together to target the young farmer graduates (Hamilton et al., 1993). Both partners felt there was potential to learn from each other. It was agreed that information for operational decisions was readily available to farmers. However there was a need for improved strategic decision making *(whether to or not?)* within farming systems, especially in fallow management. This need was seen to be potentially better fulfilled by giving the farmers skills, rather than information.

9.1.3. What skills would be relevant?

To further clarify the information gathered in the Rapid Rural Appraisal and Focal Group Analysis, a questionnaire was designed to determine possible areas of interest that could be addressed. The questionnaire assessed the level of interest in six broad areas: farm management, farming systems, fallow management, crop agronomy, economics, and farm mechanisation. The questionnaire was sent to 300 graduates from the DAC. Results from the 106 responses showed clear interest in the economic, fertility decline, fallow efficiency and crop rotation aspects of the farming system (Hamilton et al., 1993).

9.1.4. Designing a relevant course.

The course, titled *Investing in Young Farmers*, was based on the adult education principles of action learning and acknowledged the capability and knowledge of the participants as graduates of the DAC and as farmers. Determination of the course content was conducted as a participatory process with input from the graduate farmers.

The course framework was provided by the economic tool *With and Without* (see Chapter 8.2). This framework was complemented by, and integrated with technical input from QDPI staff and DAC staff on fertility decline, machinery, fallow management efficiency and cropping systems. The combination of the economic framework and technical input allowed the DAC graduates to integrate their own knowledge in order to investigate the various components of a farming system; to measure the benefits and penalties; and to assess the impact of aspects on a farming system.

The course aimed to:

- give DAC graduate farmers tools to analyse fallow management and farm management that enhance sustainability and profitability on their farms;
- give DAC graduate farmers an improved capacity to make informed strategic decisions, so that they may become viable and their resource more sustainable; and,
- encourage and train participants so that they may assist in communicating the concepts of viable farming systems to other farmers in their district.

9.1.5. Course Process

The course was conducted at the DAC. The course delivery placed emphasis on a combination of lectures, action learning and participation by the graduate farmers. This delivery reflected the learning style that DAC graduate farmers had been exposed to in their college education and the nature of their present work as farmers.

The economic framework was initially presented in abstract form, and then the farmers established their own profile based on information from their personal farming systems (*Without)*. Options were examined based on the information received from the technical input. The farmers then assessed the impact of the change in their own farming system (*With)* if they implemented the presented technology

QDPI and DAC personnel worked in teams to provide the technical information to complement the economic tool *With and Without*, and also acted as tutors throughout the course. The course was evaluated using quantitative methods (a questionnaire) and qualitative methods (a discussion group, participant observation and unstructured interviews). To provide triangulation, an external skilled evaluator was present during the course as a participant observer and conducted informal discussions with the participants.

Evaluation of the course was conducted to:

- assess the impact of the course on the graduate farmers;
- give feedback on the process;
- assess the structural design and QDPI `performance';
- help set direction for future interaction with graduate farmers; and
- help improve future courses with the above information.

The questionnaire was handed out at the end of the 3 day course. A group evaluation discussion was also facilitated at the completion of the course. Participants were asked to address 'What was good?' and 'What was not so good?', and, indicate future possible interaction with graduate farmers.

Evaluation of the structural design, relevance, and pitch of the designed course, and of QDPI performance, was also conducted by an adult education specialist. The evaluation was conducted using informal discussion with students and course presenters and participant observation of the course in action.

9.1.6. Evaluation of the *With and Without* Tool

DAC graduate farmers found that the *With and Without* concept to be a simple, informative and logical tool for exploring options in the farming system. Use of this tool reduced the 'guess work' related to making farming choices and enhanced the decision making process. The majority of graduate farmers found the course 'useful' to 'extremely useful' and indicated that they would use the *With and Without* as a decision making tool on their farm.

Their major reasons for applying *With and Without* were primarily related to examining a change in their farming operation. *With and Without* was considered most useful for:

- exploring a change of enterprise;
- examining the effect of an increase or decrease in enterprise; and
- calculating stock numbers and crop areas.

Unexpected benefits also emerged such as using the basic techniques of *With and Without* to accurately calculate stock numbers and stocking rates, and to determine crop areas in a farming system.

9.1.7. Relevance of course content and structural design

A majority of farmers found the information to be useful and relevant. However, information gained from the graduates in the group discussion at the completion of the course and from the external assessment, clearly showed areas of improvement were still required in structural design.

The course content involved:

- reducing the system under investigation to its information elements;
- analysing each element; and,
- reconstituting the system.

The information contained in the course was responding to graduate needs (as determined from the pre-course questionnaire results). The information as it presented during the course, was rated as "good". However the graduates felt it would have been preferable to streamline the information and discuss it in relation to the farming system, rather than in isolation from the farming system. For example, to understand how a car works you cannot examine the gear box in isolation from the other components of a car. In the farming systems' situation, weed control is best examined as a component which interacts with the fallow management system which, in turn, interacts with the

whole farming system, that is, the participants preferred to see the information presented as an integral part of the farming system, rather than in isolation to the farming system (see Figure 12).

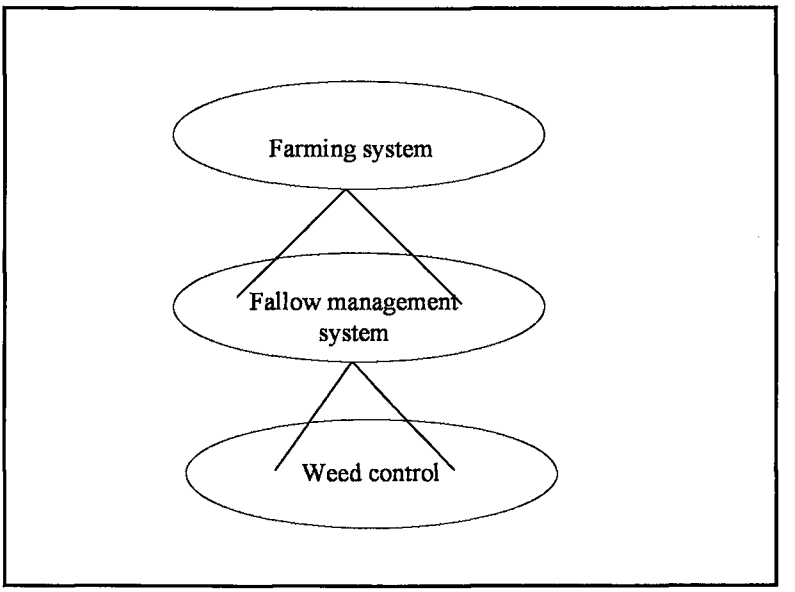


Figure 12 Preferred structure of course content

Course presentation. The external assessment showed that the VFSG acknowledged and incorporated the capabilities of the farmers and based the strategy for information exchange and the participatory activities around the capabilities of the graduates. The course design and delivery were regarded as being consistent with adult education principles.

The pre-existing common link among the participants and with the DAC, and use of the DAC as the venue, had a positive influence on participants' attitudes to the course and to participation. To the DAC graduate farmers, the quality of the QDPI speakers and the diversity of participants' farming backgrounds were considered important factors. The opportunity for information exchange with other DAC farmers was considered important by the farmers because of the knowledge gained and the encouragement offered among participants. This was due to the confidence that DAC graduate farmers had in each others' knowledge and ability.

9.1.8. Implications

Targeting specific clients, identifying their needs and responding to them by matching the adult education process and learning style, results in strong impact. *Investing in Young Farmers* created a forum for integrating several disciplines from within the QDPI; and integrating several disciplines between the QDPI and DAC. The use of facilitators in conjunction with technical experts enhanced the presentation and learning of the information and resulted in a better job being done with regard to the whole farming system.

The concept of applying content in a style compatible with learning style was demonstrated to enhance the outcomes and impact. The reproduction of this principle in other adult education

situations would require investigation of preferred learning style prior to the design of content and of presentation, but the DAC exercise demonstrated that this investment would pay handsome dividends. Matching the process to the target improves the impact of the information.

The position of DAC graduates within the farming community justifies continuing investment in this group. They are young farmers who are considered innovative within the farming system. Their capabilities and receptiveness to new concepts should be supported.

The affiliation of QDPI with the DAC reaped benefits for both organisations. Different perspectives towards a common goal gave a `richness' to the course. This demonstrates that operating with formal education institutes can enhance the extension process.

9.2. PRODUCING INFORMATION - WITH FARMERS, FOR FARMERS

9.2.1. Research Information: Its Contribution to Farmer's Decision Making

At the start of the VFSG project, both researchers and extensionists considered that the research base needed to support the project's goals was more than adequate. The question of improved fallow management techniques has been the subject of research in Queensland for over two decades. Treatments commonly tested have included zero tillage, reduced tillage and a control mechanical treatment (commonly referred to as conventional tillage but the tillage implements used have changed over time).

The research for much of this period focused on yield as the key dependant variable. However, the differences resulting from the fallow management treatments generally reveal either no significant difference or inconsistent significant difference in terms of yield. The long term average yield response to tillage under similar stubble and nitrogen regimes showed no significant difference between the zero tillage treatment and the tillage treatment (see Figure 13). However, for individual years the yield response does vary. For example, zero tillage has significantly higher yields than conventional tillage under very dry growing conditions but significantly lower yields than conventional tillage under very wet growing conditions. This information is of little use to farmers' decision-making until the prediction of growing conditions is possible.

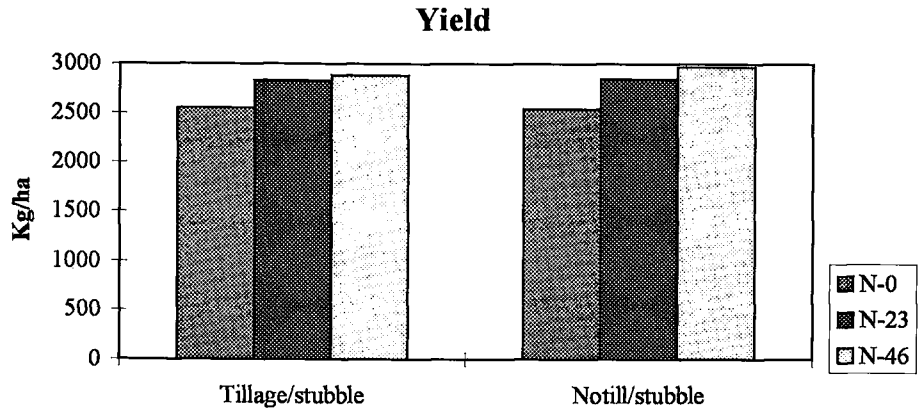


Figure 13 Research information illustrating the impact of several treatments on one variable (yield).
(Source: Thompson & Freebairn, 1991).

9.2.2. Incorporating more an alternate technical variable

In recent times, the market for grain has changed from being quantity based to additionally being quality based. Quality (measured mainly as protein) now attracts a premium. For example, for wheat, this premium has gone from being less than 5% of the received price to being greater than 30% of the received price of grain. Yields under zero tillage are significantly lower under zero tillage unless nitrogen is applied. Nitrogen is effectively "tied up" under a reduced or zero tillage treatment. To maintain yields, the addition of nitrogen is an important requirement. This information could be produced and added to the existing yield information (see Figure 14).

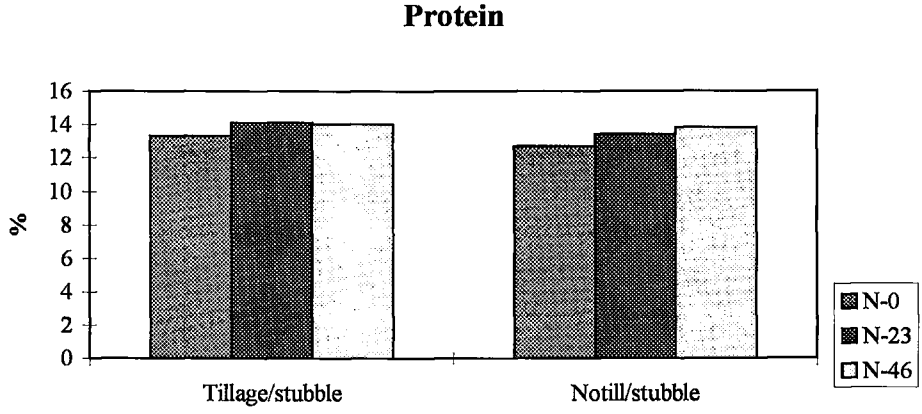


Figure 14. Research information illustrating the impact of several treatments on an alternative variable (protein).
(Source: Thompson & Freebairn, 1991).

Producing this information does not relate the research findings for yield and protein to each other, nor does it give a clear indication of the interaction between the two variables. Consequently, it does not place farmers in a much better position to understand what this information means to them. With two interacting variables now to pursue, quality and yield, the research data had to be reformatted to provide information on both these variables.

9.2.3. Substituting an economic variable

Farmers began to question the value of information of tillage effects on yield and protein until some economic variable was included. Again the research data were reworked to produce information relating to partial gross margin under various treatments (see Figure 15). The effect of moving from grain yield and grain protein to partial gross margin resulted in significantly different relationships between treatment and the independent variable.

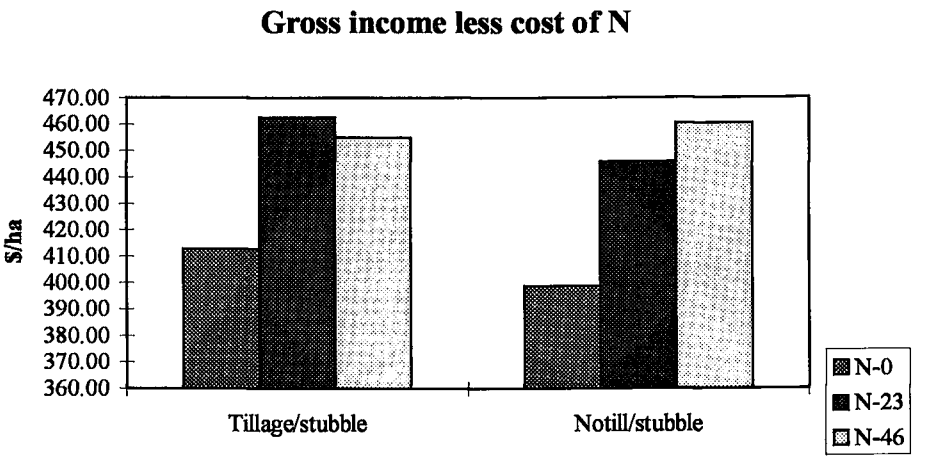


Figure 15. Research information illustrating the impact of several treatments on an economic variable (partial gross margin).
(Source: Thompson & Freebairn, 1991).

Again, while farmers generally agreed that partial gross margin was an important variable, it is not the only variable of concern to them. It is possible to go on rearranging research data into different information packages taking into account other variables. For example, if capital costs are included as a component of the analysis, the relationship again changes, with the zero tillage treatments being less profitable than the tillage treatments because of the greater capital costs associated with these fallow management systems. The cost of using chemicals in terms of health and environment could also be costed and if these costs were introduced into the information set, the results would again change. There have been attempts to include the cost of soil loss. However, these sorts of variables are very time and situation specific, that is, they have different values depending on who is measuring them, where they are measuring them and when they are being measured. Given the potentially vast array of information that could be produced by this reductionist method of combining disparate data sets, the end result would

probably be complete and utter confusion amongst the client body, whilst producing little insight into changes in system dynamics over time or into systemic interaction.

9.2.4. Rules-based information derived from a research context

Similarly, the attempt to derive some simple rules from the research data leads to misleading or incorrect conclusions. For example, the rules that were derived and presented in a research publication:

- *Best yields over the period of the experiment have come from a combination of zero tillage, stubble retained, nitrogen fertiliser and nematode control;* and,
- *Zero till + stubble treatment has more organic carbon, total nitrogen, mineralisable nitrogen, microbial biomass and earthworms than other treatment combinations.* Source: Thompson & Freebairn (1991).

While the first statement is true, it gives the impression that zero tillage always gives significantly higher yields. The second statement is also true but the usefulness of this information is debatable. It is certainly not transparent to farmers in that it gives no clear insight into the principles upon which to base a decision.

This exercise demonstrated that the data contained in a research project can be formatted to produce a vast of range of information. Each piece of information might relate to an individual need but collectively this range of information contributes to complicatedness and confusion. While it is possible to develop information at a higher level of abstraction and generality, complicatedness and complexity are reduced, and in the process information becomes less specific and less concrete.

9.2.5. Rules-based information derived from a farmer's context

In brief, the VFSG finally concluded that the normal scientific information production method did not achieve the desired information output. We went back to what farmers suggested they needed as information. Instead of producing the absolute and prescriptive relationships that we formerly had attempted to produce, we responded to farmers' needs by generating information on relative relationships, and included most of the major variables that we had revealed in our socio-economic research. This initiative resulted in the information taking on a completely character presented in a different format (see Figure 16 and Figure 17).

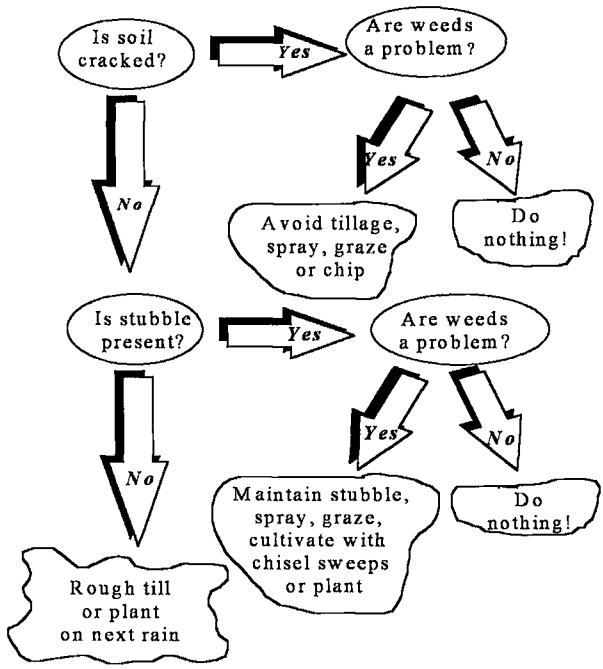


Figure 16: Graphic overview of decision stimuli, indicators to observe and decision alternatives.
Source: Hamilton, N.A. Freebairn, D. & Lawrence, D. (1995).

The information was captured in graphical format making it easier to understand and enhancing the reader's ability to see the range of options available. Rather than representing research results and assuming that farmers will change when they see these results, the information instead dealt with an overview of the stimuli for making a decision (see Figure 16). In the case of fallow management, this is usually a rainfall event.

The graphic further incorporated indicators a farmer considers when he is making a decision. Again, in the case of fallow management, these are the presence of vegetation (weeds/stubble) and the state of the soil (cracked/fine tilth). It then gave the range of options available. Text was supplied with the graphic to expand on the reasons and meanings contained within the graphic.

Additional information illustrating the impact of social, economic and technical factors on the range of alternative fallow management practices was also produced (see Figure 17). This information was derived from the market research phases of the project.

Aspects to be considered	No tillage 1 (+ stubble)	Minimum tillage 2	Full tillage 3
Soil	least <	erosion	> most
	more <	rainfall storage	> less
	less <	nitrogen release	> more
	softer <	surface structure	harder
	more earthworms, <	insects	> more black field earwigs
	insect pests, insect predators		
Crop	higher in drier years <	yield	> higher in wetter years
	wider <	planting window	> narrower
	lower <	establishment on clay soils	> higher
	higher <	wheat yellow spot & crown rot	> lower
Costs	lower <	tractor & implement operation & maintenance	> higher
	longer <	tractor & implement replacement intervals	> shorter
	higher <	boomspray & planter operation & maintenance	> lower
	higher <	herbicides	> lower
	lower <	labour	> higher
Management	more <	decisions	>less
	faster <	speed of operation	> slower
Lifestyle	more <	herbicide use	> less
	least <	tractor hours	> most
	more <	leisure time	> less

Figure 17: Chart illustrating the range of fallow management strategic decisions with major influencing social, economic and technical variables.
Source: Hamilton, N.A. Freebairn, D. & Lawrence, D. (1995).

The end product contained a much reduced volume of information, was more easily read and allowed the reader to view the range of options at the same time. It did not contain the precision of the previous research information but included other factors that the research information had assumed or ignored. It was far simpler as a result. Details of the research information were added as a "further reading" addendum. The final product was well received by farmers when it was presented at seminars, farm walks and follow up to the related activities of the VFSG (Cawley & Hamilton, 1995).

9.3. *MAKING BETTER DECISIONS FOR YOUR PROPERTY* - THE CONSULTATIVE EXPERIENCE OF WRITING STRATEGIC DECISION SUPPORT INFORMATION

9.3.1. Introduction

Our early experiences of producing written information taught us valuable lessons about how not to present information. We therefore set about information presentation in another way. Results from the RRA and Focus Group Analysis have shown that farmers are seeking resource material to support decisions, but that these are more *strategic* than *operational* (Blacket and Hamilton, 1992). Information which assists farmers to make operational decisions such as planting rates and choice of herbicides is being adequately provided by QDPI and agribusiness extension advisers and by QDPI extension material such as the *Crop Management Notes*. Through the RRA and FGA we noted farmers' suggestions that strategic planning and the accompanying strategic decisions have the greatest impact on viability and sustainability. These include:

a) whole farm planning issues such as:
- changes in enterprise mix,
- viable farm size,
- property redevelopment,
- property expansion,
- farm succession,
- off farm investment,
- machinery purchase;

b) interacting with support services:
- banks,
- accountants,
- insurance companies;

c) developing personal skills:
- farm business management skills,
- managing risk,
- coping with stress.

The knowledge required to address these issues is fragmented and dispersed throughout the knowledge system. Most of these issues are beyond the expertise of QDPI staff. No specific group in the knowledge system possess the collective knowledge or skills required to address these issues. Yet, there is a demonstrated need to provide information on these types of issues with a wider perspective than just the technical perspective, incorporating information such as their impact on social and lifestyle factors.

The VFSG, in remaining true to the client demand attempted to address these needs for which its skills and knowledge were inadequate. We thus adopted a facilitation role and a partnership-based participatory learning process in order to determine:

- who was the audience;
- who did have the relevant skills and knowledge;
- what information would be relevant;
- how would the information best be presented; and,

- who should collate and write the information.

The following paragraphs [9.3.2 - 9.3.4] describe the points raised and conclusions reached by an interactive group comprising members of the VFSG and volunteers from, primarily the farming community, but also including from time to time other actors such as bank managers, accountants, assurance agents and agribusiness personnel. The interaction continued over a period of 18 months, from 1993 until 1994.

9.3.2. Who is the audience?

The market research had suggested that the types of decisions this type of information would be targeted at were decisions made by the farm family. Rural women are recognised as having a major role in this decision making (as opposed to operational decision making where the male farmer has the predominant role and where he is often pre-occupied, at the expense of strategic decision making). Hence, while we decided that the information should be targeted at landholders in southern Queensland, emphasis was given to explicitly incorporating rural women as an important target and as being particularly receptive to this type of information for decision support. This explicit targeting in turn determined that information directed the types of decision making that rural women are likely to be involved with, should receive priority.

