UNIVERSITY OF SOUTHERN QUEENSLAND

Faculty of Business and Law

DIFFUSION OF INNOVATION THROUGH VIDEO MEDIATED SOCIAL NETWORKS:

INFLUENCING SUGAR CANE FARMING PRACTICES APPLYING EVIDENCE-OF-ADOPTION STRATEGIES

A Thesis submitted by

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For the award of

Doctor of Philosophy

2011

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SUMMARY

Faced with declining government investment, agricultural research and development needs a more cost-effective adoption pathway than traditional extension activities have been able to provide. Yet despite the high value placed in online services by most other industries, farmers and extension agents have not capitalised on the Internet's enormous potential. However, before contemplating the use of Internet and social networking technologies, it was felt a more rigorous understanding of the social context that underpins farmer-to-farmer adoption was required.

To this aim, the Video Mediated Social Network is presented here, as a method that refashions technology transfer from an archaic top-down process into a participatory bottom-up approach that enables change by facilitating the transfer of innovations between farmers using video. Central to this approach is the *Evidence-of-Adoption Framework*, where motivating ideas are formed at the intersection between exposure to industry-wide evidence-of-adoption and the cultural-historic context of individual farmers. These motivating ideas, brought about by a tacit acceptance of validity claims conveyed through a language of operational detail combine with the significant influence of peers to trigger change.

This research conducted in two phases, began by iteratively building theory through exploratory research, which lead to a synthesis of *Communicative Action*, *Cultural-Historic Activity Theory* and *The Theory of Planned Behaviour* in its theoretical framework. Observations of facilitated discussions were then combined with an electronic survey, with samples stratified across 12 regional locations. Treatments consisted of two DVDs, a website and video presentation. Video clips conveyed the personal accounts of farmers' experiences adopting new technologies and practices on their farms.

Correlation analysis using Spearman's ρ revealed that farmers who watched the video clips felt strongly encouraged by the model farmers, from whom they obtained details about

practices that had previously eluded them. These normative beliefs increased their confidence and self-efficacy towards practice change, which combined with existing positive attitudes, motivated them to change. This ultimately led to some degree of behavioural control, including facilitating change (96%), planning to change (60%) and actual change (32%). Additionally, farmers who were regular Internet users found this content compelling enough to want to access it online.

CERTIFICATION OF DISSERTATION

I certify that the ideas, experimental work, results, analyses, and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

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Henry Thomas Candidate Date

ENDORSEMENT

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John Leis Associate Supervisor Date

TO BONNIE, MERCEDES, STIRLING, AND

MUM AND DAD

ACKNOWLEDGEMENTS

I would like to thank the many people who have assisted me with this research project. Thanks to my masters' supervisors John Leis and Craig Bailey and my PhD supervisors Joseph Mula and Jeff Coutts for their patience, persistence and thoughtful guidance. Thanks to my video production collaborator Avril Robinson who provided excellent logistical support for this project. Additionally, without the assistance and participation of numerous farmers, researchers, agronomists and extension officers who were willing to be interviewed, the video clips would not have been possible. Thanks to Neil Garson, Angela Williams and Trish Cameron for supporting my scholarship application. For their financial support, thanks to the Sugar Research and Development Corporation's scholarship program, Queensland Primary Industries and Fisheries, CANEGROWERS, and the Department of Agriculture, Fisheries and Forestry's Caring for Our Country program. Finally, for taking a punt sight-unseen and funding my first trip to video tape farmers in the Burdekin, thanks to North Queensland Dry Tropics, the Pioneer Cane Growers Organisation, and Burdekin Productivity Services.

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ABBREVIATIONS

ARS	Audience Response System
BSES	Bureau of Sugar Experiment Stations
CHAT	Cultural-Historic Activity Theory (Vygotsky, 1986)
DoI	Diffusion of Innovations (Rogers, 2003)
DPI&F	Department of Primary Industries and Fisheries (now QPIF)
DSS	Decision Support System
Ha	Hectares
QPIF	Queensland Primary Industries and Fisheries (formally DPI&F)
RDC	Research and Development Corporation
R&D	Research and Development
RD&E	Research, Development and Extension (Dept. Agriculture, Fisheries & Forestry, 2008)
ToCA	The Theory of Communicative Action (Habermas, 1984;1987)
ToPB	The Theory of Planned Behaviour (Ajzen, 1991)

LIST OF PUBLICATIONS

Thomas, H 2009 'Facilitating ad-hoc abstraction to improve end-user programmed decision support tools' *Proceedings of the 2009 IEEE International Conference on Industrial Technology*, pp. 1-6, Gippsland, VIC

Thomas, WHP 2009 'Online Shedmeetings: Experiences producing video webcasts that showcase sugar industry best practice' *Proceedings of the Australian Society of Sugar Cane Technologists*, vol. 31, pp. 240-249, Balina, NSW

Thomas, WHP 2010 'Video Mediated Social Networking: A case of how this occurred in the Australian sugar industry' *Proceedings of the Australian Society of Sugar Cane Technologists*, vol. 32, pp. 497-506, Bundaberg, QLD

Thomas, WHP 2011 'Video Mediated Social Networks: A future adoption pathway for the Australian sugar industry?' *Proceedings of the Australian Society of Sugar Cane Technologists*, vol. 33, Mackay, QLD

1 INTRODUCTION

1. 1 Background to the research

This study deals with issues surrounding the process of *Extension*, specifically, the online delivery of agricultural extension services to achieve technology transfer outcomes. In agriculture, technology transfer is the process by which useful research outcomes are developed into practical, commercially relevant technologies and practices. Extension is the final step, where communication and educational activities are employed to facilitate the uptake of new technologies and practices by farmers.

Attempts at online extension have met with mixed results; while some extension agents report that farmers have found their websites useful (Cooke *et al*., 2002; High & Jacobson, 2005; Schmidt *et al*., 2003; Wiersma, 2007), farmers continue to express a preference for interpersonal communication channels and on-farm demonstrations over online sources of information (Howell & Habron, 2004; Licht & Martin, 2007; Radhakrishna *et al*., 2003). For instance, Table 1.1 lists research reports from the field of extension that relate to farmers' preferred information sources or use of extension websites. From these reports, it is clear that farmers prefer interpersonal communication to online sources of information. Of the reports that use surveys as a data source, most compare websites to other sources of information ranging from printed material, through to one-on-one consultations and on-farm demonstrations. This is done to ascertain which information sources farmers prefer, the results of which are generally presented with other demographic information about the survey population. Surprisingly only one study in Table 1.1 (Howell & Habron, 2004) identifies a need to determine the "*actual effectiveness of web sites*" as comparable information source. A question, which to the best of the researcher's knowledge, remains unanswered.

Table 1.1 – Research reports on farmers' preferred information sources or use of extension websites.

Research Report	Data Source	Analysis
Riesenberg and Gor (1989)	Mail survey (n=179)	Farmer attributes and preferred information sources
Bruening *et al*. (1992)	Mail survey (n=246)	Farmer attributes, preferred information sources, perceptions about environmental issues
Gelb and Bonati (1998)	Expert panel (n=23)	General agreement on perceived benefits of the internet
Marsh and Pannel (1999)	Literature review	Discussion
Gloy *et al*. (2000)	Mail survey (n=1,742)	Farmer attributes, preferred information sources
King and Boehlje (2000)	Literature review	Discussion of e-extension
Black (2000)	Literature review	Discussion of the Internets' limitations
Thysen (2000)	Literature review	Speculative discussions about role of IT
Marsh and Pannell (2000)	Literature review	Discussion of the Internets' limitations
Fultz and Schwartz (2001)	Literature review	Discussion of the Internets convenience
Schmidt (2001)	Literature review	Discusses the nature of information
Cooke *et al*. (2002)	Server logs	Extension website usability and page hits
Chapman and Tripp (2003)	Literature review	Comparative discussion
Schmidt *et al*. (2003)	Focus group (n=?)	Extension website usability and design
Radhakrishna *et al*. (2003)	Mail survey (n=231)	Farmer attributes, preferred information sources
Howell and Habron (2004)	Mail survey (n=403)	Farmer attributes, preferred information sources, Internet use
High and Jacobson (2005)	Email survey (n=115)	Farmer attributes, preferred information sources and perceived usefulness of website
Stenberg and Morehart (2006)	Census data and survey	Farmer attributes and Internet use
Kallioranta *et al*. (2006)	Literature review	Discussion of extension websites
Johnson *et al*. (2006)	Survey of agents (n=139)	Self-reported assessments of successful extension strategies
Licht and Martin (2007)	Focus group (n=29)	Preferred information sources
Ray (2007)	Server logs	Extension website unique visitors and page hits
Wiersma (2007)	Mail survey (n=194)	Farmer attributes, preferred information sources and perceived utility of website
Park *et al*. (2007)	Survey (n=303)	Satisfaction with video-on-demand e-learning system
Xie and Gu (2007)	Literature review	Discussion of extension websites
Harder and Lindner (2008a)	Email survey (n=125)	Agents' perceptions of online extension website
Sobrero (2008)	Literature review	Discussion of prerequisites for online social learning
Herring (2008)	Email survey (n=184)	Extension website enquiry attributes and demographics
Sobrero and Craycraft (2008)	Literature review	Discussion about appropriateness of online communities of practice

In the studies in Table 1.1 where farmers express a lack of preference for online sources of information, none included an assessment of the quality or relevance of the content provided by the extension websites in question. Thus, there is no way of knowing if the website content was equivalent to the other sources of extension information they were being compared to. As such, differences in the content design or communication styles employed may have been confounding variables in these reports. For instance, in reporting on the information preferences of growers, agronomists and consultants, Parsons (2009) illustrates how document savvy, as opposed to Internet savvy, a typical state department responsible for agriculture is. Its not surprising then, that as recently as March 2009, 77% of farmers surveyed in the central agriculture region of Western Australia indicated they would prefer to receive a printed copy of a newsletter in the mail than receive it electronically by email (Stone & Devenish, 2009).

A study of farmer online learning by Starasts (2005) reports that the current '*supply of information*' by rural institutions is not supporting the highly situated nature of self-directed learning and information seeking exhibited by farmers. As such, these websites fell short of the expectations of avid users of the Internet, who were looking to the Web as a source of new information about rural technologies and research. At the other end of the skill—ability spectrum, Starasts observes that the digital divide is multi-dimensional because information literacy is multi-faceted, encompassing the ability and preparedness to operate online environments, the skill to locate and use relevant online resources, and the time to browse and search for sources of information. While rural users in the study valued the Internet as an information and communication resource, its potential for knowledge sharing through social interaction was yet to emerge.

Problems with online extension stem from the need for extension agents to put extra time and effort into activities (Sobrero, 2008) that fall outside of their traditional role and skill-set (Cooke *et al*., 2002; Wiersma, 2007). At an individual level, agents find it difficult to perceive the relative advantage of online service delivery (Harder & Lindner, 2008a). These

perceptions are exacerbated by this lack of evidence in the literature that online extension is effective, which explains why there appears to be so little urgency to embrace a technological solution (Harder & Lindner, 2008b). This lack of evidence reinforces an entrenched view amongst many practitioners that traditional modes of delivery – particularly those that involve interpersonal communication – are ideal (Vanclay, 2004). While a common belief held amongst extension practitioners is that '*farmers learn best from other farmers*' (Manjala, 2009), this research will show that theories and techniques to facilitate this type of learning online are presently underdeveloped.

The status quo would be fine if governments in the present political and economic climate were still willing to pay for the high-cost of traditional modes of delivery. However, in Australia, public support for agricultural extension services continues to decline. This is evidenced by an ongoing fiscal contraction that has seen a 30% reduction in extension staff over the past decade (FutureBeef Project Reference Committee, 2008). There are simply not enough extension agents left to maintain a business-as-usual approach. Instead, productivity gains are needed to offset these declines in order to maintain current levels of service. It is anticipated these productivity gains will come from delivering more services online (Jan Taylor & Associates, 2008). Thus, effective methods for online service delivery have become a political imperative[1].

This is not to suggest that online delivery of agricultural extension services will supersede other forms of interpersonal communication, and replace extension agents altogether. Rather, it is expected that service delivery will be segmented into high-cost/low-volume and low-

[1] In a *Queensland Country Life* interview on 19th March 2009, the Minister for Queensland Primary Industries and Fisheries, Hon. Tim Mulherin, made the following election commitment: "We will upgrade the DPI&F IT platform to make services integrated, modern and user-friendly, with 50% of departmental services delivered online by 2012".

cost/high-volume partitions, with high-volume services delivered via electronic means (Jan Taylor & Associates, 2008). However, King and Boehlje (2000) suggest that re-invention from the inside is unlikely to occur because agricultural extension is bound by a culture of gradual and incremental improvement. As such, resistance to moving services online is more likely to come from the significant cultural shift that must occur amongst extension agents, than from farmers' lack of acceptance of online services (Schmidt *et al*., 2003). For instance, Australian rural communities recently reported high levels of access to the Internet and use of online services like Internet banking and local weather forecasts (Australian Communications & Media Authority, 2008), yet online access to agronomic information continues to be a low priority for farmers.

At a national level, the recent Productivity Commission (2011) Inquiry Report into Rural Research and Development Corporations (RDCs) identifies *'insufficient attention to adoption pathways'* as a serious deficiency in the current national R&D framework. Noting that:

> *No matter how intrinsically valuable a piece of rural R&D, if its outcomes do not result in changed practices, then beyond the knowledge generated, there will be no benefit from that research for the community (Productivity Commission, 2011, p. 87).*

The Productivity Commission Report goes on to recommend that the adoption of useful research outputs be treated as an integral part of future R&D planning and delivery processes; specifically stating that as a condition of receiving government funding, RDCs will, amongst a list of nine other requirements, *'have in place suitably resourced processes to facilitate timely adoption of research results'* (Productivity Commission, 2011, p. xxxi).

The Commission's Report also criticises the absence of a '*strong evaluation culture*', which the report suggests permeates the entire national R&D framework, noting that significant amounts of government funding for rural R&D were invested largely as an *'act of faith'*, because it came with *'so few strings attached'*. This lack of evaluation placed little onus on

funding recipients to (amongst other things) improve service delivery and increase adoption. Consequently, future recipients RDC funding will be expected to use effective evidence-based approaches to ensure useful research outcomes are adopted.

This is a serious issue, particularly in the light of present day fiscal pressures brought about by the global financial crisis. Ministers, and ultimately their constituency – the Australian taxpayer – expect to see evidence of specific, measurable, time-bound outcomes from publicly funded programs. The absence of which Anderson and Feder (2004) observe, weakens public commitment and support and ultimately undermines the '*Fiscal Sustainability'* of government run Agricultural R&D institutions.

In summary, it is posited that agricultural R&D needs a lower-cost adoption pathway than traditional extension approaches have been able to provide. While it is anticipated this will come from greater use of the Internet, extension agents appear to have been poorly equipped to make these advances on their own. It will be clear that, evidence of an effective low-cost/high-volume technology transfer strategy, developed and presented in this thesis is both timely and significant.

1. 2 Research problem, research issues and expected contributions

Having established that interpersonal modes of service delivery – which have historically been linked to technology transfer – are contracting, while at the same time, an effective low-cost/high-volume mode of delivering these services electronically has yet to emerge, it can be posited that there is presently a service delivery gap. The logical consequence of this gap is a mismatch between the current level uptake of useful research outcomes and their adoption potential. At an industry level, this shortfall in uptake represents a latent opportunity to potentially increase the productivity, profitability and sustainability of farming enterprises. Thus, finding a solution to bridge this gap could have broad benefits for individual farms, agricultural industries and rural communities.

However, before contemplating the potential use of the Internet or social networking technologies to bridge this gap, it is felt that a more rigorous understanding of the social context that underpins farmer-to-farmer adoption is needed. Even though extension practitioners recognise the benefits of farmers learning from other farmers, little has been written about the precise behavioural influences that are at work. For example, Leeuwis and Van Den Ban (2004) stress the importance of extension agents '*supporting horizontal knowledge exchange*', and provide numerous theoretical perspective on adult learning, behaviour, and adoption, but fail to link these back to farmer-to-farmer learning exchanges. Similarly, Phillips (1985), Vanclay (2004), Pannell *et al*. (2006), and Curry and Reid (2009) all recognise the social-cultural influence of peers in adoption decision making, but fall short of providing any details about how these mechanisms actually work. The concern is that without a robust understanding of how farmer-to-farmer behavioural influences trigger change, efforts to facilitate farmer-to-farmer learning exchanges online may be misdirected and potentially ineffective. This would continue to undermine extension agents' faith in technological solutions. Thus, with the goal of filling this knowledge gap, the overarching research question addressed by this study is:

> ***When farmers interact and learn from one-another what behavioural influences trigger decisions to adopt new technologies and practices and can these influences be effectively conveyed via electronic means?***

The case made in this thesis is that while many aspects of farmer-to-farmer learning can be explained by theories ranging from adult learning to innovation diffusion, the specific behavioural mechanisms in farmer-to-farmer learning that trigger change are not. As such, this research aims to provide a robust theoretical framework informed by iterative exploratory research and empirical testing.

Two mechanisms by which farmer-to-farmer learning occurs are posited. The first mechanism, relating to communications style, is how self-disclosure engenders trust, making

the claims implicitly acceptable, the communication more efficient and ultimately the information more influential in decision-making. The second, relating to content, is how farmers favour a language of operational detail over generalisable abstractions, preferring to communicate about innovations in their operationalised form.

In its investigation of these mechanisms, this study used video to capture and communicate the personal accounts of farmers' experiences adopting new technologies and practices. A key idea, stemming from *Chasm* theory (Moore, 1999), is that informal social networks form during each phase of an adoption lifecycle as a result of individuals sharing their knowledge and experience about the innovation. In the case of farmers, certain evidentiary requirements must be met during each adoption phase: in the beginning farmers want evidence that the technology works in a production setting, then evidence that it has a compelling value proposition, finally as the technology matures, evidence that standards have emerged and evidence that agribusiness vendors are willing to support them.

This study will show that *motivating ideas* are formed at the intersection between exposure to industry-wide evidence-of-adoption and the individual cultural-historic context of existing farming practices. These motivating ideas, coupled with the significant normative influence of peers ultimately drives adoption decisions. However, given that an adoption lifecycle can take many years (Rogers, 2003), this study used the *Theory of Planned Behaviour* (Ajzen, 1991) to test the influence *evidence-of-adoption* videos had on the farmers who watched them.

The study was conducted in two phases.

In Phase I, an iterative *Agile* development process was combined with exploratory research techniques. Agile development methods were used to design and create the study's experimental treatments; the video clips and website. Inductive analysis of the exploratory research results lead to the development of a heuristic model of farmer-to-farmer communication.

In Phase II, extent literature was reviewed to progress this model into a theoretical framework that posits behavioural influences that trigger change in farmer-to-farmer learning. Within this framework, quantitative and qualitative measures are combined under the realism paradigm to test previously unexplored hypotheses and propositions by answering the following research sub-questions.

RSQ1: Does video mediated industry-wide evidence-of-adoption influence farmers' decisions to adopt innovations?

RSQ2: Are farmers' decisions to adopt innovations significantly influenced by the subjective norms of peers?

RSQ3: Does farmer self-disclosure allow evidence-of-adoption validity claims to be accepted?

RSQ4: Do farmers favour operational detail over generalised abstractions when communicating about innovations?

In answering these questions, this study seeks to make several contributions to theory and practice. Firstly, a heuristic model of farmer communication, conveyed by a simple set of rules for creating effective evidence-of-adoption video clips. Secondly, a theory of the behavioural influences that trigger decision to adopt new technologies and practices when farmers learn from one another. Finally, recommendations for the deployment and evaluation of this approach within an RD&E program setting, including its scope and limitations.

1. 3 Justification for the research

This research can be justified on six grounds.

Firstly, it can be justified on the grounds of relative neglect of the **research problem** by previous researchers. While the benefits of farmers-to-farmer learning are widely recognised

by extension practitioners, little has been written about the precise behavioural influences that occur. This theory building research aims to fill this gap.

Secondly, this study can be justified on the grounds of relative neglect of the **research methodology** by previous researchers. This research deals with complex social science phenomena involving reflexive human subjects (Healy & Perry, 2000). This type of phenomena does not fit neatly into the standardised, *'situation-free'* assumptions required by the purely quantitative research methods (Luthans & Davis, 1982), which have previously been used (Gandhi *et al*., 2007; Oladele, 2008; Polson, 1999). This study combined exploratory, quantitative and qualitative measures using a theory-building paradigm to describe the phenomena under investigation.

Thirdly, this research can be justified on the grounds of **industry importance**. This research was conducted for the benefit of the Australian sugarcane industry. This industry generates a gross product of over one billion dollars annually (Dept. Primary Industries & Fisheries, 2008b), 80% of which comes from exports. This industry provides incomes to cane farmers, harvest operators and mill workers and thus regional communities up the north eastern coast of Australia, from Ballina in northern New South Wales to Mossman in far north Queensland (Dept. Primary Industries & Fisheries, 2008a). It is also an industry that is highly mechanised with an appetite for technological innovations that range from sustainable farming systems to precision agriculture. Therefore, development of an effective low-cost/high-volume technology transfer strategy described in this thesis will make a significant contribution to this industry.

Fourthly, this research can be justified on the grounds of **equity of service**. With the ongoing contraction of public funding for extension services, the regional delivery of traditional extension activities like one-on-one consultations, bus trips and field days have become less equitable. The needs of some farmers are effectively over-serviced while the rest get ignored (Jan Taylor & Associates, 2008). Problems include, but are not limited to (Xie & Gu, 2007):

- there are not enough agents to provide one-on-one consultations to all farmers;
- repeatedly making the same presentation and delivering the same information at different times and/or in different regions is inefficient;
- there is over reliance on the individual agent's expertise. This can be limited if the agent is inexperienced and new to the job, or may become unavailable if an experienced agent leaves the job or retires;
- efficacy can be influenced by 'human' factors (e.g. personalities and communication skills may impact the credibility and attractiveness of the message delivered);
- travel and time away from work comes at a high cost to both farmers and agents; and,
- farmers who cannot attend may lose opportunities to learn.

Many of these problems stem from the fact that the activities that are of most interest to farmers are infrequent, and occur at times in the season when farmers are at their busiest. All of these limitations are overcome by the technology transfer strategy developed in this study.

Fifthly, this research can be justified on the grounds of **social justice**. Innovative farmers championed by extension programs are called upon to provide access to their farms for bus trips, field days and shed meetings. As such, they shoulder a disproportionate burden of voluntary responsibility for encouraging best-practice adoption. This research demonstrates that using video to capture and communicate their experiences is a more efficient way to share these farmer's experiences with a much larger audience, reducing the demands on their time.

Finally, this research project can be justified on the grounds of **greater efficiency and lower cost**. The technology transfer strategy described in this study provides significant time savings for farmers on the basis of the relative opportunity-cost of individual information opportunities (see. Section 6.5).

1. 4 Methodology

This research was conducted in two phases. **Phase I**, covered in Chapter 2, combined an iterative *Agile* development procedure with exploratory research techniques. Agile development procedures are used in rapid prototyping, and were used to design and create the study's experimental treatments; the video clips and website. Agile development involves iterative, collaborative design, using the barest of methodologies. This is done in order to remain nimble and responsive to uncertain and changing requirements (Highsmith, 2002). Exploratory research techniques were also employed as part of this iterative process to inform the identification of relevant theories and related literature. These techniques included the observation of analogous situations, opinions obtained from knowledgeable persons, and a search of secondary sources (Green *et al*., 1988).

The treatments developed in Phase I, consisted of two DVDs, a website and a video presentation. The DVDs and video presentation contained about 20 different stories each, with over 60 in total, which were also made available on the website. The stories conveyed the personal accounts of farmers' from Queensland's sugarcane industry adopting new technologies and practices on their farms.

Phase II, combined quantitative and qualitative data collection measures, within the realism paradigm. Sampling was stratified across 12 regional locations in order to minimise selection bias (Kish, 1995). The sample population was approximately 4,000 cane farmers. The sample frame consisted of members of the industry's peak body CANEGROWERS, who's membership accounts for over 90% of Australian cane farmers.

For the qualitative data, once subjects were exposed to all the treatments, a *Theory of Planned Behaviour* questionnaire (Ajzen, 2002; Francis *et al*., 2004) was administered electronically using an interactive Audience Response Systems to collect the data. The sample size was 78. Non-parametric tests were used for the data analysis. These included Spearman's rank correlation coefficient, the Kruskal-Wallis H test and the Wilcoxon signed-

rank test (Gravetter & Wallnau, 2008). The methodology used a retrospective within-subject quasi-experimental post-test-only design based on the assumption that inferences about causal relations could be drawn from three types of evidence (Green *et al*., 1988, pp. 107-110), associative variation, the sequences of events, and the absence of other possible causal factors.

For the qualitative data, after subjects were exposed to each of the three treatments in the video presentation, they were recorded participating in facilitated ad-hoc discussions designed to recreate via simulation, farmer-to-farmer learning exchanges. The sample size was 118. The recorded conversations were transcribed and analyzed for descriptive concepts using a process of coding, analysis of meaning, and grouping. Tabulated data was analysed and reported using simple statistics, and dissenting cases explored to rule out alternative explanations.

The appropriateness of this methodology for research within the realism paradigm is justified (Section 4.3.2) on the quality criteria established by Healy and Perry (2000). It is ontologically appropriate, because this study deals with complex social science phenomena involving reflexive human subjects. It has contingent validity, because it emphases the description of broad influences where causality is contingent on context. It is epistemologically appropriate because it began with exploration, built theory from supporting evidence, and tested theory from multiple perspectives. It has interpretive validity, because it uses low inference descriptors (Johnson, 1997). Finally, it has analytic generalisability, because the results are primarily theory building.

1. 5 Definitions

The following terms used in this thesis have the meanings as stated below.

Edaphic

Edaphic means produced or influenced by the soil[2]. In the context of farming this might include soil structure, the proportion of sand, silt and clay particles, levels of organic carbon and humic substances, drainage properties and the depth of aeration. Soils are highly variable across regions and in many regions' soils, highly variable even within paddocks.

Extension

The term extension comes from the notion of extending "*the educational advantages of an institution to persons unable to avail themselves in a normal manner*" (Maunder, 1972). A traditional definition of extension is: "*A service or system which assists farm people, though educational procedures, in improving farming methods and techniques, increasing production efficiency and income, bettering their levels of living, and lifting the social and educational standards of rural life*" (Maunder, 1972, p3). A modern definition of extension in Australia is "*the process of enabling change in individuals, communities and industries… [which] improves practice in two significant areas: increasing the sustainability of production, and enhancing natural resource management*" (State Extension Leaders Network, 2006).

Delivery

Delivery is the implementation of services provided by government agencies to the public along with the operational resources to ensure they reach the people and regions they are intended for. Government services are examples of *public goods* (Marsh & Pannel, 1999); services that no individual or organisation should pay for because they are assumed to have a broader social, economic or environmental benefit. Agricultural RD&E by government agencies is an example of the regional delivery of services.

Website

A website (or web site) is a collection of related pages, images, digital media or services that are available on the World Wide Web. These resources are typically accessed from a single home page or via a search engine, organised into tree like navigation structures and located via a single domain name (e.g. www.example.com).

Online Service

An online service is a user interface software component of a website that permits users of the World Wide Web to interact with an organisation's back-office information systems. Some services may be open and allow equal access to anyone, others may require registration, and may be tailored to the specific attributes, preferences or requirements of the end user. For example, in Queensland, updating the address of a driver's license online involves verification with data held in the Department of Transport and Main Roads license database, which also gets updated with the new address.

Online Service Delivery

Online Service Delivery occurs when a website delivers government services. This can range from static web pages providing information, to web services that allow end users to access a range of back-office processes. For example, the Australian Bureau of Meteorology collects data on weather, simulates forecasts and provides access to a range of information on its website. Ideally, any service that a government agency provides over the counter or via a call centre should be able to be accessed online.

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[2] Page 442, The Australian Concise Oxford Dictionary, 4th Ed (2004) Oxford, University Press

Model farmer

The term model farmer is used in this thesis to mean the farmer whose behaviour is being observed and '*modelled*' by other farmers. It is acknowledged that this term may be confused with notion of model farms, which is a historic extension practice that was used to conduct research and development to showcase best practices amongst rural communities, however this is not the intended meaning.

Self-disclosure

Self-disclosure is the sum of all observable information revealed by a model, both deliberate and unconscious. This includes things like facial expressions, gestures and body language (Jourard, 1971).

Operational Detail

Operational detail is the specific description of the day-to-day workings and activities associated with a given practice and the tools and procedures it employs.

1. 6 Delimitations of the scope, key assumptions, and their justifications

Data was only collected from farmers in the Australian sugarcane industry in the state of Queensland, where the majority of Australian sugarcane is farmed. The Phase I research began in early 2009. The Phase II research followed, with the launch of the research website, which coincided with the first DVD (treatment) being mailed out in October 2009. The second DVD was mailed out in April 2010. The qualitative and quantitative data collection was completed in the first week of October 2010. There is no reason to believe that if the sampling had occurred outside this particular timeframe any significant difference in results would have occurred.

As already noted, the Australian sugar industry is highly mechanised, with an appetite for technological innovations that range from sustainable farming systems to precision agriculture. Therefore, the choice of this industry can be justified because it provided a more suitable test bed for technology adoption research than other less mechanised farming sectors would have.

In particular, this industry has the following characteristics.

- Australia has approximately 4,000 sugarcane farmers.
- The average farm size is 100 Ha.
- The average farmer age is over 50.
- The industry is highly mechanised.
- Production systems range from dry land to fully irrigated.
- The industry is deregulated.
- Prior to the current rise in sugar prices, the industry struggled with a sustained low sugar price for two decades; as a consequence many farmers are believed to have supplemented their income off farm.
- The value chain is highly interdependent; sugar mills need adequate throughput to be profitable, and farmers have no other market for their sugarcane than the local mill.
- A peak body negotiates on behalf of cane farmers with the mill, much like a union.

Despite some unique characteristics, within the context of technology transfer, it can be assumed that sugarcane farmers as a population are not dissimilar to other farmers in Australia or overseas, where farmers are involved in similar, highly mechanised agricultural sectors like broad acre and perennial horticulture. Consequently, the scope of results presented in this thesis, beyond which their generalisation is not intended, is limited to technology transfer in agriculture in highly mechanised settings. While it is assumed that the

approach to technology transfer presented in this thesis will benefit extension practitioners in government agricultural RD&E agencies, it is expected to be just as useful for independent rural consultants and agents of agribusiness firms.

The key variable, central to this study was whether farmers were able to identify a specific practice in the video clips that they planned to try out on their farms, or had already adopted. The study then used various behavioural constructs from the *Theory of Planned Behaviour* to test which influences correlated with this plan to change. This study assumes that respondents answered these questions truthfully. With respect to this key variable, during the data collection, when asked, farmers were able to identify and describe specific ideas they got from watching the video clips that motivated them to change.

This study also assumes that the survey instrument, and the facilitated discussion techniques used were valid, and measured the desired constructs. The bases for these assumptions are justified in Section 4.3 in the methodology. Nevertheless, one has to be mindful that these results are from a single study that builds on the limited research of others (Gandhi *et al*., 2007; Oladele, 2008; Polson, 1999). Tilley (2000) would caution readers that a study of this kind only demonstrates '*what works for whom*' and '*in what circumstances*'.

1. 7 Outline of the Thesis

With the exception of the addition of Chapter 2, this thesis adheres to a classic thesis structure recommended by Perry (1998), which consists of the following chapters:

1. **Introduction:** This chapter provides a background to the research problem and introduces the reader to the key ideas and findings presented in each chapter.

2. **Exploratory research and treatment development**: This chapter describes the methods and process used to design and develop the study's experimental treatments, and inform the selection of relevant theory and literature in phase II of the research.

3. **Research issues and literature:** This chapter begins with theoretical perspectives that link the mechanics of interpersonal communication with the agency of social cognition in order to shed some light on the potential significance of self-disclosure and operational detail in farmer-to-farmer learning exchanges, identified in Chapter 2. A synthesis of these theories with extant literature progresses this heuristic model into a broader theoretical framework and posits behavioural influences that trigger change. The principal theories, *Theory of Communicative Action* (Habermas, 1984; Habermas, 1987), *Cultural-Historic Activity Theory* (Vygotsky, 1986) and the *Theory of Planned Behaviour* (Ajzen, 1991), are all of a sociological and behavioural nature. Finally, research sub-questions, hypotheses and propositions are developed from these theories.

4. **Methodologies:** This chapter describes the methods used to collect data to answer the salient research questions.

5. **Analysis of data:** This chapter reports the results of applying analysis techniques to the data collected with the methodology.

6. **Conclusions and implications:** The final chapter uses the analysis to draw conclusions about the salient research questions, relating them back to the body of knowledge to infer implications for theory, policy and practice.

In summary, this chapter began by arguing the rationale for this research project. It introduced the research problem, research issues and contributions. Then the research was justified and its methodology briefly described and justified. Finally, definitions were presented, limitations given and the structure of the thesis was outlined. On this rationale, the thesis continues with Phase I of the research, the iterative development of the experimental treatments.

PHASE I

2 EXPLORATORY RESEARCH AND TREATMENT DEVELOPMENT

2. 1 Introduction

In order to arrive at a point where this study had a set of treatments to use in its quasi-experimental design, a considerable amount of analysis, experimentation, testing and reflection had already occurred. This chapter provides a condensed, reflective account of the key iterations that occurred in the design and development of these treatments, namely the video clips and the websites. However, the emphasis in Phase I was on applied research, with timely discovery and practical decision-making through iteration rather than formal validity and rigour, which occurs in Phase II.

This chapter begins with a description of the methods employed. It then discusses the problem of bias, revealing the researcher's background, sources of potential bias, and the methods employed deal them. Next, the farming and institutional context is introduced. This is followed by a description of each of the key iterations in the design and development of the treatments. Finally, the conclusions and implications for Phase II are presented.

The approach taken in this chapter can be justified on the grounds that the steps taken to develop the treatments are not self-evident and the prerequisite skills are uncommon to agricultural researchers working in this field. This is consistent with Perry (1998, p. 29) who recommends that authors provide enough detail '*for a reasonably knowledgeable colleague to repeat the data collection and analysis*'.

2. 2 Methods

The methods employed in the development of the treatments were a combination of iterative *Agile* development procedures with exploratory research techniques. Agile development has broad similarities to grounded theory and participatory action research. That is, rather than conducting a literature review and attempt to plan everything up front, iterative design focuses on building and deploying working prototypes that enable key functionality to be tested within each iteration; feedback and analysis from which is used to inform subsequent iterations. However, given that the video clips and website being developed were intended to be used as experimental treatments in a quasi social science experiment, exploratory research techniques were added to strengthen the rigor of this approach.

2.2.1 Agile development procedures

Agile development is a movement that evolved out of a need for rapid change when business software developers were confronted with the rapidly evolving expectations of the emerging Internet revolution. The Agile approach is a radical departure from the slow lumbering *big planning upfront* methodologies that typified pre-internet software development. Instead, Agile development provides speed and flexibility by focusing on collaboration, '*adaptability over predictability*', the judgment of individuals over formal processed, and a bare minimum of methodological overhead (Highsmith, 2002). These points are summarized in the *Manifesto for Agile Software Development*, which was developed by the founding members of the movement. This manifesto declares that:

> *We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:*
>
> ***Individuals and interactions*** *over processes and tools*
>
> ***Working software*** *over comprehensive documentation*
>
> ***Customer collaboration*** *over contract negotiation*

> ***Responding to change*** *over following a plan*
>
> *That is, while there is value in the items on the right, we value the items on the left more. (Highsmith 2002, p. vii)*

Agile development usually involves creative teams, so some procedures, like paring members to solve problems together, were unsuitable for a team consisting of one individual, i.e. this researcher. Nevertheless, the three focal points of Agile development – namely people, relationships, and uncertainty – and the general principals that stem from them, were applied to this development project. A description of each follows.

Rapid delivery of working prototypes - In this context, prototypes were either new website features and functionality or new video clips, experimenting with different communications styles or content design strategies. These prototypes were created in a compressed timeframe of one to four weeks. The goal in each iteration was to maintain a functioning website containing content with minimal errors even if some functionality was missing. Likewise, video clips needed to be of a high technical standard, even if the depth of information provided by them was incomplete.

Welcoming changes and adapting to uncertain requirements - In the case of the website, an object orientated model-view-controller architecture was used. This architecture decouples the *view* elements, like the user interface, which were likely to change rapidly, from the *controller* elements, like modular units of logic and functionality, which were less likely to change. Both of which were decoupled from the *model* elements, like the object relational database, used to store and retrieve data, which was very slow to change.

In the case of the video clips, adaptation involves trying to capture subject matter with as many camera angles as possible to encourage experimentation. This allows different material from the same recording session to be assembled together in different ways to create different perspectives of the same event.

Close, co-operation between the developer and end users - The working prototypes, website and video clips, from each iteration were presented to farmers, extension staff, technical officers, researchers, policy officers, managers and rural consultants, to gauge their opinions and seek feedback.

Regular face-to-face conversations - The developer, this researcher, was embedded within the institutional and farming context. He had an office at the QPIF Bundaberg Research Station, so he was in daily contact with extension staff, technical officers, researchers and farm staff. He was also in regular contact with farmers, policy officers, managers and rural consultants.

Continuous attention to technical excellence and good design - This researcher had 20 years of experience which covered the disciplines of journalism, graphic design, audio visual production, website design and software development. This background provided a broad range of skills and experience to produce the website and video clips with technical finesse and high production values.

Simplicity - This stems from a process known as refactoring, where hindsight gained from solving problems, is applied to existing work products to see if alternative approaches can improve their design. One of the prerequisites of refactoring, is being emotionally prepared to throw '*stuff*' away in order to arrive at more elegant, straightforward and simple solutions.

2.2.2 Exploratory research techniques

In addition to following Agile development procedures, each iteration combined exploratory research techniques (Green *et al*., 1988). The purpose of the exploratory research was to identify problems, formulate relevant variables and consider alternate courses of action. The exploratory techniques employed by this study were:

- the examination of analogous situations;

- obtaining information from knowledgeable persons, and;
- searching secondary sources.

One of the key objectives of exploratory studies, which makes them compatible with agile development is the goal of flexibility and ad-hoc versatility. That is, letting the research go where the data takes it. As such, these exploratory techniques were applied to iterations as needed, and on an ad-hoc basis.

Examination of analogous situations - Analogous situations reveal what can be learned about the problems being solved and its variables. An example of an analogous situation used here, was to video and analyse farmer interactions on a bus tour, rather than attempting to observe farmers-to-farmer learning on individual farms. In another example, subjects where observed watching video clips to gauge their involuntary emotional reactions to elements within the video clips.

Obtaining information from knowledgeable persons – This procedure is simply to identify competent, articulate individuals and talk to them about the problem. Information is obtained from unstructured conversations with well-informed persons in the subject matter under investigation. A *referral* sample is frequently employed, where subjects suggest other people who may be able to provide further information.

Search of secondary sources - This is roughly equivalent to a mini literature review, however information may be drawn from less scientifically rigorous sources.

2.2.3 Sources of bias and mitigation strategies employed

In social science research involving human subjects, the realism paradigm asserts that it is impossible to isolate the personal biases and subjectivity of the researcher from the observations they make. Instead, the researcher needs to critically reflect on their background and experiences along with the social and institutional context in which their

research is conducted. The researcher needs to account for the effect of their personality and presence has on their interactions with subjects and the researcher's interpretation of responses (Mauthner & Doucet, 2003). With this in mind, this section provides a frank description of the principal research instrument in this study, this researcher.

The researcher can be described as a white, Australian, private school educated, forty-something, middle-class, married male, who is polite, well spoken and affable. He is also able to confidently make the acquaintance of strangers and be personable.

He experienced farm life first-hand as a child, spending many holidays on his grandparents farm near Junee in southern New South Wales. From this experience, he formed a deep attachment to the land through somewhat bucolic and romantic memories of a carefree childhood spent in wide-open spaces, riding horses, driving tractors and working sheep with dogs. In the late 1980's, his grandparents farm was sold when his grandfather died. A few years later, his farther purchased a sugarcane farm near Bundaberg, on the central coast of Queensland. At first, sugarcane had none of the attractions of the farming he had experienced as a child. Sugarcane farms are much smaller, and every square metre of productive soil is generally under some form of cultivation. There are no animals. However, impressive fleets of machines dominate sugarcane production. These include tractors, implements, harvesters, haul-outs and transportation infrastructure, like transfer sidings and narrow gauge railways, all of which have a unique charm of their own.

The researcher received his bachelors degree in visual arts, majoring in film and television production in 1988, from the Alexander Mackey School, which was to become the visual arts campus of the University of New South Wales. Straight out of university, he was hired as a graphics artist and 3D animator by a US based computer game company. By 1995, he had moved to California's Silicon Valley where he spent the next eight years working as a software developer and founder of several high-tech start-ups. In 2003, after the dot-com

meltdown, he and his wife returned to Australia to start a family together and live closer to their parents and siblings.

During the course of this research project, Queensland Primary Industries and Fisheries (QPIF) hired the researcher on a part time basis as a principal policy officer. His role was to develop a business plan to guide the modernisation of service delivery across the department. This unfortunately turned out to be a frustrating project, because of considerable internal resistance and structural inertia, which proved difficult to overcome.

Throughout his career working for high-tech start-ups in Silicon Valley, the researcher had witnessed the transformative effects entrepreneurial business that leveraged innovative software systems. From this he had formed the somewhat utopian view that sustainable competitive advantage came from hiring the best and brightest minds, incentivising multi-disciplinary teams of highly skilled individuals, encoding the core competencies of businesses into software systems, and using networks to connect these business processes to customers and suppliers. All of this, he believed, combined to build compelling value propositions, which were the foundation of successful enterprises. Henry's experience working with the department, and Agriculture more generally challenged this view. Not every problem can be solved with innovative software.

At QPIF, the researcher witnessed a clash of cultures between divergent thinking and the desire for transformative change on the on hand, and a strict adherence to policies, procedures, and an aversion to risk on the other. Structural inertia stemmed from the significant challenges managers were confronting. Their department was contracting, budgets were being cut, and they had to make unpalatable decisions about employment contracts that were not going to be renewed. Staff were stripped of resources in preference to laying off employees, research stations were closed, and many projects were critically under funded. Despite the passion contract staff had for the work they were doing, many felt like

second-class citizens, never to be afforded the same personal development opportunities and job security that their more senior tenured peers had enjoyed.

After about 6 months working part time for the department, the service delivery modernisation project was abandoned due to a lack of funding as priorities shifted with the announcement that QPIF would be merged into the Department of Employment, Economic Development and Innovation (DEEDI).

Personal biases

Reflecting on potential sources of personal bias, this researcher makes the following observations. He is more suited to working as a change agent with smaller dynamic and entrepreneurial businesses than large mature institutions. He prefers flexible solutions that address needs of individual people over standardized, homogeneous processes and procedures. He favours applied research. He finds the innovations and practical solutions developed by farmers personally interesting. He favours social equity. He is of the view that successful outcomes are important, providing an influential catalyst for change.

Strategies for managing bias

Two strategies were employed during this research to overcome personal bias. The first strategy comes from the researcher acknowledging their preconceptions and preferences and being reflexive (Cecez-Kecmanovic, 2001). This is accomplished in the following way. The researcher may have positive or negative emotional reactions to subjects and their statements. These may stem from similar or opposing belief systems and attitudes. The researcher needs to sense these emotions and be aware of their potential to influence subjects and take steps to prevent or counteract their influence. For instance, during an interview, the researcher needs to encourage subjects to speak openly and freely yet remain dispassionate towards the statements made, while at the same time being empathetic to the subjects need for affirmation.

The second strategy is to consider the outcome that the researcher may expect will occur or might whish to occur. The researcher should then deliberately look for evidence of cases that potentially contradict this outcome.

In conclusion, while it is impossible to completely isolate the influence of the researcher in social science research, in this study, a combination of bias disclosure, reflexivity and seeking outlying cases was used to mitigate the potential impacts of these influences.

2. 3 The farming and institutional context

Sugarcane farmers are presently confronted by three main issues:

1. declining farm incomes in the face of an aging population of farmers;

2. yield decline and the transition to more sustainable farming practices; and,

3. the imposition of state regulations to improve the quality of water leaving cane fields and entering the great barrier reef lagoon (The State of Queensland and Commonwealth of Australia, 2003; The State of Queensland and Commonwealth of Australia, 2009).

Of these issues, the one most relevant to this study was sugarcane yield decline. One of the unintended consequences of industry deregulation was that the area of cane under production was no longer assigned by mills. Traditionally one fifth of a farm's productive area was assigned to fallow each year. Sugarcane is like a grass, and re-grows after it is harvested. Each successive crop is called a ratoon, and as these ratoons get older, their productivity eventually decreases. Traditionally after the 4^{th} ratoon, the crop was ploughed out, left fallow for a year and re-planted. However, after deregulation, farmers were able to plough-out and replant without a fallow, and in doing so increase their income. However, over time this continuous monoculture of sugarcane lead to an increase in soil born pathogens that lead to yield decline across the industry.

Research was undertaken by the Sugar Yield Decline Joint Venture (SYDJV) to address this industry problem, which lead to four farming practices being recommended: green cane trash blanket, controlled traffic, minimum till and legume break crops (Garside *et al*., 2005). Research demonstrated that this combination of practices, improved soil health, soil structure and drainage. Minimum till also reduced the number of tillage operations, saving fuel and labour hours but required a higher capital investments with increased financing costs. Perhaps most controversial was that sugarcane productivity under the new system did not increase significantly. Nevertheless, the '*new farming system*' as it is known was accepted by many farmers, who believed that the system improved the resilience of sugarcane crops to adverse weather events – flooding and drought – reducing the overall risk of losses over entire cropping cycles.

In 2007, the federal government provided financial incentives through a program called Reef Rescue to incentivise farmers to adopt best practices, including elements of the '*new farming system*', because it was believed that the substantial switching costs were limiting uptake. In 2010, the Queensland state government introduced Reef Plan, a set of regulations that require farmers to adopt many of these best practices in order to reduce nutrients, pesticides and sediment in runoff from leaving farms, and entering catchments that lead into the Great Barrier Reef Lagoon (The State of Queensland and Commonwealth of Australia, 2009).