9.3.3. How will the material be used?

The end product of the process was determined to be a Manual to support strategic decision making. Two options were canvassed to determine how the information might be used: as stand alone material, or, as information to support group discussions. The preferred mechanism was for the information to be used as support material to be used with small discussion groups or planning workshops. The QDPI already had a process of supporting strategic planning known as the Property Management Planning Workshops. The primary aim of this manual was to support this process.

It was recognised that some topics are personal and address family and lifestyle issues such as *Passing on the Family Farm, Is the Farm Profitable?* or *Quitting with Dignity.* So the material had to be flexible enough so that it could be further tailored to meet the individual needs of different groups and the sensitivity of the topic.

It was further recognised that other stakeholders (besides QDPI staff who are involved in Property Management Planning) also play a role in assisting farmers in this decision making process, and they may have a use for this type of information. These may include financial counsellors, accountants, insurance agents and bank managers. The information had to be designed to assist these people in their role. Finally, the information had to be able to stand alone as simple handouts in general extension work.

9.3.4. How will the information be presented?

Testing various writing formats with farmers and rural women showed that they like a "question and answer" style. They criticised existing information, for example, on topics such as zero-tillage and conservation farming systems, as being *somewhat overdone*, containing too many *big, imprecise words and cliches*, and having too much *technical jargon.* The writing

style was also criticised for being *indirect* and too often *containing long, somewhat hard to understand sentences.*

Farmers say they like a point form of writing which is simple, positive, personal, and active. They do caution that it is important that the information tells a story. Point form can interrupt the flow and turn a reader off. The information has more impact if it is provocative and challenging. It should give farmers information so they can make their own decisions and find their own answers to issues.

This format is common in public relations or advertising material. It has not been commonly used within QDPI in presenting the normal technical/advisory messages. It reflects a "journalistic" format. This requires the information to be presented in an "inverted triangle" where the most important points come first (Mortiss, 1993:21). Incorporating the "question and answer" format meant that the first sentence in the answer is the topic or theme sentence. This format means that even if a farmer or his wife reads only the first sentence, they will receive the main idea of the answer. This format also requires that specific technical information is not included. Rather a list or map of further reading and other resources available about each topic is included.

9.3.5. Who are the authors?

To maintain the multiplicity of perspectives and to implement the mundane task of writing the information, a team of extension and research staff from the region was formed. The team members were chosen to reflect a range of experience (financial, social, technical), years of experience, training and personality. A journalist was also included to assist in developing a user-friendly style.

9.3.6. The writing process.

The series of topics emerging from the market research were developed further by members of the team. Information sources were contacted individually and relevant information was collected and brought to the team for discussion and distillation. The aim was to capture and encapsulate material based on acquired individual knowledge and knowledge created through interactions with other team members. Emphasis was placed on avoiding the use of texts or technical books, except as 'idea prompts'.

The first draft was written at a three day workshop. The workshop was structured so that collective decisions were made regarding topics, format and size on the basis of market research results. The tone of the information was also decided, that is, challenging and provocative. At this stage, only members of the VFSG and other QDPI collaborators were present.

Writing exercises were completed by the team to set the scene and standardise the writing approach authors would use. This developed team member skills in considering their audience, planning their article, using simple sentences and paragraphs, and writing directly and positively.

The group then focussed on a single topic by using a card system (Kaye, 1989). This involved brainstorming key points about the topic and writing them on cards. The points were sorted

and consensus determined the most important ideas. These became the main points which formed the basis for each question. Any irrelevant or repeated points were discarded.

The team then addressed each question to determine relevant points of information. The team then split into groups of three. Each group addressed a number of topics and wrote to a deadline. Each group spent no more than one and a half hours on each topic to produce text, which was no longer than 2 x A4 pages. Topics were swapped for peer editing. Some topics were combined and new topics emerged and the process was reiterated. Within three days all topics had been edited and typed, ready for testing with members of the potential audience.

9.3.7. Market testing

The manual *Making Better Decisions for your Property,* produced from the workshop was rigorously tested with farmers and rural women, professional people such as agribusiness and QDPI extension staff, accountants, bank managers, social security officers and ministers of religion. Open semi-structured questions were used to gather feedback.

As well as considering the information, people were asked to say which type of printing format they find easiest to read (for example, use of one or two columns, font and font size). Ways to illustrate the material such as quotes, farmer case studies, cartoons and diagrams were tested.

The market testing exposed some differences in how the material was viewed by technical and professional advisers as opposed to farmers and rural women. Technical and professional people were somewhat sceptical, concentrated more on grammar and style, and wanted to 'beef up' the material with more technical information. Farmers and rural women seemed more positive, suggesting extra ideas, and liking the style and simple language. They also highlighted jargon such as *decreased rainfall risk* and *capital assets.*

Farmers and rural women appeared more able to relate to the concept behind the manual (empowering farmers to answer their own issues and assist long-term strategic decision making) than the technical and professional group, who appeared to want to give farmers the solutions to problems as defined by the 'experts'.

9.3.8. Implications from the process

Writing resource material to support strategic decision making is not easy. It requires a change in thinking for each member of the team. Team members experienced difficulty in resisting a return to their normal method of writing and slipping back to the comfort of technical information.

The make up of the team was found to be important. A balance of experience and energy along with a mix of personalities assists the team to function and ensure that each of the team roles are performed (Belbin, 1981).

Forming a working team to tackle a writing exercise such as this was found to be very rewarding both personally and in outcome. The peaceful setting away from distractions helped the team focus on the task.

The manual *Making Better Decisions for your Property* has been incorporated into the Property Management Planning (PMP) workshops the QDPI runs with Landcare groups. Five hundred copies of the manual have been produced and they (or parts of them are distributed to participants in the PMP workshops. Specific exercises that are based on sections of the manual (such as Passing on the Family Farm workshops) have also been developed and build on the foundations the manual has laid. Other regions have reviewed the manual and wish to make use of it. They are currently debating whether to reproduce the entire process or merely edit and republish the manual.

9.4. *"IS COTTON THE CROP FOR ME?"* - THE PARTICIPATIVE EXPERIENCE OF WRITING STRATEGIC DECISION INFORMATION FOR COTTON

9.4.1. Introduction

The market research phase had indicated that bankers were important, but hitherto neglected actors in agricultural transformation. Banking personnel were found to have a significant impact on farmers' decision making. Bankers however acknowledged that they lacked strategic information to make informed judgements.

To further examine their role and to create a linkage with bankers, the VFSG initiated a group workshop with regional Bank Managers. The discussion group determined that there was indeed a potential role that QDPI information could play with bankers (Hamilton et al., 1994).

9.4.2. Bankers information needs

Bankers suggested that the QDPI needed to develop specific information to meet bankers' needs. Their information need was found to be highly specific and little existing QDPI information corresponded to it. Consequently, the QDPI determined to develop specific information to meet banker's needs.

Bankers stated that they wanted QDPI information as it is 'good' information from a credible source. However, improvements in the marketing of QDPI information were necessary to suit the needs of bankers. Improvements were recommended in:

- documenting what information was available;
- presenting information, both written and visual;
- improving accessibility of information; and
- improving the timeliness of delivery of information.

There also emerged a preference for information targeted at improved strategic decision making *(whether to or not?)* within fallow management systems and farm management. This was consistent with the findings of the RRA and the focal group analysis. Many of the bankers' clients, and the bankers themselves, were faced with the strategic decision of whether to change from their existing farming system and grow cotton for the first time or not. Little information existed to support this strategic decision making process and what information was available, was buried amongst information aimed at operational decision making.

9.4.3. Choosing a relevant topic

Choosing cotton as the topic for the brochure was intentional as:

- cotton is an expanding summer crop with a potentially large number of new growers who could be targeted with specific information for strategic decision making;

- information for strategic decision making on cotton was not easily accessible in the market place. Growing cotton appears to be attractive financially; however, it has different agronomic and managerial requirements to other traditional summer crops, and a higher risk of failure. Hence, decisions made for growing cotton are different to decisions made for other summer crops;

- timing was 'right' for cotton. Growers would be considering cotton in their rotation and both bankers and growers would benefit from the information for making strategic decisions; and,

- immediate use of a brochure format, would enable the value of it to end users, and the process used to develop it, to be assessed quickly.

9.4.4. Process skills not technical skills

A process to facilitate the collection and presentation of information for this strategic decision was formulated and a team was formed to implement the process (Hamilton et al., 1994). The final product aimed to be a short brochure, *Is Cotton the Crop for me?*, designed to outline the important strategic questions facing new cotton growers, without providing answers. An information map that showed potential growers where to access more detailed information they would need was included.

A team was formed by VFSG to implement the process. The team was diverse in skills and comprised officers with a focus in extension, coupled with technical skills in economics, and agronomy. The strengths of such a team were seen to lie in:

- being oriented towards process, extension, and communication skills for collecting information, rather than the technical skills in cotton. This broadened the perspective of information because it was interpreted from multiperspective view points. Hence, the information is more useful to a wide range of users;

- allowing the collection of information pertaining to *whether to or not?* (strategic) decisions. The team did not have specific technical skills in cotton oriented towards information for operational decision making. This was seen to be an advantage to the process as the team did not feel comfortable in any case in dealing with the *how to* (operational) decisions. Operational information on how to grow cotton is readily available in the market place;

- ensuring the brochure specifically hit the target audience of bankers and new growers. Some team members had experience with bankers' information needs. Other team members had experience with the information needs of growers who are considering cotton for the first time. The focus of providing information for these two target groups was maintained;

- ensuring *Is Cotton the Crop for Me?* was a professionally acceptable information source to other QDPI officers and people in the private cotton industry. Use of economic and agronomic terminology throughout the brochure was essential. The skills of the team in this area ensured they were correctly used; and,

- resulting in a better product. Collectively, the team's output was superior to what would have been achieved individually. The team created synergy.

9.4.5. Collecting the information

Representatives of all relevant stakeholders were involved in supplying the information for the *Is Cotton the Crop for Me?*

Farmers were represented by experienced cotton growers, new cotton growers and growers who had made the decision not to grow cotton. It was important to survey these sections of the farming community to cover all avenues in the strategic decision to grow cotton. Obtaining multiperspective views resulted in a broader range of issues that had to be addressed in the decision making process and hence, addressed in the brochure. The information showed that the opportunities and risks created by growing cotton may change as you spend more time growing the crop. It was possible to incorporate these "lessons of experience" factors into the brochure giving a broader perspective of the crop.

Technical expertise in growing cotton was represented by the both QDPI and private cotton agronomists. Information received from both groups showed similarities. However, in some cases different perspectives were obtained in specific areas from each group. As the use of both Government and private cotton agronomists are essential to growing cotton, including all these perspectives was essential to providing the best information in the brochure.

9.4.6. Testing the information

A draft brochure was produced by the overseeing team. The draft then went back to the farmers, cotton agronomists and the bankers for comment on content, usefulness of information and presentation of information. This was crucial step in the process as it:

- strengthened the ownership of the brochure with those involved in supplying the information;
- re-involved the bankers, reinforcing their ownership of the product and demonstrating an on-going commitment to meet their information needs, and,
- allowed fine tuning of the brochure.

Suggested changes were discussed and incorporated, and the cycle repeated.

9.4.7. Information presentation

Improving the presentation of QDPI information was considered by bankers an important strategy for improving the bankers/QDPI linkage. The bankers requested short, reader friendly information initially, with indications of where to go for further information. These criteria were used by the team when considering presentation.

The title of the brochure *Is Cotton the Crop for Me?* with an accompanying graphic was designed to be not unlike "headlines" and to generate immediate interest. Just as headlines sell newspapers, headings can "sell" brochures.

Is Cotton the Crop for Me? was designed to be a document you can work with. The information was presented on the two inside pages of the brochure only. This gave a total view of the information in one glance. The presentation of the information with questions and a box to tick each question as it was answered allowed the reader the opportunity to employ a kinaesthetic learning style (combining learning with an action such as making notes), making the decision making process more active. Questions require answers. Whether the answers are verbal, or become manifest by ticking/crossing the box, the decision making process becomes active. This two page layout with question boxes allowed the user to see the strengths & weakness involved in the decisions quickly and clearly.

Attention was paid to making the language user friendly - "If the Smiths can get it, the Smythes will get it too!". Critique of the use of language was specifically requested in the feedback process.

Use of colour in the brochure was important. Major strategic decisions were printed in red and large print, with following "points to consider" in smaller print and blue. Readers could easily see what the important decisions are that have to be made. The 'easy to read' layout encouraged the reader to initially focus on areas they considered of prime importance to themselves, rather than first having to wade through personally less important information.

9.4.8. Information maps

The strategic decision support component of the information package *Is Cotton the Crop for Me?* required strong links to the other information. It is necessary to source this further information for the information package to be effective. The back cover clearly outlines where a grower/banker may find further information. The information map indicates a linkage between the brochure and other information sources such as the QDPI, private agronomists, banks and growers. This linkage adds status to the information in the market place.

9.4.9. Distribution of the brochure

Bankers had suggested that there was a lack of effort by the QDPI to distribute information. They felt that the QDPI needed to examine the accessibility of their information to farmers and to bankers (Hamilton et al., 1994).

Is Cotton the Crop for Me? was actively distributed, rather than just passively placed on the front counters of QDPI offices. Banks were also directly targeted to distribute the product through their local branches. However, it turned out that the Regional Managers of the banking corporations preferred to organise (and control?) distribution to local branch managers.

Potential new growers were targeted through private and QDPI cotton agronomists, and QDPI information centres. The brochure was made available via poll fax, and its existence was advertised through newspapers, journals and radio.

9.4.10. A successful process, a successful product?

Evaluation of the presentation and content of the brochure was obtained by personal interview with bankers, cotton agronomists and farmers initially involved in the process. The usefulness of the brochure to bankers and agronomists was assessed after cotton planting. Two thousand copies of the brochure were printed. Less than 100 remain available for distribution. Its impact has been significant as it determines the questions that new growers can gain information for, from a range of activities delivered by QDPI cotton extension staff and agribusiness, and ensures that all relevant information is uncovered. Interviews with users of the brochure are very positive in their response. A regional bank manager said, *This is a valuable document. It allows me to discuss with my clients an important topic and to make sure we have all the bases covered.* A farmer and his wife, who picked up the brochure from different locations on the same day gave unsolicited feedback that *We have been arguing over this decision for months and getting nowhere. Now we can sit down and discuss all the points raised and finally make a decision one way or the other. It's just what we needed.* The process has been reproduced to address similar needs for information for strategic decision making for (i) horticultural crops (S. Heisswolf, pers. comm. 1995) and (ii) to assist would be small acreage landholders to make decisions about whether this type of lifestyle meets their needs (J. Clark, pers. comm. 1995).

9.5. LEARNINGS FROM THESE ACTIVITIES AND PROCESSES

The impact of the "participatory information production" process was still to be fully determined. Where this information is marketed at a specific target, and is supported by group activities and action learning opportunities that incorporate this information, we believe the value of the process is greatly enhanced. We had learned, for example:

(i) The *With and Without* tool, had demonstrated in the group situations at the DAC that it was a useful tool for enabling farmers to develop their constructs of their current farming system and for where they would like their farming system to go. The experience raised the question whether we could apply it in other adult learning scenarios.

(ii) The *information development techniques* used in the *With and Without* analysis tool, were of benefit to those participants directly involved in the exercise, but the benefits from the *information output* that resulted from these exercises were not generally regarded as being of great use to the broader population.

Was there a better was of developing this sort of information for general distribution? The concepts of using clients as participants in the development and writing of information seemed to be the way to go. The type of information produced was information (namely the strategic type information), that was not readily available through standard extension activities. To try and improve the impact of mass media information, the VFSG got together a team of extension and research staff, farmers and other players in the knowledge system to participate in writing information that would be hopefully more useful in a mass media distribution. This resulted in the production of the *Making Better Decisions for your Property* material described in section 9.3 above.

So our next learning experiment was to see if we could produce better strategic information for a specific scenario through similar processes, but utilising participants from the knowledge system to

produce and present the information. The result was *Is Cotton the Crop for Me*? The information produced in *Is Cotton the Crop for Me*, was at the higher levels of the information system, that is, a systemic relationship exists between information for strategic decision making and at a lower level of the hierarchy, information for operational decision making. At the higher level, complexity is reduced, but at the lower level, complexity and complicatedness of the available information makes using this lower level of information extremely difficult. *Is Cotton the Crop for Me*? gave very little specific information in itself, rather it asked questions about strategic issues that were related to decisions that are made when choosing whether to grow cotton or not. The process also developed an information map to assist farmers to find that information out of the complexity of information that exists, and to use that information to assist in answering these questions for themselves. This enables the user to create their own constructions of information that they require for strategic decision making in cotton growing.

All four of the cases presented in this chapter address the important question of how to improve the use of available information at the farm level. They represent four different ways in which the VFSG sought to ally science-generated information and expertise, and farmer-generated information and expertise, and, four different ways to formalise and present the resulting pooled body of understanding and information. As the team learned more about how to manage the process of participatory learning, and how to produce "information products" through action research, a number of features stand out, which appear key to the satisfaction expressed by participants and users:-

- the "pulling down" of generalised, universal information to become relevant to specific, time-bound, concrete problem situations and decision contexts;
- the focus on the *whether to or not* questions, rather than the mundane *how to* questions;
- the equalisation of participants' multiple, diverse, and sometimes opposing experiences and information as the stimulus to dialogue and clarification, resulting in enriched data and information sets;
- the care taken to create arenas in which the language, visualisation techniques, and behaviours of normally distanced actors became (more or less) mutually transparent, comfortable, and open to interrogation; and,
- the care taken to involve end-users throughout the processes of development, testing, and application, generating a wide circle of champions of the products and experiences, and the energy for voluntary, on-going promotion and use.

10. AN EMERGENT PERSPECTIVE FOR WORKING WITH STAKEHOLDERS

10.1. INTRODUCTION

The learning that the team acquired in the course of the project was of immense benefit to team members themselves. As the project progressed, personal and professional lessons emerged from each of the case studies. These in turn fed into each new phase of the project while the applications provided further insights and hindsights useful for analysing the activities that had been completed.

To structure this discussion, I have used the general research framework (see Figure 18) proposed by Checkland (1985) which I discussed in Chapter 2. This general framework is made specific with specific F, M and A's as I use it to analyse three relevant themes that emerged: (i) the market research phases, (ii) the pursuit of better information products, and (iii) participatory learning processes.

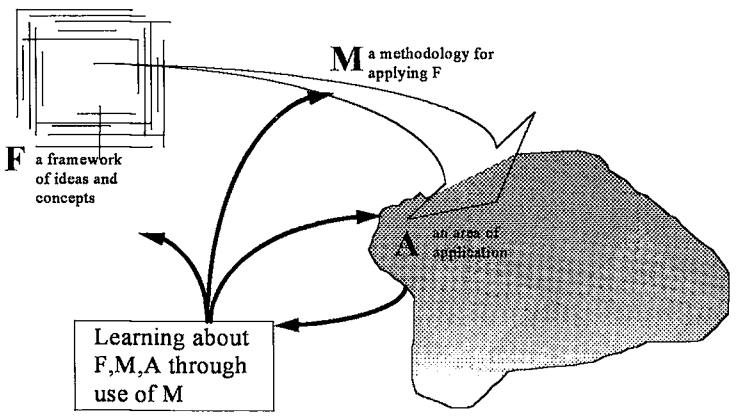


Figure 18: The general research framework
Source: modified from Checkland, 1985.

The lessons and insights derived from this study are generally related to this general research framework as:
A - the pursuit of more sustainable fallow management systems;
F - the framework of concepts used to make sense of this complex area; and,
M - the methodologies being used to investigate "reality".

The emergence of the lessons was an iterative process, with cross fertilisation between the cases and from (and to) the environment in which operated the project team. The co-learning process will not end with the completion of the project. Issues have arisen which the project itself does not and cannot explore further.

10.2. RESEARCH QUESTIONS REVISITED

The research initially focussed on three questions, two of which were maintained for the duration of the project and were refined, modified and expanded during the course of the project.

Focal question 1: Does the use of participatory processes improve client decision making compared to Transfer of Technology?

Focal question 1 was refined, modified and expanded as the result of the market research phase to include:

- identification of hitherto overlooked actors and stakeholders in the community;
- identification of linkages (or the lack of linkages) among them;
- identification of hidden attributes associated with these linkages that affect their performance;
- adaptation or creation of tools for co-learning;
- the role of tools to "discover" information, the role of providing information itself, and ways to link the two; and,
- creation of forums and opportunities for communication and joint problem solving.

Focal question 2: Does formatting information to meet market requirements improve client decision making?

This question also was developed as the result of the market research phase to include:

- the relationship between hidden attributes, information and information use, and ways to improve these relationships;
- the systemic relationships between types of information, particularly between information for strategic decision making and information for operational decision making; and,
- the relationship between information for the biological component of the farming system, and information for the socio-economic component of the farming system.

The **outcomes** the team was set in the initial proposal were:

- to better understand the complex nature of
  - the farming system we were addressing;
  - the interactions between the decision makers and their farming system;, and
  - the interactions between change agents and clients; and,
- to improve the interventions being applied; and,
- to improve the results of these interventions, that is, more sustainable fallow management systems.

We certainly understood the system better at the end. Specifically, we came to see it more clearly as a 'coupled system' (Roling, 1994) with the implications: (i) that performance, defined in terms of fallow management options, would be diverse rather than standardised; and (ii) that sustainability is an emergent property, not a single objective function or end state, toward which we could hope to move the farming community within the flux of the environment and season, economics, and farmers' objectives.

We also came to realise that interactions between decision makers and their farming system was both flexible, in that farming systems are open, dynamic systems requiring on-going attention if farmers were to move toward desired objectives, and locked into their (natural and socio-economic) history of past treatments and experiences.

We showed that the way to purposefully move forward, is in terms of a co-learning process, by improving insight into systemic relationships and by improving monitoring and visibility of those (soil, water, plant and socio-economic) variables thought to reflect changes in state. We realised however, that researchers and change agents would not readily adopt such a co-learning process unless and until they themselves began to operate in and explore the PLAR mode.

We demonstrated that, by means of such a PLAR process, more farmers tried one or more option; that farmers in a greater range of target categories tried one or more options; and that farmers became more purposeful in their decision making. End results were not predetermined by the process but through improved understanding of the situation they were dealing with, farmers became more purposeful in their decision making, they arrived at end results that they determined for themselves and these end results more than adequately assured the project would meet its goals (that is, more sustainable farming systems).

We also, more painfully, realised early on that, however powerful the learning process was for the team, it aroused considerable hostility among other members of our intellectual community. Specifically, it challenged the positivist realist framework of R & D and technology development, and the TOT model of technology adoption at the farm level. The challenge of others forced us in turn to reflect on the epistemological and methodological assumptions and logic of the process we seemed to be drawn towards, and to examine closely the guarantees of rigour of that epistemology and methodology. Thus the research approach eventually taken in the project began at a rather pragmatic level, as worth trying because past approaches were not delivering the goods, and subsequently became grounded (see chapter 2.5 on grounded theory) in a constructivist epistemology and PLAR methodology.

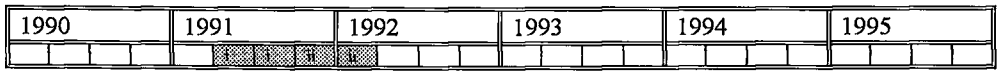
Later on in this chapter I will analyse the extent to which we met the criteria for:

(i) reliability suggested by Pretty and Chambers (1994) described in chapter 2.4;
(ii) rigour suggested by Guba and Lincoln (1994) described in chapter 2.7; and,
(iii) quality assurance suggested by Jiggins (1994) described in chapter 2.8.

10.3. MARKET RESEARCH - PAINFUL BUT EXHILARATING REVELATIONS

10.3.1. First Steps in Exploring Constructivism

The market research phase marked the commencement of interaction between the project team and client stakeholders.



Key: (i) Rapid Rural Appraisal
(ii) Focus Group Analysis

It was a key event in that it set foundations for all future activities and hinted at the theoretical framework which we moved toward in order to understand the complexities we uncovered.

The methods (M) used in a two phase operation were Rapid Rural Appraisal to develop a breadth of multiple perspectives on the area of application, and Focus Group Analysis to explore and add depth to the important perspectives that emerged (see Figure 19). The area of application (A) or scope of the method was to gain insights into the attitudes, beliefs, knowledge and practices of our primary clients - the farmers of southern Queensland.

Although we did not so clearly realise this at the time, the market research phase applied a methodology which tested the usefulness of the TOT model and conceptual approach (F), compared to "soft systems" approaches in the constructivist tradition.

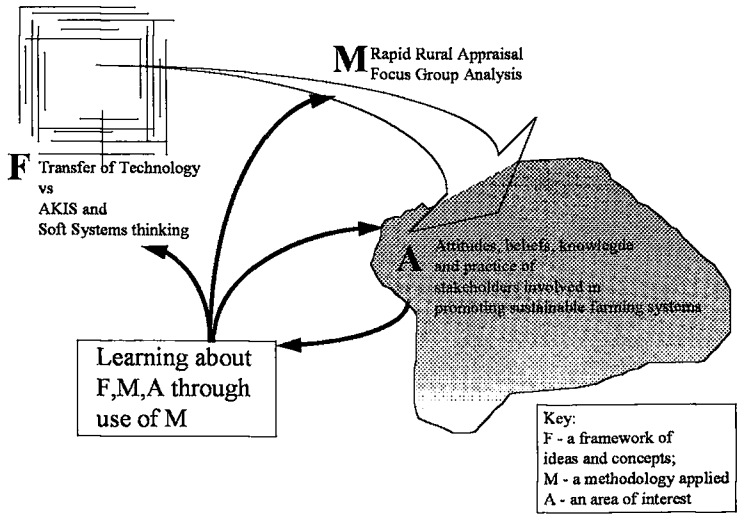


Figure 19 The research framework - market research phase
Source: modified from Checkland (1985).

10.3.2. The initial theoretical framework is abandoned

At the commencement of this study, the theoretical framework underpinning the project team's operations essentially reflected a "Transfer of Technology" paradigm. This is (still) the dominant paradigm of most officers of the QDPI and agricultural scientists generally. The positivist realist framework, assumes that:

- a single objective "reality" exists,
- this single reality is apprehensible by an objective investigator who neither influences the reality nor is influenced by it during the course of the investigation, and,
- the facts or laws governing this reality can be discovered by the rigorous application of prescribed procedures so that this reality may be predicted and/or controlled by use of the technology and appropriate management practices..

Once reality has been described by the objective investigator, that description can be communicated to those who will become enlightened and change their attitudes and behaviour as a result of this communication.

Soon after the project commenced, the team became acquainted with an alternative theoretical framework and applications. The applications included Agriculture Knowledge and Information Systems approaches (Röling, 1988) and Soft Systems thinking and Soft Systems Methodology (Checkland, 1981, Van Beek, 1988). These alternatives created tension within the team as they challenged our existing paradigm.

The market research phase demonstrated that we had entered a situation which was more complex than we had envisioned. Instead of a single perception of reality, we found that stakeholders and groups of stakeholders had a range of different perspectives of their

situation. These perspectives were in effect socially constructed by the individual stakeholders, which converged to some extent, but also diverged in their views.

These different perspectives in turn put into question our perspective on the problem situation. We could find no valid grounds to dismiss this diversity of perspective, since it expressed views which were valid for the stakeholders who espoused them. Moreover, we realised that the capacity to force a choice did not exist, that diversity and complexity were inherent and would remain so. If we were to have any impact in changing the problem situation, we would have to accommodate diversity and complexity, and not try to impose our simple perception of the situation onto our clients.

The inescapable conclusion was that TOT was an unsuitable paradigm to apply to this problem situation.

10.3.3. A change in and on our theoretical framework results

Having abandoned the Transfer of Technology paradigm, we were forced to scrutinise the constructivist epistemology, and the use of Soft Systems Thinking, Soft Systems methodology and AKIS.

The realisation that if we were to influence the sustainability of the agriculture of the region we would have to explicitly include and focus on the human aspects, that is people's interaction with the hard system aspects of the farming system, (rather than the hard systems aspects alone). This fitted a constructivist epistemology. Further, the discovery during the market research phases of a multitude of perspectives, socially constructed by individual stakeholders, fitted the expectations of soft systems thinking. We developed written reports that captured the "rich picture" of the initial situation and which provided rich insights from respondents as to their conception of the future. The CATWOE analysis of SSM was used as a check during the analysis of RRA and FGA results, to identify Customers, Actors, and Owners. This enabled us to target appropriate participants in the next suite of activities. We also applied AKIS analysis to identify relevant stakeholders prior to the RRA and FGA. In our initial application of AKIS, using the earlier thinking on this subject (Röling, 1988), we had used "innovativeness" as a criterion to segment and sample the stakeholder community. The market research results brought into question the usefulness of using innovativeness for this purpose. Innovativeness was defined from our perspective, that is we assumed that the most innovative had adopted zero tillage (which we considered the best option). We learned that farmers had different perspective on what constituted an 'innovative' farmer. Organic farmers and zero tillage farmers (and all types of farmers in between) could be judged to be innovative depending on who was defining 'innovativeness'. We further found farmers whom we would normally judge to be innovative, employing a range of technologies on the one farm.

The application of AKIS analysis subsequently was found to be useful in modelling the knowledge system at a higher level (at the lower levels, that is, on an individual stakeholder basis, it was found to be less useful because farmers particularly were difficult to group on this basis). The relationships and interactions we found indicated that an actor oriented approach was a feasible and complementary analytic framework.

The total AKIS was too complicated to model as a whole so we modelled pertinent sub-systems (see Figure 20 and Figure 21)

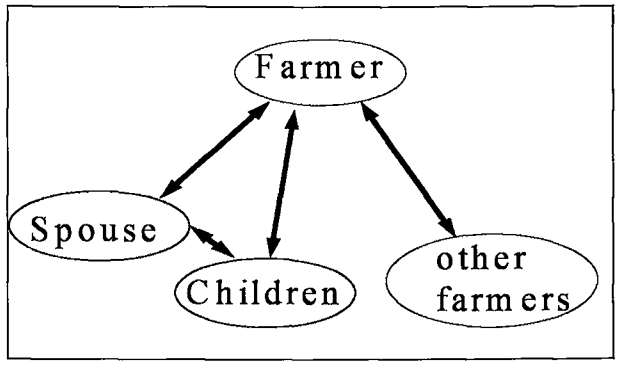


Figure 20: Model of farmers' major sources of strategic information
Source: Blacket & Hamilton, 1991.

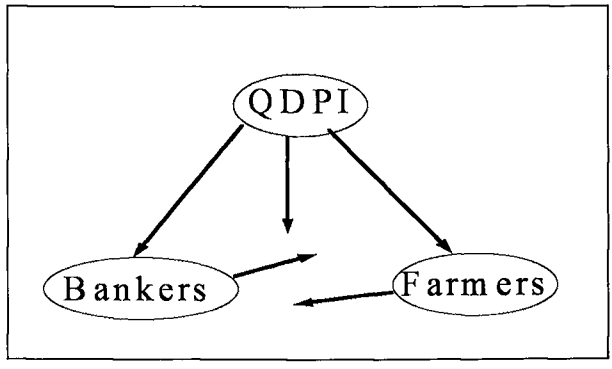


Figure 21: A dysfunctional linkage in the Knowledge System
Source: Hamilton, P.S. et al. (1994)

These models of the sub-systems of the AKIS were used in the development and execution of project activities. For example, the model illustrated in 20 was used to target farmer with their neighbours in groups for many activities, spouses in separate groups for similar activities and the children of farmers (specifically DAC graduates) in another separate group for the same activities. The concept was to give access to each element of the AKIS to VFSG participatory learning activities in groups that avoided the introduction of hidden attributes such as status disrupting the group's learning. By targeting each sub-system individually, the strategic decision making unit (the farmer, his wife and their children) had access to more knowledge and was better able to communicate and make purposeful decisions. In the example in Figure 21, the linkage between farmers and bankers was dysfunctional. The VFSG targeted this linkage to produce an information product (*Is Cotton the Crop for me*?) by targeting farmers with relevant knowledge and producing the product primarily for the bankers. The bankers distributed the information product and used it jointly with farmers to assist in making the strategic decision of whether to grow cotton or not. Arriving at a successful decision was in the best interests of both the bankers and the farmers.

10.3.4. Insights into the team's transformation.

To enable the Rapid Rural Appraisal and the Focus Group Analysis to be implemented, staff received training in social science processes. The training, the experience and the analysis of the experience began the process of transforming the team's world view from "positivist realist" to "constructivist" This is not a case of the lights suddenly coming on but rather an emergent recognition that each individual views reality from his or her own worldview, and makes sense of that reality for him or herself. Their worldview and sense of reality may converge or diverge, with other people's worldviews but are experienced as valid as anyone else's. Although I observed this transformation, I must add that I doubt many, if any, of the team members were conscious of themselves at the time as constructivist, positivist or anything else. Such epistemological thinking was not part of our profession.

10.3.5. Insights into the methods used.

Our application of RRA and Focus Group Analysis was intended to be a participative process. However, at best, the process, as it was applied, was a consultative process. The RRA particularly could have been made more participative by the inclusion of key stakeholders from the area of inquiry. The introduction of stakeholders as members of the research team would have further reinforced the perception amongst positivist scientists that the RRA was not a valid research method, but would have enhanced the perception among the VFSG that it was a valid research method. The RRA did use "unskilled" members in that no one had had previous experience of the method and their contribution greatly enhanced the process and the outcomes that resulted.

A crucial component of the RRA process was the inclusion of people from outside the project team. This introduced a wider range of perspectives and skills to the team itself, and prompted the elicitation of a wider range of responses. The naive questioning and probing by these members produced the real gems of information. They were also an important force in making explicit and balancing our biases.

The training of team members in social science skills such as interviewing technique and active listening was one of the keys to the quality of information that emerged. The skills have made a lasting contribution. As one team member put it *I have been an extension officer for nearly twenty years and I don't think I have really heard what farmers have been saying to me until now* (Coutts, 1995).

The team-based approach to research was also the key to quality assurance. The switching of interview pairs and the nightly de-briefing improved information collection in both scope and detail, improved recording and recall, improved the neutral presentation of the information, and enriched discussion of learning points. It also confronted team members with the (normal, human) tendency to premature interpretation based on one's own world view (influenced by discipline, life experience, gender, age, etc.), and thus served as the first development of understanding of what constructivism (as they learned later to understand it) might be all about.

The RRA and particularly the Focus Group Analysis was found to be useful in cross checking the information elicited. It continually raised for us the question of "Did I hear what I was told?" This is a form of triangulation. Guba and Lincoln (1989:240) suggest that

triangulation itself carries too positivist an implication, to wit, that there exist unchanging phenomena so that triangulation can be logically a check . I contend that triangulation in qualitative studies is not a check of sameness but of consistency, divergence and convergence. Under this contention, triangulation remains a useful approach.

The analysis of the RRA data and the writing of the report proved problematic. The content of the report received a variable reaction when it was presented. The RRA report had twelve authors, each with his/her own style which made the report format to be different from a typical scientific report. This peculiarity was one cause of criticism by our scientific peers and management when the report was presented. Reaction to the content of the RRA report varied from empathetic agreement to indignant disagreement. I deal with this reaction in the next section.

Ethnograph, as a tool for analysing data, was also found to be useful. The problems we had with the mass and complexity of data gathered during the RRA, were less in the Focus Group Analysis tool. We were not aware at the time of the ways in which RRA information could be presented and analysed systematically, by respondents jointly with researchers. Although some contextual information was necessarily lost between a real life situation and a transcription of an interview, *Ethnograph* did expose differences between what was said and what was heard. The systematic analysis made possible through *Ethnograph* also made the reporting of the information to the wider public easier.

The consistency that emerged between the findings of the RRA and the findings of the Focus Group Analysis, (again, the use of two methods is a form of triangulation), built confidence within the team that what was emerging was useable and useful. It was an important factor in enabling the team to continue its activities in the direction the market research suggested in the face of considerable criticism.

10.3.6. It wasn't all beer and skittles

The publication of the market research reports, particularly the RRA report and the presentation of the information contained in these reports with a wide range of reactions. Many scientists and QDPI managers were extremely critical of our findings and of the process we used to arrive at our findings. This criticism on the one hand included threats to withdraw funding of the project, a published criticism (Bartholomew, 1993) of the process with the wonderfully caustic secondary title of "... Is the Emperor wearing any clothes," to a senior scientist's claim that he "had never been witness to such an arrogant and aggressive presentation" and the dismissal of qualitative research of this type as being "touchy, feely". On the other hand, there were scientists that were supportive of our findings and process and worked to incorporate them into their work. Our farmer clients were the most supportive, with unsolicited comments like "the DPI should do more of this type of work" and "I felt it was the first time the Department really listened to what I had to say". The team was struck by how little attention was paid by our critics to the farmers' response. Clearly, our critics did not at the time accept the implications of calling farmers 'clients'. The criticisms had the potential to split the team and cause the project to founder, but the team members had such confidence in what we had found that we pushed on regardless, determined to prove our critics wrong. Most of the team subsequently nominated the RRA as the key learning event of the project (Coutts, 1995). It was the critical event that opened the way to all that followed.

The main bone of contention seems to have been that the report demonstrated that the perspective of "science" was not accepted as wholly valid to many clients of science, and rejected as totally invalid by some. This was our first experience of paradigm clash, or as Gage (1989) describes of *paradigm war*. The criticism was important to the team because it precipitated our understanding that by being involved in a participatory process we had changed our perceptions of and perspectives on reality.

The introduction of a constructivist perspective into a scientific community that has a positivist realist perspective is a recipe for conflict. The constructivist perspective challenges the belief of positivists that reality exists, that they hold the knowledge of what reality is, and that their version of reality is the only valid version. Being positivist requires fairly black and white choices. If my version of reality is right and yours is different, yours must be wrong. A constructivist perspective, on the other hand, accommodates diversity and differences in worldviews. It does not reject positivist realist worldviews, but nor does it accept that these are the only, or the only valid views to be taken into account.

We learnt from the RRA experience in that the Focus Group Analysis report was carefully prepared and well presented. This ensured that it was more acceptable, as being more recognisable as the kind of report our intellectual community was used to receiving. Attitudes towards the two reports, and the process, changed. Both reports required reprinting (a total print run of 800 copies of each report) such was the demand for them within the QDPI, nationally and internationally. I was requested to give seminars and training to interested extension staff in QDPI and interstate. For seminars on RRA, I included as a participant, a critic of the RRA process so both the pro and anti perspectives could be aired. The VFSG's experience spawned similar initiatives in different districts of Queensland and interstate. Management also used the reports to support the employment of twenty staff in southern Queensland and used our recommendations to assist in writing their position descriptions.

10.3.7. Concluding remarks

The market research phase was a key process in the project. Through our involvement in the market research phase and the results emanating from this phase, our paradigm was changed. It gave us confidence to progress into activities that could be seen to be intimately linked to the outcomes of the market research phase. It exposed previously unknown actors and linkages within the knowledge system. It certainly exposed the complexity of the area we were interacting with. This, in turn demonstrated to us the need to pursue information needs other than the technical information need associated with fallow management systems that we were previously focussing upon. Unless these diverse information needs were pursued the resulting farming systems and human activities associated with them would be unlikely to become more sustainable.

The market research phase certainly drew criticism. The criticisms are now seen as alternative view points that demonstrated to us that we had changed and were key to exposing the lessons that we had learnt. They forced us to reflect upon our actions and observations and make judgements about the validity of them. This reflection process reinforced our belief and confidence in what we had uncovered, and gave us confidence to pursue the activities that would result. The team had in effect become a learning team.

Certainly, these phases were time consuming and expensive when compared to similar problem analysis and situation analysis of previous work and other work around us. However, the investment in time, and resources can be seen as a high return investment in the final analysis of the project.

10.4. THE PURSUIT OF BETTER INFORMATION PRODUCTS: AN ASSESSMENT

10.4.1. Overview

Written information is a major output of the QDPI, yet our market research showed that farmers preferred to receive information other than written information. Firstly, our work demonstrated that there are various matters of concern with regard to the QDPI's output of written material. Secondly, farmers are already well informed with respect to operational decision making information. The QDPI's *Crop Management Notes* which focus on operational information and are distributed to every farmer, are highly regarded as a source of operational information. Thirdly, information for strategic decision making was lacking or inadequate. Fourthly, we demonstrated that it was not enough to provide information for operational decision making and assume that our clients had adequate skills to make strategic decisions or that these skills and improved strategic decisions would evolve from superior information for operational decisions. Our analysis of the market research results and early activities raised two questions:

(i) Is the information that QDPI is producing useful to farmers?
(ii) How can information be made more useful?

We evolved a framework (see Figure 22) to guide our thinking about information products. Each event provoked renewed analysis and reconsideration of our approach.

Our methodological approach (M) thus evolved from an expansion of research information to meet the needs expressed by farmers, through incorporation of user information, to production of this information in consultation with the users, and finally to production of information in participation with users.

It became clear that the core challenge comprised the relationships among indigenous knowledge, scientific knowledge, information use, and farmer decision making.

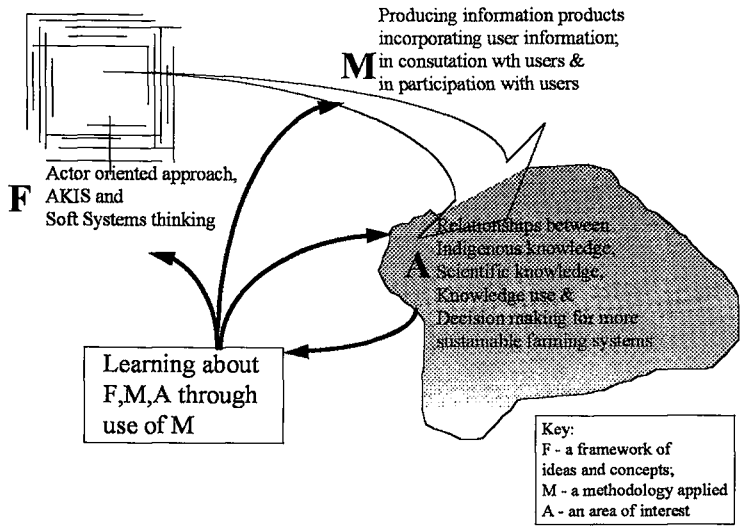
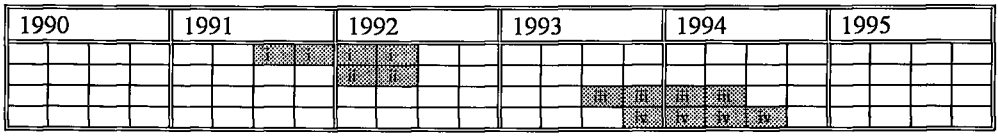


Figure 22 The research framework - creating information products
Source: after Checkland (1985)

The main events connected with the development of information products are given below:



Key:
(i) expansion of research information to meet the needs expressed by farmers;
(ii) reformatting research information through incorporation of user information; - matching information to on farm indicators and decision making, and producing farmer case studies using the *With and without tool*;
(iii) production of information in consultation with the users - *Making Better Decisions for your Property*
(iv) production of information in participation with users - *Is Cotton the Crop for me?*

10.4.2. The inadequacy of existing scientific information for strategic decision making

Pre-VFSG, the written information support was seen by farmers to have a bias towards high input, chemically intensive systems, that is, applicable only to a limited number of farmers. For many farmers, presentation of information with this perceived bias was regarded as pushing them in a direction they would prefer not to go, and the information was judged to have less relevance to them. Another flaw with the scientific information products was that they reported the outcomes of the application of a decision, but gave little insight into how to make the decision, and how to improve the effectiveness of decision making processes.

10.4.3. A failed attempt to improve existing scientific information for strategic decision making

In our early efforts to make scientific information products more useful to a wider range of stakeholders, additional variables such as quality and partial gross margin analysis were incorporated by the VFSG into existing scientific information (in consultation with the research officer who did the research). It was anticipated that this would add depth to the information and make the information understandable from a farmer's point of view. While this did improve the information product, it still did not address many stakeholders' needs. The variables that they considered important were still not incorporated. It also soon became apparent this method of expanding information products is a never ending cycle with increasingly marginal returns. While we had improved upon existing scientific information, the information product still was not particularly useful to our clients. If we were to meet a larger number and range of stakeholders' needs, we obviously needed an improved and different information product.

10.4.4. Producing a better scientific information product

In spite of the apparent failure at our first attempt to improve the existing information product, the process did enlighten us to some of the major failings of research information. A major flaw is the failure to link the scientific information with farmers' decision-making. Most research information reports the outcomes of a decision implemented. A researcher implementing a decision such as zero tillage, (or reduced tillage or mechanical cultivation tillage), has little need to pay heed to the variables that a farmer has to take into account in his decision-making. The scientist's output is a simplification of a complex situation that contributes little or nothing to farmers' understanding of dealing with complexity, and simultaneous adjustment of practices.

For example, zero tillage as applied by a research officer is a rigid fixed system that is implemented irrespective of seasonal conditions or soil conditions. The decision is made at the commencement of the fallow and rigidly adhered to. When viewed from the farmer's perspective, zero tillage is actually a description of the outcome of the decision-making process. A farmer may have a strategic plan to implement zero tillage, but his decision on a day-to-day basis is a response to the environment he is interacting with, and decisions are modified according to these environmental stimuli. If the farmer succeeds in zero tilling, it is the result of a continuum of decision making, rarely a rigid application of a single decision.

Clearly we needed to assist farmers in this strategic decision-making process. The expansion and adding value to existing research information was not useful in this respect. By reviewing the information collected in the RRA and the FGA, and through interaction with farmers (particularly with the Rainfall Simulator), a very simple overview of the strategic alternatives available to farmers, and the environmental factors that are considered important in the decision-making process were uncovered.