This farming and institutional context influenced the subject matter of the video clip treatments developed for this study. 'Best practice' approaches were chosen to assist farmers in changing practices as prescribed by both the SYDJV research and reef regulations.

2. 4 Critical reflections on each iteration

This section provides a narrative to describe how the video clips and website were created. This account is a summary of a larger diary of events, which has been paired down through self-reflection to reveal the key lessons learned and the significant activities from which these insights were gained.

2.4.1 Inception

This research project began life as a Masters research project, investigating how systems software and the Internet might be used to improve the decision making of farmers. At the time, the researcher had a strong desire to apply the skills and knowledge he had gained from a successful career as a software developer in Silicon Valley, and make a contribution in some way to agriculture. He had experienced the intense competition amongst very bright people chasing after similar business ideas in Silicon Valley, and believed that the needs of agriculture had largely been ignored, and under served.

However, a critical review of the history of decision support software in Agriculture revealed that most Decision Support System (DSS) projects failed (Botha & Atkins, 2006; Matthews *et al*., 2008; McCown, 2002; McCown *et al*., 2006; McCown *et al*., 2002; McCown & Parton, 2006). Numerous reasons were given for why this happened, but the view of this researcher was that they were mostly the result of business failure. That is, most DSS projects simply didn't have a strong enough business case to be financially sustainable beyond the initial funding of their development. DSS software simply doesn't have a compelling enough value proposition to command the premium it needs from individual farmers to pay for ongoing maintenance because the user base of interested farmers is so limited.

This limited utility of the DSS can be explained by *Chasm* theory (detailed later in Section 3.2.2). The adoption of innovations by different groups within the adoption lifecycle is predicated on specific types of evidence. As such, a DSS may only ever be an appropriate source of information for *Innovators*, who are willing to make a bet on the economic potential, but need evidence that the innovation works in an operational setting. Likewise, an economic analysis tool may only find a limited audience with *Early Adopters* who are looking for evidence of the economic benefits. Neither tool would likely find a strong

interest among the *Early Majority* because they require different sources of evidence than either tools would be able to provide.

This historic failure of DSS was the genesis of the present investigation. The report by Brennan *et al*. (2007) was particularly relevant. Farmers were having trouble choosing an appropriate winter wheat variety based on their soil moisture bank and the likelihood of future rain, because the relationship between these inputs, the risk of a crop failure and the potential yield was counterintuitive. A computer model was used to help make a selection. A website was developed as a simple interface to the computer model, and regional agribusinesses were trained to assist farmers with the service. The expectation was that farmers would use a fee-for-service model in successive seasons to schedule their planting operations and variety selection. What actually happened was quite unexpected. Farmers shared their experiences with each other and within three years, developed an intuitive understanding of the relationships between the inputs and outcomes, so much so, they no longer believed that they needed the simulation model to make their planting decisions.

Brennan et al.'s (2007) account indicates that learning interactions between farmers are extremely powerful. Thus, the degree to which these exchanges could be captured and communicated via electronic means, like online video was worthy of further investigation. Thus, having ruled out DSS as an unpromising avenue of doctoral research, it followed that these farmer-to-farmer exchanges might be facilitated online by social media technologies like YouTube, which lead to the following review of previous video use in agriculture.

Previous use of video in agricultural extension

The use of video in agricultural extension is by no means a new idea. The Digital Green project in India (Gandhi *et al*., 2007) found a participatory video extension program, that is locally based, to be highly effective in transferring knowledge in a cultural environment where social stratification has disadvantaged poorer marginal farmers. While aspects of this study's finding may be specific to the culture of rural India, it is clear that video of on-farm

demonstrations and farmer experiences are a preferred form of content. Gandhi *et al*. (2007) specifically enumerate themes and report that video clips relating to innovations, demonstrations, testimonials, concepts, mistakes, new farmers, showcases, cost-benefit analysis and entrepreneurship are preferred to video clips of lectures and events. The Digital Green project emphasised targeting content design to the specific attributes of each local community with great success; 85% of farmers in the target communities adopted at least one new agricultural practice shown in the videos, whereas only 11% of the farmers in the control villages using traditional modes of information delivery did so.

Using a slightly different approach, Polson (1999) reports how an inexpensively produced video of a '*Master dairy farmer*' is created. A team of Ohio researchers and extension providers follow the '*master*' farmer around his operation in a remote area of northern New York State. They quiz him in front of the camera on the various aspects of his highly productive dairy farm. Normally the knowledge acquired from a field trip like this would only reside in the memories of those fortunate enough to attend. However, in this case, the video was taken back and shared with other dairy farmers in Ohio. Polson surveyed 21 of the farmers who borrowed his video over a three-month period, finding that 69% of farmers who watched the video adopted one or more new practices shown in it.

These studies qualify their results by saying *'one or more'* practices from the videos were adopted by farmers. If the goal had been to increase uptake of every practice demonstrated, then the levels of uptake reported would be much lower. However, one has to also consider that farmer information seeking is highly contextualized (Kilpatrick & Rosenblatt, 1998), in which case, causality is contingent on context, so it may be the case that knowledge of many innovations is required before one that is suitable for a specific farming context is identified. Alternatively, Kaine (2008) notes that the overall uptake of agricultural innovations is under-estimated because the expected population of '*potential*' adopters tends to be over-estimated. The reality being that the number of farming contexts for which innovations provide relative

advantage is often quite limited. Nevertheless, neither adoption study provides any theoretical underpinning to the pedagogical processes involved.

Video has also been used in farmer education. For instance video conferencing, commonly used in distance learning, has also been trailed as an alternative to face-to-face teaching in workshops (Brown & Bewsell, 2009). However, presenters found it difficult to transition from face-to-face teaching to delivering lessons via video conferencing. For instance, translating hands-on, in-the-paddock exercises into a format suitable for distance learning was difficult. It required a careful redesign of the resources and procedures to ensure that remote students received the same benefits from participating in exercises as those students who participated in person.

In a study that compared the use of a training video to face-to-face group training, Oladele (2008) reports that farmers rated the training-video higher in terms of its adequacy as a means of disseminating information. In addition, the knowledge gained amongst the video-taught group of farmers was higher, with mastery of the subject achieved by the third viewing of the video. Oladele concludes that training videos provide a viable alternative to group training and recommends the use of video to alleviate problems with low extension agent to farmer ratios. With the video, farmers were able to learn at their own pace and watch the video as many times as needed. However, Oladele also believes that extension agent contact with farmers is still necessary in order to answer questions and clarify details. David and Asamoah (2011) achieve similar outcomes, noting that video is an effective and relatively low cost training method which can transfer knowledge, information and skills on complex technical subjects to farmers where literacy and numeracy barriers would otherwise be a problem.

Another particularly relevant application in developing countries is where video is used to facilitate Participatory Innovation Development (Waters-Bayer & Van Veldhuizen, 2004). In this regard, Van Mele (2006) emphasises that context-specificity is critical to the diffusion of

practices via video. Perhaps more interesting are Van Mele's observations that the participatory video production process changed attitudes among research and development actors towards the value of local farmers' knowledge. In these accounts, western R&D agents, tasked with helping farmers in developing countries improve cultural practices, used video and mass media to communicate innovations across regions to effect change (Chowdhury *et al*., 2011; Van Mele, 2006; Van Mele, 2011; Zossou *et al*., 2009). After producing the videos, researchers began using farmers' highly-situated concepts and innovations when explaining these practices to other communities.

Of most concern are approaches like that of Scientific Animations Without Borders (Bello-Bravo *et al*., 2011), where a technology centric solution is being promoted because of a large list of perceived benefits from the perspective of its content creators. Here local farmer participation is replaced by 3D computer animations featuring western looking characters that prescribe generic solutions to common problems faced by farmers in developing countries. The video clips are designed with the expectation that they will be viewed on mobile phones. The principal benefit of this approach appears to be that translations to multiple foreign languages are easier and less costly to produce. However, there is no evaluation data provided to support the assertion that this approach is effective.

An Australian example is *Web on Wednesdays*, a well-known (James, 2009) weekly video webcast produced by Cotton Seed Distributors[3]. While no evaluation data is available about this project, from this researcher's investigations, the video clips generally consist of an interview with a researcher, technician or consultant, and feature a 'talking head' style interview with a single tripod mounted camera using the on-camera microphone. They have limited editing, and suffer from poor sound quality and a lack of descriptive shots to illustrate the topics being discussed. Nevertheless, they have been produced on a weekly

[3] Web on Wednesdays can be viewed at http://www.csd.net.au/wow/list

basis for many years, so high quality '*production values*' may have made these video clips too time consuming and costly to produce. Judging by the publicly available statistics, they appear to attract a regular subscriber base of a few hundred farmers.

An example of video use outside of Agriculture is the Journal of Visualized Experiments (JoVE)[4], which claims to be the first peer reviewed, PubMed indexed video journal. The journal was established to improve the understanding and efficient reproduction of experimental research techniques by using video technology to capture and communicate the multifaceted intricacies of highly specialised life science research disciplines. This visual presentation of experimental processes and procedures was established to address problems with inefficient skills transfer and poor reproducibility of results in biological, medical, chemical and physical experiments. At the time of writing, the journal features over 1,500 published video clip articles.

In terms of production techniques, Miller and Honeyman (1994) found that farmer participation in video content design was a key determinant of its effectiveness. Lunch (2004) takes this one step further, training local groups to direct and film their own messages, which are shown at nightly public screenings to the wider community, setting in motion dynamic exchanges of ideas which challenge commonly held perceptions. Van Mele (2006) also reports that group discussions following video presentations increase their impact. Despite advocating for farmer participation, Miller (1997) emphasises that content designers not underestimate the importance of quality and clear communication. Anderson *et al*. (2001) also raise the importance of production values, recommending the use of professional production techniques by noting that poor quality is distracting for the viewer. This is a view supported by Everard and Galletta (2005) who demonstrate that presentation

[4] Journal of Visualized Experiments can be viewed at http://www.jove.com

flaws influence perceptions of trustworthiness and credibility when information is communicated online.

In summary, the results reported by Gandhi *et al*. (2007) and Polson (1999) were impressive, however the absence of any theoretically and empirically founded understanding of how and why these techniques worked provided a fertile avenue for further research to confirm their suitability for technology transfer. For instance, being highly mechanised, the Australian sugar industry is a substantial purchaser of industrial technologies like controlled traffic, GPS guidance, minimum till, and precision applicators for nutrients and pesticides. These technologies can be highly technical and capital intensive. As a result, their adoption requires a sophisticated investment decision that must balance financial risks against perceived benefits and the likelihood of their realisation (Hardaker & Lien, 2005). The question is whether techniques like Polson's (1999) could facilitate the adoption of new technologies and practices where complex financial decision-making processes are involved.

2.4.2 How people learned new skills watching YouTube videos

Before deciding to create the first farmer-to-farmer video clips, it seemed prudent to examine how everyday people were using YouTube to learn new skills. Opinions were sought from persons who had used YouTube to learn something new in this way. The approach used was to examine the videos they found most and least helpful, and see if patterns in the different presentation styles used could be identified. Three subjects were informally interviewed.

The first person, who enjoyed cooking recreationally, had used YouTube to learn how to bake Amaretti (almond macaroons). This person regularly traded links to recipes with friends via email, so she was able to provide links to several videos, rating them from worst to best. An examination of these videos revealed the attributes that were rated most poorly were when the presenter stated the obvious – like '*you need a mixing bowl*' – while overlooking significant details. They also wasted time on long introductions rather than '*just getting on*

with it'. Interestingly, some of these poorly rated videos were, from a technical stand point, well produced, and some even had relatively high view counts on YouTube. In the ambivalent category were useful recipes that were let down because they communicated steps using text overlays rather than a narrator, meaning they required ones undivided attention in order to follow the instructions. The best video clip actually had poor audio quality and shaky handheld camera work, but was short and concise, used text overlays for the measurement of ingredients and cut away shots to close-ups of each step. It also spent a considerable amount of time showing how the eggs whites were whisked as they were heated to an exact temperature using a thermometer by sitting the mixing bowl over a pot of boiling water on the stove.

The second person had used YouTube to learn how to surf. The video clips he liked the most were short and well produced, presenting one lesson per clip. They had a narrator, and jumped straight into the action, using close-ups, slow motion and freeze frames to explain the steps, which were often repeated from several different camera angels. Other videos he found helpful were amateur video clips without narration, which simply captured the movement of interest and repeated it several times with successively slower frame rates.

The third person, a kitesurfer, had used YouTube to learn new kite surfing tricks. The video clips he disliked the most were ones that advertised DVDs. They often had high rankings, nice looking thumbnail pictures, and misleading titles, providing no indication that they contained an advertisement for a DVD. The kitesurfer found this irritating because he accessed the Internet from an Internet Café, so every video that wasn't what he was looking for, was a waste of time and money. He and his friends would share links to video clips they liked using a Facebook channel set up for their kitesurfing group. When he found an amateur video clip of a technique he was interested in learning, he would download the video clip to a flash drive and use a video player on his laptop to step through the frames one at a time to analyze the timing of actions involved in the technique.

Vicarious learning

Many attributes of learning processes described above can be classified as vicarious learning. In vicarious learning, the person being observed serves as a role model for others to emulate (Gioia & Manz, 1985). By observing a role model in action, the observer gains an understanding of the behaviours and judgments needed to reproduce an observed outcome. Thus, rather than learning what to do through trial and error, the observer models their own behaviour on the actions and judgments of the role models who's outcomes they aspire to reproduce (Bundura, 1977). This is what makes vicarious learning a more efficient mechanism than self-experience (Manz & Sims Jr., 1981), because it can transfer knowledge, practices and skills from person to person.

Before preceding further it is important to note that the theories just mentioned, while closely related, are described by their authors differently. The different names attributed to these theories include vicarious learning, observational learning, social learning and modelling. While social learning is probably the most apt of these descriptions, there is some controversy as to what this term is understood to mean (Koutsouris & Papadopoulos, 2003). Given that this study is interested in how these theories relate to observation of others via video, rather than through two-way interactions, the term vicarious learning was chosen to encompass the relevant aspects of these related theories.

There are four steps that occur in the modelling process described above, which together effect vicarious learning outcomes (Bundura, 1986). In simple terms, these are:

- **Attention -** People must pay attention to the model in order to learn from it. Attention can be influenced by the characteristics of the model. For instance, the model could be particularly attractive, competent or powerful. Alternatively, the model may possess individual qualities that exemplify aspirations common amongst observers.
- **Retention -** People must be able to recall what they were paying attention to. This is where observation and listening come into play (Cox *et al*., 1999). People form mental

images and verbal descriptions in the process of remembering what they saw the model doing. These images and descriptions are later recalled when the behaviour is reproduced.

- **Reproduction -** People must be able to translate the images and descriptions into actions in order to reproduce the model's behaviour. However, these actions do not have to physically occur, they can be imagined, much like the way athletes visualise a performance prior to performing it.
- **Motivation and opportunity -** People will not reproduce the behaviour unless they are sufficiently motivated and have the opportunity to do so. Bundura (1986) suggests several different motivations:
    - *past reinforcement* – people are motivated to imitate the behaviour because they were rewarded last time they did something similar;
    - *promised reinforcements* – people are motivated to imitate the behaviour by the promise of a future reward; and,
    - *vicarious reinforcement* – people are motivated to imitate the behaviour because they observed the model being rewarded for it.

While these steps occur in the observer, it is clear that the audiovisual design of video clips can potentially influence the effectiveness of vicarious learning outcomes. That is, effectively designed video clips could work to strengthen these attributes. The case histories of YouTube learners presented above, provide clues as to how these attributes might be strengthened.

Attention can be strengthened by focusing on a single topic, wasting as little time as possible getting to the information that the observer is most interested. Thus, obvious information that is redundant or self-evident should be avoided, as well as formalities like long introductions. The expertise of presenters was also highly ranked by YouTube learners.

However, it was not only the presenter's expertise in what they did or how they did it, but also how effectively the behaviours and judgments that were needed to reproduce the desired outcomes were conveyed that was valued.

Retention can be strengthened by ensuring that the critical details that the learner is interested in observing are covered in the content design. This involves the use of camera angles like wide shots to contextualize where the action is taking place, and close-ups of important details. Temporal techniques like slow-motion and freeze frames are also useful in circumstances where a complex sequence of actions occurs in rapid succession. All of these details help the observer retain the information they have observed.

Reproduction can be strengthened by providing multiple perspectives to strengthen viewers understanding the information presented, so as to essentially triangulate the communication of meaning. This includes the presenter describing what is happening, cut-away shots that illustrating what is being said, as well potentially providing abstractions of the key concepts though the use of diagrams or text overlays.

Motivation can be strengthened by ensuring that the rewards that motivate the presenter are conveyed to the observer. For instance, in the case of the preferred Amaretti video clip, the chef presenting the recipe described the attributes of the biscuit they liked, and showed a cutaway close-up of the inside of the biscuit after they had taken a bite out of one that had been freshly baked.

Differences between YouTube clips and training videos

The conventional approach to designing instructional videos is fondly referred to as '*The three Ts*' (Stinson, 2003), these are (1) *tell 'em what you're going to tell 'em*; (2) *tell 'em*; and (3) *tell 'em what you just told 'em*. However, when video is embedded in a website, the website's navigation structure and page organization supplants that of the video. In effect any internal structure within the video is subordinate to the website, and as such becomes

redundant. The passive viewing style that is typical when watching an instructional video is replaced with an active, goal-based interaction style where the user previews and abandons video clips as they search for content of interest (Christensen, 2007). As a result, the design requirements of video clips used on websites are going to be different to traditional instructional videos. As we have seen, the favoured instructional video clips were short and focused; where each one communicated a single narrative or idea. For instance, in a website containing instructional videos of recipes, it would be more logical and useful to have one recipe per video clip, than multiple recipes in a single video clip.

In an exhaustive review of practical research in this field, Park and Hopkins (1992) identify six instructional conditions under which *dynamic visual displays* (a definition which includes video) are effective. These conditions are:

- '*demonstrating sequential actions in a procedural task*';
- '*simulating causal models of complex system behaviours*';
- '*explicitly representing invisible system functions and behaviours*';
- '*illustrating a task which is difficult to describe verbally*';
- '*providing a visual analogy for an abstract and symbolic concept*'; and,
- '*obtaining attention focused on specific tasks or presentation displays*'.

  (Park & Hopkins, 1992, pp. 443-444)

There are similarities between some of these items, particularly items one and four, and attributes of the prefered YouTube video clips described earlier, which provides some theoretical and empirical support for why these attributes were considered effective.

Creating the first video clips

The next step was to design video clips using the elements identified in the YouTube instructional videos. These first video clips covered presentations given by farmers on a

multi-farm field trip. Each farmer presentation from this field trip was edited together into an individual clip. Each clip was about three minutes in duration.

Technical Details: The presentations were given in paddocks and sheds, and were essentially off-the-cuff. A portable Public Address (PA) system had been used to amplify each presentation. To get an audio recording, a wireless microphone, with a low gain setting, was placed against the PA speaker. The wireless receiver was connected to the audio input on the camcorder. This allowed the videographer (this researcher), to be able to roam about freely during each presentation without any concern that the audio recording would be compromised. A range of different camera angles were recorded, including the presenter talking, the crowed reacting, close ups of implements being presented and the crops on which these implements had been used.

What was interesting to this researcher was that the farmers giving the presentations often repeated themselves, essentially saying the same thing in different ways, several times over. This actually made the process of editing the material together easier. It was like having several takes (a film term meaning multiple recorded versions) of the same event and being able to choose the take where a particular idea was expressed the best. This turned out to be a common feature of farmer interviews. Speaking off-the-cuff, farmers being interviewed would regularly rephrase and restate the same concept several times in different ways.

Proof-of-concept

Two weeks after proposing the idea of using video to facilitate farmer-to-farmer learning, this researcher had designed and deployed a proof-of-concept website which included the video clips from the field trip. This reveals an important characteristic of this researcher, an unusually diverse technical skill set. In many respects, these skills stem from starting his career as a software developer in the computer game industry, at a time before the advent of off-the-shelf computer game engines, when animated 3D graphics required programming skills, which were largely self-taught. In those days, computer game developers had to be

able to program just about anything, from the user interface, to simulations, asset management, statistics, real-time audio, animation and special effects; along with their optimisation in machine code. As a result, software developers from this era believe they can program just about anything given enough time and resources. Another characteristic revealed about this researcher is an almost paranoid sense of urgency, which came from working in Silicon Valley during the heydays of the dot-com era.

2.4.3 Observations of farmer-to-farmer learning interactions

Rather fortuitously, the raw video of the multi-farm field trip also managed to capture the interactions of farmers participating in farmer-to-farmer learning exchanges. The following is a brief description of these interactions.

On the field trip, at each stop, the farm owner gave a presentation. The theme of these presentations was minimum till farming practices. Each talk would run for about ten minutes, and sometimes a local extension agent would give a follow-up talk on what the farmer had done. Reviewing the video, this researcher observed that the presentation would begin with the audience tightly grouped around the presenter, however by the end of each presentation, the audience members would have broken off into small groups to look at the machinery and implements that were being discussed. Some farmers in the audience would then engage in a dialogue with the presenter to clarify the meaning of statements that had been made, while other farmers simply stood around and watched this discourse. The majority of farmers however, would be mulling around in small groups looking at things of interest and discussing them.

In the process of documenting these events, conversations amongst farmers in these groups were also videoed. Typically, one farmer would be conveying their understanding of how they believed something worked to the group. Other farmers in the group would contribute to this shared understanding by following up with their own thoughts on the matter. From the

perspective of adult learning theory, and in particular self-directed learning, these observed conversations can be classified as *dialogic learning* (Mezirow, 1985).

Below is an example of one of these conversations, where a farmer is explaining to a group of four other farmers how he thinks various components of a customised precision planter work. On this particular type of planter, each seed dispenser used a pair of small plough discs in a wedge configuration, known as double disc openers, to cut a furrow in the soil. Behind the openers were press wheels, fill-in discs and covering rakes. What you don't see in this transcript is the hand gestures that the farmer used as he spoke. He not only touched and manipulated several of the components, he also used gestures to simulate the path of the seed and the motion of the soil as flowed around and though these components.

> *[POINTING TO DOUBLE DISK OPENERS ON A MINIMUM TILL PLANTER]*
> *…keeps the seed in the furrow, if its… harder ground the seed will run in there and bounce. [FORMING A 'V' WITH HIS FINGERS TO SIMULATE THE FURROW] Some of them bounces out of the furrow, so they got that there [POINTING TO A NYLON WIPER] so I think that keeps it in the furrow. Then you get the press wheels, and then they hill it up a little bit? I see they've got these little um covering rakes. [CHORUS] Hmm.. Hmm.. [THE OTHER FARMERS NOD IN AGREEMENT]*

These fragments of conversations were videotaped as a by-product of covering the event, so obviously many more conversations took place than those that were captured by the roaming camera. Nevertheless, seven conversation fragments that were recorded, and they all exhibited similar attributes common to dialogic learning. That is, individuals within these groups, or *learning circles*, would convey their perspective of how and in what circumstances something worked to the other members of the group, and together they would build a shared understanding. Sometimes this would involve other members asking follow-up questions or making comments to clarify the meaning of statements that were

made; all the time, participants in the group were essentially learning by observing and listening to the conversations taking place.

While the goal of these conversations appeared to be a shared understanding of how and under what circumstances members believed a particular component or process worked, the farmers were not arguing different perspectives to arrive at single *truth* or correct way of doing things. Thus, this discourse did not appear to be dialectical in the classic sense. While individuals within the group may have been internally processing this information to decide whether a particular component or process was suitable for their particular farm (Mezirow, 2003), the function of the group appeared to be the sharing of multiple perspectives. This was done with a view of understanding the broad range of contexts in which members believed particular components and processes worked effectively. Communication was also highly nuanced, involving gestures, body language and facial expressions in combination with vocal utterances.

This form of dialogic learning fits squarely with the social constructivist theory of education, which believes that understanding is constructed by people, as they work together solving the problems they encounter in the course of participating in joint activity systems (Wells, 2000).

These observations raise an interesting question. On the face of it, watching video clips as discussed earlier, would appear to be a vicarious learning process. However, it can also be argued that it is dialogic, because the video clips portray a discourse between the interviewer and the interviewee. Here, the video maker cogently assembles elements to form a logical narrative to convey a shared understanding with their audience. This may involve all the elements that were observed in these interactions between farmers, like critically reflecting on statements made and asking questions for clarification, as well as providing numerous individual perspectives from different subjects.

Why some presentation styles are more interesting than others

Having analysed the fragments of conversations that were videoed as by-product of covering the multi-farm field trip, lets now consider the actual video clips that were produced. Their presentation style turned out to be less engaging than direct-to-camera testimonials. In hindsight, this is not surprising, given Gandhi et al's (2007) results that show video clips of events were found to be less favourable by farmers.

At the time, a local researcher, experienced in extension, asked to be videoed. He was conducting several trials for the sugar industry, and felt it would be prudent to document each stage of his research project, so that later, when he had results, he could refer back to earlier activities that had taken place using these videos in his presentations. In the process, we decided to produce several video clips that explained some research findings from projects he had already completed. Unlike the multi-farm fled trip where the presenter was talking with a microphone and PA system to an audience of about 40 farmers, the local researcher was on his own, and spoke directly to the camera. Once again, multiple camera angles were used, including close-ups of implements, however this time, close-ups of his hands performing actions were staged for the benefit of the camera.

When both sets of video clips were completed and compared to each other, the video clips of the local researcher appeared to work better. QPIF extension staff, asked to comment on these differences, agreed that the local researcher's presentation was tighter, more focused and deliberate, whereas the farmer presentations were less polished. Staging actions to visually illustrate what was being discussed also proved to be more engaging. These were notable differences between the local researcher's video clips and the multi-farm field trip video clips.

2.4.4 Techniques for interviewing farmers

In the previous section, it was noted that the video clips where the local researcher spoke directly to camera were preferred over the field trip video clips where farmers gave presentations to a large audience. The next question to be answered was whether the skill needed create such attention-grabbing video clips resided in the interviewer or the interviewee. That is, could any farmer make a direct-to-camera testimonial or just a subset of farmers who were skilled orators and thus more able to articulate their thoughts clearly to present them well to others?

At this point, it is important to note that direct-to-camera testimonials are a technique commonly associated with infomercials (Hetsroni & Asya, 2002). This is not the style of direct-to-camera testimonial being discussed here. The approach used in this study is more akin to creating a short documentary. In this context, the main difference between the documentary and infomercial is that the documentary maker is not interested in having the farmer *sell* a particular technology or practice change, but is instead interested in capturing a genuine conversation with the farmer where the farmers true thoughts and experiences are captured and conveyed.

Similarities and differences with documentary making

Ira Glass, the presenter of the popular *This American Life* radio program explains the qualities of good documentary stories and how they are obtained in the following excerpt:

> *"A word now about doing documentary stories. [In the background we hear high school kids goofing around in a car after a prom as they get lost looking for a friend's house] When you are doing these kind of stories, this is pretty much exactly the kind of moment that you dream of - everybody is acting the way they act when there is no tape recorder present. It's intimate, its alive, you feel you are hearing these people as they really are, even though there is a tape recorder and a boom*

> *microphone - like a huge one, a foot and a half long, and a stranger. And to get to this kind of point you have to spend hours with these people, get them used to you, get them to the point where they are actually bored with being recorded."*
> *(Glass, 1996)*

Thus, a key element of the documentary making process is that the subject needs to be desensitised to the influence of the documentary maker. This is in many ways similar to social science research, where the researcher attempts to limit the effect of their presence on the human subjects they are studying.

However, while a documentary maker may simply follow a story where it goes as it unfolds, the purpose of these video clips was essentially to act as a proxy for the farmers who would ultimately be watching them. That is, the video clips needed to reflect what a farmer would expect to see and hear if they were present. Thus, the video clip maker needs to play the dual role of the documentary maker and the dialogic learner. As such, they must switch between being a dispassionate observer on the one hand and asking questions to elicit responses on the other. Responses that build meaning to arrive at a shared understanding created from the language, gestures and symbols recorded.

Interview techniques

Through trial and error, as the video clips were being created, a set of interview techniques, discussed below, was found to be useful. This is a summary of a more detailed report by this researcher (Thomas, 2009).

Given the high cost of travelling to a location, and the inconvenience of taking up the farmer's time for an interview, it is important to make the most of every opportunity. Production teams should listen intently to the farmer while they are being interviewed, think about what was said, and then spend most of their time acquiring shots to illustrate the key points being discussed. It is very important to get these shots on the day, because it is often

impossible to come back to videotape something that was missed. This requires a production team to listen intently and think on their feet. It also helps to have a few rules of thumb to guide the process.

Know the subject matter - Invariably, farmers are nervous and often reserved. The job of a production team is to entice a good performance out of them. It all comes down to preparation and the infectiousness of genuine enthusiasm. A production team should make a point to know all they can about each farmer, and they should display genuine interest in what they are there to videotape. Once farmers get over their initial nerves, they generally enjoy having an opportunity to talk about their achievements. The more a production team knows, the more in-depth and interesting these conversations will be. Polson (1999) reported similar experiences videotaping master dairy farmers. However, in his case, he brought along a team of extension agents and specialists to formulate the questions being asked.

Start with demonstrations - Camera fright can generally be avoided if a farmer is asked to demonstrate how something works. This takes their mind off the camera, and once a conversation has started the camera generally won't bother them as much if it points at them for short periods during the interview. It is also generally a good idea to point the camera at something else of interest whenever a new line of questions is started.

This approach was devised during this project, on the first day of production, during the first farm visit, out of desperation, because the approach that was initially used simply wasn't working. What follows is a brief account of what happened:

The production team was visiting a farm in the Burdekin district where a farmer was using piezometers to measure ground water levels and salinity on his property. A team was assembled comprising experts as Polson (1999) suggested, consisting of an agronomist and several extension agents. Vidoeing started with the farmer standing in front of the camera with the piezometer behind him. The crowd of experts, who had assembled behind the camera, began asking the farmer questions. The farmer was very nervous and uncomfortable

standing in front of the camera, and he found it increasingly difficult to answer questions without getting flustered and loosing his chain of thought. After persisting for about five minutes, it became quite obvious to everyone that this approach wasn't going to work. In retrospect, what the experts were doing wrong was asking the farmer questions about why the research they were doing on his farm was important for other farmers, an approach that was never found to work, and should be avoided. The reason, revealed later in this thesis, is because farmers prefer to communicate about innovations using operational detail, not abstractions.

The team decided to take a break while they considered another course of action. What was surprising everyone was that earlier that morning, when the team had assembled in the farmer's shed, they had discussed the project with him and he had spoken articulately and passionately about it. What needed to be done was recreate that moment and capture it on video. So, while everyone was away from the farmer, this researcher (operating the camera) intuitively asked farmer to turn around and just show how he used the piezometer to monitor his ground water levels. Then as he started to open the cover he was asked to explain what he was doing as he did it.

Below is a transcript of that video. While it is evident that the farmer is still nervous, what is surprising is that only a few minutes earlier the farmer had been unable to finish a single sentence.

[FARMER LIFTS CAP OFF PIEZOMETER]

This is one of our pizos we've got installed. Um, this one here has got a logger in it.

[FARMER PULLS THE LOGGER FROM THE PIPE]

And that logger goes down and keeps an eye on the fluctuations in the water. That plugs into the computer and tells us – it could be a month, two months of readings – the fluctuations in water in between when I've read them.

[FARMER PLUGS LOGGER INTO NOTEBOOK COMPUTER]

Yeah, we just let it go through and we put it on the program. And I've got to pop it in, scroll down, hit okay. And then it goes through, gets the data. We then have to reset the data and then take it out. And that's virtually what we've got to do, and then put it back down the hole. That's pretty well right. All the data is stored on our computer then.

[FARMER PICKS UP THE SAMPLING DEVICE ON A MEASURING TAPE]

And then put this gadget down which has got a float inside. It turns on a light and tells me when it's at the right height. And I'll measure it.

[FARMER PLACES DEVICE INTO PIPE AND LOWERS IT DOWN]

I record today's height. Also, the way it's set up, you dunk it a few times and it catches water in the top of it.

[FARMER WINDS UP MEASHING TAPE AND RETRIEVES SAMPLING DEVICE]

Which we put [HE TIPS THE WATER INTO A CUP] so much in there and we check the electro-conductivity of the water and we record it. Yeah, the salt levels of the drain water. And that's basically what we do on a fortnightly… at a time.

[FARMER STANDING IN FRONT OF A RECYCLE PIT]

All my farm water is from a centre headland down both sides. It's all captured, and runs into here, and I use 100% of my recycled water. The only time potentially I do lose water is in a large rain event. All small rain events I catch the water and reuse it. But this amount would keep me about two days in irrigation. Out of this pit, which I capture, I rewater about 40 acres of my farm.

Well as I see it, I come here, I've only been growing about 7 years, and I want to

keep going for a lot longer. I've got young kids. I want to see a future in cane for them. But, yeah, we sort of bought into an area, I don't want to see the area go bad, um and yeah, see us potentially expand as well.

Overall, the *starting with a demonstration* approach proved to be very effective. Every time this researcher ran into the problem of a nervous farmer not knowing what to say, he would direct them to turn away from the camera, towards the object being discussed and ask them to demonstrate how it worked.

Provide context - Every video clip needs to answer the perennial questions (Wohl, 2008), *who* is talking, *what* are they talking about, *when* did this occur, *where* did it occur and *why* did the farmer do what they did? The job of the production team is to capture with shot-by-shot coverage, visual answers to each of these questions, often several times for each scene. The *who*, is answered by videotaping the person talking. The *what*, is answered by sequences of shots that illustrate the key points being discussed. The *when*, can usually be inferred by clues in the scenes, for instance, by shots of soil preparation, planting, crop growth or harvesting. The *where*, can be answered by wide establishing shots of the location where the action is taking place. The *why*, is often the most difficult question to answer visually, and should generally be left to the dialogue as it draws on the internal decision-making of the farmer. To show this visually would typically require an extreme close-up of a farmer's eyes to convey a thought process followed by a cutaway shot to imply their motivation; like for example, a weed infestation that needs spraying. A short vignette can also be used to provide a more detailed back-story. The difficulty in attempting to convey the *why* visually occurs when an otherwise obvious motivation is laboured or overstated at which point it becomes clichéd and trite. Therefore, it is probably best to avoid doing this, and instead rely on the farmers motivation being expressed verbally with what they say.

Ask for explanations - While the aim of videotaping a farmer is to capture a natural-sounding conversation, in the final edit <u>all</u> questions from the interviewer should be removed

from the dialogue track. This transforms the dialogue into a personal conversation between the farmer and the audience, which fundamentally changes the nature of an audience's role from being a passive and invisible third party to being personally engaged. For this to work, each question should elicit an explanation, so questions become self-evident in the answers that are given. When the answers are self-evident, the interview questions are much easier to remove.

Prioritise illustrative shots - As details come up in the conversations, a production team should video them as they go, pausing discussions to capture important details that will be of interest to other farmers watching the video.

Finally, the whole point of these interview techniques is for the camera to act as a proxy for what a farmer would expect to see and hear if they were present. As such, the production team must keep asking and visually answering the question: what would a farmer ask to see if he or she were here with me?

Switching the audience between listening and observing

Delving further into the realm of applied media aesthetics uncovers an interplay between design elements within the frame, the motion of objects, the motion of the camera, and how these elements effect viewer attention and cognition. This is a broad field of knowledge that requires the video clip maker to see beyond the physical objects in front of them, instead, they need to look for and compose elements of design, like contrast, harmony, discord, repetition and texture, as well as the arrangement and motion of objects, and the negative spaces created between them (Zettl, 2007).

This discipline can take many years of experience to understand and master, however in simple terms, there are some useful ideas that can be drawn from this field. Essentially, their will be times during an audio visual presentation when we want to the audience to focus on

what is being said, and there will be other times when we want the audience to focus on what being observed.

In the case of listening, the camera should be stationary, framed against a flat background with the person talking or a signifier of the concept being discussed providing the central focus. The frame should consist of two-dimensional plans (like walls) parallel to view plane (screen) so as not to draw the viewers attention in any particular direction. This avoids visual distractions and helps the viewer to concentrate on what is being said.

In the case of observing, the camera should move around a stationary object in three-dimensional space, or if the object is moving, track it as it moves past the camera. This causes the three-dimensional nature of the object to be revealed, which improves audiences visual understanding and memory of it.

Essentially, when we want the audience to listen and remember, we need to reduce the visual drama and distraction, and when we want to them observe and remember, we need to heighten the visual drama and avoid too much competing dialogue. That is, the farmer can still be talking, but should be describing details of what we are seeing.

Who should be responsible for creating video clips

The discussion thus far, has not made it clear who should be responsible for creating video clips of farmer testimonials. Given the social networking culture imbued in media sharing platforms like YouTube (Christensen, 2007) it is justifiable to consider that farmers might create and submit videos of their own, much like users of YouTube presently do. To gain an understanding the tradeoffs and limitations of different approaches, lets now examine an analogous information-sharing medium, the online discussion forum, and the corollary question of whether content for discussion forums should be created by extension agents or by farmers. That is, should the system be restricted and closed or public and open.

Sobrero (2008) recommends a *restricted* discussion forum, the virtual *Communities of Practice* and details experiences with the '*eXtension*' website as a positive example of their application (Sobrero & Craycraft, 2008). However, Harder and Lindner (2008a) identify several faults with its implementation. The '*eXtension*' website is unlike a typical online discussion forum because only registered users can ask questions, and it is up to members of the virtual '*Communities of Practice*' to answer them. This approach has the clear benefit that the advice being given by the website comes from a '*trusted source*', but it comes at the high cost of excluding other potential contributors.

By contrast, a significant weakness of open discussion forums comes from self-reporting bias (Banerjee & Fudenberg, 2004). Farmers who are already happy with their production systems won't be looking for information, so may not be active online. Thus, if the only farmers attracted to participating in an online discussion are novices, then the value of their contributions may be less informed and of limited value. This may downgrade other more experienced farmers' perceptions of the value of information provided by the discussion forum; further discouraging the experienced farmers' participation. Thus, the value of information provided on a completely open system can be self-limiting.

Translating these observations back to this study, the following conclusions can be drawn. Firstly, there is quite a different set of skills required for contributing to a discussion forum than creating a video. Whereas written skills are obtained from going to school, media skills are largely self taught or learnt at a tertiary level, thus they are far less common, although with the accelerating popularity of video sharing websites like YouTube, this skill deficit is changing. Nevertheless, at present it limits the ability for farmers to make the type of presentations that the YouTube learners discussed earlier were shown to prefer (Section 2.4.4).

Secondly, given that technology transfer of agricultural R&D is a deliberate act, with a clear set of outcomes, shifting responsibility for videoing farmer testimonials onto the shoulders of farmers would seem counter productive.

Thus, a pragmatic and accessible solution that marries these competing desires for open participation by farmers and control over content relevance and quality is the video web-log (commonly referred to as a *video blog* or *vlog* for short). In this scenario, trained extension staff would gather farmer testimonials, create the video clips and post them onto a video blog website. Farmers would then be able to openly participate in discussions about each video by posting comments at bottom of each page. This approach overcomes all the concerns about skill barriers, quality and content relevance, while encouraging participation. This was the approach employed by the research website created for this study.

2.4.5 Impacts of the research website

Having thus far, largely focused on the creation of the video clips, the discussion will now turn to the research website, which turned out to be controversial in ways that this researcher had not anticipated.

At that time the project started, it was against QPIF departmental policy to access streaming media using the departments network. To help enforce this policy, the departments firewall blocked access to streaming media websites like YouTube. It was also against departmental policy for employees to communicate directly with the public. All communication had to be vetted through regional communications officers.

Even though there was a strong desire to modernise outward facing services within QPIF, these efforts were hampered by these policy settings, which had been designed manage and protect inward facing services, referred to as ICT (Information and Communications Technologies). Inward facing services include things like desktop operating systems and

their applications, along with email and the departments internal information network (Intranet).

The problem was that the research website (Figure 2.1), although created by this researcher in his own time using his own computer system and network resources, stepped outside the department's policy. This led to tensions with the department's ICT management. The articulated concerns mostly revolved around the risk of potential liability to the department. For instance, the department had privacy and universal access obligations. One concern was whether the research website adhered to these standards. This included technical things, like whether the images provided alternative text for visually impaired users – which the research website did. Another concern was over the content itself. Could the information being provided by the farmers be considered advice, and if so, could the department be held liable for unfavourable outcomes. This was resolved by including a disclaimer at the bottom of every page on the research website.

Figure 2.1 – A screenshot of the Shedmeeting website.

Reservations about the research website meant the department would not endorse it or its use by staff. Instead, staff were given permission on an ad-hoc basis to participate in the project. Regardless of these impediments, research and extension staff did assist this researcher with information and farming contacts. They also appeared in some video clips and participated in the discussion forum on the website.

Through this period, the website provided some insights into the challenges faced by extension staff transitioning to delivering services online. The first example below, deals with the issue of service jurisdiction and publicly accessible websites. That is, who are staff responsible for providing services to, and how should they respond to requests that fall outside their responsibility. The second is essentially another example of dialogic learning, except this time farmers learned from reading other peoples discussions in an online forum, even though they didn't actually participate in that discussion.

Service jurisdiction and decentralized control

The first example, occurred August 2010, when the website received a request for information from a large cane farmer in an overseas country.

> *"We are about to start the development of a 7,300 hectares of Sugar Cane plantation farm ... using ferti-irrigation (underground dripping hose), in Piura, Peru, South America., to produce 400,000 litres daily of ethanol directly from the stock, without going through sugar and molasses. The mechanical harvesting will be 100% green and we do not have any rain fall to help in the use of the organic matter; the harvesting will yield 1,600 Tons of green trash daily, year around. The green cane harvesting is new for us, and not so easy to handle specially in this kind of conditions with high yields. We would be very grateful if you contact us with somebody in the industry that would share their experience with us on how to handle the Green cane trash blanket (GCTB). If you have any questions please feel free to ask."*

The email was automatically forwarded to all extension staff who had subscribed to the comment feed on the website. A copy of this email was forwarded to other extension agents, and from what this researcher was able to ascertain, the person who forwarded it, believed other staff would be impressed by the size and scope of the project, which was very ambitious by Australian standards. This created the impression amongst some who read the email that extension staff were routinely answering requests from sugarcane farmers in foreign countries. This lead to a '*please explain*' email from a senior manager. The incident was then used to argue why staff should not be given permission to participate in blogs and discussion forums.

This is symptomatic of a broader challenge faced in the deployment of Web 2.0 technologies. While it is the researchers and extension officers who possess specialised knowledge, they are not permitted to speak directly the media; instead, communications officers handle all public statements. This is done to protect the department and the minister from inadvertent controversy. Unfortunately participating in online discussions has been judged to fall under this policy, leading to tensions between a desire amongst staff members to leverage social media technologies, while at the same time having adequate policy and procedural settings to protect the department. These tensions were not unique to this project. Other QPIF research and extension staff confronted similar obstacles, for example (Charleston *et al*., 2009; James, 2009).

The invisible influence of website discussion forums

In this second example, a video and online discussion cascaded into the development of a self-levelling modification for sugarcane harvesters. This is a summary of a more detailed case study reported by this researcher (Thomas, 2010). A full transcript of this online discussion appears in APPENDIX E.

It began with the observation in Bundaberg, that the shallow root structure of the cane plant might explain harvester damage in dual row systems. A video created to report these

observations lead to an online discussion by farmers and agents about the problem on the research website. The video and subsequent discussions were observed by farmers in the Burdekin, who engaged an engineering firm in Mackay to develop a solution. This was unknown to the researcher who only discovered this serendipitously when the he visited the farm to video the self-levelling modification.

The problem: The implementation of any new farming practice can sometimes have unintended consequences. Farmer's who had switched to controlled traffic, GPS guidance and thus wider row spacings, also needed to extend the length of their harvester's elevators so they could reach the haul-outs. As the extended elevators slew, they create additional weight on one side. On wheeled machines, this causes the harvester to lean, which in turn causes the base cutters on that side to cut deeper into the soil. Not only does this raise the hydraulic oil pressure and operating temperature of the harvester, causing extra wear and fuel consumption, the cane roots are also damaged and are not as productive in subsequent seasons (ratoons). The resulting yield loss was troubling farmers, who questioned the merits of dual rows in the face of this problem.

The insight: Technical officers at QPIF made a revealing observation, which shed some light on this issue. They were conducting nutrient analyses of cane plants as part of a nutrient cycling research project, for which they had used a cutter bar to dig up a large quantity of cane roots. They noticed that the root mass was shallower than they had expected, sitting in the first 5 cm of soil. This indicated that there was little margin for error when setting the harvester's base cutter height: too low and there is a risk of damaging the cane plants' root system, too high and lodged cane can be left on the ground. Ideally, the based cutter needed to be set to skim the surface of the soil.

The QPIF technical officer was videotaped explaining these findings and a video clip was placed on the shedmeeting.com.au website (Thomas, 2008). An online discussion ensued.

The online discussion: A farmer asked if “anyone noticed a loss of stool as ratoons get older” in dual rows. In postings that went back and forth, this farmer revealed he had switched to the wider row farming system ten years earlier, but could not get the harvester to cut at ground level and was considering returning to single rows. However, this would be incompatible with his soybean fallow and he was also concerned about a yield loss from single rows.

A QPIF technical officer reported that their family’s farm had returned to single row plant spacing because of this ‘soil mining’ caused by harvester lean from the extended elevator. He added that there was no evidence of yield loss from single rows from trials at the QPIF Bundaberg Research Station.

A BSES engineer mentioned the harvester alterations other farmers had tried in order to solve this problem. This researcher noted that a local farmer had a 3 m dual row harvester with independent hydraulic rams on each wheel to adjust the base cutter height and that it appeared to work well. The BSES engineer reported online that he had spoken to a harvesting group in Mackay who contacted a local engineering firm about “the development of a ‘self-levelling’ system using the harvester lift rams to ensure the base cutter box remains level, thus minimising stool removal.” (It was later revealed in subsequent discussions with this engineering firm that using the front wheels to level the harvester was an inferior solution because it caused the frame to twist).