Additionally, we learned that strategies are based on consideration of options, and the interaction these have with a range of factors, including social factors (such as lifestyle, uneasiness with chemicals), economic factors (such as costs of time and management input), and not just technical variables. We needed to be able to provide farmers with three things:

(i) a framework to guide the decision making process;
(ii) improved information inputs over time, drawing on the existing body of knowledge but also on time and context dependent observation and measurement; and,
(iii) improved skills and tools for interpretation.

10.4.5. The pursuit of farmer based information

If the value adding process of expanding research information to meet a wider range of stakeholder's needs only marginally improved the situation, would working from the other end by producing information from a farmers' perspective, result in a better product? We developed a case study approach to developing farmer based information, utilising farmers and farmer groups. To ensure consistency between the case studies we used the economic tool *With and Without* as a framework for this information development. The farmers who were involved in producing the case studies found the process extremely useful. They learnt a lot about their situation, and they learnt a lot about alternative strategies for improving their situation. However, the readers of information products which resulted from these exercises still did not find the information very useful, although they did allocate this information high status and regarded it as valid, because it was from farmers - their preferred information source.

The reaction of scientists, on the other hand, was to suggest that this information was invalid because it was not representative. Yet this was information that captured an individual's reality. We encountered here the fundamental distinctions among

(i) universalised knowledge, floating free of context;
(ii) local knowledge, socialised among those farming within a shared context and recognisable range of objectives; and,
(iii) the specific knowledge arising in and belonging to a particular experience.

While we learnt from the processes used in producing information that by incorporating farmers' information and by including farmers in the process of producing information will result in a better information product, the fact that written information is not highly regarded by farmers was still not overcome. However, the success of the *With and Without* tool as a framework for an individual to explore his problem situation in a structured manner gave us confidence to continue to use it to produce information, as the basis of improved information products. I argued that by approaching information development and presentation in this way, we would incorporate elements from all three knowledge domains (i - iii above) in ways which were relevant, valid, and effective.

10.4.6. How well did these information products address the total problem of sustainability?

The information products did not address all aspects of the problem of sustainability. The market research phase illustrated that information for sustainability is more that just scientific research information. However, it is also more than just the interaction between the farmer and his physical environment. The reduction in farm viability, and farm failure, has more to do with off-farm effects than on-farm effects. These include marketing skill in a market where margins are thin and unstable, farm succession, and families' needs and wants. If sustainability

is considered as an emergent property (rather than a defined end state), then the role of information products necessarily is limited, albeit essential.

10.4.7. The pursuit of non-technical information.

The challenge of sustainability clearly required further exploration. We were confronted with a situation where our technical expertise had limited value unless it could be linked to other issues of concern to farmers. If we were going to impact on sustainability, we had to address also the non-technical factors.

Our self-image as "information rich" changed to a recognition that we were "information poor"; our role changed dramatically. No longer were we "experts". To be useful, we had to become information seekers ourselves. The process of discovering this information, collecting it and publishing it was one of facilitating the linkage among "information rich" with respect to the information needs that farmers expressed, and packaging it and delivering it in ways which supported farmers' decision making.

We developed at this stage a collaborative approach in that the information needs were researched by us and we then sought information from other experts to meet these needs. While the information was tested with a range of farmers, the process did not fully include these farmers in the process of seeking information.

Even so, the farmers who were involved found the process very useful in their own decision-making. The usefulness of the information product was improved by utilising the farmers' skills in determining what makes information "good", and knowledge about how they like information presented. However, where the final product was passively received by farmers not involved in the process, it still did not meet the requirements of being "good" information.

10.4.8. New concepts emerge

The collaborative process did throw up some new concepts about information that we had not previously recognised. The first concept related to problem definition. Information is only useful if it is applied to a problem situation. Further it is only useful if that problem is well defined and the information can be used to assist in improving the problem situation. This led us to the conclusion that information for this type of decision-making must include a component which assists in better problem identification. This took the form of questions about a problem situation, that is, questions that had to be answered for the problem to be defined, rather than to be solved.

Secondly, the collaborative process also raised the issue of the mass of information that was available and the mass of sources that were available. To incorporate all these sources and their information in a single written publication would have resulted in a "weighty" tome. To address this problem, we developed the concept of information maps. Information maps point the information seeker to information sources, rather than provide the information directly. Again, farmers found the information maps extremely useful and utilised them to seek and find information useful for their own specific decision-making needs. It is a concept that we incorporated into our later work.

10.4.9. Information hierarchies emerge

As we started to work with information for strategic decision-making, we reviewed the information for operation decision-making that we had been producing. We discovered that there was a hierarchal relationship between the two (see Figure 23).

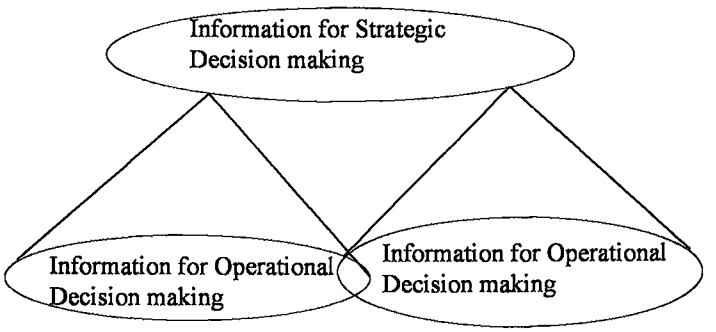


Figure 23. The hierarchical relationship between information types
Source: Hamilton, 1994(a).

For example, the strategic decision of whether to adopt a higher stubble retaining system was interrelated with the operational decisions of how to cultivate or to plant in the fallow with higher stubble levels. This hierarchical relationship gave us further insights into the use of systems thinking in developing information. Working from the higher level of strategic decision-making information and then reviewing the lower levels of operational decision-making information, allowed us to discover holes in the operational information and to develop suitable information to fill these gaps. We also found that to maintain clarity in the linkages, it was necessary to re-arrange the operational information so that it reflected the strategic decision-making information. To improve this relationship further, information hooks were developed so that the information we were producing for strategic decision-making directed people towards relevant information at the operational information level.

After our experiences with a consultative approach to producing information products, and because of a need expressed by farmers to gather information regarding a major change in the farming system, (the incorporation of cotton into the farming system), we used the lessons from the consultative process and transformed them into a participative process.

Once again, the project members who were involved in producing this strategic information had few technical skills in the information domain. Their role was not as a source of information, but as a facilitator. Their role was to facilitate participants' identification of information needs, identification of information sources and match the two. As with the

consultative approach, working at the higher level of the hierarchy of information allowed a clarity to emerge.

10.4.10. The emergence of principles

In particular, our experience led to the formulation of generalisable principles. Capturable outcomes of developing information for strategic decision making in a PLAR mode are:

- improving the definition of the problem situation;
- providing a framework within which the problem, its solution and communication about the two can be enacted providing information maps where relevant specific information can be found; and,
- allowing the stakeholder to seek their own solutions.

From the book *Making Better Decisions for Your Property* a consultative approach, and *Is Cotton the Crop for Me?* a particpiative approach, a new role for written information emerged. By assisting farmers to better define their problems and to consider the strategies available in their decision-making rather than presenting them with written information up-front we found that farmers would then seek written information and other information that was pertinent to the decision or small range of `decisions that they had determined as being necessary for them. When this information is sought out by the user, and the use of this information to make the decision becomes a purposeful activity, the usefulness of this information is given a completely different judgement. Because it was pertinent to the problem situation, and because the users of information had developed their own insights and skills and could mould the information to fit their needs, the information became valuable.

10.4.11. Insights into the team's transformation.

Prior to this project and in the early stages of this project the team prided themselves in their technical expertise. Yet, both QDPI and its written information is not the most highly regarded information that farmers access. This position is held by their family, and their neighbours. If we were going to be useful as information providers, our role had to change. This change was accomplished by merging farmers' information with our information. Further, that technical information was not the most important information that farmers needed to be sustainable; this also meant that our role as technical experts was redundant in many situations. Again if we were to be useful, we had to adopt a new role - that of facilitator of information production and information sourcing. This transformation was both a revelation and a threat to us. Our technical skills were under threat of being devalued and consequently, our perceived status was reduced. We were entering into a process that required us to develop new skills that were not highly regarded by our peers. Yet, once we had developed and applied our new skills through the process of being participatory and facilitatory, our confidence in our skills was enhanced. Our skills were no longer just solely technical skills, they included facilitation skills.

Concluding remarks

Information as a written product has only minor impact on the decision making process. The QDPI had demonstrated that it was very good at producing information for operational decision-making. The VFSG had further learnt and demonstrated that it was possible to produce information for strategic decision-making and that the production of this information

enhanced the decision-making process for the participants but to a much lesser degree for the passive respondents of this information.

Our experiences in producing information for strategic decision making demonstrated that information alone was not sufficient to cause change to occur. Even the production of this information at the higher levels of the hierarchy was still not seen to be sufficient on its own to be judged as effective, efficient or as having efficacy.

Why? This information gave assistance to the decision-making process but was somewhat prescriptive and reductionist in nature even at the higher levels of the hierarchy. It still doesn't accommodate the complexity of the decision making processes farmers are dealing with. It does not allow for evaluation of the decision-making and in the final analysis the goodness of the decision-making process is the key criterion for leading to more viable and sustainable farming systems. In effect the information produced is more likely to result in what Argyris & Schön (1974) referred as single loop learning. The stakeholders who did benefit most from these activities were those who were involved in the process of creating information, not those who received the end product. The process is more useful than the product. Involvement in the production of this information can be seen to reflect what Knowles (1980) refers to as an andragogical approach for the participants in the information production, and for those who use the information product as a framework for learning about their problem situation as they are guided to seek the information they require to construct their own solutions. Conversely, the passive receipt of information reflects a pedagogical approach and is limited in its effectiveness.

10.5. ASSESSMENT OF THE LEARNING PROCESS

10.5.1. Overview

The delivery and passive receipt of information has been demonstrated to be a fairly ineffective process in stimulating change. The question still existed with respect to the processes that could be invoked to improve the situation. Our experiences with the Rainfall Simulator both prior to the project and during the early phases of the project gave us some indications of a direction to move in.

The framework of concepts and ideas, the method applied and the area of application are illustrated in Figure 24.

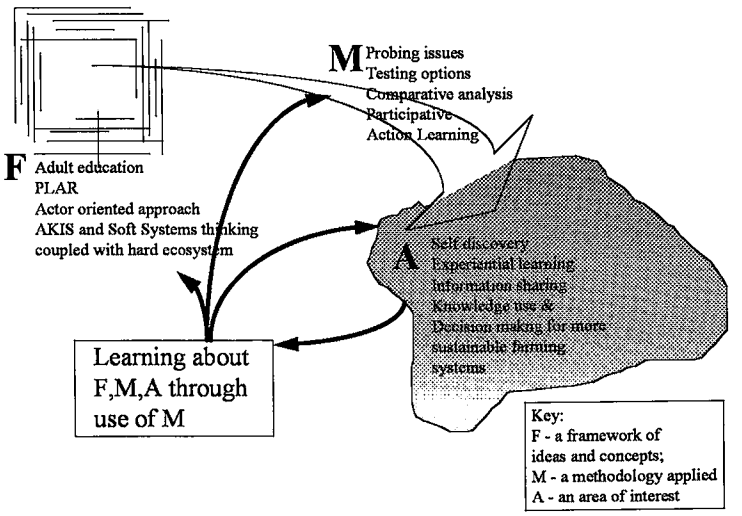
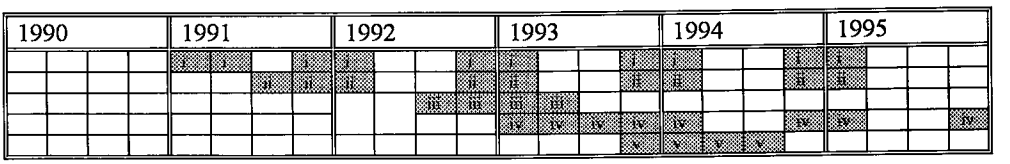


Figure 24 The research framework - learning with farmers
Source: after Checkland (1985).

10.5.2. Timing of the experience



Key: (i) The Rainfall Simulator activities.
(ii) The Soil Corer
(iii) The Dalby Agricultural College experience in using *With and Without* as an adult education framework
(iv) *How Wet*
(v) The *Fallow Management Game*

10.5.3. A serendipitous event

Tools like the Rainfall Simulator are used to generate interpretations of the application of a decision. The term Rainfall Simulator is in fact a bit of a misnomer. The only thing that the Rainfall Simulator simulates is the velocity and mass of a raindrop (we can't order rain on demand). Once that raindrop impacts on the surface we are not dealing with simulation but with a reality which becomes accessible to interpretation .

Earlier uses of the Rainfall Simulator had been as a demonstration tool. In effect the decision-making process and the implementation of the decision was removed from the participants and retained by the scientists running the demonstration: in effect they were using it to make empirical statements. Our fortuitous observation of a farmer interacting with the Rainfall Simulator and learning from it directed our early thoughts on how to use the Rainfall Simulator as a learning tool. We surmised this process could be improved by allowing the participants to interpret what they observed, to make a decision, to implement it, and to evaluate it.

10.5.4. Changes in perception of scientific status

This shift from development of empirical to interpretative understanding does create some tension within the scientists running the exercise. No longer is their knowledge or their perceptions of what are desirable outcomes and how to arrive at them, of prime importance. The knowledge of the participants and their judgements on the outcomes becomes the important factor, and leaves the scientist with his technical knowledge in the background. In effect, used in this way the Rainfall Simulator allows the emergence of double loop learning and is an andragogical approach. It contrasts sharply with previous applications which reflected single looped learning and a pedagogical approach. For example, with a pedagogical approach, the cause (keeping stubble with zero tillage) and effect (more moisture storage, less runoff and erosion) relationships were predetermined and demonstrated. Recipients of this information were left to apply the cause prescriptively, irrespective of the changing circumstances a farmer may face. Under this approach, the possibilities for inquiry and learning are limited or cut short. This leads to the "learner" becoming defensive and the "teacher" controlling behaviour. With an andragogical approach, the cause and effect relationships are explored and discovered (individually and collectively). Information is sourced from an individual's own experience, other members of the group and from observing the activity. Individuals, through reflection, amend not only their action strategies but also the governing strategies behind these strategies. It allows the decision maker to make dynamic decisions to reflect the dynamic situation he is dealing with.

This perception of a reduction in the status of the scientist's knowledge and its capacity to influence change proved to be a barrier to implementing the Rainfall Simulator in our preferred mode. Some QDPI staff found it impossible to give up their status of having the necessary technical knowledge amongst a group of farmers or allow the farmer's knowledge and information to come to the fore. They reverted to a pedagogical approach, that is, to a process of demonstration rather than assisted learning. This reduced the effectiveness and efficacy of the process. With team training and through experience these same scientists learnt that the process could be made more efficient and effective if they did pursue the andragogical double loop learning process. This in turn enhanced their status.

10.5.5. Learning to make judgements about the "goodness" of a decision

The other great advantage of tools like the Rainfall Simulator is that they assist the evaluation of the decision-making process. During the term of this project we did develop an understanding of a basic rule for making judgements about the goodness of the decision-making process.

Too often, the "goodness' of the decision making process is judged by its effect once the outcomes are apparent. In effect, the environmental events occurring after the decision has been implemented and their effect on the farming system are given prime importance. They are not seen to be one of a range of possible environmental events. Farmers often judge a decision to have been good or bad depending on the final outcome. If the outcome is good, the decision must have been good; if the outcome is bad, the decision must have been bad. For example, if a farmer has a soil profile that has a minimal amount of stored soil moisture, but makes a decision to plant, and the rainfall between planting and harvest is well above average, and consequently, the yields received for that crop are also well above average, the outcome is "good". Without taking into account the probability that "well above average" rainfall occurring within the crop is a low probability, the farmer could judge this decisions to be a good decision rather than a lucky (low probability outcome) decision. The decision and its outcome need to be seen in the context of the range of possible outcomes that could be expected.

Our understanding of the "goodness" of a decision-making process were found to reflect the concepts of Total Quality Management proposed by McConnell (1986). He argues that judgements about the decision making process should be made at the point of the decision even before the outcomes become apparent. To judge it when the outcomes become apparent, to judge it solely on the outcomes, then to accept or reject the decision as being good and incorporate this into future decision making processes, causes greater instability in outcomes. The effect on future outcomes of judging decisions on outcomes alone, results in greater fluctuations in outcomes around the median of outcomes possible.

Conversely, judging the decision on the basis of viewing the outcome as being within a range of potential outcome will reduce the fluctuations of outcomes in future decision-making processes towards the medium. To improve judgements about the goodness of a decision a farmer needs a range of information that relates to this decision and its possible outcomes, so he is better able to make these judgements.

10.5.6. Gathering information to make and judge decisions

Once we had developed this understanding, the redevelopment of the soil coring tool became an important need. The Soil Corer is an aid to measuring and monitoring soil moisture. It complements the Rainfall Simulator which is an aid to understanding how moisture enters the soil and is stored. The use of the Soil Corer as a monitoring device and the training of farmers to develop the capacity to measure and monitor soil moisture, assumes a key role. Not only does the capacity to determine soil moisture at planting become an important variable to assist the decision-making process but it also assists in determining the array of outcomes that are possible. It further becomes an important tool in determining and understanding the reasons that these outcome occur.

Farmers develop an indigenous knowledge of the relationship between soil moisture at planting and the range of yields that are likely given post-planting rainfall. For example, most farmers know that average soil moisture followed by average in-crop rainfall results in an average crop. Farmers however, were found to have an imprecise knowledge of the amount of moisture they had stored in their fallow. The tool that most farmers use to judge their stored soil moisture is a simple probe which measures the depth of wet soil. The probe does

not indicate the degree of wetness of this wet soil, only its depth. The Soil Corer added precision to the measurements farmers could make of stored soil moisture.

This had two facets: (i) it gave them an indication of the total depth of soil that was available to plant roots on their own farm (the scientific jargon is effective rooting depth). This could be discovered by farmers by seeking the existence of plant roots in the soil core; (ii) It also allowed farmers to determine the depth to which soil moisture had been stored which in turn gave them a proportional measurement of existing soil moisture as against potential soil moisture. It further gave them an indication wetness of the wet soil.

This further improved the precision of determining stored soil moisture at planting. This precision could have been enhanced further by drying the wet soil and measuring the exact amount of water that had been stored in the soil. With a simple calculation the difference between the amount of moisture in the soil and the wilting point water holding capacity of the soil could be determined.

10.5.7. Making existing farmer information more useful

What the Soil Corer did not do was give farmers an understanding of the relationship between rainfall and soil moisture storage. The Rainfall Simulator showed farmers how water infiltrated into the soil. The development of *How Wet* was a further stage in the attempt to relate rainfall events to stored soil moisture. Rainfall records are the one record that are consistently and accurately kept by farmers. If we could use this information and transform it into a measure of stored soil moisture this information would suddenly become very much more valuable to the farmer decision-making process.

Investigations of the relationship between stored soil moisture and known rainfall events showed that there was a good approximation could be developed of stored soil moisture from rainfall records. The day by day accumulation and subsequent loss of stored soil moisture followed a fairly consistent pattern. A basic rule-of-thumb - that 25% of all rainfall during the fallow is stored in the soil - could be improved dramatically by looking at individual rainfall events, understanding how much moisture would infiltrate the soil, how much would run-off, how much would evaporate in subsequent periods, and, how much would be stored.

Initially this was developed as a pen and paper exercise and used farmers own rainfall records. To automate and expedite the process, a simple computer programme was developed - *How Wet*. *How Wet* automatically calculated stored soil moisture from rainfall records.

10.5.8. Crawl before you run

We found that using the *How Wet* on its own, black-boxed the information on the movement of water in and out of the soil and consequently did not give farmers an understanding of these processes. This reduced the effectiveness of the program. For greatest effect, it was important to take farmers through the pen and paper exercise before they moved to the computer exercise. By taking this latter route, the computer program was given a status by the farmers because they recognised that the results of the computer program were results that they could generate themselves using their own data. Further, the pen and paper process was important in farmers developing their understanding of the processes of accumulating and losing soil moisture. It effectively opened up the black box.

10.5.9. Experimenting with decision making

With these three tools we now have the capacity to help farmers interpret how water is accumulated and lost from their farm, how this water can be more accurately measured, how these measurements can be utilised in improving decision-making and how judgements about the goodness of these decisions may be made. Even so, while moisture accumulation, subsequent crop growth and yield are important outcomes, farmers needed to be able to translate the information into economic terms, and to test the impact of implementing alternative decisions, if they were to further enhance their decision-making processes.

The *With and Without* tool was a tool developed by economists for use by extension to determine economic impact of implementing various decisions. Previously the information that was derived from the *With and Without* tool was generated by extension officers and transferred to farmers. Used in this way, the *With and Without* tool is a fairly rigid instrument. Extension officers usually used values of variables determined from a classical economic perspective. These values often differed significantly for values farmers placed on these variables.

Giving the farmers the tool to determine the outcomes themselves, gave them a better understanding about the relationships of soil moisture, yield and other crop factors and the economic factors of their farm. The *With and Without* tool was found to be flexible enough to allow farmers to impose their own definition of certain economic variables. For example, the price per tonne of seed for planting is an economic variable that is widely understood and given the same value by farmers and scientists alike. Other variables such as cost of farmer's own labour and depreciation of machinery are variables that farmers gave different definitions to and impose different costings on compared to other farmers and scientists. Some farmers regard their labour as being a fixed annual amount, that is their living expenses, while other farmers cost it on an hourly basis. If they have to work an extra 5 hours a week that increases the cost of labour, whereas often farmers cost this increased labour at no extra value. Nor, for all farmers, is the end result of increased profit the only outcome that they utilise to determine whether to implement a decision or not. Other factors such as the cost of achieving this increased profit, or the change in cash flow required to achieve this increased profit, are further variables that farmers consider in the decision-making process. The *With and Without* tool proved to be flexible enough to accommodate these varying farmers' needs. In effect, it was a framework that allowed farmers to create their own version of reality.

Using the tool in groups further enhanced this activity as it allowed farmers to be exposed to differing view points about similar situations and to modify their own version of reality on the basis of this information. The *With and Without* tool further enhanced the information that farmers could generate for themselves to assist in their decision-making process.

What the *With and Without* tool did lack was the capacity to generate and compare a range of scenarios that occur due to the range of environmental conditions that may occur after the decision has been implemented. It used in most situations an average season scenario and thus gives a comparison of outcomes between two decisions for a single season.. The economist who developed the *With and Without* tool is currently developing an extension of this tool that will allow farmers to survey the range of environmental variables and their impact on a decision after the decision has been implemented.

10.5.10. Playing with decision making

The *Fallow Management Game* was our attempt to develop a tool that would be even more effective in mimicking a farmer's reality. To handle the complicatedness of this reality, the use of the number crunching capacity of a computer was required. However, rather than follow previous attempts at developing computer programs where the information is entirely contained with-in the computer program, we pursued an entirely different process.

This process was to include a minimal amount of information within the computer program and allow the computer program to (i) interact with a farmer and (b) support interaction between this farmer and other members of a group. The desired outcome was not to teach the farmer a specific solution but to develop the farmers' own learning and interpretive capacity.

Rather than develop a complete piece of software, we developed a "bare bones" framework for a program. This software utilised the basic relationships that had been developed for the *How Wet* program.. We then allowed farmers to determine what were the important components to be included in this program, and the program is being expanded and modified accordingly.

The process of development incorporated and built upon the *How Wet* tool. The game utilised the pen and paper procedures to open up the black box and allow farmers to determine the status of the internal workings of the program, and to input their own data, and to evaluate a range of scenarios. We then introduced the *Fallow Management Game*.

Although this activity is continuing to evolve, the minimal amount of use we have had with it so far, suggests that is an exciting and different approach to assisting farmer's decision making, It is a process that incorporates more members of the farm family involved in the decision making process. It provides a forum that allows husbands, wives, children and cross generational aspects of family decision making to emerge.

Importantly it does not change the status of the individual members within this decision making group. However, some very important features that we had not anticipated when we first started to develop it, became apparent as we put the game to the test. Daniels & Woods (1993), found that in a standard family decision making group, the farmer (male) is involved in all decisions relating to the farm. The farmer wife has been shown to be involved in the majority of strategic decisions, but only a minimal amount of operational decisions (ibid, Blacket & Hamilton, 1992). For farming women to develop an enhanced capacity to input into strategic decision making, their understanding of the relationship between operational decision making and strategic decision making also needs to be improved.

The game empowered women to develop a better understanding of operational decision making and to enhance their strategic decision making capacity. Conversely, farming wives are more likely to be the bookkeepers on a farm and have a better understanding of the financial variables and relationships and their impact on the operation of the farm. The game allowed the male farmer to develop a better understanding of these economic variables, and this, in turn, enhanced his strategic making capacity. The gaming approach avoided the threat to husband - wife relationships that had emerged in previous activities, for example, the Rainfall Simulator activity run with farming women. Women who were involved in the game reported that because technical information associated with the farming system remained "the

computer's" information rather than being identified with the farm woman, their husbands were not threatened by their possessing this knowledge. They could use the computer's knowledge (which they internalised) to input into the decision making process. By expanding the knowledge and understanding of all participants involved in the decision making process, better communication and input into the decision making process and synergy emerged within the family.

We had expected that in playing of the *Fallow Management Game*, the normal decisions the players were making would be replicated. Unexpectedly, farmers explored what they had previously perceived to be very risky options, removing the risk associated with implementing a decision, that is by gaming rather than implementing in reality. In fact, they explored these options in preference to options of lower risk that they had better understanding of. This capacity to play at no risk is a feature of the game and a feature that enhances farmers' and farm families' capacities to make decisions. We understood this process as a powerful example of the effect of working at the level of interpretative rather than empirical understanding.

The families that were involved also reported an unexpected benefit - that playing the game was fun. For a short period, the game removed them from the stresses of their daily existence. The game has a degree of fantasy attached to it, but it is also embedded in reality.

10.5.11. Reflections on a set of successful activities

Of all the activities that the VFSG undertook during this project, the use of these learning tools and learning activities were the activities that had the greatest impact on change. That change has been demonstrated to be quite spectacular and unexpected. The reasons why these learning tools had their impact are many fold:

Firstly, these learning tools were used in an andragogical approach. This approach is atypical when compared to other scientific approaches used to initiate change.

This approach changed the status and role of the "teacher" and the "learner". It gave control to the "learners". It utilised their indigenous knowledge; it allowed them the freedom to build their own constructs; it encouraged them to determine the treatments and measure the effects; and it allowed them the freedom to make their own decisions.

Similarly, the role of the QDPI officers was changed from being the technical expert to a role of facilitation. The technical knowledge that the QDPI possessed was not excluded from the process, but only introduced to allow the farmers to discover further information, or to present alternate perspectives on the relationships that were emerging.

The learning tools stimulated the farmers' need to know and this need to know was supported at, during, and after the activities.

The process also assisted farmers to reflect upon their learning, by providing a feedback loop, with observations and measurements. This feedback loop was also used to present farmers with written information pertaining to the area that they were learning about: a new role for written information.

The activities also matched the preferred learning style and perceptual modalities of the participants, with the learning activity. It combined more than one perceptual modality.
There is a close relationship between communication, sensory systems and learning. We express ourselves through speech, writing, gesture and movement. Our personal learning style depends on the way we use our brains and our bodies in receiving and expressing information - our perceptual modalities (see Table 6). Through communication and learning, we use all of these perceptual modalities to some extent, but for each individual, one is often dominant and used more automatically.

Table 6 Characteristics of learning processes associated with perceptual modalities

Element	Learning process
print	individuals learn by reading and writing
aural	focuses on listening to other individuals and ourselves through lectures, audiotapes, or reading aloud to oneself
interactive,	discussing ideas in groups or by debating activities
visual	which may be individuals observing videos, graphs, words, or pictures
haptic	which is the sense of touch by hands-on experience
kinesthetic	in which participants learn while engaged in physical movement such as taking notes or pacing
olfactory	which involves the sense of smell

Source: James and Galbraith (1985).

For example, the Rainfall Simulator combined the perceptual modalities of a haptic element, a kinaesthetic element and an interactive element. Print was provided in the feedback loop.

Undoubtedly the Rainfall Simulator and the Soil Corer, by being a haptic perceptual modality (the dominant modality of our farmers) had the strongest impact. For some learning experiences the development of a haptic learning tool is problematic or not possible. For example, for more abstract concepts, such as nitrogen or economics, we could not conceive a suitable learning tool that incorporated a haptic modality. We therefore developed learning experiences with processes that adopt an andragogical approach to adult learning for these concepts. Our experience continues to demonstrate that this approach is also a powerful initiator of change. This is demonstrated by the success of the *With and Without* workshops with the DAC graduates and the *With and Without* exercises with farmer groups (both andragogical approaches) compared with the limited success of transferring the outcomes of the *With and Without* exercises (a pedagogical approach). In both these situations, the change that occurred has been significantly greater than previously experienced change.

These processes also fulfilled a departmental policy need to move from reactive one-to-one farmer interaction and into group activities. A common complaint of group activities is that an excessive amount of one-to-one activity is generated by the group activity. Our experience has been the opposite of this. I believe this demonstrates that an andragogical approach encourages farmers to become independent self-directed learners. The andragogical approach is an independency model, whereas the pedagogical approach is a model of dependency.

The other great advantage of these learning tools is that they allow a rapid and extensive penetration of the target audience. For example, the Rainfall Simulator in a four year period has interacted with more than 50% of the farmers in the southern Queensland region. Interestingly, in the population surveys of the region, farmers who had been involved in the Rainfall Simulator indicated that this event had major impact on changing their decision-making processes. Further, there was a smaller proportion of farmers who had not been directly involved in the Rainfall Simulator activities but who had also suggested that they change their fallow management decision-making processes because of the Rainfall Simulator exercises. Diffusion still works, but it is still inefficient. That diffusion does still occur raises questions about the nature of adoption under diffusion processes. Do the farmers on the receiving end of a diffusion process adopt a technology or the outcome of somebody else's decision or do they engage in some form of independent learning such as dialogue or observation to gain understanding about the decision making process, arrive at similar understandings, reach similar conclusions and adopt the same technology? While this study has uncovered the existence of this phenomenon, it does not provide much insight into the understanding of it and this phenomena is worthy of further research.

10.6. QUALITY ASSURANCE

The methods used in the eleven cases presented in this study demonstrated varying degrees of quality assurance. By contrasting each case and the methods use against the six criteria of Pretty and Chambers (1994) for judging the reliability of participatory approaches (see Figure 25), the relative success or failure of each method is highlighted.

The contrast demonstrates that once participation is not part of the process, the reliability of the method fails. The difficulty in developing participation in the passive receipt of information suggests that other options be investigated. For example, we had more success in developing participation in the production of information products such as *Is Cotton the crop for me?* by providing information at the strategic level and allowing the recipients of this information package to pursue their own information constructions at the operational level. Despite this success, the role and value of scientific information still needs to be better defined and ways to increase participation in the use of this information need to be conceived and tested. This may mean better integration between traditional reductionist research and participatory research. It may further mean the development of more integrated information systems that clients can quickly and easily access. The participation of clients in the development of these information systems is an imperative.

	Defined methodology & systemic learning process	Multiple perspectives	Group inquiry process	Context specific	Facilitating experts & stakeholders	Leads to sustained action
Rapid Rural Appraisal	+	+	+/-	+	+	+
Focus Group Analysis	+	+	+	+	+	+
Rainfall Simulator	+	+	+	+	+	+
Soil Corer	+	+	+	+	+	+
How Wet	+	+	+	+	+	+
Fallow Management Game	+	+	+	+	+	+
With & Without - in groups	+	+	+	+	+	+
- passive receipt	-	-	-	-	-	-
With & Without - Dalby Ag College	+	+	+	+	+	+
Producing information for farmers with farmers	-	-	-	-	-	-
Making Better Decisions for your Property	+/-	+	+/-	+	+/-	+/-
Is Cotton the crop for me?	+	+	+/-	+	+/-	+

Key: + more than adequately meets the criterion
+/- adequately meets the criterion
- does not adequately meet the criterion

Figure 25: The contrast of each case and its methods used against the six criteria for reliability of Pretty and Chambers (1994).

Comparing the cases and their associated methods against the two sets of criteria for judging rigour suggested by Guba and Lincoln (1994), the relative trustworthiness and authenticity of each can be judged (see Figure 26).

	Trustworthiness				Authenticity				
	Credibility	Transferability	Dependability	Conformability	Fairness	Ontological	Educative	Catalytic	Tactical
Rapid Rural Appraisal	+	+/-	+	+	+	+	+	+	+
Focus Group Analysis	+	+	+	+	+	+	+	+	+
Rainfall Simulator	+	+	+	+	+	+	+	+	+
Soil Corer	+	+	+	+	+	+	+	+	+
How Wet	+	+	+/-	+	+	+	+	+/-	+
Fallow Management Game	+	+	+/-	+	+	+	+	+/-	+/-
With & Without - in groups	+	+	+/-	+	+	+	+	+	+
- passive receipt	-	-	-	-	+/-	-	-	-	-
With & Without - Dalby Ag College	+	+	+	+	+	+	+	+	+
Producing information for farmers with far	-	-	-	-	+/-	+/-	+/-	-	-
Making Better Decisions for your Property	+	+	+/-	+	+	+	+/-	+/-	+/-
Is Cotton the crop for me?	+	+	+	+	+	+	+	+	+

Key: + more than adequately meets the criterion
+/- adequately meets the criterion
- does not adequately meets the criterion

Figure 26: Comparing the cases and their associated methods against Guba and Lincoln's (1994) criteria for judging rigour.

The trustworthiness of the market research phases is demonstrated by the credibility of the outcomes. The reconstructions presented in reports were regarded by the co-operators who provided them, as being acceptable. In fact, these constructions were regarded by many co-operators as being an all too rare example of the QDPI listening to what co-operators were telling them.

The transferability of the report's content is somewhat problematic. Certainly within the area of discourse the outcomes reported are transferable to other situations. However, transferring the report outcomes to situations outside the area of discourse is a form of extrapolation that reduces the capacity to transfer. The transferability of the process has been demonstrated through its use in other districts, other regions, other states, to be highly transferable.

Dependability of the market research phase was enhanced by the use of diverse research methods, RRA and FGA, and the use of multiple sources and multiple researchers. The information that emerged from the market research phase has similarly been demonstrated to be confirmable by subsequent research acts and by the similarities and convergence of the outcomes of the RRA compared to the FGA.

The market research phase can also be seen to be authentic. In terms of fairness, the market research phase uncovered actors and groups of actors who had previously been overlooked or ignored or marginalised and gave these people a voice. The impact of the market research

phase on the project team reflects its ontological authenticity. Our world views were changed, enlarged and deepened through the research process and the outcomes of the research. The research also had educative authenticity. It lead us to understand the many constructions that emerged from the many stakeholders. It had catalytic authenticity. The market research phase was the basis for virtually all the action that followed in the project. This action being grounded in the market research phase gave us confidence to pursue very different methods, areas of interest, and processes. The market research phase has also demonstrated tactical authenticity. It empowered the team to action, to be responsive to stakeholders needs and wants, and to utilise processes that empowered the stakeholders themselves to further action. The market research phases also empowered other groups, such as QDPI management to utilise its findings it the provision of new staff with new job descriptions that reflected the findings of the market research phase. The market research phase did have some weaknesses (which are covered above). However, in the final analysis, this market research phase may be judged to be a rigorous process.

The use of a market research phase to commence the project was effective in assisting in developing a clearer understanding of the problem situation. The efficiency was adequate, but the use of two phases did make for a drawn out process. Perhaps the efficiency could have been improved by combined the two methods, that is, using personal interviews as well as groups in a Rapid Rural Appraisal, and analysing the data collected by using the tool *Ethnograph*. In their own right, the activities that the market research spawned and the impact these activities had in initiating and fostering change suggest that these two market research tools were the right tools for the job - they demonstrated efficacy.

The creation of information products can be judged to be credible when participants were involved. The processes used, reconstructed many co-operator's constructions about certain areas of interest. In most situations the co-operators who produced these constructions deemed our representation of them as being acceptable. However, passive receivers of these constructions regarded them much in the same light as constructions that had previously come from science. This also applied to information products developed in the absence of participants. In that respect these processes do not adequately meet the criteria of transferability. It was only the information products that were developed in a participative manner, and that targeted strategic information decision-making and linked information to the decision-making process that transferability was adequately met. Similarly, the dependability of these processes must be judged as being variable. The consultative and participative processes utilised multiple research methods and multiple sources. The information that was produced was confirmable thus meeting that criterion.

The processes used adequately met the criterion of authenticity. The constructions were judged by users to meet the criterion of fairness. They were ontologically authentic in that they enlarged personal constructions and they were educative in that they improved the understanding of construction of others. In all cases the processes used stimulated to action users of information and to a lesser degree stimulated to action other producers of information.

The production of information products with client participation was effective for those clients, but was also time consuming (hence not very efficient). By attempting to transfer the information by mass distribution means, the effectiveness was poor but the efficiency was enhanced. This would suggest that the development of information products remains

problematic and demonstrates that the tools we are using are inadequate for the purpose we pursued. The efficacy of information production was enhanced when we pursued participatory development of information for strategic decision making. This was both effective and efficient. This process indicates that by providing a framework to assist strategic decision making, an information map to show the decision maker where the specific information they require is able to be located and allowing them to build their own information product is a preferable process. Such a process would require the development of a suitable information system and infrastructure to support it.

Of all the approaches we have experimented with, the participatory action learning approaches can be seen to be the most trustworthy. These approaches are credible because they allow all individuals to build their own constructions. These constructions are acceptable to the co-operators. The reports that we created from the application of these processes allowed the processes to be transferred to other location, within Queensland, within Australia and internationally. The processes can be seen to be dependable in that they used a range of diverse and interconnected research methods and multiple sources. The research process is confirmable in that while the constructions are diverse, any one construction will converge with many similar constructions but will also diverge with different constructions.

These participatory action learning approaches can be seen to be the most authentic. They maximise fairness in that they allow an increased number of participants to be involved on an equal basis. They enlarge personal constructions through allowing the individual to interact with reality and to communicate with their peers. This further demonstrates ontological authenticity as this building of own constructions and communicating about these constructions leads to improved understanding, but not necessary consensus of agreement, about the constructions of others. These processes have been very successful in catalytic authenticity. They have been demonstrated to be powerful in stimulating action among participants. They also have successfully met the criteria of tactical authenticity. They empower action among participants.

These participatory learning approaches, utilising tools to assist learning were found to be extremely effective and efficient, especially when the learning pursued problem situations where the key variables are tangible (for example, soil and water). When the learning process pursued intangibles, (nitrogen and economics), the effectiveness was lessened. The gaming approach of the *Fallow Management Game* and the computer program *How Wet*, showed promise in making the intangible more tangible, but they will have to be further developed, particularly in their graphic representations to be truly effective. The efficacy of these action learning approaches had the biggest impact in achieving the outcomes desired. They were definitely the right tools for the job and similar approaches should be pursued for other complex situations.

10.7. REVIEW AND INTERPRETATION OF THE ENTIRE PROCESS

10.7.1. Positivist approaches vs constructivist systems approaches.

Under very simple biological systems, the reductionist approach has adequately explained simple cause and effect relationships. As these become more complicated, the methods used by reductionist science have changed to include methods such as multivariate analysis which

allows these dense relationships (complicatedness) between cause and effect and multiple cause, multiple effect relationships to be untangled and understood. With uncertainty playing a major role in the multiple cause, multiple effect relationships, computer programs and computer models have been utilised to handle this complicatedness. However, because the social and economic variables are to a large degree excluded by the system, or only reflect the social and economic variables of the researcher and are subliminally incorporated into the relationships, computer models are still unable to handle true complexity. The products of these hard systems approaches are only applicable to a small range of stakeholders who hold the same or similar social, economic and technical values of the researcher.

To handle complexity in these situations, scientists are increasingly moving to soft systems approaches and adult learning approaches. Under these approaches, individual stakeholders are encouraged to build their own constructions. Science has a different role in facilitating learning rather than teaching the scientific construct. Science further has a role to create scenarios and tools that facilitate this learning. For example, in this approach, computer programs and software occupy a different role to their normal role. Under an approach of reductionism and handling complicatedness, it is assumed that all the relevant information can be contained within the computer package. The computer package transfers the information to the decision making and he needs no more. It works well for simple systems. Under complex systems, the computer program cannot account for the complexity and emergent roles are now being developed. These include using software as a framework to allow people to discuss the complexity that they are facing, select which information they individually require and thus arrive at different end points even when they are receiving the same information. In effect, these are very open systems and include open sequence control mechanisms. There is also an element of communication in that they feed forward and accommodate the complexity but don't try to accommodate it by incorporating it into the model.

10.7.2. Emergent roles for scientists in constructivist approaches

Under a constructivist approach, an essential role required is for facilitation of the process rather than a role of the technical expert. The role of a technical expert can add to the process if its contribution is facilitated to prevent it dominating the process, but it is not essential to the success of the process. Conversely, the absence of a facilitator usually results in the process reverting to the expert dominating proceedings, telling farmers what he thinks the problem is and what he thinks the solutions are. In complex situations, this process has been demonstrated to be ineffective and inefficient. Does this mean all technically expert scientists have to become facilitators? Or can a facilitator and a technical expert work in concert in a constructivist approach? Facilitation skills can be learnt. A technical expert brings into a co-learning situation his/her status as a technical expert. This hidden attribute immediately colours proceedings and the tendency is for other participants to feel that the technical expert is more knowledgable than they are. They defer to this perceived superior knowledge and the process reverts to the expert dominating proceedings. In situations where a technical expert is perceived by participants as such, they probably should not also attempt to facilitate the process but utilise an independent facilitator. Does this then mean that technical scientists should not be facilitators? By understanding the role of a facilitator, the technical scientist will develop a superior understanding of the role of a technical expert in a co-learning situation. Developing an understanding of the role of a facilitator is best achieved through experiential learning. If technical scientists develop facilitation skills and utilise them in situations where

their status as a technical expert is not relevant, they will develop a better understanding of their role as a facilitator and as a technical expert. Through this understanding, the process will be enhanced when they are required to fulfil a role of technical expert in a co-learning situation. Ideally, each co-learning situation should involve a facilitator. The incorporation of a technical expert into the co-learning situation can enhance the process, provided it is facilitated. The technical scientist can occupy the role of facilitator and technical expert but it is much more difficult. To be successful, the different roles would have to be explicitly explained to the participants at the commencement of an activity and ground rules laid down. As the technical scientist changes from a facilitation role to a technical expert role, (or vice versa), he/she should inform the group of the role he is endeavouring to fulfil.

10.7.3. Development of learning tools

Tools to assist learning have been shown by this study to play an essential role. Most of the learning tools used in this study already existed as tools being used by scientists to enhance their own learning. More scientific tools exist that could be developed into learning tools for farmers. While I am not advocating that farmers should suddenly be confronted with electron microscopes, I am suggesting that often scientists perceive their tools to be too sophisticated for farmers to use without testing this assumption. Some lessons do emerge as to what these tools should be.

- They must be used by the participants rather than demonstrated to the participants. The Rainfall Simulator only became effective when it was used by participants as opposed to its previous use to demonstrate treatments to participants.
- The should have the capacity to comparatively analyse options. The *With and without* tool and the Rainfall Simulator became more effective because the comparative analysis feature was incorporated.
- They do not require the high level of absolute accuracy that science requires but should be capable of discovering relative relationships. Participants have different perceptions of the value of variables. The placing of an absolute value on an outcome from one perspective may not be relevant to other participants. The transfer of information from one learning situation to another situation of application means that values have to be interpolated or extrapolated. Absolute values thus become relative anyhow.
- Where tangible variables are being investigated, they should utilise this tangibility and not digress into the intangible or abstract. The Rainfall Simulator is more effective than for instance computer simulations because it incorporates tangible features familiar to the participants such as mud, water, soil and stubble.
- When intangibles are being investigated, graphic representations are important. The graphical representation of variables are more easily understood than cold figures and words. Care should be taken to make graphical representations that are easily interpreted by the participants or else the graphical representation becomes as confusing and difficult to interpret as words and figures.
- "Black boxes" within the tool and/or process have to be discovered and opened up. In using these tools to assist learning, participants showed us "black boxes" that were depreciating the impact of the activity. The computerised version of *How Wet* completed calculations that were hidden from the participant and not trusted until the participant could undertake the same calculations with a pen and paper and arrive at the same result. The Rainfall Simulator was not seen to have bottomless trays until farmers dug to find them and didn't. By incorporating this into the process, a potential barrier was removed.

10.7.4. Information and decision making

Another key point to emerge as to why these tools and approaches are successful is that they support decision making in the context where the decisions are made. Under previous positivist approaches such as Transfer of Technology, the relationship between information and decision making has been poorly defined and understood. The decision maker was thought of as being a rational economic person. This led to attempts to quantify decision making by determining variables that played a role in decision making and attributing values to them. These models of decision making, while providing some insights into decision making, were unable to account for the complexity of decision making. From a positivist's perspective, decision makers often took decisions that were seen to be irrational and uneconomic. (From the decision maker's perspective, their reasons for making the decisions they did were usually very rational. They utilised variables and attributed values to them that were personally valid). This would suggest that a constructivist approach would be preferred in assisting an understanding of decision making. Rather than try and capture the decision making process in a positivistic sense, by learning through participation, a better understanding of decision making is possible. The understanding of the decision making process is important for all participants - scientists and clients both. If clients can better understand their own decision making, they can develop strategies to cope with unexpected circumstances. If scientists better understand decision making, they can better support the process. However, the relationship between decision making processes and the role of information is still poorly understood and is worthy of further research.