The vendor solution: These problems were also experienced by other farmers. A farm manager at a Burdekin harvest group saw the video, read the discussion, and showed it to his boss, who discussed it with other Burdekin farmers in their harvest group. Together they approached the Mackay engineering firm who recognised this was an industry-wide problem and, as such, decided to make the investment in the R&D to develop a solution, believing it would be worthwhile from a business standpoint. Their solution was to cut off the left rear

wheel, replace it with a dead axle, swing arm and hydraulic ram, install a level sensor and place a control pad in the harvester cabin to allow the driver to operate the unit.

The Burdekin harvest group trialled the solution for one season, and aside from a few teething problems with the location of position sensors, the solution worked. Field results demonstrated it was effective at picking up lodged cane, and hydraulic oil pressure was lower, indicating that the base cutters were level, thus, soil wasn't being mined and root damage wasn't occurring.

Key observations: What is striking about the connections between these people is that they may not have taken place, but for the online video and discussion forum. It would be uncommon to have technical officers from Bundaberg, farmers from the Burdekin, and a manufacturing firm from Mackay in a room together discussing this type of problem. No bus trip or field day would be likely to replicate these connections, given the large distances between the individuals. The communication also occurred asynchronously, often weeks apart. Perhaps most confronting from a website evaluation perspective is that the farmers who benefited from the online discussions, didn't actually participate in them.

Website activity, access logs and statistics

Having discussed a few examples of controversies and impacts that the research website had, the discussion will now turn to the activity that took place by reporting the access logs and usage statistics. This data is a summary of the *awstats* analysis generated by the web server.

Over the year in which this study took place, there were an average of 37 unique visitors to the website each day, and an average of 1140 each month. Each visitor accessed about 2 pages. About 70% of the originating requests (Sites) came from within Australia, with another 20% of unknown origin, with the remaining requests coming from overseas countries. In addition, each unique visitor watched an average of about one video clip per visit. In the first month, 50% of originating requests came from QPIF. In subsequent months,

the number of originating requests from QPIF fell to below 15%. A summary of these statistics appears in Table 2.1.

Table 2.1 – Website access summary for shedmeeting.com.au

	Daily Average		Monthly Totals			
Date	**Pages**	**Visitors**	**Pages**	**Visitors**	**Sites**	**KBytes**
Aug-10	99	70	3,085	2,171	615	693,416
Jul-10	89	55	2,780	1,720	571	486,231
Jun-10	86	42	2,582	1,280	599	890,664
May-10	88	49	2,728	1,525	540	629,029
Apr-10	73	36	2,193	1,106	595	676,193
Mar-10	86	37	2,667	1,151	674	652,790
Feb-10	67	29	1,900	825	471	453,907
Jan-10	55	22	1,717	706	348	500,156
Dec-09	47	21	1,487	666	329	655,418
Nov-09	60	24	1,827	722	392	729,654
Oct-09	72	21	2,255	670	378	738,413
Averages	**75**	**37**	**2,293**	**1,140**	**501**	**645,988**
Totals			**25,413**	**12,700**		**7,130,305**

The video player recorded on the server logs each time a video was played, and whether it was watched through to the end. This was done to see whether any particular type of video clip held visitors attention more than any other. The differences were not statistically significant. All video clips exhibited similar *watch-through* rates of between 95% and 98%. Essentially, if a visitor to the website decided to watch a video, they generally watched it thought to the end. This may be more a reflection of the website's page design, rather than the videos being of equal interest to all visitors. Each video had an image and description of its content. Thus, visitors may have made few mistakes in selecting the video clips they were interested in watching. The latest video on the home page (which was updated regularly) received significantly more views than video clips on other pages.

The website also included a discussion forum at the bottom of each video page, which received a modest level of activity. Some videos attracted quite active discussions while most received no attention at all. Interestingly enough, as was noted earlier, discussion forum activity was not necessarily a true reflection of discussion forum impact.

Concerns about the research website's use for data collection

Despite the level of activity that took place on the research website, this researcher made the decision not to use the website to collect data for this study. This was in part due to the controversy the website had created with the department. Working with CANGROWERS and using DVDs to distribute the video clips to CANEGROWERS members proved to be a less confrontational and less risky approach, and one that ultimately provided a more accurate and representative sampling frame.

While, from the perspective of cost and convenience, collecting data online would seem ideal, there were several significant reasons for not doing so. In the ideal scenario, it would seem that videos clips could be uploaded to a web site and a range of data collection options would be employed including session tracking, web log analysis, single question polls and email surveys to collect data, all at a relatively low cost and convenience. However, each of these methods of data collection is more problematic than one might expect.

On their own, web server logs, are of limited value (Bertot *et al*., 1997). Adding session tracking raises privacy and ethical concerns because all users of the website become survey subjects and cannot easily opt out of a study (O'Neill, 2004). Online polls are not very useful due to inherent biases in the sampling frame (O'Neill, 2004). This bias would be a particular concern because presently only a minority of farmers access agronomic information online (Australian Communications & Media Authority, 2008). Email surveys have also been shown to suffer from low response rates (Archer, 2008), which can adversely skew their results.

In conclusion, while this project's website was active and in one case described above, shown to be quite influential, it was not an integral part of this studies data collection. Instead, it provided a focal point for discussion by serving as a proof of concept, presenting a working example of what an extension website that applied the approach developed in this study might look like.

2. 5 Summary of exploratory research findings

This chapter has revealed that a considerable amount of analysis, experimentation, testing and reflection occurred in the development of the experimental treatments for this study, namely the website and video clips. The attributes of YouTube video clips used by learners were analysed. Farmer-to-farmer learning interactions were observed, and techniques for interviewing farmers and creating video clips were developed. Finally, the impact of the research website was discussed. In this final section, these ideas, observations and lessons learned are distilled down into a simple set of rules for videoing farmers. These rules are then analysed to inductively build a heuristic model of farmer-to-farmer communication, which is developed further in Phase II of this research.

2.5.1 Six rules for videoing farmers

From the iterative exploratory research presented in this chapter, a simple set of rules for creating the video clips was identified. These rules reflect the dialogic nature of interactions that should occur between the interviewer and the farmer. In articulating these rules, there are two opposing challenges. On the one hand, the rules need to capture enough detail to ensure that the desired outcome is achieved. On the other hand, the rules need to be simple enough to follow and concise enough to remember.

The six rules for videoing farmers are as follows:

1. Provide a role model, that is, a person who can demonstrate mastery of a technology or practice, i.e. **a farmer gives the presentation**.

2. Be in a location where the behaviours of interest can be observed, i.e. **the presentation is given on their farm**.

3. Communicate intimately and directly to convey local knowledge and experience as well as the attitudes and judgments that informed them i.e. **the farmer talks directly to the camera, in their own words, about their own experiences**.

4. Observe the behaviour, as well as the judgments and skills involved in its execution i.e. **the farmer demonstrates the sequences of actions involved in the practice**,

5. Provide memorable images and descriptions that are easily recalled i.e. **important aspects of the practice, particularly those that are difficult to describe verbally, should be illustrated visually**.

6. Communication should be chunked down into easily accessible pieces i.e. **each video clip presents a single practice or technology**.

Clearly, it is assumed that practitioners will also have all the prerequisite technical knowledge and skills needed to video farmers and edit the recordings together into video clips. However, this set of rules identifies a set of conditions to guide practitioners so they can create video clips similar to those created for this study.

2.5.2 A heuristic model of farmer-to-farmer communication

Inductive analysis of these rules reveals a heuristic model of farmer-to-farmer communication with two axes, self-disclosure and operational detail.

Self-disclosure

When farmers talk directly to the camera, in their own words, about their own experiences, video clips capture and communicate aspects of interpersonal communication that are unconscious and sometimes unintentional (Jourard, 1971; Luft, 1969). The farmer being interviewed invariably discloses their thoughts and feelings towards the innovation though vocal inflections, facial expressions, body language and gestures. This act of self-disclosure creates intimacy between the farmer in the video clip and the audience who watches it (Jourard, 1971).

Audience reactions to these video clips can also be unconscious including smiling, laughing and sometimes even tearing up. The smile is particularly interesting. One form of smiling, stems from the interview technique of *knowing the subject matter*, described earlier (Section 2.4.4). Here the interviewer, by revealing a depth of understanding in the subject matter, is able to disarm the farmer being interviewed to the point that their uninhibited enthusiasm and passion for the subject matter is revealed. This often results in a particular type of smile, one that could be described as a smile of pride; pride in personal accomplishment, and feelings of being appreciated and recognised for these accomplishments by someone who understands them. When audiences were observed during the moments in video clips where these smiles of pride occurred; audiences of farmers invariably reacted in kind by smiling in a similar fashion.

These spontaneous reactions to the video clips may very well engender perceptions of social intimacy. Audience members may form emotional attachments as they identify personal qualities and belief systems they have in common. For example, one farmer after watching the first DVD contacted one of the farmers he had observed, hoping to be able to visit him on his farm while travelling though that district. He recalled with surprise how familiar the farmer in the video clip was to him when they first spoke on the telephone – almost like they were old friends – even though they had never actually met. He also recalled how awkward the conversation actually was, because this familiarity was so one-sided.

This sense of social intimacy is potentially significant because it has been shown that when farmers seek information, the degree of influence the information they obtain has, varies according to the level of intimacy they have with the information source (Phillips, 1985). Perhaps more importantly, self-disclosure may allow the basic validity claims of sincerity, social appropriateness and truthfulness to be accepted on face value by audience members (Habermas, 1984).

Operational detail

When farmers in the video clips demonstrate the sequence of actions involved in the practice, they essentially communicate how farming principals have been operationalised to a specific farming context. Communicating operational detail, when it leads to implementation goals is more efficient at transferring the knowledge needed to realise those goals, than implementation goals based on general principals (Brandstätter *et al*., 2001). Thus, the operational detail provided by farmer's accounts should make the knowledge transferred readily actionable.

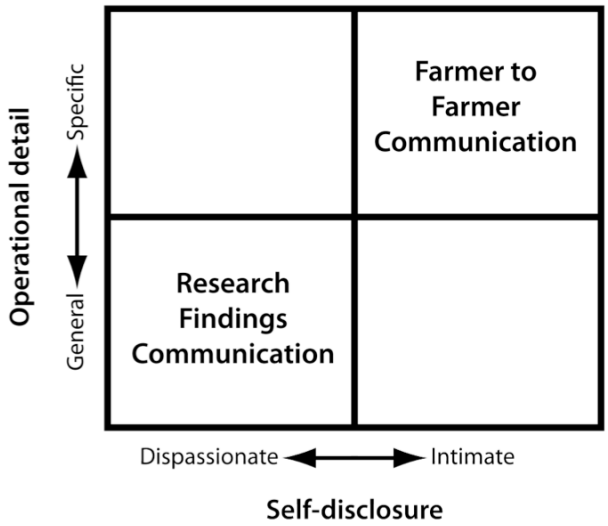

Figure 2.2 – A self-disclosure and operational detail, communication style matrix.

These two axes, self-disclosure and operational detail can be expressed as a communication style matrix (Figure 2.2). This matrix helps to explain the key difference between farmer-to-

farmer communication and other forms of extension communication like presenting research findings. That is, because research recommendations are expected to be generalisable and bias free, their communication style is deliberately general and dispassionate. As such, research communication lies at the opposite corner to farmer-to-farmer communication in this matrix.

In conclusion, this heuristic model of farmer-to-farmer communication, which was at this point untested, stemmed from the researcher's systematic and critical self-reflections on what was learned during each stage of an iterative process involving exploratory research. In this respect, the model was grounded in practical experience. In the next chapter, which begins Phase II of this research, this heuristic model is developed though a synthesis of related theory and extant literature into a theoretical framework to explain the mechanisms by which farmer-to-farmer learning triggers decisions to adopt new technologies and practices.

PHASE II

3 RESEARCH ISSUES AND LITERATURE

3. 1 Introduction

This chapter begins with an exploration of the activity of farming thought the theoretical lenses of the *Theory of Communicative Action* (Habermas, 1984; Habermas, 1987), *Cultural-Historic Activity Theory* (Vygotsky, 1986) and the *Theory of Planned Behaviour* (Ajzen, 1991). Together these theories shed light on the potential significance of self-disclosure and operational detail, identified in the previous chapter (Section 2.5.2). A synthesis of these theories with extant literature progresses this heuristic model into a broader theoretical framework, which posits the behavioural influences that trigger change. Finally, research sub-questions, hypotheses and propositions are developed from these theories.

3. 2 Parent theories and extant literature

While the most prominent adult learning theories are arguably andragogy and self-directed learning (Merriam, 2001), the observations of farmer-to-farmer learning described in Phase I (Section 2.4.3), were distinctly dialogic in nature. For this reason, extant literature relating to dialogic learning provides the starting point for parent theories relevant to the research problem. However, given that the literature on adult learning is expansive, this review is limited to the areas with specific application to the research problem and is therefore limited to theoretical perspectives that link the mechanics of interpersonal communication with the agency of social cognition.

3.2.1 Explaining communication style with the theory of communicative action

In this section, the *Theory of Communicative Action* (ToCA) is presented to postulate why the *communication style* of farmer-to-farmer learning exchanges is efficient.

Habermas's ToCA rests on a distinction between different concepts of rationality (Habermas 1984, pp. 8-22, pp. 168-185), most notably instrumental, strategic and communicative (Figure 3.1). *Instrumental action* is predicated on privately defined goals of success, while *strategic action* involves influencing the goal decisions of opponents. By contrast, *communicative action* pursues a rationally negotiated shared understanding bound by common social values.

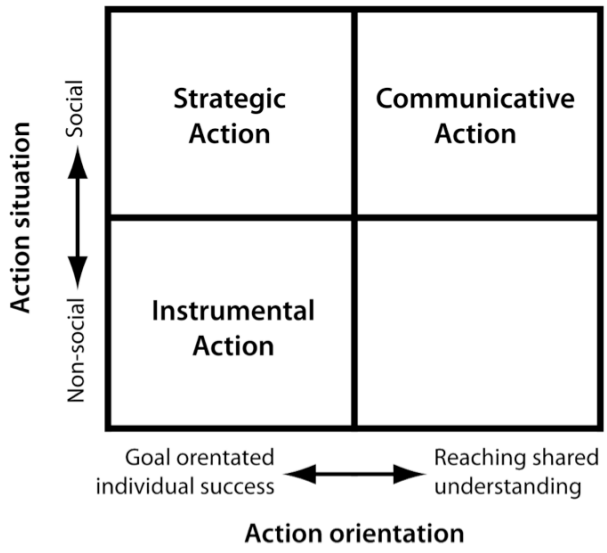

Figure 3.1 – The relationship between communicative, strategic and instrumental action.

In ToCA, language and actions are intrinsically linked, with rationality situated within the structures of discourse. That is to say, rational ideas reside in the language used to express them, rather than being disembodied from those discussions. However, discourse it not limited to vocal utterances. Meaning can also be conveyed though non-linguistic forms of expression like symbols, gestures and knowledge artefacts.

Central to ToCA are speech acts aimed at achieving a mutual understanding through an argumentative dialogue amongst actors engaged in discourse. These speech acts test three basic validity claims, the objective, subjective and inter-subjective (Habermas 1984, pp. 319-328). Dialog in the *objective* world concerns claims about the truth of things. Here truth is deliberated via references to the relative strengths and merits of facts and evidence. Dialogue in the *subjective* world concerns claims of authenticity and sincerity. Here historic truthfulness is evaluated by comparing past utterances with past actions in support of present claims of future action. Finally, dialogue in the *inter-subjective* or social world concerns normative claims of rightness. Here claims' of social acceptability are tested against the shared norms and cultural values that stem from the relationships between actors.

Habermas argues that in everyday social life, claims of communicative actions are not usually tested or argued because actors share a common background knowledge or '*lifeworld*' within which many actions are tacitly negotiated (Habermas 1987, pp. 119-52).

In farmer-to-farmer learning, we see a similar tacit social contract. Farmers expect that other farmers will be truthful and sincere, which leads to a similar implicit acceptance of validity claims. That is, farmers accept the statements other farmers make on face value because they share a set of common cultural values where social acceptance in learning circles is predicated on participants being truthful and sincere.

Thus, it is argued that this implicit acceptance of validity claims leads to greater cognitive efficiency in learning interactions for two reasons. Firstly, there is a lower communication overhead because validity claims are accepted on face value, saving time that would otherwise be lost in their negotiation, so more information can be shared in the same allotted time. Secondly, when learners are less distracted by arguing the finer details of validity claims they are more able to focus their full attention on the primary goal of reaching a shared understanding around themes of common interest.

Seen from this perspective, the communication style of farmer-to-farmer learning is both efficient and intrinsically *egalitarian*, because the power relationship amongst participants is essentially equal (Flecha, 2000). This does not to suggest that farmers never embellish the truth by omission or exaggeration, for instance, over a cold beer at the pub. Instead, the social contract between them seems highly nuanced; perhaps it is simply a common understanding amongst farmers that they will give an honest account when that is what is socially expected of them.

3.2.2 The role of evidence in the diffusion of innovation

Having established a basis for such a the tacit social contract between farmers to be truthful and sincere, this section explores the role of *inter-subjective* dialogue in farmer-to-farmer communication by drawing ideas from Moore's (1999) *Chasm* theory. Here, it is argued that the social acceptance of an innovation by successive groups of adopters is an integral aspect of the discourse about innovations amongst farmers. Evidence-of-adoption essentially plays the role of providing *inter-subjective* validity claims about the suitability of the innovation, by identifying the risk profile of farmers for whom it is presently most appropriate.

Diffusion of innovation

The so called '*progressive farmer strategy*' as explained by Rogers (2003) *Diffusion of Innovation* (DoI) theory, has been a dominant model of adoption in agricultural extension. Rogers observes that in any population of farmers, the willingness to adopt new technology can be identified by a general set of characteristics (Figure 3.2).

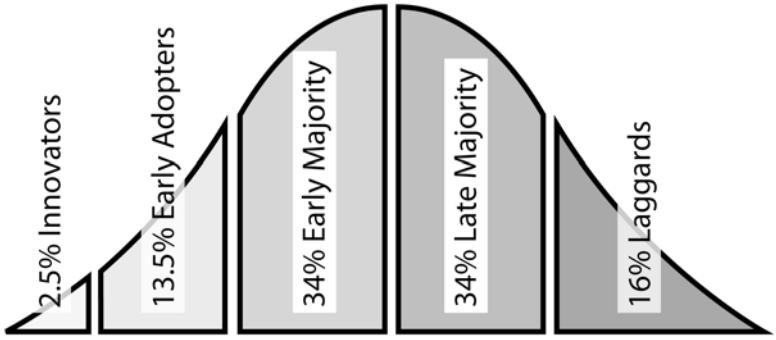

Figure 3.2 – Adopter categories corresponding to discrete phases in the adoption lifecycle (Adapted from Rogers, 2003)

Rogers' (2003) model predicts that about 2.5% of farmers are *Innovators*. These are farmers who are willing to experiment and risk failure on the chance of a substantial personal gain. These farmers typically have better education, larger than average holdings, greater wealth, and a '*venturesome spirit*'. They are also likely to actively seek opportunities with RD&E providers to participate in local trials. In Rogers' (2003) model *Innovators* play the important role of **providing evidence that a new technology works**.

In the second phase of Rogers' (2003) model, the next 13.5% are the *Early Adopters*. They are quick to see the value of a new practice in their local region, and will try it if they feel it has a fair chance of success. These farmers are typically younger than average, have a high level of education, are socially active and frequently seek out opportunities to source new information. The *Early Adopters* play the important role of **providing evidence of the economic value of the new technology**.

In the third phase of Rogers' (2003) model, the next 34% are the *Early Majority*. They are of average age, experience and education and tend to be prominent figures in their local communities. They will only adopt a new practice when they are convinced of its value. The *Early Majority* plays the important role of **providing evidence of the general acceptance of a new practice by a local farming community**. From this point, innovation diffusion enters the final two phases of adoption by the *Late Majority* and *Laggards*, who are progressively more conservative, risk averse and have more marginal farming operations.

In addition to describing the attributes of the farmers, Rogers (2003) also considers how they perceive the innovation and how these judgments influence the innovations' potential for adoption.

- **Complexity:** Relative to the skill and knowledge of the farmer, how complex is the innovation to understand and implement.
- **Compatibility:** How compatible is the innovation with the farmers soils, terrain, rainfall, equipment, and farming system, as well as their core values and beliefs.
- **Trialability:** How difficult, in terms of time and resources, would it be for the farmer to implement the practice on a trial basis and make any necessary modifications to adapt the innovation to their needs.
- **Relative advantage:** How well does the innovation compare in terms of productivity, profitability, or another compelling attributes to the alternatives of either doing nothing or adopting something else.
- **Observability:** How long does it take after adopting for the farmer to be able to observe results.

The presumption is that innovations with low complexity and high compatibility, trialability, relative advantage and observability scores have a higher adoption potential.

Kaine (2008) cautions against identifying adoption attributes as a key source of difference amongst groups of farmers, which he observes leads to the tendency to overestimate the size of the potential population of adopters, and under-estimate the actual level of uptake. Instead, Kaine argues that the relative advantage of an invitation to specific farming contexts is the limiting factor. Thus, the degree to which an innovation can be adapted to different farming contexts becomes an important narrative in how the innovation is communicated amongst farmers.

Rogers' (2003) theory has been criticised for having limitations (Brennan *et al*., 2007; Fichman & Kemerer, 1999; Lyytinen & Damsgaard, 2001). Even so, this may not be a problem with the theory so much as how it is applied. Stephenson (2003) singles out a common misperception amongst extension agents; believing their job is done once a few progressive farmers have adopted a new technology. The logic being that the new practices will invariably diffuse out to the majority of farmers. Stephenson observes the following deficiencies with this approach.

- **A pro-innovation bias:** The implicit assumption that all farmers should adopt each innovation.
- **An individual-blame bias:** The language of innovation diffusion implies early adopters are *good* and late adopters are *bad*. If the emotional bias in these terms is inverted, we could just as easily call the early adopters *fools* and the late adopters *sensible*. The danger is that farmers are blamed for poor extension outcomes, when it may be a fault with the design of the program or innovation.
- **A lack of equality:** The implicit characteristics of *Innovators* and *Early Adopters* may bias programs to favour larger, wealthier farmers.

Despite these problems, DoI does provide a useful set of classifications and descriptions of mechanisms and attributes that can be observed. However, we should also to be mindful that in the past, an over simplistic understanding of their meaning has lead to problems with their application. Be that as it may, the real problem with DoI, from a service delivery perspective, is that the theory is descriptive rather than predictive. That is, while DoI can be useful in describing the characteristics and degree of adoption that has taken place (Harder & Lindner, 2008a), it does not predict the outcome of a new extension strategy or the level of adoption it will likely attain.

Evidence of adoption

Moore's (1999) *Chasm* theory extends Rogers' model, noting that because adopters share common characteristics, informal social networks form around the exchange of information and experiences about a common interest – the innovation – making these groups both self-referential and self-reinforcing (Figure 3.3).