10.7.5. Supporting the participant's learning process

The success of these activities is also reflected in the manner in which they supported the participant's learning processes. This has several aspects. Being based in experiential learning, the activities' success was related to how well they pursued understanding the alternate strategies for action and the assumptions that underpin these actions. By such an approach, individual participants are more able to relate the learning situation to their own situation and apply their outcomes to their own situation. This contrasted to providing prescriptions for action that leave the individuals uncertain about their relationship their own particular situation and this uncertainty is only reduced by their own experiential learning in situ (if they do attempt to apply the prescription supplied).

The success of these activities was also reflected in how well their delivery was compatible to the learning style of the participants. This is partly related to (i) formatting the exercises so they reflected the participant's preferred perceptual modality, and, (ii) by supporting information exchange amongst participants that trusted one another.

The relationship between learning style , learning process, understanding of situations and discovering relevant outcomes is an area that I believe has potential to improve the effectiveness and efficiency of this type of work. It is also an area that is worthy of further research.

11. IMPLICATIONS

This research study demonstrates the power of participatory learning and action research in initiating and fostering changes. PLAR is also demonstrated by this study to be more effective and more efficient than transfer of technology processes in dealing with complex problem situations such as sustainability. The inescapable conclusion is that for complex problems, approaches such as PLAR are the preferred approach for improving the problem situation: they have greater efficacy in these situations.

Does this then infer that (a) science should abandon its traditional positivist realist position and change to a constructivist position or (b) is there potential to develop partnerships between the two paradigms, utilising the strengths each paradigm has to offer to create a more synergistic approach to the application of science to real world problem situations? When dealing with the chaos and complexity of the real world, choices do have to be made. The basic issue is not that choices have to be made, rather that these choices should be made purposefully instead of unconsciously accepting the *status quo*. Pursuit of the former (a) demands choice of one paradigm over the other, on an individual basis and on an organisational basis. This is a positivist notion in itself - that one paradigm is "good" whilst the other is "bad". Pursuit of the latter (b) also demands choice but not the choice of one paradigm and the dismissal of the other. It is a constructivist notion that allows individuals within organisations to express their position but at the same time recognise that their position is neither the only position nor the perfect position. Pursuit of this option will also require changes within the individuals of an organisation and the organisation itself.

The choice of paradigm to apply will be a case of "horses for courses". When confronted with a problem situation, science will have to carefully explore the situation before making decisions about an appropriate approach. These decisions will be enhanced if research and extension practitioners develop a fuller understanding of the options available. These options are still relatively poorly defined. Positivist approaches have been in use for so long, the basic assumptions underpinning these approaches have been accepted and are not questioned. PLAR approaches are relatively new and the assumptions underpinning them are still being determined. It will be through investigation of, and dialectic debate about, the relative strengths and weaknesses, opportunities and constraints of each paradigm, that more informed choices will be made and each paradigm will find a more comfortable niche. Consequently, the paradigms will be able to coexist and contribute to improving problem situations in the real world, together. This study has uncovered some of the strengths, weaknesses, opportunities and constraints of utilising a constructivist paradigm. They have implications for operational aspects of these constructivist approaches, implications for the role of the researcher or "expert" and implications for the organisations which employ them.

11.1. STRENGTHS, WEAKNESSES, OPPORTUNITIES AND CONSTRAINTS OF CONSTRUCTIVIST APPROACHES.

11.1.1. Strengths

1. Constructivist approaches accommodate complexity. Complex problem situations are dynamic, continually changing in space and time. External forces are continually interacting with the problem situation and a part of the cause for this continuing change and the resultant complexity. For example, the impact of legislation or the perceived potential for outside groups to influence government agendas impinge on the problem situation. Internal relationships are also continually changing. People respond to circumstance. For different participants, different outcomes are desired, and these outcomes vary over time. For example, a farmer with a young family may place a higher priority on providing an education for his children than purchasing a new technology. Constructivist approaches accommodate this complexity rather than ignore it; Positivists isolate components from the complex situation and in so doing, fail to account for the interactions that occur between these components and the "system". Constructivists accept that problem situations are complex and may be viewed differently from different worldviews. Complexity is partly a result of these different worldviews, and the corresponding different needs and wants of the stakeholders involved in the problem situation. To account for this complexity, these approaches pursue learning about the problem situation in an attempt to improve the situation, not with a global "one solution fits all" but on an individual "this solution or improvement fits my understanding of the situation". It seeks to allow individual outcomes, each constructed by the individual who will apply it.

The strength of positivist science lies in its systematic and ordered investigation (hypothesis testing) of a problem but this is a weakness. It requires the enquirer to think about a problem in a predetermined manner and to reduce it to testable relationships. This reductionism allows the experimentation to be reproducible. The observations and results should be repeatable and if they are, the hypothesis is confirmed. If the observations and results are not repeated, the hypothesis is rejected. But this reductionism also handles the complexity of the problem situation with its multiple cause, multiple effect relationships, by excluding it, ignoring it or incorporating it (often subconsciously) in a reduced and simplified form. When the results of reductionist research are reapplied back into the complex situation, these interactions are still at play and because the complexity has not been adequately accounted for, chaos re-emerges.

2. Constructivist approaches lead to new insights and ways of thinking about a problem situation. By interacting with and participating with the multitude of worldviews of a problem situation, our own understanding and the participant's understanding of the problem situation from multiple perspectives is enhanced and new ways of thinking about the problem situation emerge. The exposure to this multitude of worldviews also causes us to reflect upon our own worldview, exposing and challenging our assumptions about a problem situation and continually modifying and moulding our worldview as new information is encountered. Our method of operation in dealing with the problem situation also changes. Rather than revert to trying to solve the many individual problems belonging to the many individuals who construct them, (the resources required would prohibit this approach anyway) the role of science

changes from being a solver of problems to being a co-learner with others as they seek to solve individual problems and an enabler of these participants to seek their own solutions.

3. Constructivist approaches encourage multi-disciplinary thinking about the problem situation. The beneficiaries of scientific endeavour, for example, farmers, live in a world where they have to be multi-disciplinary to survive. Constructivist approaches require the scientist participants to also adopt a multi-disciplinary approach and thinking if they are to make a contribution to problem situations. Few scientists have the skills to cover a wide range of disciplines. Their specialty skill is just one of many that need to be applied to a problem situation. This better places their disciplinary skill in context and allows decisions to be made about its relative appropriateness and value. It also creates need to develop a broader range of disciplines to apply to the problem situation. This may be achieved by importing the required disciplinary skills (see next point), undertaking training in the required disciplinary skills, utilising the multitude of skills amongst participants, or developing the required skills as part of the process. All four may be utilised to enhance the multi-disciplinary thinking about the problem.

4. Constructivist approaches encourage multi-disciplinary team approaches to the problem situation. In tackling problem situations that require multi-disciplinary skills, efficiency is gained by importing collaborators with the necessary skills. By becoming participants, these skills are applied to the problem situation and through participatory application, other participants acquire these skills.

5. Constructivist approaches enable participants to work without a "sense of unease" - they expand the comfort zone. By jointly investigating the problem situation, jointly determining the methodology to apply to improving the problem situation and jointly accepting responsibility for the outcomes, the participants are more able to accept and implement the results. By participation, their perception of their own status is enhanced. They are more able to accept failure. By participating and belonging to a group, they have increased faith in the process and the outcomes and are more protected from or immune to external criticism. This is not to infer that external criticism is ignored, rather it is treated as another perspective being brought to bear on the problem situation and is considered in this light. This also leads to participants pursuing a less conservative or traditional approach to improving the problem situation. Instead of asking why and avoiding untried approaches, they ask why not and pursue new approaches. Whilst this sometimes leads to failures, it often brings spectacular success. And, in contrast to the experience of failure in positivist science, much is learned from analysis of what went wrong, and from what turn out to be inadequacies in observation and interpretation.

6. Constructivist approaches are iterative and flexible approaches rather than prescriptive approaches. Because of the dynamic nature of the problem situations being addressed, a flexible approach is required in dealing with this dynamic nature. For example, the capacity to introduce new testable options and the throw out previous options that are no longer applicable is required if solutions are to be obtained that are useful and useable in the changed and changing problem situation. Prescriptive approaches that predetermine the direction of the enquiry and thus the general if not the specific outcome, need to have superior anticipation of the dynamic changes that may occur in the problem situation. This is exceedingly difficult in complex problem situations. Alternatively, the approach allows for so many outcomes it discovers none adequately. Constructivist approaches with their emphasis on the learning

process rather than specific content of the learning have the flexibility to deal with the changing situation. Through reiteration, the applicability of the learning outcomes is able to be applied in a broad range of situations and learning continues in these situations, rather than only in the specific situation in which the initial learning took place.

7. Constructivist approaches are experiential learning-in-process approaches. By being participatory, these approaches allow the participants to direct what is to be learnt, when it is to be learnt and in what format it is to be learnt based on their own need to know. Participants become active learners rather than passive receivers of information. They are adult education approaches, andragogical in nature as opposed to the more normal pedagogical approach. These andragogical approaches break the dependency link that exists under a pedagogical approach. A common complaint of group learning approaches is that they create so much demand for individual interaction after the event, that they are inefficient. In these situations, the suspicion is that these group learning is actually teaching to a group, and the inefficiency is a response to maintaining dependency and control over participants.

The status and role of the "expert" and the "student" in the teaching/learning situation are also changed. All participants' knowledge is valued and accorded a similar status with no individual's knowledge inherently accorded the status of being a superior knowledge. This does not mean that all knowledge is of equal value. Obviously values are attached to knowledge but these values are judged on the value of the information rather than prejudged on the status of the possessor of the information. Experience in dealing with problems in the real world is highly valued. This enhances the participant's self esteem. Collectively, the total amount of knowledge brought to bear on a problem is increased. As past experiences are deemed important, the approach utilises experience in the process and utilises the process to generate experience. By experiencing an activity, participants are learning and teaching each other.

11.1.2. Opportunities

1. Constructivist approaches have the capacity to refine ideas on an on-going basis. The inquiring nature of constructivist approaches and the dynamic, changing nature of the complex problem situation they are applied to give these approaches the necessary flexibility to remain compatible and useful whilst change is occurring. They also utilise process rather than content and hence don't seek solutions that are determined at the commencement of the enquiry. Rather they seek improvements through an iterative process where prior knowledge and information is built upon or discarded as necessary. They also utilise failure as a positive feature to be learnt from, not discarded or only used to prevent the same failure from occurring again. A failure in one situation in time and space may be a success in another situation in time and space.

2. Constructivist approaches enable the use of hard systems approaches and reductionist methods where they are appropriate. Being participatory processes, the decision about how and when hard systems approaches and reductions methods are appropriate is made by the client, rather than the deliverer, or made jointly. There is considerable scope for these hard systems approaches to incorporate client participation from the beginning, to explore potential outcomes determined by the client and maintain the client's involvement for the duration. Similarly, these hard systems approaches and reductionist methods can develop enhanced input into change if they are used as part of a learning process rather than tools to teach, to

lecture, or to demonstrate the "best bet" option developed from a research perspective. This also opens up the opportunity for these hard systems approaches and reductionist methods to be developed from the beginning as tools to assist learning rather than tools to teach. As tools to assist learning, the format of these hard systems approaches and reductionist methods may take a completely different form. The value of hard systems approaches and reductionist methods will be enhanced if they are used to discover relations between facts and processes rather than to teach straight facts.

3. Constructivist approaches give rapid feedback. The generation and development of knowledge and information is not separated from the application of knowledge and information. Rather, the generation/development and the application of knowledge and information are intimately linked as part of the same process. This allows for rapid feedback from the application to the generation/development and in turn allows new directions for generation and development to be rapidly determined from the application, whether the application is judged to be successful or not.

4. Constructivist approaches are able to be used by anyone, anywhere and are not dependent on the involvement of a "highly educated" specialist. Humans are naturally inquisitive. When this is combined with a need to know, they will become experimenters and seek to learn from their experiences. Constructivist approaches are thus already occurring without the involvement of highly educated specialists. However, the learning process can be improved by the input of skills to enhance learning. These skills may be facilitation skills that enhance participation. They may be scientific skills that enhance the method of enquiry and the analysis of outcomes. They may be the contribution of expert knowledge to the pool of knowledge without discrediting other knowledge in the pool as being inferior because it was not developed by science. The key to enhancement through the input of external specialists is their involvement as equal participants, not dominant participants.

5. Constructivist approaches are better suited for qualitative data collection and sense making of the "richness" of complex situations. The nature of complex problem situations is that there is large amounts of qualitative data interspersed with, interacting with and often in conflict with quantitative data. This is partly what makes these problem situations complex. From an enquiry point of view, the qualitative nature of the complex situation may be handled by quantifying it or dealing with it in situ. The former is a typical reductionist approach that either ignores the qualitative data or attempts to put "square pegs in round holes" and deal with the data objectively. This commonly leads to mis-identification of the problem and the error is compounded by mis-application of reductionists methods. The latter accommodates qualitative data as part of the "richness' of the complex problem situation. People's perception of the values attached to data are regarded as being more relevant than some external value applied to the data. Through participation and by working with and from people's perception of the value of data, these values are changed and changing through the participation and are incorporated into the improvements applied to the problem situation.

11.1.3. Weaknesses

1. Constructivist approaches do not allow for quick solutions. For complex problem situations the issue of understanding and defining the problem situation is a key to pursuing the multitude of improvements that may be made to a problem situation by the individuals that interact with it. This investigation of the problem situation is, of necessity, a time consuming

task. It is only through adequate definition, understanding of the problem situation and interacting with it that solutions will emerge. Hence, quick solutions are seldom found.

2. Constructivist approaches do not lead to a single or minimum number of solutions. Again, with complex situations the number of worldviews of any complex situation that are present means that for each world view a specific improvement or solution will be sought and gained. These solutions reflect the complexity of the problem situation and it is seldom possible that a single or minimum number of solutions will be held by the wide number of world views.

3. Constructivist approaches do not lead to clear solutions. In complex situations, both from an individual's viewpoint and from a group's viewpoint, the improvements being applied seldom result in benefiting all aspects of the problem situation. Improvements to a problem situation are of net benefit, but some costs are attached to the improvements implemented. Often, the solutions applied create further problems of their own, in the short or longer term, and these in turn become part of the complexity of the situation that is addressed in the next iteration.

4. Constructivist approaches mean the outcomes are unknown and unknowable until they are arrived at. Because of the large number of world views present for a complex problem situation and the number of variables that are at play in creating the complexity of the situation, no individual has the superiority of knowledge or visionary capacity to be able to predict the outcomes. Outcomes are an emergent property rather than a predetermined end point. The outcome of improving problem situations is discovered via a learning process. Learning requires interaction with the problem situation so that it may be better understood and through this interaction, insights may be gained. Through this learning process, improvements will be determined and applied. At the beginning of a learning process, the improvements that may be possible, and the improvements that will ultimately be applied are unknown and unknowable.

11.1.4. Constraints

1. Constructivist approaches require freedom of expression. Whilst scientific participants may be accustomed to giving and receiving criticism of their views, many other participants in a constructivist approach are less accustomed to criticism and may react to criticism by withdrawal or angry reaction. The approach thus requires that participants within a constructivist approach be given freedom to express their opinions and their experience without fear that it is being downgraded. This is not to suggest that proponents of constructivist approaches should shun debate about their methods. Nor should participants in the application of a contructivist activity avoid putting the contrary view. Dialectic debate is a key learning experience in constructivist approaches and, handled with tact, becomes an enabling feature rather than a disabling feature.

2. Constructivist approaches are not restrictive to a particular domain of knowledge or area of interest and often require non-experts to work in other experts domains of expertise. The nature of constructivist approaches with unknown outcomes and unknowable outcomes means that these outcomes may not bear relation to the technical experts involved as participants in a the constructivist approach. The options are for these people is withdraw from the learning process or to adopt a role of an active adult co-learner in the process. Often, while these specialists have few expert skills in the domain that needs to be pursued, they do have a

network that can access important information or skills to assist in learning about this situation. This often means that they enter into other scientist's domain of expertise. This can cause friction between participants of the learning experience and experts external to it. On occasions, the external experts may to attempt to veto information that is derived from the learning experience. Again while dialectic debate is an important feature of the learning experience provided it is handled tactfully the incorporation of external expert's knowledge into the learning process can be beneficial. Conversely, if the external expert's opinion is thrust in a learning situation as a veto, it can be damaging. The expert's knowledge as it is applied from his/her perspective of a problem situation should be treated as any other knowledge: on the basis of the knowledge rather than the basis of the status of the possessor of the knowledge. How well the expert's knowledge fits the problem situation being investigated as a learning activity, causes judgements to be made about that expert's knowledge. It can be accepted or rejected, or be modified and incorporated into the knowledge pool being developed by the learning group. By this process, the experts lose control of their knowledge. This can be a source of resentment.

3. Constructivist approaches require the recognition of the potential to fail. The openness in attempting to improve a situation should explore non conservative means. On occasions, it is inevitable that failures will occur. If these failures are incorporated into the process and learnings are derived from them, they can enhance the process. Some of the most effective learning experiences come from failure. However, it is a requirement that the potential to fail be recognised so that options are not made to reduce the potential of failure as this may exclude potentially useful "skunk" solutions being attempted.

4. Constructivist approaches require openness and modesty. In participating in a constructivist approach, it is often more important for individuals and participants to learn for themselves, what some participants in the group already know. Rather than have these "knowledgeable" participants introduce their knowledge as *fait accompli*, the learning process becomes as important a process as the facts or knowledge that are derived from the learning process. Hence, these approaches require participants to be modest about their knowledge in situations where the learning process should take precedence. Constructivist approaches also require openness in that participants entering into a joint learning experience should equally contribute their skills and knowledge and accept other's skills and knowledge as an equal contribution.

5. Constructivist approaches require a suitable work environment. Being learning activities these approaches require considerable periods for planning and considerable periods for reflection. Commonly in work environments, emphasis is placed upon action and observation but these are only part of the components of an adult learning cycle. Without the planning and reflection phases being adequately addressed, the learning is diminished. A suitable work environment also requires that the captured output of learning experiences as written reports, or seminars be applicable to a wider range of audience than normal scientific reflection. This often means that reports, for example, take a format that is not commonly a scientific format. If all members of the audience are to grapple with and understand a report, it has to address these members. A scientific style of report is of little benefit to participants or an external audience, other than scientists.

11.2. CONSIDERATIONS IN DETERMINING AN APPROPRIATE APPROACH

A summary of these strengths, weaknesses, opportunities and constraints is presented below in Table 7. The strengths, weaknesses, opportunities and constraints of constructivist approaches allow some light to be thrown as to where constructivist approaches have the capacity to deliver the required outcomes, and hence, are a preferred approach to positivist realist approaches such as TOT.

Table 7: Summary of the strengths, weaknesses, opportunities and constraints of constructivist approaches.

Strengths:	**Opportunities:**
• accommodates the complexity of the situations where it is applied; • leads to new thinking about the problem situation; • encourages multi-disciplinary thinking about the problem situation; • encourages multi-disciplinary team approaches to the problem situation; • enables participants to work without a "sense of unease" - it expands the comfort zone; • is an iterative and flexible approach rather than a prescriptive approach; and, • is an experiential learning-in-process approach.	• capacity to refine ideas on an on-going basis; • enables the use of hard systems approaches and reductionist methods where they are appropriate; • gives rapid feedback; • is able to be used by anyone, anywhere and is not dependent on the involvement of a "highly educated" specialist; and, • is better suited for qualitative data collection and sense making of the "richness" of complex situations.
Weaknesses:	**Constraints:**
• does not allow for quick solutions; • does not lead to a single or minimum number of solutions; • does not lead to clear solutions; • the outcome is unknown and unknowable until it is arrived at.	• requires freedom of expression • requires non-experts to work in experts domain of expertise • requires the recognition of the potential to fail; • requires openness and modesty; • requires a suitable work environment; • it is not restrictive to a particular domain of knowledge or area of interest.

In situations that are complex, the Transfer of Technology approach in a positivist realist paradigm fails to address the human components in a socio-technical environment. The only humans involved in the process of investigation and knowledge creation are the scientists and they assume that they are objective observers, external to the problem situation. TOT treats the problem of change as a design process that can be determined without the active

participation of the very people who are to implement the "improved" design and suffer or benefit from it.

Conversely, PLAR in a constructivist paradigm embraces the sense making capacities of human relationships. It assumes that the researcher and the other stakeholders are equal participants in attempting to improve a problem situation. All participants stand to benefit or suffer from improvements that are implemented. To maximise the benefits and minimise the costs, PLAR treats the problem of change as a facilitative process, with participants having an active role in determining desirable improvements.

The role of the expert or researcher is also different depending on the paradigm in use. Under a positivist realist paradigm, the researcher is outside the system. Being outside the system perpetuates the status quo of the researcher being the expert in a relationship, possessing the vision to adequately define the problem for all worldviews, and with the capacity to provide solutions for all recipients. This leads to a bias towards conservatism as it does not pursue investigations to derive solutions or improvements that (a) are more suitable to definitions of the problem situation derived from other world views, or (b) seek improvements that are more able to be implemented by any single individual. This also infers that the expert and his/her speciality becomes an important feature of the enquiry and results in the area of inquiry being strongly bounded by the expert's capability. Consequently, the enquiry is inward looking and biased towards analysis. As a result of this positionality, positivist realist paradigms utilise a methodology that is systematic.

On the other hand, with PLAR in a constructivist paradigm, the expert or researcher is inside the system - an equal participant. The experts change as part of the dynamic of change, both personally and functionally. This leads to a bias towards rapid evolution and growth of skills being applied to a problem situation. It allows multiple investigations to be conducted at the same time. The constructivist approach leads to a bias towards synthesis. As a result, the methodology is systemic rather than systematic.

11.3. RESEARCH IMPLICATIONS OF THE TWO PARADIGMS

The positivist paradigm assumes that the world is systematic and that it can be engineered. To enable it to be engineered, methodologies are required that are orderly, employing principles of repeatability, replicability and reduction. This leads to empirical understanding with models of the world that are assumed to accurately reflect the world, that is, they have an ontological emphasis. This often leads to dislocation between the pure research that seeks to discover the relationships in a systematic world and the introduction of the outcomes of research in situations in the real world. Positivist paradigms also pursue operational research in that they seek optimisation, but optimisation is defined from the researchers' view point only. They fail to account for the large number of other variables that are at play, which if considered, would change the judgement about outcomes and their optimality.

The constructivist paradigm assumes that the world is problematic. It assumes that systems do not exist, or if they do, they are unknown and are undetermined until people perceive them. They are constructs of reality within the participant's mind. Thus the methodology is systemic, that is, it embodies systems principles. It develops an interpretive understanding via personal constructs, that is how people perceive reality to be. In contrast to a positivist paradigm, it has an epistemological emphasis. It is an iterative enquiry pursuing multiple goals

and moving targets. These goals are pursued by implementing change through communicative rationality. Consensus on the definition of the problem situation and the strategies worth inquiring into are the result of dialectic debate rather than through compromise.

11.4. IMPLICATIONS OF THIS STUDY FOR SPONSORING ORGANISATIONS AND THEIR STAFF

This project and the associated research study has demonstrated that PLAR approaches to complex situations are effective, efficient and have efficacy. This analysis (in hindsight) differs from the analysis made in the early stages of the project. To succeed with this project, the VFSG was required to create space for itself, so it could pursue an atypical and largely untried approach that in the end was judged to be suitable and useful. The QDPI has recognised the appropriateness of this approach for dealing with complex problem situations such as the VFSG was confronted with. The question now arises is *How can this approach be perpetuated and sustained?* This study provides some insights into some of the key requirements if this style of approach is to be perpetuated and sustained.

Management adjustments will have to made to accommodate the approach in an organisation that is predominantly pursuing the application of research and extension from a positivist paradigm and perspective. In essence, the emergence of PLAR brings into question the appropriateness of the paradigms used by realist positivist science, and their application without question to all problem situations. If sponsoring organisations are going to be professional about their science, they will have to review the epistemology and ontology underpinning the paradigms in use, and the resultant methodology. In effect, they will have become learning organisations with the organisation as the client of the learning process.

11.4.1. Understanding the role of experiential learning

Sponsoring organisations will have to develop an understanding of the role of experiential learning among their staff and their clients. This will require an understanding of how the "end point" resulting from the application of a process was arrived at, not just acceptance that the end point was achieved. Compared to transfer of technology processes, the "end point" of PLAR may appear to be the same, but the path to the end point is vastly different. This makes the nature of the end point different. Rather than the prescriptive application of a best bet solution, the end point is arrived at through participatory understanding, learning and action. The changes occur in the researcher, be (s)he a farmer, an extensionist, a research scientist or some other actor participating in the process underpins these activities. The changes are determined by the participant, rather than a external body. The changes are grounded in the participant's construction of reality rather than someone else's construction. The participants, through improved understanding, learning and the development of shared meaning with others, determine relevant changes and own the changes. Consequently, they accept greater responsibility for them. They are not the application of prescriptions developed by external entities applied with minimal cognisance of the situation they are to be applied in. The participants are better able to modify and apply relevant solutions at specific points in time to a dynamically changing situation rather than a prescribed solution that fits the general situation over time adequately, but fails to fit the specific situation at any one point in time well.

In the process of PLAR, the participants acquire power to make well-founded decisions and control their own destiny. This is not the zero sum concept of power, where power is lost by one group and gained by another. It is a synergistic definition with all the participants gaining increased power. Sponsoring organisations may conceive that the empowerment of their clients may diminish the organisation's power (status). Similarly, staff of an organisation may have the same perception. While this study demonstrates that the staff and their organisation actually gain power as their clients are empowered, this study also demonstrates that one has to experience this synergy to understand it.

11.4.2. Review of the appropriateness of the paradigms in use

A key to success will be the training of staff in the epistemology, ontology and methods of alternate paradigms. Ideally, this training should start during the formative period of a scientist's development, that is, at University. Currently, few Universities with social science courses devote sufficient components of their curriculum to the study of the science they are teaching. The University of Western Sydney (formerly Hawkesbury Agricultural College) has pioneered this form of training. It has also (bravely) changed the style of instruction from the normal pedagogical approach to an integrated pedagogical/andragogical approach that is atypical of normal University instruction. Wageningen Agricultural University has also recently begun to adopt this approach in some courses.

Universities currently teach the mechanics of science for physical scientists. They pay little attention to the sociology of the science that underpins these scientific approaches or investigate optional approaches. At this stage of a professional's career, it is important that an understanding of the paradigms in use be developed. It is only through exploring alternatives that scientists will make informed judgements about appropriateness of a paradigm, its associated methods and its potential to impact on the areas of interest. Instead of applying a paradigm prescriptively , or even unknowingly, scientists with adequate training will be better placed to make informed decisions about which paradigm to use where.

For scientists already beyond the University system, reviewing the appropriateness of the paradigms in use should result in better application of appropriate methods and approaches to specific situations and circumstances. Constructivists have a role to play in assisting positivist realist scientists review their own paradigm and other paradigms. This study also demonstrates it is pointless to use a positivist approach such as TOT to assist in this review. When scientists are clients, they, as much as farmers when they are clients, resist having enlightenment thrust upon them. The preferred research process will be Participatory Learning and Action Research. Only through participation will the paradigms that underpin positivist reductionist research or constructivist approaches be reviewed. Hence, if constructivists are going to assist in this process they need to enter into partnerships with positivist science and become joint participants in the review process. Through this participatory approach, the paradigm clash that was evident in this research study might be avoided. Through participation, shared understandings will emerge.

11.4.3. Professional development of staff

To become involved in participatory learning and action research, technical scientists will require training in the appropriate processes and methods. Again, these processes should not be taught or applied prescriptively, but learnt through participation in approaches such as

Participatory Learning and Action Research. This may mean the development of more multi-disciplinary project teams such as the VFSG. Through participation in a multi-disciplinary team, understanding of the processes and methods as they are being applied should result, with insights emerging that will allow better decisions to be made about paradigm choice and approach. This will result in the application of approaches which complement the needs of the situation they are being applied in.

In addition to participation in multi-disciplinary teams, there will be a complementary need to develop an adult learning ethic amongst science and relevant skills training to enable this participation to be adequately undertaken. The observation and reflection components of adult learning are emancipatory, not only on the area of interest, but also on the framework of ideas and concepts that the scientists bring into a situation and the methodology they apply to it. These observation and reflection phases should address the issues of rigour and quality assurance.

Technical skills alone will not meet the needs of performing in a multi-disciplinary team. Skills such as facilitation skills will have to be developed by all team members. The training in these skills may undertaken in an adult education approach which will assist the development of an adult learning ethic as well as develop relevant skills.

Examples of this approach are already beginning to emerge. The Rural Extension Centre, a joint QDPI/University of Queensland facility, is training QDPI scientists using an adult education, action research approach. Its success is demonstrated by the rapid changes the QDPI is successfully negotiating and developing, such as, new roles for extension. Whilst few research staff have yet been involved in the Rural Extension Centre, they are beginning to become involved and the results with these staff have been equally impressive.

11.4.4. New roles for extension and research will emerge

Through a participatory explorations of the paradigms in use and their impact on the methods and areas of interest, new roles for science will emerge. While it is not possible to prescribe what these roles will be, this study does give some indications as to what these roles may be. Where positivist science is dealing with simple cause-and-effects relationships, the role of positivist reductionist science will not change greatly. It will have the potential to impact only on simple situations, for example where replacement technology is required. While this is still a vital role, it is a role of maintenance research and extension.

More and more, science is being faced with complex messy situations. As the complexity of a problem situation increases, the role of positivist science will have to change if it is to remain relevant. Unless the complexity of a situation is accounted for, the output of positivist science will become less relevant. In addressing complex situations , the role will change from seeking out best bet options to seeking out a range of best bets for a range of clients, in effect, better bets. Of the information currently generated by positivist reductionist science, different parts will become useful for different clients. There will be a need for this information to be better matched with a broader range of clients and their needs for information. This information will also have to become more visible, be able to be translated by the receiver and integrate with participatory action learning curriculum developed to assist clients to develop their own understanding which will generate subsequent information needs. In total, more of the information that is generated by reductionist science will be used by a broader range of

different groups. In the process of generating a range of relevant informations to meet a range of needs, methods will have to be developed that support this process.

11.4.5. New roles for clients

Farmers, our primary clients, will not dramatically change their role under a participatory learning and action research methodology. Farmers have always been experimenters. They have always been participants with other farmers in discovering more about their reality, constructing their versions of it, and reacting to them. However, through participatory learning and action research their capacity to experiment and learn will be enhanced. This enhanced capacity will be supported by the invention of tools to assist learning. It will be diminished if science persists in teaching (or preaching to) farmers rather than assisting them to learn.

11.4.6. Funding agencies

Funding agencies will also change as a result of participatory learning and action research. Governments, rural industry research funds and even private enterprise funds are already facing increased demand by the tax payer, or by the contributor to these funds for accountability. The projects that these organisations fund are equally facing an increased demand from the clients to be allowed to participate. PLAR has been demonstrated as being a 'can deliver" approach in complex problem situations. This research study supports and reinforces this demonstrated capacity. The question that the funding organisations will have to address is PLAR can deliver *What*? and *How* will it be delivered?

Is this a matter of faith? No more faith is required to fund PLAR projects, than is required to fund existing TOT approaches. However, it is a responsibility of the practitioners of PLAR to inform the funding organisations of the effectiveness and efficiency of their approaches and where they may have more efficacy. This will require that monitoring and evaluation assume a higher profile in the approach. Evaluation will become an important requirement. The methodologies associated with PLAR can be used appropriately for monitoring and evaluation but, at least in the QDPI context, more experimentation is required to develop these.

11.5. A PARADIGM SHIFT?

In conclusion, the implications of this study indicate the readiness for a paradigm shift in the science of agriculture, both for research and extension. As Barker (1990) states, paradigm shifts occur when *the established rules of the game fail to provide effective solutions to our problems*. That the established paradigm of positivist science is failing to provide effective solutions to the increasingly complex problems we are confronted with (such as sustainability) will more than likely be (and is being) determined by our clients and our paymasters and through the demonstration of success in alternative approaches, rather than through self reflection by science. Witness the emergence of organisations such as Landcare, where control is being exerted by the clients who are demanding a participatory approach and a role as equal participants. I believe this will be the driving force behind changing the paradigm. For science to continue to be funded, it will have to respect these new power arrangements that are emerging.

The paradigm shift to participatory approaches, where science is the target, will not be brought about by applying the processes of the old paradigm. TOT is not effective in complex and messy situations. Paradigm shifts are complex and messy situations. The processes of the new participatory paradigms will be more effective in assisting this paradigm shift to occur. This will be achieved by scientists entering into facilitated participatory activities with clients and other stakeholders.

As expert systems were the scientific flavour of the 1980's, action learning is emerging as the scientific flavour of the 1990's. There is a danger, however that the new paradigm may be corruptly applied and fail because of it. For example, scientists may undertake "facilitation" or include participants in activities without allowing the control of the situation to transfer from the scientists to the group. In Australia, we would call this mutton dressed up as lamb. What appears to be a facilitated activity or participatory activity is no more than the traditional transfer of technology approach with the pretence of facilitation or participation being incorporated. This is a combination of paradigm paralysis where there is a belief that there only one way (our way) of doing things, and paradigm effect where our existing paradigm causes us to view and select data that fits our paradigm.

Finally, if a paradigm shift does occur in science, (and I am confident it will occur, preferably through informed choice but probably through being forced to change), the potential exists for paradigm flexibility to accompany the change. This will be an active challenging by science of the paradigms in use and an active seeking of improvements to the paradigms in use so that the client benefits. After all, the benefit to the client is the goal we are all pursuing.

Appendix I: List of the members of the Viable Farming Systems Group

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Project Officer, then Project Leader
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Dalby. Queensland. Australia.

David Blacket
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Penny Hamilton
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Clive Knowles-Jackson
Queensland Dept. of Primary Industries
Oakey. Queensland. Australia.

Scott Cawley
Queensland Dept of Primary Industries
Miles. Queensland. Australia.

Dave Lawrence
Queensland Dept of Primary Industries
Pittsworth. Queensland. Australia.

Lew Markey
Queensland Dept of Primary Industries
Dalby. Queensland. Australia.

John Gray
Queensland Dept of Primary Industries
St George. Queensland. Australia.

Vernon Keighley
Project Officer 1992
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Wandoan. Queensland. Australia.

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Summary

In this thesis, the relationship between the use of participatory processes in the development and use of information and knowledge and their impact on change is described and explored. This research utilises a major extension project carried out with respect to fallow management in southern Queensland, Australia between 1991 and 1995. This project was carried out by a project team known as the Viable Farming Systems Group (VFSG).

The problem addressed by the extension project. At the commencement of the project the fallow management practices in use left the soil unprotected from intense rainfall. Consequently, much of the rainfall ran off the cultivations. In the process, soil erosion was worsened and soil moisture storage, so necessary for growing profitable crops, was not optimised. Scientific research had demonstrated that by maintaining stubble cover above 30%, soil erosion was minimised and soil moisture storage in the fallow was optimised. Yet, in 1990, less than 30% of farmers were implementing the findings of this research. The extension project was undertaken to promote change in fallow management practices amongst farmers in southern Queensland. The project initially aimed to use a Transfer of Technology approach, the dominant approach used in the Queensland Department of Primary Industries (QDPI). Debate, within the extension environment of the QDPI and Australia generally, challenged this approach as being the most appropriate with participatory action learning being suggested as being more appropriate.

The problem addressed by this research. Initially, the research focussed on deciding the most appropriate approach for the project. This was determined to be participatory action learning. The research then focussed on (i) the relationships between participatory processes and client decision making, and (ii) the role of information in these processes. The research and the project were different entities but were intimately and systemically linked. The pursuit of the project purpose generated case studies that allowed the pursuit of the research purpose. The results of the research fed back into the project and modified its role and process.

The research methodology and approach. The research was emergent in design. It proceeded on the basis of a series of eleven interventions, a mix of pre-planned, opportunistic and serendipitious activities. The research was mainly qualitative in nature due to the complex nature of the social phenomena being inquired into. The research was undertaken from a constructivist perspective and using the principles of grounded theory, followed a Participatory Learning and Action Research (PLAR) methodology. My tools and perspectives in undertaking this research included soft systems thinking, Agricultural Knowledge and Information systems, a coupled system's approach to managing ecosystems and an actor oriented approach. The research process began with the identification of focal questions. These were refined during a two phase market research process, and explored during the nine case studies. The theoretical insights generated by the research are analysed and the theoretical and practical implications are discussed.

Market research phases. This was a consultative process conducted over two phases. The first used a rapid rural appraisal (RRA) to produce a wide overview of the problem situation. The second phase used a focus group analysis to validate and probe in depth priority issues emerging from the RRA, and to verify or legitimatise project assumptions. The RRA revealed: (i) important elements (and hence linkages) of the knowledge system that were not encompassed by

the original proposal; areas of knowledge deficit that required further investigation during the subsequent phases of the market research in order to allow action to be planned and implemented; and, areas of knowledge deficit that required action (to be planned and implemented in conjunction with clients) to develop or capture the required knowledge.

The Focus Group Analysis revealed that: (i) the situation we were intervening into was complex, with an associated extended Knowledge System; (ii) actors had preferred communication channels; (iii) decision makers required information supporting strategic decision making rather than operational decision making; (iv) decision makers required understanding of the fundamental causes of land degradation rather than prescriptions of solutions; and, (v) the information requirement extended beyond technical information to economic and social information and the interactions between these.

The outcomes of the market research phases produced different reaction amongst the scientific community, the farming community and the project team. Scientists tended to dismiss the findings as unrigorous because they were not statistically based, while those working in the farming community tended to discuss the findings as already being common knowledge. The criticism at first threatened the cohesion of the team. But in intensive team discussions, they realised that the criticism was basically unfounded, and appreciated that the VFSG was involved in discovering or creating a complementary paradigm began to develop. The team believed they were on an exciting and important learning path. The market research phases had given the team cohesion, and empathy with the range of people involved directly or indirectly with farming were created. In this respect, undoubtedly the biggest impact was brought about by the greater understanding of the multiple "world views" concerning viable farming systems through communicating and interacting with respondents.

The market research phases uncovered some important lessons from and changed the project direction. Lessons included:

(i) By balancing the status between departmental staff and the interviewee, better information emerged.
(ii) The use of third party interviewers demonstrated the value of alternate worldviews.
(iii) The team members of the VFSG developed enduring social research skills.
(iv) The power of qualitative research processes was demonstrated in the range of emergent issues, breadth of data, contextual details and insights.
(v) Altered the deemed importance of various stakeholders.
(vi) Changed project management objectives.
(vii) Challenged long standing assumptions.
(viii) Discovered that information for strategic decisions was a major issue.
(ix) confirmed that a RRA will create a demand amongst participants for follow up activities.

As a result of the market research, the original project proposal, its assumptions and TOT approach were discarded. The market research phases demonstrated that participatory approaches were promising mechanisms for initiating and facilitating change. The market research also illuminated areas where VFSG activities could be developed and implemented. These activities were then the nine cases studies that the subsequent research focused on.

New Applications for old tools included the **Rainfall Simulator** which allowed clients to develop better understanding of the relationship between fallow management practices, rainfall, soil moisture storage and runoff and to experiment with optimising soil moisture

storage; the **Soil Corer** which allowed clients to develop better understanding of their soil profile and monitor soil moisture storage; and, ***How Wet***, a decision support tool, which allowed clients to gain a better understanding of their soil-water relationships from rainfall records.

These tools were the most powerful initiators of change. These tools allowed clients to play with their environment, to test various options, to gather information, to enhance our and the client's understanding of the problem situation, and to gain knowledge without any direct risk. They were highly reproducible processes for a range of facilitators, client groups, and situations in time and space. Their impact was enhanced by science facilitating the process and the client becoming the researcher. This change in roles enhanced the clients' self perception of their status, and their perception of their ability to generate knowledge and the value of that knowledge. In turn, this enhanced their trust in the research and its results and their understanding of the situation. This enhanced perception is the driving force that makes these tools and their associated processes powerful agents in creating change. Conversely, fear of perceived loss of status associated with being a facilitator was a barrier for some scientists to adopting this role. The use of the tools in group situations was also important in their success. Through dialectic discourse and joint observation, understanding is enhanced and consequently, more purposeful decision making is made by the clients. We also learnt that these tools and processes contained "black boxes" which, when opened, enhanced the client's trust in the tool and the belief they had in the results. The status attached to these tools by farmers as they used them was also an important agent in their impact. We also learnt that the power of these tools in initiating change was related to the tools being compatible with the clients' preferred learning style.

The creation of new tools for specific purposes and clients included the ***Fallow Management Game*** - a computer based game that provides information to users as a normal decision support program, but it also facilitates discussion, information exchange and learning between producers within groups; and, *With and Without* - a comparative analysis tool designed to analyse and test options on a whole farm basis. These tools enhance participatory learning by engaging in a form of "risk-free" action research based on formal representations of real farm situations.

The *Fallow Management Game*, when it was used by groups, facilitates learning between group members. Farmers also enjoyed playing the game and expressed that "farming in a fun sense" had an impact on how they responded in practice. Clients play a role in developing the game. By playing the game, farmers identify which variables would be useful to their decision making and these variables are incorporated in updated versions.

Prior to our involvement, *With and Without's* main use had been within the QDPI, to improve extension officer's understanding of the costs and benefits of change, with only the results being transferred to farmers, that is, a classic TOT approach. We tested the use of the tool in two situations: (i) a co-learning situation within a PLAR framework (between the VFSG team and farmers) to test the implications of major changes in strategy on a whole farm basis, and, (ii) as a framework for delivering a semi-formal education course for DAC graduates.

The use of these tools brought home to professional agriculturalists and farmers the need for such tools in order to understand and explore "reality" from differing perspectives. The tools provided a forum in which scientists', extensionists', and farmers' experience and knowledge

were placed on a more equal footing than is the case in the TOT approach. Information and data were shared, not transferred. Both farmers' and agricultural professionals' understanding were enriched by the exchange and the opportunity for dialogue. The tools allowed the manipulation of impersonal-but-contextualised "reality" which could be interrogated at will. In the process, deeper insight into the nature of technology as a social construct was gained. The use of participatory processes to develop information either as an information product for mass distribution or internalised by the participating farmers as personal constructs, demonstrates the power of participation as opposed to the reception of information that the user had not input or participation in. This raised the challenge of replication: how possible is it, in practical terms, to reproduce participatory learning opportunities across the target farming population?

Innovative approaches to working with target clients included ***Investing in Young Farmers*** - working with graduates of the Dalby Agricultural College utilising *With and Without* as a framework for delivering a semi-formal education course for DAC graduates; *Producing information - with farmers, for farmers* - producing information by transforming existing scientific information with the addition of variables farmers had indicated as being important, through producing rules based information for a research context to producing rules based information for a farmer's context; ***Making Better decisions for your Property*** - a consultative experience of writing strategic decision support information; and, ***Is Cotton the Crop for Me?*** a participative experience of writing strategic decision support information.

From these activities, we learned that in the group situations, farmers were enabled to develop their own constructs of their current farming system and for where they would like their farming system to go. The information development techniques were of benefit to those participants directly involved in the exercise, but the benefits from the information output that resulted were not generally regarded as being of great use to the broader population.

An emergent perspective. We came to see the system we were dealing with as a 'coupled system' (Roling, 1994) with the implications: (i) that performance would be diverse rather than standardised; and (ii) that sustainability is an emergent property, not a single objective function or end state. We also came to realise that interactions between decision makers and their farming system was both flexible and locked into their (natural and socio-economic) history. We showed that the way to purposefully move forward, is in terms of a co-learning process, by improving insight into systemic relationships and by improving monitoring and visibility of those variables thought to reflect changes in state. We realised however, that researchers and change agents would not readily adopt such a co-learning process unless and until they themselves began to operate in and explore the PLAR mode.

We demonstrated that, by means of such a PLAR process, more farmers tried one or more option; that farmers in a greater range of target categories tried one or more options; and that farmers became more purposeful in their decision making. End results were not predetermined by the process. Through improved understanding of the situation they were dealing with, farmers became more purposeful in their decision making, and they arrived at end results that they determined for themselves.

We also realised that, however powerful the learning process was for the team, it aroused considerable hostility among other members of our intellectual community. Specifically, it challenged the positivist realist framework of R & D and technology development, and the TOT model of technology adoption at the farm level.

We discovered that written information is an ineffective mechanism for fostering change. It is more useful as a support mechanism for PLAR activities. However, written information can be made more effective if it enables the recipient to (i) improve their definition of the problem situation; (ii) provide a framework within which the problem, its solution and communication about the two can be enacted and by providing information maps illuminating where relevant specific information can be found; and, (iii) allowing the stakeholder to seek their own solutions.

Of all the activities that the VFSG undertook during this project, the use of these learning tools and learning activities were the activities that had the greatest impact on change. That change has been demonstrated to be quite spectacular and unexpected. The reasons why these learning tools had their impact are many fold: (i) these learning tools were used in an andragogical approach; (ii) the role of the QDPI officers changed from being the technical expert to a role of facilitation; (iii) the process assisted farmers to reflect upon their learning, by providing a feedback loop, with observations and measurements; and, (iv) the activities matched the preferred learning style and perceptual modalities of the participants, with the learning activity. The other great advantage of these learning tools are that they allow a rapid and extensive penetration of the target audience. Contrasting the various activities demonstrates that once participation is not part of the process, the reliability of the method fails.

The conclusion is reached that under very simple biological systems, reductionist approaches are adequate in explaining the simple cause and effect relationships. However, to handle complex situations such as sustainability, soft systems approaches and adult learning approaches are concluded to be more effective and efficient. Under these approaches, individual stakeholders are encouraged to build their own constructions, and science has a different role in facilitating learning rather than teaching the scientific construct.