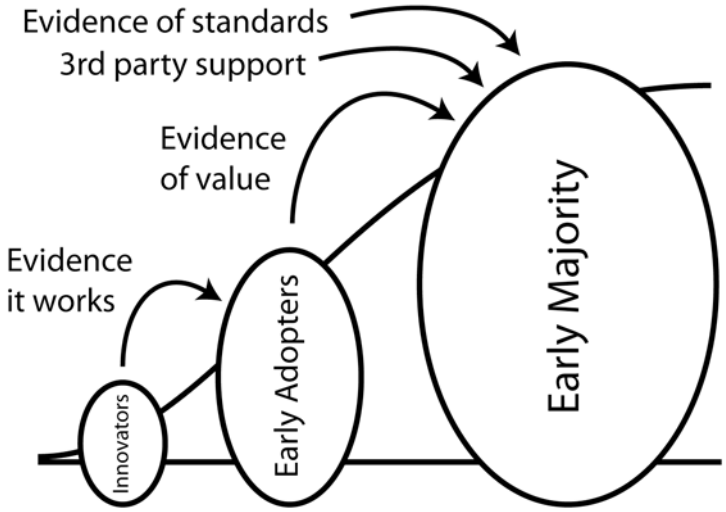

Figure 3.3 – The role of evidence in each phase of the adoption lifecycle

For instance, *Innovators* who are technology specialists will seek out other technology specialists – who could be either farmers or RD&E providers – and in the process exchange knowledge and experiences with each other. It is only when enough *Innovators* have demonstrated that the technology works, the next group, the *Early Adopters*, will begin to take notice, and so on.

The influence of individual knowledge and skill

Essentially, evidence-of-adoption allows farmers to mitigate the risks associated with individual development efforts by aggregating risk across a network of individuals who possess different expertise and experiences.

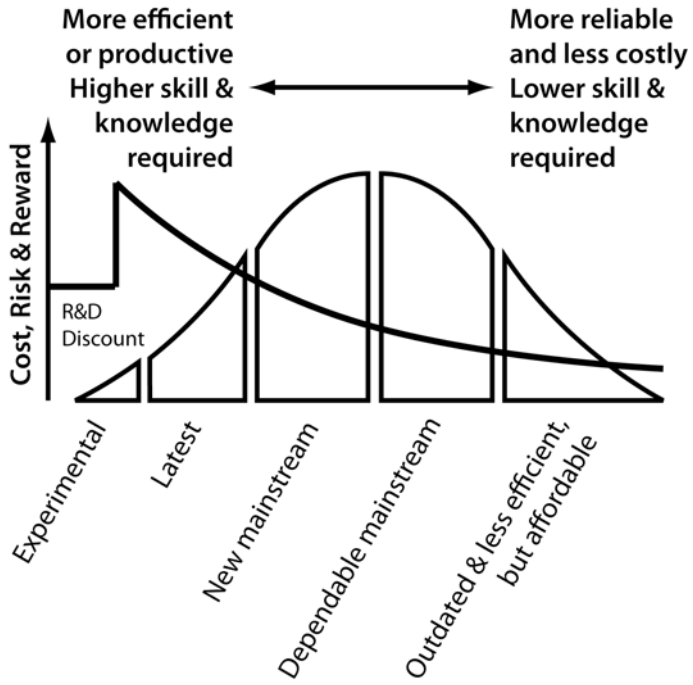

Figure 3.4 – Influences on the decision and timing of adoption
(Adapted from Moore, 1999)

To understand why this works let's consider the nature of a farmer's individual development efforts in complex farming systems with interdependent components. The influences on the decision to experiment or adapt technology to improve business outcomes are numerous. The cost, risk and reward all follow a similar curve (Figure 3.4). Experimental technologies often include a substantial R&D discount from a combination of pooled grower levies matched by government incentives. However, they also require greater skill and knowledge on the part of the farmer to implement. At the other end, mainstream technologies are generally more affordable, cheaper and easier to use, but provide less competitive advantage. Given that costs, risks and rewards of compelling innovations by definition balance each other out, the key determinant remaining is the knowledge and skill set of the individual, which in itself is a reflection of their cultural and historic learning environment.

Informal knowledge networks

As informal social networks form around the exchange of information about an innovation, they provide participating farmers with a pool of knowledge about readily adaptable

processes and components from which they can advance their own farming systems. Thus, by participating in these social networks, farmers benefit by learning from the successes and failures of others. In this way, the social network collectively aggregates knowledge across individuals in the network.

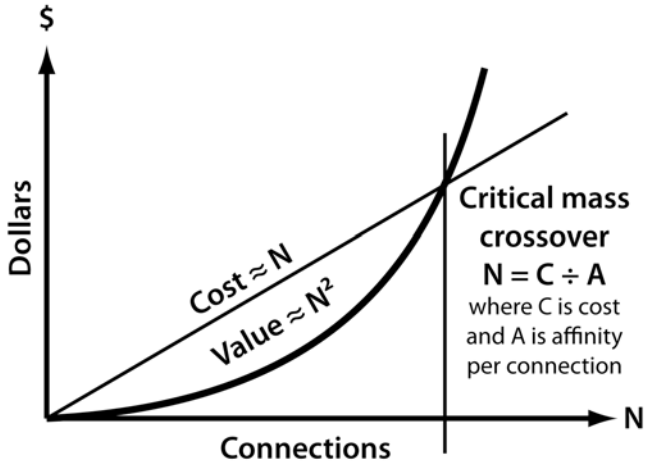

Figure 3.5 – Metcalfe's Law (Metcalfe, 2006)

To appreciate why these networks form and the value they provide to the individuals who participate in them, Metcalfe's Law[5] provides a useful heuristic (Figure 3.5). Coined by George Gilder (2000) in his book *TELECOSM*, the law states that the value of a network grows with square of the number of users connected to it. In this case, the impact of an informal social network is likely to be proportional to the square of the number of farmers who participate in it. However, the extent to which participation is required to be active (sharing knowledge) or passive (observing knowledge) is not known. Nevertheless, the point of Metcalfe's Law is not so much the absolute number of participants, but the idea that there is a '*critical mass*' after which beneficial '*network effects*' out-way the cost of participation. Given that social networking is central to farmer-to-farmer learning Metcalfe's Law would

[5] Bob Metcalfe invented Ethernet at Xerox PARC. His '*Law*' was part of a 35mm slide presentation he used at his company 3COM in the 1980s to convince early adopters of Ethernet to install networks larger than some '*critical mass*' so they would exhibit beneficial '*network effects*'.

suggest that extending the reach of these networks should improve learning outcomes, and thus technology transfer.

In summary, this section has explored role evidence in the diffusion of innovation. It has shown that evidence of other farmers adoption helps farmers identify whether an innovation is suitable for their specific circumstances. In doing so, informal social networks form between farmers interested in exchanging information about the innovation. This provides value to individual farmers by helping them to mitigate risks associated with their individual development efforts by avoiding mistakes that others have already made. Thus, it is argued that evidence-of-adoption satisfies the third of Habermas's (1984) validity claims by communicating the inter-subjective social acceptance of an innovation amongst groups of farmers who are at the same phase in the adoption lifecycle, and share similar adoption characteristics. The nature of the language used to convey this evidence amongst farmers is discussed next.

3.2.3 Explaining message content with cultural-historic activity theory

In this section, *Cultural-Historic Activity Theory* (CHAT, Vygotsky, 1986) is presented to postulate why the *message content* of farmer-to-farmer learning exchanges is effective.

Vygotsky's theory rests on the concept of artefact-mediated collaborative activities, which transform learners and their communities-of-practice over time. Participation in some form of community-of-practice is seen as an integral aspect of learning. In this way, knowledge is built as people work together solving the problems they encounter in the pursuit of common activities (Figure 3.6). Even when learning appears to be solitary and independent, it is in fact linked to the wider community-of-practice through knowledge artefacts and tools (both physical and conceptual) that have previously been created (Wells, 2000). That is, individual learning is a social phenomenon that does not occur inside a vacuum, devoid of any external knowledge sources.

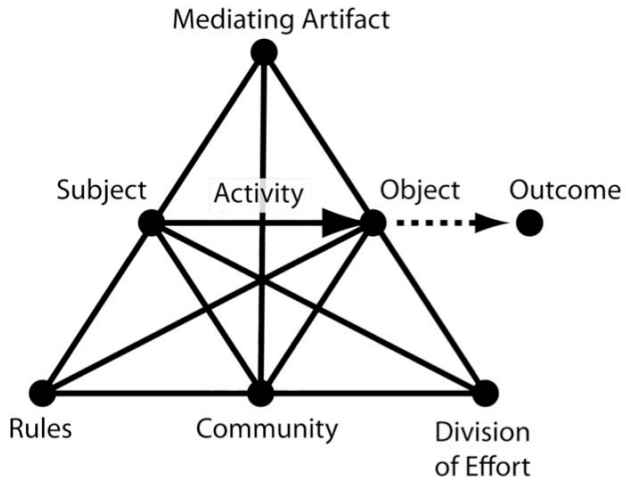

Figure 3.6 – The mediational triangle which includes the subject, object, and mediating artefact, along with other people (community), social rules (rules), and the division of effort between the subject and others (Cole & Engeström, 1993).

However, learning is not an end in itself, the mastery of tools and practices is essential for actors to participate in the activity systems of their communities. From this perspective, society can be seen as a set of overlapping activity systems, each with their own associated communities-of-practice. Together these systems constitute the fabric of human existence. Seen another way, human societies are maintained as generations of actors produce and reproduce these activity systems over time. Thus, learning is central to the maintenance of the activity systems that constitute a society (Roth & Lee, 2007).

The corollary to the community of practice is the '*community of enquiry*'; here learning is both collaborative and exploratory. Learners share their knowledge and experiences about a common interest or shared learning goal, an '*improvable object*' that is the focus of their systematic inquiry (Wells, 2002). This object is *improvable* because actors must build new knowledge before learning goals are satisfied. Central to these learning goals is the desire to understand, and it is this desire that motivates the learner, opening them up to experiencing what is new and allowing them to reinterpret what is already known in the light of these new perspectives. Vygotsky (1986) calls this construct the '*zone of proximal development*', where

each individual is able to achieve more in collaboration with others than they are able to achieve on their own.

Much like Habermas (1984), Vygotsky's theory situates knowledge building (rationality) within the structures of discourse. Here, agents take successive turns speaking as they collaboratively negotiate a '*structure of meaning*' between them. Each speech act is simultaneously a process and a product; both responding to what came before it and expressing what is said in anticipation of future responses. This mode of discourse rests on this principle of '*responsivity*' that is central to the dialogue of knowledge building (Wells, 1999). These '*speech acts*' may include the use of signs, symbols and artefacts that signify meaning; however speech is the most appropriate metaphor because these alternative signifiers can be articulated through vocal utterances.

Lotman suggests that '*a text*' can serve a similar dialogic function, becoming both a '*thinking device*' and a '*generator of meaning*' (Lotman, 1988; as cited in Wells, 2000 p. 77). That is, the activity of writing can provide agents with transformational learning goals. Conversely, the act of reading can in some way satisfy this learning goal in others. This construct has a rather profound implication if we extend the notion of '*a text*' to other artefacts that embody similar transformative knowledge processes. For instance, in the activity of farming, a crop can be seen as one such knowledge artefact. Much like in the speech act, farmers respond to the specific climatic, edaphic and operational constraints they face and express their knowledge in the soil preparation, planting and growing decisions they make. Likewise, the growing crop is both a process and a product, simultaneously expressing the decisions and choices that were made in the past, while anticipating future outcomes.

In this way, discrete farming activities of individual farmers reflect their own learning and life experience, which cannot be separated from the collective life experiences, knowledge, history and cultural norms of family, community and the broader rural society within which

they live. Thus, the knowledge artefacts produced in growing crops are reflective of the cultural-historic activity of farming that leads to their creation.

Crops as knowledge artefacts also function as both a *thinking device* and a *generator of meaning*. This is because applying new technologies or practices to the activity of farming provides farmers with transformational learning goals. Conversely, observing another farmer's cropping activities can in some way satisfy the earning goals of other farmers. In this way, the operational detail used to convey these knowledge artefacts can be seen as the language though which these shared *structures of meaning* about the activity of farming are expressed and efficiently conveyed between farmers.

By communicating meaning under the tacit social contract of truthfulness and sincerity, as discussed earlier (Section 3.2.1), this language of operational detail may also help to reduce bias (Nickerson, 1998). This is because the language used to convey meaning reveals the specific day-to-day workings and activities associated with the practices, tools and procedures that were employed. Therefore, farmers participating in this type of discourse, have the '*raw*' data at their disposal to make independent judgments and draw their own conclusion about which factors they believe were significant in achieving the stated outcomes. This creates a self-reinforcing interdependency between operational detail, truthfulness and sincerity, because when all farmers have the '*raw*' data, attempts to exaggerate claims are easier to discover. For these reasons, it is argued that the operational detail is the language though which farmers convey meaning with one another about farming innovations.

3.2.4 The knowledge needs of farmers as systems integrators

For another perspective on the need for operational detail, this section explores the knowledge needs of farmers as systems integrators. Farmers become systems integrators in many of the activities they perform. For instance, in cultivation, the components used in a

tillage operation will differ between light sandy soils and heavier clay soils. Similarly, different approaches to planting, irrigation and spray application will be affected by climatic and edaphic variation. Thus, farmers need to customise the processes and components they bring together as they tailor farming systems to meet their specific needs. As a result, farmers prefer information to be highly contextualised (Kilpatrick & Rosenblatt, 1998). That is, they prefer to learn from someone else who has already done something under similar circumstances to their own. Baring that, they need a broad knowledge of the available components and processes to choose from (Pavitt, 2002) because as systems integrators they need to have '*knowledge in excess of what they need for what they make*' (Brusoni *et al*., 2001).

To understand why, let's consider the nature of a farmer's individual development efforts in a complex farming system with interdependent components. On their own, a farmer may only be able to make small incremental advances at a time as they adapt and localize technologies with which they feel confident. Figure 3.7 illustrates this process where the farmer attempts to introduce a new component (+), which replaces a few existing components (-), while leaving the remaining system unchanged. For example, GPS guidance can be used to replace marking out, and at the same time consolidate some tillage operations.

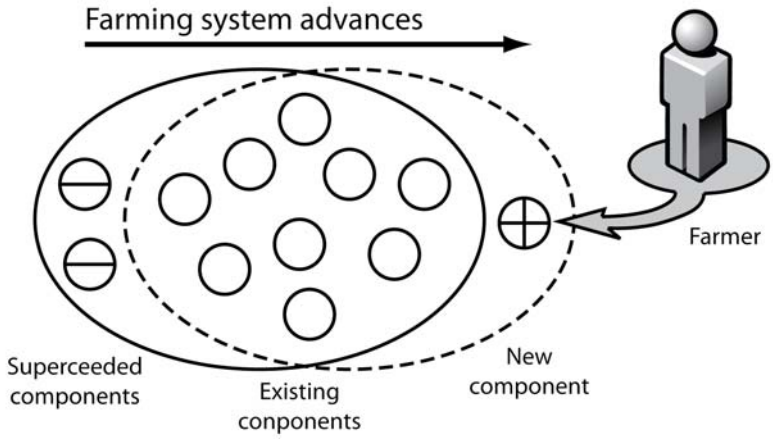

Figure 3.7 – The nature of development for the individual farmer in a complex farming system with interdependent components

In areas where groups of organisations share similar interests and motivations toward a particular area of technology, clusters of innovation are known to form (Greve, 2009). In this scenario, much like Vygotsky's '*zone of proximal development*', farmers pool their combined experience and expertise and are then able to adapt technologies at a faster pace than individual farmers are able to achieve on their own (Figure 3.8). Here the farmer is able to introduce several new components (+), both his own and those seen on other farms, which replace numerous existing components (-), while leaving the remaining aspects of the system unchanged.

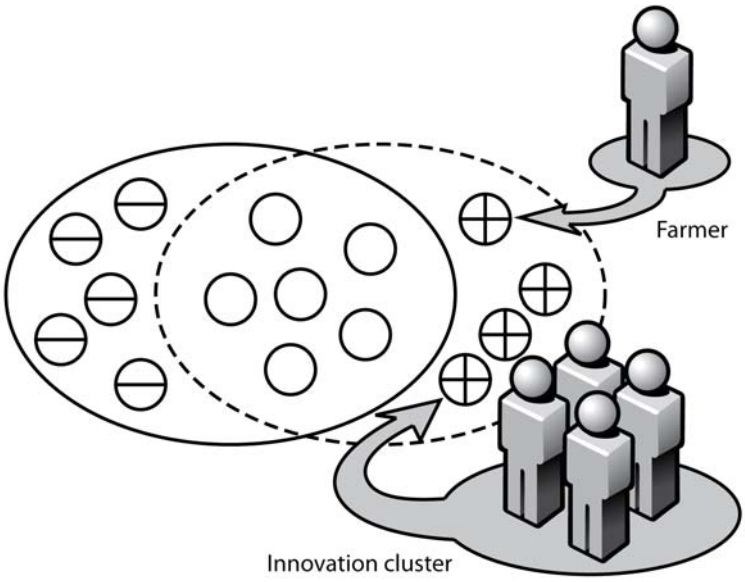

Figure 3.8 – Farmers with similar interest and motivations toward a particular area of practice change often form clusters of innovation

From this scenario, we can see how important a broad knowledge of components is in systems integration. However, a general knowledge of these components is unlikely to provide enough detail to make critical decisions about their suitability, particularly when complex financial decisions are required for their adoption. This provides another perspective supporting the primacy of operational detail in the language of innovation communication amongst farmers.

3.2.5 Explaining adoption decisions with the theory of planned behaviour

Having explored farmer-to-farmer learning exchanges from various theoretical perspectives, the next step is to consider how behavioural influences might trigger adoption decisions. All the theories thus far, ToCA, DoI and CHAT, have been descriptive. As such they provide little predictive power as to whether a technology transfer '*intervention*' will be effective, for that a predictive model is required (Edwards-Jonesa, 2006), so this discussion now turns to the field of social psychology.

The *Theory of Planned Behaviour* (ToPB) is respected predictive behavioural model that is both theoretically and empirically founded (Ajzen, 1991). ToPB contends that the strength of a person's intention towards a behaviour, is a reliable predictor of whether they will follow through and exhibit that behaviour (Figure 3.9). The ToPB has been widely used in health related interventions like exercise, smoking and diet, and a meta-analysis of 185 independent studies by Armitage and Conner (2001) demonstrates the usefulness and validity of the theory. Kaufmann *et al*. (2009) detail numerous investigations in business, natural resource management and agriculture where ToPB has been successfully applied.

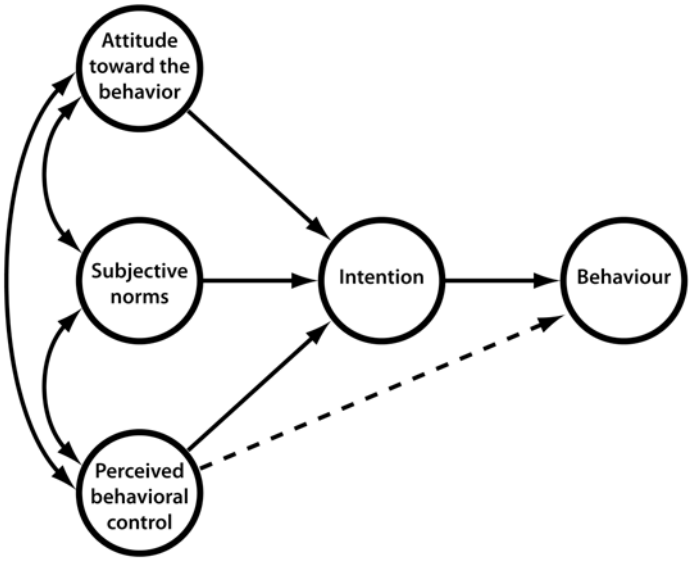

Figure 3.9 – The Theory of Planned Behaviour (Ajzen, 1991)

In ToPB, the strength of evidence of a person's intention comes from the three *'predictors'*.

- *Attitude* – whether a person is in favour of doing something.
- *Subjective norms* – whether the persons' peers will support them in doing it.
- *Perceived behavioural control* – whether the person believes they have the skill and ability to act.
    - *Actual behavioural control* – the dashed line in Figure 3.9, which represents the actual behavioural control that must occur to exhibit the behaviour.

Attitude towards a behaviour reflects our overall assessment of that behaviour. This has two components: beliefs about the consequences of the behaviour, and positive or negative judgements about these consequences (Ajzen, 1991).

For instance, a farmer may have a positive attitude towards an environmental outcome of doing something even though the outcome might not result in an economic benefit. In this case, the negative economic consequence may be outweighed by other positive beliefs like lifestyle considerations (Greiner *et al*., 2009)

Subjective norms are our estimate of the social pressure we feel to either perform or not perform a behaviour. This has two components: beliefs about how other people who may be important to us would like us to behave, and positive or negative judgements about how much we care about their opinions (Ajzen, 1991).

Perceived behavioural control is the extent to which we believe we can enact behaviours. This has two components: beliefs about whether we have control over the behaviour, and a judgement as to how confident we feel about being able to perform or not perform the behaviour (Ajzen, 1991).

ToPB can be used to guide the design of behavioural interventions (Kaufmann *et al*., 2009), which are devised to influence one or more of the three predictors (Figure 3.10). A

corresponding set of new salient beliefs is assumed to drive these predictors. The process of devising an intervention involves the identification of '*accessible*' beliefs, and targeting those that are deemed to bare the most influence, provided there is room for change (Ajzen, 2006).

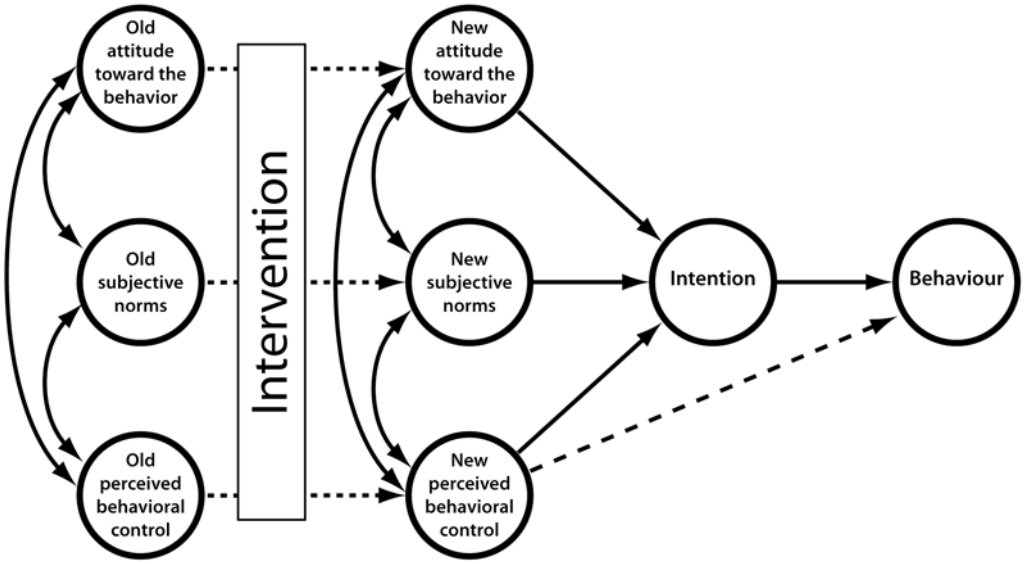

Figure 3.10 – A ToPB intervention should influence each of the three behavioural predictors

Ajzen (2006) identifies several strategies for changing beliefs:

- altering an existing belief;
- altering the strength of an existing belief;
- altering a belief's scale; and
- introducing a new belief.

Ajzen (2006) recommends the introduction of new beliefs because it is often easier than attempting to change existing ones. New beliefs tend to come from smaller subgroups from within a population. To be effective in an intervention they also need to be tested to ensure they *ring true* with the larger population. The question is, of the three behavioural predictors, which ones are more likely to be a fertile source of new beliefs for farmers, and is there room for these new beliefs to influence farmer behaviour?

Predictors with room to support change

Attitudes appear to have the least room to support change. Attitudes in farmers are deeply rooted, and while they may be changed in some individuals, they are unlikely to be changed readily. The recent observations by Greiner et al. (2009) showed that group empowerment activities were unable to shift farmer attitudes and instead only managed to equip them to act on their existing beliefs. Instead, farmers existing attitudes play the role of mediating the acceptability of new practices.

> *In a typical learning process, intimates help confirm attitudes toward new practices, acquaintances are used to sound out how new practices could be implemented, while more distant experts provide technical knowledge and skills.*
> *(Kilpatrick & Rosenblatt, 1998, p. 41)*

Subjective norms appear to have the most room to support change. Kilpatrick and Johns (2003) observed that farmers do most of their learning by *seeking information* through informal exchanges with other farmers as well as domain experts like consultants, extension practitioners and agronomists. Farmers then qualify this information with their own observations and experiences. Essentially, farmers need social interaction and opportunities to observe each other to learn efficiently. This is because for many farming activities, there are a limited number of opportunities – often one per season – for farmers to experiment, observe outcomes and make judgments; too few to efficiently learn from self-experience alone. Informal exchanges amongst farmers also allow them to collectively mitigate the individual risk of individual trial and error.

Likewise, Phillips (1985) found that in a typical year, dairy farmers would embark on as many as 30 learning projects. In these endeavours, farmers would seek information from experts to fill information gaps, validate and evaluate them with acquaintances and finally seek support and approval for decisions to change from intimates like family members or close personal friends. Therefore, the role others were found to play in farmers' decision-

making process reflected the perceived social distance between them. The more socially intimate the communication, the more deeply that information was assessed against the goals and aspirations of the farmers.

Kilpatrick and Rosenblatt (1998), argue that farmers are notoriously independent and require educational resources to be highly contextualised to the specific climatic, edaphic and operational constraints of their region. They also prefer information that comes from known sources. They distil the attributes of farmers' information seeking as follows:

- farmers seek information from others in a two-way process where each party is working from their own base of knowledge;
- farmers expect to be able to withdraw at any stage without any sense of obligation;
- farmers expect to be free to accept or reject the information; and,
- farmers want to learn things they believe are directly applicable and readily adaptable to their own situation.

Parminter (2011) suggests that farmer innovativeness can be encouraged by strengthening both formal and informal social networks.

Finally, **perceived behavioural control** appears to have some room to support change, given that farmers are extremely capable of learning new skills and other control beliefs through observation alone (Heiniger *et al*., 2002).

Of these three predictors, subjective norms in combination with perceived behavioural control appear to have the most room for new beliefs to influence farmer behaviour. Thus it is argued, that farmers will be most influenced by other farmers showing them how they have implement new practices on their farms.

3.2.6 The apparent neglect of technology transfer

Lets now return to the Productivity Commission (2011) Inquiry Report into Rural Research and Development Corporations, which identified '*insufficient attention to adoption pathways'* and the absence of a '*strong evaluation culture*' as problems that permeate the entire national R&D framework. This requires some explanation, lest the mistakes of the past be repeated by the solution being proposed here.

Competing methodologies

In a comprehensive review of extension practice, Black (2000) investigated the major strengths and limitations of top-down, bottom-up, formal education and training, and group-empowerment strategies. Black suggests that rather than thinking of top-down and bottom-up strategies as mutually exclusive, they should be considered as opposite ends of a spectrum (Figure 3.11).

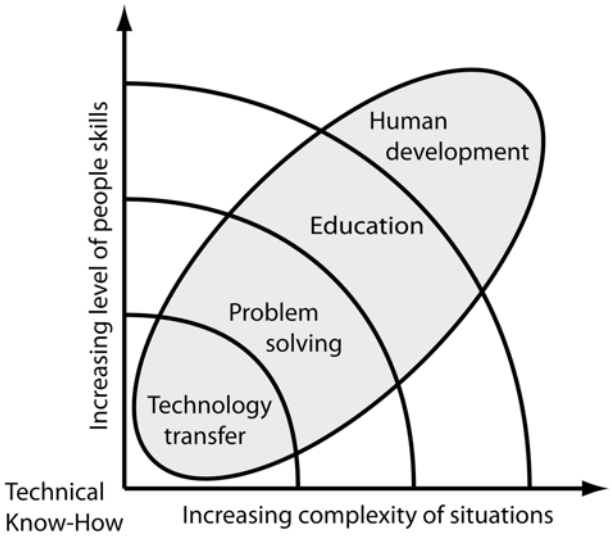

Figure 3.11 – The extension spectrum
(Campbell & Junor, 1992; Van Beek & Coutts, 1992)

As research becomes more complex, extension strategies should focus on empowering groups of farmers to be actively involved in the R&D processes; building on their existing know-how with experimentation, evaluation and contributions towards new learning as

strategies move outward toward human development. This is largely what extension practitioners have done. In the process, they have also moved away from what is now considered the archaic positivist thinking of the past, and embraced post-positivist approaches like grounded theory and participatory action learning.

Looking through this extension spectrum lens (Figure 3.11), it is easy to see why technology transfer has fallen out of favour. It is seen as an anachronistic legacy of the positivist era rather than a core methodology for future extension programs. While much of historical and contemporary agricultural research involves experimental designs with quantitative data collection and analysis, the concern with positivist approaches when applied to the social sciences is that the results of isolating and measuring phenomena may not be particularly applicable to the real world (Luthans & Davis, 1982).

At the other end of the spectrum are approaches like Participatory Innovation Development (PID), which fosters local innovation through farmer-lead, expert-supported innovation development (Waters-Bayer & Van Veldhuizen, 2004). One interesting aspect of PID, is that its not only designed to empower the technical participation of farmers, but also aims to transform the facilitating extension institutions.

Yet, the problem still remains that insufficient attention to adoption is hampering agricultural RD&E in Australia. Is it possible that a shift away from positivism, particularly in extension has caused research in extension practice to favour descriptive, theory-building approaches, making extension practitioners philosophically at odds with the need for programs to report quantifiable outcomes?

The key departure from positivism in agricultural research has occurred in extension, which intersects the scientific disciplines involving human subjects. These disciplines, which include social science, psychology and adult learning, reject the underlying positivist assumption that data and its analysis is '*situation-free*' and is unaffected by the procedures that measure and observe it. These assumptions are inappropriate for investigations of social

science phenomenon because human subjects are not '*independent, non-reflective objects*'. Instead, human subjects interact within the research context, acting interdependently and reflectively within the problem situations they encounter (Healy & Perry, 2000).

This conflict between program requirements for simple evaluation measures on one level, and the need to iteratively tailor interventions toward human development on the other, is not unique to agriculture. The education system is wrestling with similar dilemmas, where a conceptual oversimplification at the program level, treats learning as a product or outcome of instruction to be measured rather than something that needs to be tailored to meet the needs and aspirations of its recipients (Wells, 2000). The challenge is to find solutions that can adequately address these competing demands simultaneously.

Impediments to evaluation

Evaluation is another area that has come under fire. One would think that program management methodologies like Prince II (Office of Government Commerce, 2003), are designed to guard against a lack of rigour in program logic. Yet, these procedures are not impervious to the softening of measures. For example, one might argue that it is more cost effective to measure number of farmers that participate in a program and whether they felt the program was useful, rather than measuring whether the program lead to specific changes some time after it was delivered, given that the latter is substantially more costly to accurately measure. The argument for softening program evaluation is reasonable given that the specific impacts of extension programs on farming practices are notoriously difficult to isolate and measure (Anderson & Feder, 2004). In addition, most project funding occurs in a three-year timeframe, with delivery often occurring in the final year, making multi-year time-series evaluations particularly challenging.

The overlooked role of peer influence

In addition to this departure from theory testing paradigms and structural impediments to evaluation, program logic has also been hampered by an overly simplistic model of an attitude—behaviour relationship, for example (Barr & Cary, 2000; Crisp, 2010; Willock *et al*., 1999). Burton (2004) and Conte *et al*. (2010) observe that the role of peer influence (subjective norms) in present day extension activities is often poorly understood and implemented. To understand why, it is helpful to introduce Bennett's Hierarchy (Bennett, 1975) because it is such a widely used program logic framework in contemporary extension programs and their evaluation (Coutts, 2005).

Developed by Claude Bennett from the United States Department of Agriculture in the early 1970s, it remains as influential today as it was then. The hierarchy involves a seven-step '*chain of events*' that links inputs, the resources expended, to end results, the social, economic and environmental outcomes they lead to (Figure 3.12). The intervening steps begin with measuring the number of *activities* planned and conducted, the number of *people* who participated, their *reactions*, leading to changes in *knowledge*, *attitudes*, *skills* and *aspirations* (KASA) and ultimately practice change. One of many the strengths of this approach is that self-reported measures can be independently verified. Bennett notes that the evidence of program impact becomes stronger as the hierarchy is ascended; however '*hard*' evidence becomes more expensive to obtain the higher up the hierarchy you go.

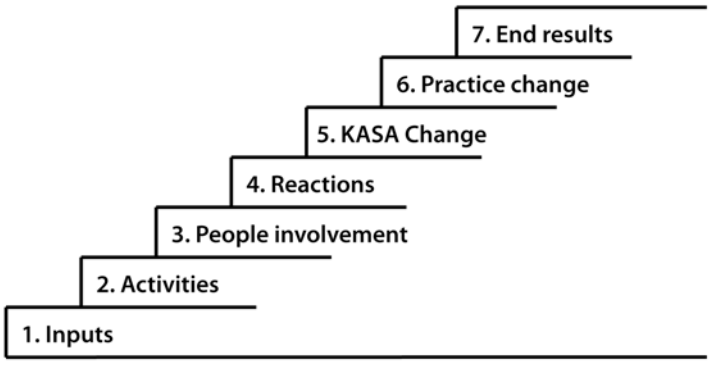

Figure 3.12 – '*A hierarchy of evidence for program evaluation*' (Bennett, 1975, p. 9)

A central assumption in Bennett's Hierarchy is that changing farmer *knowledge*, *attitudes*, *skills* and *aspirations* (KASA) leads to behavioural change. Unfortunately, by not keeping pace with advances in behavioural science, Bennett's Hierarchy overlooks the important role of peer influence in behavioural change (Burton, 2004). This leads to problems of *individual blame bias* where farmers are blamed for having '*attitude problems*', when in reality poor extension outcomes may be the fault of program design or the suitability of the innovation in question (Stephenson, 2003).

This discussion makes clear that for any technology transfer strategy to be effective, it will need to focus on the human development end of the extension spectrum, by empowering groups of farmers to leverage peer networks while at the same time providing programs with measurable evidence of outcomes. Above all, it must avoid the mistake of oversimplifying the theoretical basis of learning interactions and the behavioural influences on adoption. In this sense, technology transfer needs to be refashioned from an archaic top-down process into a participatory bottom-up approach that enables change by facilitating the transfer of innovations between farmers. However, it is also worth remembering that not all innovations will be useful to all farmers, and even when they are, farmers will have legitimate reasons for non-adoption (Vanclay, 2004). Thus, industry-wide farmer-to-farmer technology transfer should be seen as a means of assisting farmers who are looking to make changes, find solutions from a diversity of potentially suitable technologies and practices.

These competing challenges provided the impetus for selecting the realism paradigm for this study. Realism brings together practical elements from positivism and post-positivism in ontology, epistemology and methodology. In particular, mixed methods encourage theory building and theory testing, allowing both the description of broad influences where causality is contingent on context, and the measurement of treatment effects within those contexts (Healy & Perry, 2000).

Summary

In the previous section, four elements relating to farmer-to-farmer learning emerged. Firstly, the tacit social contract amongst farmers to be truthful and sincere, which makes their communication style efficient and egalitarian. Secondly, the social acceptance of an innovation by successive groups of adopters is an intrinsic aspect of the discourse about innovations amongst farmers. Thirdly, evidence-of-adoption allows farmers to mitigate the risks associated with individual development efforts by aggregating risk across a network of individuals who possess different expertise and experiences. Finally, operational detail is the language though which farmers communicate with one another about farming innovations.

Returning to the video clips created using the six rules set out in Section 2.5.1, we see that each of these elements is covered. For example, when asked to talk directly to camera in their own words about their own experiences, farmers are tacitly expected to be truthful and sincere. By describing their farming context and their experience implementing the innovation, they reveal how far the innovation has advanced in the adoption lifecycle. For instance, does it work? Does it have economic potential? Have any standard approaches emerged? The video clips also provide an opportunity for the farmers who watch them to be part of this virtual social network. Finally, by demonstrating the sequences of actions involved in each practice, farmers communicate the operational detail of the activities associated with the practice and the components it employs. Therefore, the video clips satisfy the basic validity claims of communicative action. The video clip creation also involves a bottom-up participatory process that engages directly with farmers. All of this suggests that from a theoretical perspective the video clip approach to technology transfer is very promising. The next step is to consider how evidence-of-adoption intersects with the cultural-historic context of individual farmers to trigger adoption behaviours.

3. 3 Theoretical framework and related research sub-questions

In this section, a synthesis of ToCA, CHAT and ToPB with extant literature previously discussed is combined with the heuristic model of farmer-to-farmer communication developed in Phase I (Section 2.5.2) to build a theoretical framework. The framework posits the mechanisms by which farmer-to-farmer learning triggers decisions to adopt new technologies and practices.

The framework (Figure 3.13) consists of four elements, industry-wise evidence-of-adoption, the individual cultural-historic farming context, motivating ideas and behavioural influences, which lead to intention and finally implementation and adoption. The terms used in this framework have been translated from behavioural science in order to make the concepts more accessible to readers.

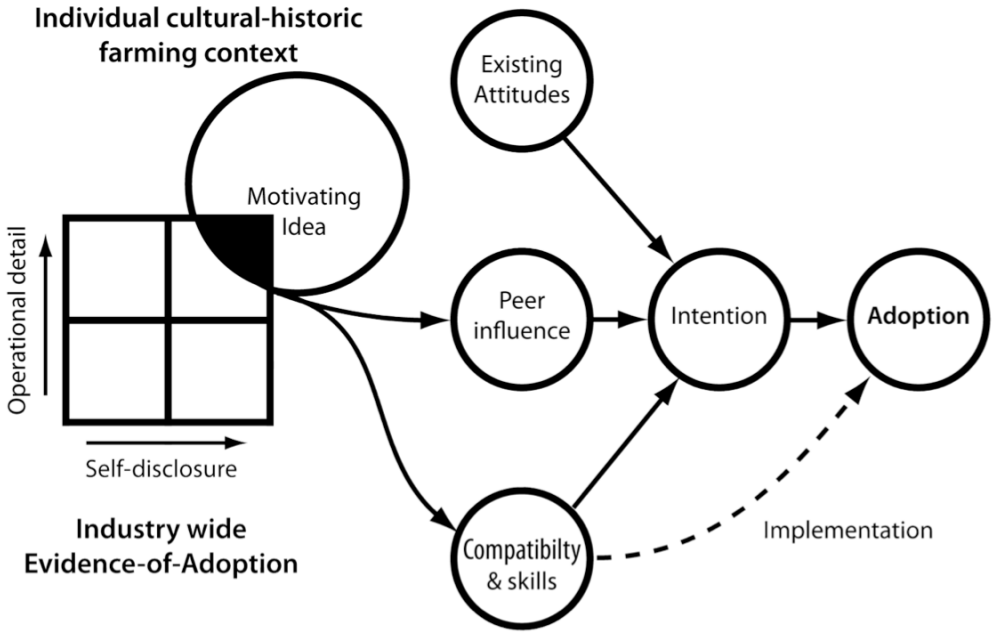

Figure 3.13 – A theoretical framework explaining how farmer-to-farmer evidence-of-adoption triggers adoption decisions.

It begins with industry-wide evidence-of-adoption, mediated by the validity claims derived from self-disclosure and operational detail. At the intersection between evidence-of-adoption and the individual cultural-historic context of the farmer, motivating ideas are formed. The

term '*idea*' was chosen here because it was a term commonly used by farmers. They would often reflect on how they '*got the idea*' to make a change after seeing something that someone else was doing.

The motivating idea is distinct from the implementation intention (Brandstätter *et al*., 2001), because the idea may not be fully resolved. For instance, a farmer may have the idea to make a change but hasn't found a suitable component that fits his circumstances. However, the idea is sufficiently motivating for the farmer to continue pursuing this learning goal.

The motivating idea leads to the behavioural influence when the farmer finds sufficient evidence to make the change. At this point, it is assumed that existing attitudes towards making the change have already been formed, and are positive. Evidence-of-adoption allows the farmer to implement the idea by providing the peer influence (subjective norms), perceptions of skill (perceived behavioural control) and evidence of compatibility. The peer influence is multifaceted because perceptions of self-identity are so intertwined with the activity of farming. That is, the way farmers choose to farm reflects the type of farmers they believe they are. For instance, production oriented, lifestyle focused or environmentally conscious. The operational detail allows the farmer to visualise how to implement the component within their existing farming system. Combined, these influences trigger the intention to adopt, which leads to actual behavioural control, the '*implementation*', which results in adoption.

Evidence-of-adoption

This framework assumes that extension programs are engaged in some form of technology transfer intervention that extension agents will facilitate. This begins with industry-wide evidence-of-adoption. Here the process and its operational definition are simply to:

Gather and communicate evidence-of-adoption.

Notice that this approach is both self-limiting and self-progressing, helping to ensure that the right messages are communicated at the right time. That is, if no evidence exists that a phase in the adoption lifecycle has been reached, not only is it unlikely to have occurred, but without the necessary evidence, it is premature to attempt to report it. That is, there is no point trying to tell farmers of the economic potential of an innovation if there is no on-the-ground evidence to support this claim. However, when adoption does shift from one phase to the next, for example from *Innovators* to *Early Adopters*, the available evidence will change, in this case, from technical know-how to economic potential.

As adoption moves through each phase in the adoption lifecycle, the quantity of evidence required will also tend to expand. That is, while *Innovators* might be satisfied with evidence that the technological innovation works, possibly from a single authoritative source – like the original researcher and their trial work – the *Early Majority* might require numerous sources of evidence from farmers and industry to feel confident that the innovation is emerging as a standard. All the downstream effects in the framework stem from the evidence gathered and communicated. It is assumed this will occur using video clips like the ones created for this study.

In terms of the quantity of evidence needed, a theoretical model of word-of-mouth learning (Banerjee & Fudenberg, 2004) suggests a minimum number of three video clips covering each innovation would be needed. That is, at least three video clips should be produced on any given subject, where each clip features the experiences of a different farmer. Through word-of-mouth, it is also assumed that these farmers formed their own opinions by drawing on information from at least three other sources. If the three stories report similar experiences, then Banerjee and Fudenberg believe the stories will have '*converged*' and will be more acceptable. If the stories don't converge, then clusters of stories around each farming context may need to be produced. Thus, in situations where significant climatic or edaphic differences exist, one or more clips covering each variation might also be warranted.

To test out this theoretical framework, four research sub-questions with related hypotheses and propositions are now presented. Here, '*evidence-of-adoption*' is used as shorthand for evidence gathered and communicated using video clips similar to those created for this study.

RSQ1: Does video mediated industry-wide evidence-of-adoption influence farmers' decisions to adopt innovations?

This question is rather fundamental. Either the video clips trigger adoption or they don't, and while the results reported by Gandhi *et al*. (2007) and Polson (1999) suggest that this is likely, these results need to be confirmed. Stated formally:

> **H1**: Farmers exposed to industry-wide evidence-of-adoption are influenced to adopt new technologies and practices.

RSQ2: Are farmers' decisions to adopt innovations significantly influenced by the subjective norms of peers?

This question tests the hypothesis that of the three ToPB predictors, subjective norms have the most room to support change. Therefore, it follows that:

> **H2**: Farmers exposed to other farmers' evidence-of-adoption, identify with this virtual peer group, leading to strong positive normative beliefs, encouraging them to adopt suitable innovations.

RSQ3: Does farmer self-disclosure allow evidence-of-adoption validity claims to be accepted?

This question tests the proposition that self-disclosure by farmers appearing in the video clips communicates enough information for objective, subjective and inter-subjective validity claims to be accepted on face value. That is, farmers will accept the truthfulness and sincerity of statements made and adoption characterises will be readably identifiable.

P1: Self-disclosure leads to an implicit acceptance that the statements made are sincere and truthful, as well as revealing the adoption characterises of the farmers who make them.

RSQ4: Do farmers favour operational detail over generalised abstractions when communicating about innovations?

This question tests the proposition that operational detail is the language though which shared *structures of meaning* about the activity of farming are expressed and efficiently conveyed between farmers.

P2: Operational detail is the language though which farmers convey meaning with one another about farming technologies and practices.

3. 4 Conclusion

This chapter has explored theoretical perspectives that link the mechanics of interpersonal communication with the agency of social cognition. The *Theory of Communicative Action* (Habermas, 1984; Habermas, 1987) revealed that the communication style of farmer-to-farmer learning with its tacit social contract of truthfulness and sincerity is both efficient and intrinsically egalitarian. Moore's (1999) *Chasm* theory revealed the role evidence-of-adoption satisfying Habermas's (1984) *inter-subjective* validity claim by demonstrating the social acceptance of an innovation by successive groups of adopters. *Cultural-Historic Activity Theory* (Vygotsky, 1986) revealed operational detail as the language though which farmers convey meaning about farming technologies and practices. The *Theory of Planned Behaviour* (Ajzen, 1991) showed the importance of peer influence (subjective norms) in behavioural change. Finally, a number of hypotheses and propositions were formulated. Measures used to test these are described next.

4 METHODOLOGY

4. 1 Introduction

The specific impacts of extension programs on farming practices are notoriously difficult to isolate and measure. Anderson and Feder (2004) note:

> *Because many factors affect the performance of agriculture in complex ways, it is difficult to attribute specific impacts at the farm level to extension services.*
> *(Anderson & Feder, 2004, p. 46)*

The premise of this statement implies adherence to the dominant positivist paradigm of isolation and measurement, which in itself can be problematic. The underlying assumption is that stable relationships exist between elements of social phenomena; where variance is explained as the error between individual cases and the 'average', and data analysis assumes that phenomena fit neatly into standardised, '*situation-free'* abstractions that can be reduced to a set of generalised variables (Luthans & Davis, 1982). The concern is that measurements of isolated phenomenon made in a controlled environment may not be particularly applicable to the real world, particularly when a mature body of literature is absent. Thus, in post-positivist social science, the central tenets of positivism are wholly rejected. Instead, *realism* is the predominant post-positivist paradigm (Trochim & Donnelly, 2007).