These conclusions have implications. When confronted with a problem situation, science will have to carefully explore the situation before making decisions about an appropriate approach. These decisions will be enhanced if research and extension practitioners develop a fuller understanding of the options available and their underlying assumptions. This means sponsoring organisations will have to develop an understanding of the role of experiential learning among their staff and their clients. A key to success will be the training of staff about the various paradigms in use and in the skills needed to successfully apply a particular paradigm. Ideally, this training should start during the formative period of a scientist's development - at University. For scientists already beyond the University system, constructivists have a role to play in assisting positivist realist scientists review their own paradigm and other paradigms. This study also demonstrates it is pointless to use a positivist approach such as TOT to assist in this review. Through a participatory explorations of the paradigms in use and their impact on the methods and areas of interest, new roles for science will emerge. This study indicates the readiness for a paradigm shift in the science of agriculture, both for research and extension. The paradigm shift will not be brought about by applying the processes of the old paradigm. TOT is not effective in complex and messy situations. Paradigm shifts are complex and messy situations. The processes of the new paradigm will be more effective in assisting this paradigm shift to occur.

Samenvatting

In dit proefschrift, wordt de relatie tussen het gebruik van actieve processen in de ontwikkeling en het gebruik maken van informatie en kennis en hun invloed op veranderingen beschreven en onderzocht. Dit onderzoek is gebaseerd op een grootschalig project, uitgevoerd met respect voor fallow management (de omgang met de akkers in de periode welke ligt tussen de oogsten) in zuid Queensland, Australië tussen 1991 en 1995. Het project is uitgevoerd door een team bekend als de Viable Farming Systems Group (VFSG).

De probleembeschrijving van het grootschalig project. Bij de aanvang van het project, werd met het gebruik van fallow management, de grond onbeschermd gelaten tegen intensieve regenval. Consequentie was, dat veel regenwater de akkers afliep. Vervolgens nam de erosie van de grond toe en grondwateropslag, zo noodzakelijk voor groei van winstgevend gewas, werd niet geoptimaliseerd. Wetenschappelijk onderzoek heeft aangetoond dat het niet rooien van 30% van het gewas tot gevolg had dat gronderosie werd geminimaliseerd en grondwateropslag in het braakliggende land werd geoptimaliseerd. Desondanks implementeerde, in 1990, slechts 30% van de boeren de resultaten van dit onderzoek. Het grootschalig project heeft tot doel de boeren in zuid Queensland te bewegen om anders om te gaan met hun grond gedurende de periode tussen de oogsten. Het onderzoek richtte zich primair op het gebruik van Transfer of Technology benadering. De heersende benadering in de Queensland Department of Primary Industries (QDPI). Dit resulteerde in een discussie, in de wijde omgeving van de QDPI en Australië in zijn geheel, of de huidige aanpak de meest of de voorgestelde aanpak van deelname aan praktijk studie de meer geschikte aanpak zou kunnen zijn.

Onderzoeksproblematiek. In eerste instantie richtte het onderzoek zich op het vinden van de meest geschikte aanpak voor het project. Bepaald werd dat dit de participerende actieve leerwijze moest worden. Vervolgens richtte het onderzoek zich op (i) de relatie tussen participerende processen en klantgerichtheid, en (ii) de rol van informatie op die processen. Het onderzoek en het project zijn ontstaan vanuit verschillende organen maar werden onmiddellijk en systematisch met elkaar gelinkt. De doelstelling van dit onderzoek was het verzamelen van case studies welke het onderzoek van doel zouden kunnen zijn. De resultaten van het onderzoek zijn verwerkt in het project en hebben hun rol en noodzaak hierin bewezen.

Onderzoeks methodologie en benadering. Het onderzoek was groeiende in zijn ontwikkeling. Het vond zijn vervolg op basis van een serie van elf interventies, een combinatie van vooruit-geplande opportunistische en verhelderende activiteiten. Het onderzoek was alleen van kwaliteit in een vorm waarin men de verplichting op zich nam om de complexe sociale verschijnselen in het onderzoek op te nemen. Het onderzoek is vanuit een constructief perspectief verricht en gebruik makend van de principes van goed onderbouwde theorieën , volgde een Participatory Learning and Action Research (PLAR) methode. Mijn aanpak en verwachtingen bij het uitvoeren van dit onderzoek hield ook het zachte systeem (soft systems) denken in, Agrarische kennis en informatie systemen, een gekoppelde systematische benadering en beheer van ecosystemen en een actor-georiënteerde aanpak. Het onderzoek startte met de identificatie van de meest voorkomende vragen. Deze werden verder uitgekristalliseerd door middel van een marktonderzoek in twee fasen en onderzocht in de negen case-studies. De theoretische inzichten die zich ontwikkelde tijdens het onderzoek werden verder geanalyseerd en de theoretische en praktische implicaties besproken.

Marktgerichte onderzoeks-fasering. Dit behelst een consultatief proces over twee fasen. De eerste fase omvat een snelle landelijke schatting (Rapid Rural Appraisal, RRA) om een zo groot mogelijk overzicht te verkrijgen over de onderhavige problematiek. De tweede fase gebruikte een meer gerichte analyse om te valideren en om diep door te kunnen dringen in prioriteiten-kwesties, die zich door toepassing van RRA openbaarden, en ter verifiëring en legitimering van de onderzoeks - veronderstellingen. De RRA liet zien dat: (i) belangrijke elementen (en van hieruit gelegde verbanden) van het kennis-systeem niet in het originele voorstel waren opgenomen; er kennisachterstand was die verder onderzoek in de daaropvolgende fase van het marktonderzoek behoefde om actie en implementatie toe te laten; en dat deze kennisachterstand actie vroeg op het terrein van het verwerven en het ontwikkelen van kennis (gepland en geïmplementeerd in samenspraak met afnemers).

De gerichte analyse onthulde dat: (i) de situatie waarin wij ingrepen zeer complex was, met een geassocieerd kennis systeem; (ii) actors prefereerden communicatie kanalen; (iii) besluitvormers vroegen om informatie noodzakelijk voor strategische besluiten in plaats van operationele besluiten; (iv) besluitvormers verlangde meer kennis van de fundamentele oorzaken van ontgronding dan voorgeschreven oplossingen; en (v) de informatiebehoefte strekte zich uit van technische tot economische en sociale informatie en de interacties hiertussen.

De resultaten van het marktgerichte onderzoek produceerde verschillende reacties onder de wetenschappelijke gemeenschap, de agrarische gemeenschap en het project team. Wetenschappers beschouwden de resultaten als ongefundeerd omdat ze niet gebaseerd zijn op statistiek, terwijl die gene uit de agrarische gemeenschap de resultaten beschouwden als reeds lang bekend. De kritieken bedreigde in eerste instantie de cohesie van het onderzoeksteam. Maar gedurende intensieve team besprekingen, realiseerde men zich dat de kritiek hoofdzakelijk ongefundeerd was, en waardering hebbende voor de betrokkenheid van VFSG in het uitvinden en maken, begon er zich een complimenteus paradigma te ontwikkelen. Het team was ervan overtuigd dat zij op een spannend en belangrijk leerpad waren aangekomen. De marktgerichte onderzoeks-fase had het team cohesie gegeven en er ontwikkelde zich empathie met de reeks mensen direct of indirect betrokken met landbouw. In dit opzicht, heeft het groter wordende begrip voor de vele "wereld visies" met betrekking tot levensvatbare landbouw systemen door middel van communicatie en interactie met respondenten onmiskenbaar, de grootste invloed gehad.

Uit de marktgerichte onderzoeks fase destileerde zich een aantal belangrijke lessen welke de richting van het project veranderde. Deze lessen hielden het volgende in:

(i) Door de positie tussen de departementale staf en de te interviewen in evenwicht te brengen, wordt betere informatie verkregen.
(ii) Het gebruik van derde groep interviewers demonstreerde de waarde van afwisselende wereldmeningen.
(iii) De team leden van de VFSG ontwikkelde duurzame sociale onderzoeks vaardigheden.
(iv) De kracht van kwalitatieve onderzoeks processen werd gedemonstreerd door de reeks van uitgekomen resultaten, de ruime hoeveelheid data, samenhangende details en inzichten.
(v) Wijzigde het belangrijke oordeel van de verschillende landeigenaren.
(vi) Veranderde de project management doelen.
(vii) Tarte lang bestaande veronderstellingen.

(viii) Ontdekte dat informatie ten behoeve van strategische besluiten van groot belang was.
(ix) Bevestigden dat de RRA een behoefte ontwikkeld heeft bij de deelnemers naar follow up activiteiten.

Naar aanleiding van het resultaat van het marktgerichte onderzoek, werd van de oorspronkelijke doelstelling, zijn stellingen en TOT benadering afgeweken. De marktgerichte onderzoeks fase demonstreerde dat participatie in benaderingen veelbelovende mechanismen zijn voor het inleiden tot en bijdragen aan verandering. Het marktgerichte onderzoek bracht ook terreinen aan het licht waarvoor VFSG activiteiten ontwikkeld en geïmplementeerd zouden kunnen worden. Deze activiteiten zijn de negen case studies waarop het vervolg onderzoek zich richtte.

Nieuwe toepassing van oude gereedschappen inclusief de **Regenval simulator** die de cliënt in staat stelt om hun begrip voor de relatie tussen technieken t.a.v. het gebruik van grond tussen de oogsten, regenval, grondwater opslag, en afvloed te vergroten en te experimenteren met het optimaliseren van grondwateropslag; de **Grondboor** die de cliënten beter in staat stellen tot het ontwikkelen van meer kennis van hun gronddoorsnede en het monitoren van hun grondwater opslag; en ***HOW WET***, een gereedschap t.b.v. besluitvorming, die de cliënten de gelegenheid bied om meer kennis te verwerven van hun grondwateropslag in relatie met regenvalregistratie.

Deze gereedschappen bleken de krachtigste initiators tot verandering. Deze gereedschappen boden de cliënten de gelegenheid om, te spelen met hun omgeving, verschillende opties te testen, informatie te verzamelen, en het begrip te vergroten tussen ons en de cliënten voor probleem situatie, en het verwerven van kennis zonder direct risico. Het waren goed reproduceerbare processen voor de medewerkers, klanten groepen, en situaties in tijd en plaats. Hun impact werd vergroot door dat de wetenschap deelnam aan het proces en de klant de onderzoeker werd. Deze verandering van rollen vergrote bij de klant zijn eigen perceptie van zijn status en zijn perceptie van zijn vermogen tot het ontwikkelen van kennis en de waarde hiervan. Dit had tot gevolg dat hun vertrouwen in het onderzoek en zijn resultaten en hun begrip van de situatie toenam. Dit vergrote perceptie vermogen is de drijvende kracht die maakt dat deze werktuigen en hun geassocieerde processen krachtige middelen zijn tot het ontwikkelen van veranderingen. Omgekeerd, angst voor merkbaar verlies van status geassocieerd met het medewerker zijn bleek een barrière voor enkele wetenschappers om deze rol op zich te nemen. Het gebruik van de werktuigen in groep situaties was ook succesvol. Door middel van dialectische voordrachten en groepsobservatie, werd begrip vergroot met als consequentie dat meer doelbewuste besluiten werden gemaakt door de cliënten. We hebben eveneens geleerd dat de werktuigen en processen "black boxes" bevatte die, indien ze geopend werden, het vertrouwen in de werktuigen en de resultaten van de cliënten vergrote. De status door de landbouwers toegekend aan de werktuigen zoals zij die gebruikten was eveneens een belangrijk oorzaak voor impact. Wij leerden eveneens dat de kracht van de werktuigen tot initialiseren van verandering gerelateerd was aan het feit of ze verenigbaar waren met de leerstijl waaraan de landbouwers de voorkeur gaven.

Het ontwikkelen van nieuwe werktuigen voor specifieke doeleinden en klanten inclusief het ***Fallow Management Game*** - een computerspel dat gebruikers voorziet van informatie als een besluit ondersteunend programma, maar eveneens gelegenheid biedt voor discussie, opname en uitwisseling van informatie tussen producenten in de verschillende groepen; en ***With and Without*** - een vergelijkend analyse werktuig ontwikkeld om de verschillende opties

te kunnen analyseren en testen ten aanzien van het totale bedrijf. Deze werktuigen vergroten het participerend leren door het aangaan van een risico vrije actief onderzoek gebaseerd op formele presentaties van echte situaties uit het leven van het boerenbedrijf.

Het *Fallow Management Game* bood, indien gebruikt, de kans om van elkaar te leren. De landbouwers hadden plezier in het spelen van het spel en lieten merken dat "landbouw op een leuke manier" invloed had op de reactie in de praktijk. Klanten spelen een rol in de ontwikkeling van het spel. Door het spelen van het spel bepalen landbouwers welke variabelen bruikbaar zijn voor hun besluitvorming en welke variabelen worden opgenomen in de gecorrigeerde versies.

Voorafgaand aan onze betrokkenheid, vond het gebruik van *With and Without* hoofdzakelijk plaats door de QDPI, om de uitvoerende medewerker een beter begrip van kosten en baten van veranderingen bij te brengen, terwijl de resultaten alleen werden gepresenteerd aan de landbouwers, dat is, een klassieke TOT benadering. We hebben de bruikbaarheid van het middel in twee situaties uitgetest: (i) een gemeenschappelijk leerproces binnen een PLAR raamwerk (tussen het VFSG team en de landbouwers) om de implicaties van grote veranderingen in strategie en het gevolg hiervan op het hele boerenbedrijf te testen en (ii) als een raamwerk ten behoeve van een semi-professioneel opleiding voor Dalby Agricultural College (DAC) afgestudeerden.

Het gebruik van deze werktuigen toonde de professionele telers en de landbouwers de noodzaak voor het begrijpen en onderzoeken van de realiteit vanuit verschillende perspectieven. De werktuigen voorzien een forum waarin de wetenschappers, uitvoerders en landbouwers hun ervaringen en kennis opslaan op een meer gelijke basis dan in het geval van de TOT benadering. Informatie en data werden uitgewisseld gedeeld in plaats verdeeld. De landbouwers en professionele telers waren beide enthousiast over de uitwisseling en de gelegenheid voor dialoog. De werktuigen gaven de mogelijkheid tot het bewerken van de onpersoonlijke-maar-opbouwende realiteit die op verzoek opgevraagd kon worden. Gedurende het proces, werd een dieper inzicht verworven in het karakter van de technologie als een sociaal gebeuren. Het gebruik van participerende processen om zowel kennis als een informatie produkt voor massa distributie te ontwikkelen door persoonlijke constructies van de deelnemende landbouwers, demonstreerde de kracht van deelname afgezet tegen het ontvangen van kennis die niet door de gebruiker zelf is aangeleverd of waar hij geen aandeel in heeft gehad. Dit bevorderde de uitdaging tot navolging, hoe goed is het mogelijk, in praktisch opzicht, om mogelijkheden te scheppen tot participerend leren verspreid binnen de doelgroep van landbouwers?

Nieuwe benaderingen in het werken met doelgroepen inclusief ***Investing in Young Farmers***. Het werken met afgestudeerden van de Dalby Agricultural College gebruikmakend van *With and Without* als een raamwerk voor het maken van een semi-professionele opleiding voor DAC afgestudeerden; *Producing information - with farmers, for farmers* - door het toevoegen van bestaande wetenschappelijke informatie aan de variabelen die de landbouwers als belangrijk hebben benoemd, door het vastleggen van regels ten behoeve van onderzoek en het vast leggen van regels voor de landbouwer. ***Making Better decisions for your Property*** - een consultatieve ervaring met het schrijven van strategische besluitvormings ondersteunende kennis; en , ***Is Cotton the Crop for Me?*** een participerende ervaring met het schrijven van strategische besluitvormings ondersteunende kennis.

Door deze activiteiten hebben wij geleerd dat de landbouwers tijdens groep situaties niet in staat bleken om eigen constructies van het gangbare systeem te ontwikkelen of aan te geven wat zij hiervan in de toekomst verwachte. Kennisontwikkelings technieken waren van nut voor deelnemers die direct betrokken waren in de oefening, maar de voordelen verbonden aan kennis output werden in het algemeen niet beschouwd als van groot nut voor een bredere populatie.

Een opkomend perspectief. We kwamen tot het inzicht dat het systeem waar we mee te maken hadden een gekoppeld systeem was (Röling, 1994) met de implicaties; (i) dat het beter is de aanpak divers dan gestandaardiseerd te doen (ii) ondersteuning bieden is een zich ontwikkelende eigenschap en geen eenmalig objectief of eind station. We werden ons er ook van bewust dat de interacties tussen besluitvormers en hun landbouw systeem flexibel is maar tegelijkertijd vast lag in hun (natuurlijke en sociaal- economische) verleden. We hebben aangetoond dat de weg naar succesvolle vooruitgang ligt in termen van co-learning processen, door het verbeteren van inzicht in systematische relaties en het verbeteren van monitoring en het bekend zijn met die variabelen waarvan aangenomen wordt dat ze een afspiegeling geven van de veranderingen die in gang zijn. We realiseerden ons niettemin, dat onderzoekers en veranderings doorvoerende tussenpersonen niet zonder meer een co-learning proces zouden aannemen tenzij en totdat zij zelf startte met werken in en onderzoeken van de PLAR methode.

Wij toonden aan dat, met gebruik van zo'n PLAR proces, landbouwers een of meer opties uitprobeerden; dat landbouwers binnen een reeks van veel verschillende doelgroepen een of meer opties uitprobeerden; en dat landbouwers meer doelbewust waren in hun besluitvorming. De eindresultaten werden niet van te voren door het proces bepaald. Door een beter begrip van de situatie waar ze mee te maken hadden, werden de landbouwers meer doelbewust in hun besluitvorming en ze behaalden eindresultaten die ze van te voren voor zichzelf hadden bepaald.

We realiseerden ons ook dat, terwijl het een krachtig en leerzaam proces voor het team was, het eveneens aanzienlijke vijandigheid opwekte onder leden van onze wetenschappelijke gemeenschap. Het daagde speciaal het positieve realistische raamwerk van R & D en technologische ontwikkelingen, en het TOT model met betrekking tot het gebruik van technologie op landbouw niveau uit. We ontdekten dat geschreven informatie een ongeschikt middel is ter bevordering van veranderingen. Het is meer geschikt als hulpmiddel voor PLAR activiteiten. Niettemin kan, schriftelijke informatie beter geschikt gemaakt worden als het de ontvanger in staat stelt om (i) de probleemsituatie duidelijker te definiëren (ii) een raamwerk te ontwikkelen waarin het probleem, de oplossing en gevoerde communicatie is vastgelegd en voorzien is van informatie kaarten waarin duidelijk gemaakt wordt waar specifieke relevante informatie verkregen kan worden; (iii) de eigenaar de gelegenheid biedt om zelf tot een oplossing te komen.

Van alle activiteiten die de VFSG heeft ondernomen tijdens dit project, hebben de activiteiten die gebruik maakten van leermiddelen en leeraktiviteiten de grootste invloed op verandering gehad. Deze verandering bleek nogal spectaculair en onverwacht. De reden waarom deze leermiddelen zo'n invloed hadden waren meervoudig; (i) de leermiddelen werden gehanteerd op een androgogische basis; (ii) de rol van de QDPI ambtenaar veranderde van technische expert naar die van deelnemer; (iii) de proces assisterende landbouwers konden zich afspiegelen aan het creëren van feedback door middel van observatie en metingen; (iv) de middelen sloten aan bij leermethode die de voorkeur had en de perceptieve modaliteiten van de

deelnemers, met de leeractiviteit. Het ander grote voordeel van deze leermiddelen zijn dat ze een snelle uitgebreide penetratie van de doelgroep toestaan. Tegengesteld demonstreren de verschillende acti viteiten dat indien deelname geen onderdeel uitmaakt van het proces, de betrouwbaarheid van de methode vervalt.

Conclusie, gesteld kan worden dat met zeer simpele biologische systemen, reducerende benaderingen adequaat zijn om de relaties tussen oorzaak en gevolg uit te leggen. Niettemin zijn voor het hanteren van complexe situaties als het bepalen van de hoofdzaken, zacht systeem benadering en volwassen leermethoden de meest effectieve en efficiënte methode gebleken. Door deze benadering werden de individuele eigenaren aangemoedigd om hun eigen constructies te ontwerpen en de wetenschapper heeft hierin de veranderde rol van deelnemend leren in plaats van het aanleren van de wetenschappelijke opbouw.

Deze conclusies hebben gevolgen. Indien wetenschappers geconfronteerd worden met probleem situaties moeten zij de situatie zorgvuldig onderzoeken voordat ze besluiten welke aanpak de meest geschikte is. Deze Besluitvorming wordt vergroot indien onderzoekers en deelnemers een grotere kennis ontwikkelen van de beschikbare opties en hun onderliggende veronderstellingen. Dit betekent dat ondersteunende organisaties begrip zullen moeten ontwikkelen voor de rol van proefondervindelijk onderwijs onder hun staf en hun cliënten. Een sleutel tot succes is training van de staf met de verschillende paradigma's die in gebruik zijn en in het aanleren van vaardigheden noodzakelijk voor het succesvol toepassen van deze vaardigheden bij een bepaald paradigma. Meest ideaal zou zijn dat deze training plaatsvindt in de opleiding van de wetenschapper - op de universiteit. Voor die constructieve wetenschappers die reeds van de universiteit zijn, ligt een rol weggelegd in het assisteren van bepaalde realistische wetenschappers bij het overdenken van hun eigen en andere paradigma's. Deze studie demonstreerde eveneens dat het zinloos is om een bepalende benadering te kiezen zoals TOT in dit overzicht duidelijk maakt. Door middel van participerend onderzoek van de paradigma's die in gebruik zijn en hun invloed op methoden en aandachtsgebieden, ontstaan nieuwe taken voor wetenschappers. Deze studie geeft aan dat men toe is aan een paradigma verandering binnen de wetenschap van landbouw, ten behoeve van onderzoek en uitbreiding. De paradigma verandering zal niet komen met gebruikmaking van processen behorende bij de oude paradigma's. TOT is niet effectief in complexe en wanordelijke situaties. Paradigma veranderingen zijn complexe en wanordelijk situaties. De nieuwe paradigma processen worden effectiever indien ze gebruikt worden ter ondersteuning bij het laten ontstaan van deze paradigma verandering.

Curriculum vitae

Gus Hamilton was born in Jandowae, South Queensland, Australia in 1955. He and his wife Penny have three boys, Dugald, Alastair and Bart. Gus completed his undergraduate degree in Agricultural Science at the University of Queensland in 1977, and obtained an M.Sc. in the Management of Agricultural Knowledge Systems (with distinction) at the Wageningen Agricultural University in the Netherlands, in 1990.

In 1978, Gus commenced his professional career with the Queensland Department of Primary Industries at Warwick in southern Queensland. Later that year, he was transferred to Miles in southern Queensland to work with conservation farming. In 1981, he was transferred again, this time to Roma in the west of the southern Queensland region and spent ten years developing sustainable agricultural systems for both crops and pastures.

After returning from the Netherlands, he was transferred to Dalby as Principal Extension Agronomist (Agricultural Systems) and to become the full time project officer for the Viable Farming Systems Group. He was later to also adopt the role of project leader of this project. For the past five years with this project, he has been pursuing sustainable agricultural systems with an integrated research and extension team.

In 1993, he initiated the first International Australia Pacific Extension Conference, held at Surfers Paradise in Queensland and was a member of the working party that convened this conference. He was also on the working party convening the 6th Annual Australian Agronomy Conference to be held in Toowoomba in 1996.