The advantage of realism is that it brings together practical elements of positivism and constructivism. From an ontological perspective, realism shares the positivist view that there is a reality external from us that can be observed and measured. However, from an epistemological perspective, realism shares the constructivism view that our ability as researchers to understand what we measure and observe is imperfect, and as such, reality is only '*imperfectly and probabilistically apprehensible*' (Healy & Perry, 2000). From a methodological perspective, because realism assumes that reality is incapable of being

perfectly understood it encourages mixed method approaches, triangulation, and seeking multiple perceptions.

Returning to Anderson and Feder's (2004) quote above, two important philosophical questions are raised. Firstly, can an intervention in agriculture ever be solely responsible for changes in farming practice, and secondly, can the attributed impacts be measured. From the theoretical perspective of *Cultural-Historic Activity Theory*, the former seems unlikely because there are such diverse influences on individuals as they learn, and are transformed by learning processes (Vygotsky, 1986; Wells, 2002). Nevertheless, from the behavioural perspective of the *Theory of Planned Behavior* (Ajzen, 1991) it is conceivable that a single inflexion point can exist, where influences tip the balance and trigger change. Thus, it is possible using ToPB to account for this narrower but potentially significant impact.

The video clips created for this study seem to be good candidates for behavioural triggers. They immerse audiences in a dialogic discourse with the farmer being interviewed. They convey acceptable validity claims through self-disclosure and communicate knowledge about the innovation through operational detail. However, the behavioural influences go further. The video clips reveal the skills needed to implement changes, so farmers can assess whether they already have or have gleaned these skills. The video clips also provide farmers with perceptions of controllability; they may have the skills, but are their farming systems compatible with the innovation? Finally, while farmers may already have positive attitudes towards making the change, hearing accounts from other farmers who have already made these changes may provide them with strong feelings of encouragement to follow though on these existing beliefs and change. The sum of all of the influences gained from watching a single video clip may trigger change in some farmers. Thus, gathering and communicating multiple evidence-of-adoption perspectives across an industry increases the likelihood of influencing change in a substantial number of farmers.

The realism paradigm was applied to the methodology of this study in both pragmatic and practical way. It involved, constructing a sequence of events with two states, pre-treatment, and post-treatment, then a dependant variable was measured for associative variation between these two states. This dependent variable reflected the influence the video clips had on farmers' decisions to change. Finally, causal relations between the dependant variable and other independent variables were used to describe the behavioural influences and rule out other possible causal factors (Green *et al.*, 1988, pp. 107-110). Post treatment, farmer-to-farmer learning interactions were also analysed to confirm the role of self-disclosure and operational detail. In this respect, this methodology serves the role of testing hypotheses and propositions arising from the theoretical framework, which in turn arose from an inductive analysis of Phase I exploratory research.

4. 2 Research procedures

The '*Video Roadshow*' as the presentation was known, was given to farmers in 12 sugarcane growing regions over a two-week period. The data collection combined qualitative and quantitative methods. The presentation consisted of three segments, each followed by a facilitated group discussion. At the end of the presentation, a survey was administered electronically.

4.2.1 Treatments

The treatments used in this study consisted of two DVDs, a website and one three part video presentation. The two 50-minute DVDs, described as '*Virtual Bus Tours*', were distributed by CANGROWERS to their members. The first DVD featured sugarcane best management practices and the second DVD featured nutrient best management practices. The DVDs and video presentation contained about 20 different stories each, with over 60 in total. The video clips included presentations by both farmers and researchers in a ratio of about 3:1. All of the video clips were available online from the shedmeeting.com.au website (Thomas, 2008),

which was set up specifically for the project. The 50-minute video presentation consisted of three segments: farming systems, spray application and nutrient application, including compost. A list of the video clips used in these treatments appears in APPENDIX A.

To ensure a high level of accuracy, CANEGROWERS organised a panel to review each video clip on the DVDs. This panel included researchers, agronomists and extension agents familiar with the Australian sugar industry. Their comments were used to vet and edit the content prior to publication. In some cases, controversial sentences were removed. For instance, one farmer stated that stool splitting spread ratoon stunting disease. A senior plant pathologist from BSES reported there was no scientific evidence supporting this controversial view, so the sentence was removed from the clip. In another case, a farmer stated that cutting green lead to elevated phosphorous readings in runoff. It was later revealed that the test strips he had been using were unreliable. Those statements were also omitted. In a few cases, entire video clips were left out. For instance, one farmer was videoed driving heavy equipment in bare feet. This was deemed an unacceptable occupational health and safety practice, so the video clip was rejected outright.

All CANEGROWERS members received a copy of the two DVDs over the course of the year starting in October 2009 when the website was launched. The DVDs were mailed out with CANEGROWERS monthly magazine. The DVD sleeve also included the web address of the research website. CANGROWERS members received the DVDs about six months apart, with the second received about six months prior to the '*Video Roadshow*', when the data was collected. The '*Video Roadshow*' presentation was given to 12 groups of farmers at regional cane growing centres starting at Mossman in Far North Queensland and finishing up in Maryborough in the Southern district (see Figure 5.2 for details). As part of this presentation, these groups viewed the three video treatments in a controlled setting.

4.2.2 Sample

Sampling was stratified across 12 regional locations in order to minimise selection bias (Kish, 1995). The sample population was approximately 4,000 cane farmers. The sample frame consisted of members of the industry's peak body CANEGROWERS, who's membership accounts for over 90% of Australian cane farmers. The sample size for the facilitated ad-hoc discussion (qualitative data) was 118. Whereas, the sample size for the survey (quantitative data) was only 78, as some participants left early for various reasons, given that there was a delayed harvest. Not all questions were answered by participants, so the actual sample size for each variable is included with each result. The most common reason for this was that some respondents were research and extension agents, not farmers, so some questions were not appropriate for them to answer. In a few cases, farmers simply did not want to answer the question for personal reasons.

The number of farmers who participated in each group ranged from 1 to 18, with an average of 10. While it was hoped that the number of farmers who participated would have been both more consistent and larger, the data collection coincided with a delayed harvest due to wet weather, which caused attendance at each region to be erratic. In one location, only one farmer out of 15 to RSVP attended due to a break in the inclement weather. In this instance, only the facilitated discussion was employed. In two additional cases, where the groups were very small (3 and 2 members respectively), only the first 18 questions were completed because only one member of the group indicated they planned to adopt a practice, which was a prerequisite for answering the final 22 questions. Given the way the electronic survey was set up, this would have also meant that the aggregated results (see Section 4.2.4), which were presented in a graph after each question would have no longer been anonymous. In retrospect, a separate electronic survey, which did not report aggregate results after each question, should have been prepared and administered for this eventuality. Fortunately, the total sample was large enough to produce statistically significant correlations for the data

analysis. This is one of the strengths of the within-subject design, it requires fewer subjects to achieve statistical significance (Gravetter & Wallnau, 2008).

4.2.3 Design

This study's methodology used a retrospective post-test-only design based on the assumption that inferences about causal relations could be drawn from three types of evidence, associative variation, the sequences of events, and the absence of other possible causal factors (Green et al., 1988, pp. 107-110). Only 13 variables, represented by the solid circles in the network graphs that appear in Chapter 5, satisfied these assumptions (see Figure 5.1 on Page 145 for an example).

Social scientists typically use some type of time-series quasi-experiment, known as a within-subject design, where subjects act as their own control. The strength of the within-subject design is that it requires fewer test subjects, as it measures changes at an individual level over time, which eliminates problems caused by test subjects with significant individual differences (Gravetter & Wallnau, 2008, pp. 353-355).

Normally ToPB surveys are administered via mail in a simple time series, a few weeks apart (Ajzen, 2006). From the point of view of time and convenience, a mail survey would have seemed ideal. However, for this study, mail surveys, along with online data collection were considered but ultimately ruled out. These approaches would not permitted the type of qualitative data needed to be collected.

All in all, the within-subject quasi-experimental design was chosen because it was practical and achievable (Owen, 2006).

4.2.4 Facilitated ad-hoc discussions and survey administration

Each session started with an introduction to the research project, a statement of its aims, and a disclosure of the methods employed. Farmers were given an information sheet

(APPENDIX C) then invited to participate in the study, and if they agreed, they were given a consent form to sign (APPENDIX D), and assured that the data was recorded anonymously, would be reported in aggregate, and they could withdraw at any time without fear of consequences. All farmers who attended, regardless of whether they wished to complete the survey were free to watch the video presentation, participate in the discussions and join in any pre-event or post-event catering.

During the course of the presentation, each group of farmers was exposed to the same three treatments. Each treatment consisted of numerous evidence-of-adoption video clips of farming practices that related to a theme. These themes were: farming systems, spray application and nutrient application, including compost (see APPENDIX A for a list of the actual video clips). These themes were chosen based on their perceived relevance and interest to farmers given the farming and institutional context presented earlier in Section 2.3. However, in each of these treatments, video clips were also included that covered controversial practices. For instance, in farming systems the use of burning as a means of reducing tillage prior to planting legume break crops. In spray application, the use of shielded sprays with low application rates, and finally in nutrient application, the use of compost to improve soil health and structure which resulted in high yields for three years without applying any additional fertiliser. These controversial practices were included to seek negative outlying cases, because not all farmers were expected to accept the validity claims of statements made by these presenters.

After watching each video segment, the researcher would ask the audience if they had any questions. If no questions were forthcoming, which was often the case, the researcher would provide farmers with additional snippets of information relating to one of the farming practices they had just seen. These statements were intended to simulate the farmer learning interactions (like those previously observed in Section 2.4.3).

For example:

> *[RESEACHER] In that shield spray unit clip, it didn't mention that he does rotate low rates of roundup with at least one spray of gramoxone to prevent weed resistance building up. He normally does that later in the season. He is also conducting a trial with the [LOCAL PRODUCTIVITY BOARD] comparing shielded roundup with pre-emergents, and they found a 10 to 15 percent productivity hit with the pre-emergents…*
>
> *[FARMER1] Just clarify for me again, I understand that you said that the test that was done, pre-emergent vs roundup that the pre-emergent was 15% better, is that right?*
>
> *[RESEACHER] No, the pre-emergent was 10 to 15 percent <u>worse</u> than the roundup. The pre-emergent was actually knocking the productivity of the cane…*
>
> *[FARMER2] It was worse than the Roundup at one litre a hectare? With the single nozzle?*
>
> *[RESEACHER] With the single nozzle…*
>
> *[FARMERS CONTINUE CONVERSATION]*

After making several successive statements, like in the example above, farmers would typically begin to ask questions of the researcher, followed by questions and statements to each other, at which point the researcher would withdraw from directing the discussion and only answer questions. However, if the conversation stopped, the researcher would begin with another set of statements about a different topic. The goal was to keep the discussion going for at least 10 minutes after each treatment. The discussions were recorded, and later transcribed and analyzed using the procedure described later in Section 4.2.6.

Contemporaneous notes were used to record any new descriptive concepts that emerged. Any new concepts would be discussed further with subsequent groups. In this way, much like a *mind map*, every group discussion attempted to explore new concepts as well as those that naturally reoccurred (Green *et al*., 1988, pp. 97-99). Recurring concepts were ticked of the list, and new concepts added to the bottom. Themes included discussions around internet use, off-farm income, the convenience of attending bus tours and field days, reef regulations, the suitability of '*best practices*' for each region, but mostly discussions centred around details about specific practices. For example, the use of Gromoxone as a rotation with Roundup to guard against weed resistance when low application rates are employed, or the potential reasons why a farmer was able to stop fertilising for three years after applying significant rates of compost to his soil.

The purpose of these discussions was to simulate farmer-to-farmer learning interactions similar to those that had been previously observed (Section 2.4.3). In this regard, it didn't really matter what topics the farmers chose to discuss, so long they related in some way to the practices shared by the farmers in the video clips. This was because the data of interest from these discussions was the acceptance of validity claims and the language used to convey meaning. While opinions were sought on different subjects, the goal was to stimulate discussion rather than reach consensus, and to ensure that a diversity of themes were discussed so negative cases were given every opportunity to be aired.

At the end of the presentation, farmers were invited to participate in a ToPB survey, which was administered electronically using an Audience Response System (ARS). The ARS is an interactive polling system that uses wireless keypads. Each survey question was presented as an individual slide in a Powerpoint presentation. The question appeared at the top of the slide with a numeric list of answers below, each answer corresponding to a number on the wireless keypad. Subjects answered the questions by pressing the numeric key that matched their desired response. After all the subjects had answered a question, a graph showing the frequency of responses was displayed. This provided direct feedback to the subjects, which

often stimulated further discussion. Bellati *et al*. (2009) reported similar experiences using an ARS in a training setting, noting that the highly interactive nature of this direct feedback enhanced farmers learning experience.

A total of 40 questions were asked which took about 20 minutes to complete. The entire presentation including the survey took an average of two hours. At the end of the first 18 questions, farmers were asked if they could identify a practice they planned to change or had changed as a direct result of watching the DVDs or the video presentation. That is, farmers where asked whether they could identify something they had seen in the video clips that they planned to try out on their farms. Only these farmers were asked to answer the final 22 questions.

The ARS had a feedback mechanism (a panel of green indicators projected on the screen) to ensure that each participant responded to each question. Nevertheless, while participants were encouraged to answer every question, they were not required to do so.

4.2.5 Survey Instrument

The *Theory of Planned Behaviour* (ToPB) is commonly used to design survey instruments that measure the influence interventions have on behavioural intentions, which are the precursor of behaviour. A standardised procedure to aid the design of ToPB questionnaires is laid out in Ajzen (2002) and Francis *et al*. (2004). A copy of the survey instrument used in this study appears in APPENDIX B.

The use of ToPB to construct the survey instrument can be justified on the following basis. In a critical review of rural studies, Burton (2004) argues that researchers' understanding of farmer decision-making processes could be improved by using ToPB as a conceptual framework. Edwards-Jonesa (2006) holds a similar view, noting a tendency in extension evaluation surveys to only measure and analyse attitudes while ignoring the importance of normative influences, self-identity, and perceived self-efficacy. Kaufmann *et al*. (2009)

demonstrate that all three ToPB predictors: *Attitudes*, *Subjective norms*, and *Perceived behavioural control*, are significant in modelling farmers' decision-making and behaviour. Finally, Fielding *et al*. (2008) confirms the strong correlation between these three predictors and subjects' behavioural intentions and ultimately their self-reported behaviour. Thus, ToPB can be justified on the grounds that it is an appropriate predictive model to measure the outcomes of behavioural interventions.

In a ToPB survey instrument, Ajzen (2006) recommends the use of two questions to assess each behavioural belief, one to measure the strength of the belief and the other to measure its impact on the subject. This repetition of questions that appear similar but are subtly different tended to irritate farmers, particularly after answering 20 pairs of questions in a group setting. For this reason, a single Likert-type scale was used to account for both dimensions in a single measurement. This was accomplished by changing the wording of the central element from *neither agree or disagree* to *ambivalent*. In this way, a single question could be answered with either the positive or negative strength or a low impact central score.

There is some contention about the selection of beliefs in behavioural interventions. Ajzen (1991) originally prescribed the use of an exploratory study to elicit beliefs that are unique to each subject and then to construct a list of *'modal'* beliefs that are commonly held by the research population. A further study would then identify which beliefs have a strong correlation to the model groups that exhibit the desired behaviour, and a weak correlation in the research population. These beliefs would then be promoted in the research population by an intervention in an effort to change behavioural intentions.

This approach is no longer recommended because it may identify beliefs in the model group that have little relative importance to the research population. Ajzen (2006) now recommends the identification of new behavioural, normative and control beliefs, and a pilot study to identify which beliefs are *'accessible'* to the research population, and which ones are not. An intervention would then promote these *'accessible'* beliefs.

Neither of these approaches was appropriate for this study. Ajzen (2006), operating in the medical field, assumes interventions will be limited in their ability to promote *'accessible'* beliefs in a campaign, for instance, using a 30 second advertisement. As such, Ajzen's pilot study prioritises and selects beliefs that are expected to have the greatest influence on the research population. Only a few beliefs are ultimately chosen. In this study, it is the opposite case, numerous video clips provide many potentially accessible beliefs, however these beliefs are only expected to influence a limited number of farmers. It is this aggregation of this plurality of accessible beliefs that is expected to provide the greatest influence.

On a more practical matter, this survey instrument used a unipolar scale of 1 to 5, which was converted to a bipolar scale for the data analysis. There is nothing in ToPB to inform whether responses should use unipolar (1-5) or bipolar (-2/+2) scales (Ajzen, 1991). Kaufmann *et al*. (2009) has tested and confirmed that either scale is appropriate, because farmers use '*all belief scales in the same manner*'. The scale of 1 to 5 was chosen because the Audience Response System used to administer the survey only had six numerical data entry keys in the wireless keypads, thus attempting to use any other scale would have been unnecessarily convoluted.

For clarity, each of the survey questions is presented with its variable (in square brackets) and the list of response options (italicised), however this variable was not shown to farmers in the actual survey. All questions use the following 5 level Likert-type scale unless otherwise noted.

[Variable] Question…

(responses) *Strongly disagree* | *Disagree* | *Ambivalent* | *Agree* | *Strongly agree*

In addition to measuring influences on behavioural intentions, the survey instrument also collected useful demographic information about the subjects. These questions are examined first.

Demographic information

The demographic information typically collected by surveys includes *farm size*, *age* and *education* (Riesenberg & Gor, 1989). Gloy *et al*. (2000) suggest the addition of *Internet use* and uptake of *Precision agriculture* as measures of technology uptake and propensity for adoption. The precision agriculture question is pertinent given that sugarcane farmers are at various stages of adopting GPS guidance to enable controlled traffic and minimum till, which are core components of the '*new farming system*' described earlier in Section 2.3. This study also considered the impact of *off-farm income*, which was not known at the time, and was believed may impact farmers' ability to attend group based extension activities.

The following six demographic questions were asked.

- **[Farm Size]** What is your farm size in hectares?

  < 25ha | 25-50ha | 51-100ha | 101-300ha | > 300ha

- **[Age]** What is your age?

  < 20 | 20-35 | 36-50 | 51-65 | > 65

- **[Education]** Which answer best describes your education?

  High School | Certificate | Trade | Diploma | University | Post Graduate

- **[Internet use]** Which answer best describes your Internet use?

  Never | Someone does it for me | Rarely | Monthly | Weekly | Daily

- **[Precision Ag]** What degree of precision agriculture has been applied in your farming operation?

  None | Controlled Traffic | Zonal Tillage | Precision Metering | Management Zones

- **[Off-farm income]** What percentage of your time is spent earning income off-farm?

  < 10% | 10-20% | 21-50% | 51-80% | 81-90% | > 90%

The region farmers came from was also recorded.

Content information

In addition to demographic information, ten questions were asked to gauge video clips' impacts and influences as well as subject content preferences.

- **[DVD Awareness]** Have you watched any of the CANEGROWERS Virtual Bus Tour DVDs?

  No | No, but planning to | Yes | Yes, several of them | Yes, several times

- **[Video clips worthwhile]** I think watching video clips of growers experiences implementing new technologies and farming practices is worthwhile.

- **[Video clips raises profile]** I think clips of growers implementing best practices will improve our industry's public image and raise its profile with government.

- **[Find & watch online]** I would like to be able to find and watch new grower video clips via the Internet.

- **[Attend another roadshow]** I would like to attend another Video Roadshow presentation next year.

- **[Contact presenter]** I would like to contact one or more of the presenters in the video clips to get further information.

- **[Prefer local content]** I prefer video clips of grower experiences from my local region.

- **[Growers vs. researchers]** I prefer video clips of grower experiences to those given by researchers.

- **[Prefer more structure]** How much structure and formality would you prefer?

  Not sure | Just the grower | Signpost each topic | Present topic, signpost each clip | Signpost and present each clip

- **[Prefer more direction]** I prefer unscripted interviews where presenters drive the conversation and tell-it-as-they-see-it.

Unscripted and unstructured | Unscripted but some direction | Mixed | Scripted but some off-the-cuff | Structured and scripted

Find & watch online was explained to be an aspirational goal, in that subjects didn't have to know how to find and watch the videos, just whether they would like to do so.

RSQ1: Does video mediated industry-wide evidence-of-adoption influence decisions to adopt innovations?

This research sub-question developed in Section 3.3 has the following hypothesis.

H1: Farmers exposed to industry-wide evidence-of-adoption are influenced to adopt new technologies and practices.

To test this hypothesis the following questions were asked.

- **[Plan to change]** I plan to change one or more of my practices after watching the Virtual Bus Tour DVDs and/or today's presentation.
- **[Area of change]** Which area of practice are you planning to change?
  Green Cane Trash Blanket | Nutrient Management | Controlled Traffic & Minimum Till | Legume Fallow | Compost | Spray Application

However, given that the dependent variable *Plan to change* was so important to this study, the following statement accompanied the question.

[RESEARCHER] 'In answering this question, can you identify a practice, something you saw in one of the video clips, that you have decided to try out on your farm after watching Virtual Bus Tour DVDs or today's presentation'

For the *Area of Change* variable, treatment '*themes*' were selected because some like *Green Cane Trash Blanket* were mature, whereas others like *Compost* and *Spray Application* were still considered Innovative, while the rest were largely mainstream. If evidence-of-adoption

favoured one group in the adoption lifecycle over another, one would expect to see uptake favouring some of these '*themes*' more than others. Numerous farmers reported that they planned to adopt more than one practice from different areas, so they were instructed to select the area that was of greatest importance to them.

RSQ2: Are farmers' decisions to adopt innovations significantly influenced by the subjective norms of peers?

This research sub-question developed in Section 3.3 has the following hypothesis.

> **H2**: Farmers exposed to other farmers' evidence-of-adoption, identify with this virtual peer group, leading to strong positive normative beliefs, encouraging them to adopt suitable innovations.

To test this hypothesis subjects were asked 17 ToPB questions. These questions were adapted from the Kaufmann *et al*. (2009) instrument used to measure adoption of organic farming. These questions were only asked of farmers who had identified one or more practices in the video clips they were planning to try out on their farms. Farmers were asked to substitute the phrase '*this practice*' in each question, for the practice they planned or had changed.

- **[Attitude 1]** *This practice* is likely to maximise farm profitability.
- **[Attitude 2]** *This practice* leads to improved soil health.
- **[Attitude 3]** *This* is a more sustainable farming *practice*.
- **[Attitude 4]** *This practice* will allow me to expand my farming operation.
- **[Attitude 5]** *This practice* creates a safer workplace.
- **[Attitude 6]** *This practice* provides a healthier environment for me and my family.
- **[Attitude 7]** *This practice* will increase the possibility of my farm providing employment.

- **[Normative 1]** I feel ... by the farmers in the videos to convert to *this practice.*

  Strongly discouraged | *Discouraged* | *Ambivalent* | *Encouraged* | *Strongly encouraged*

- **[Normative 2]** I feel ... by the researchers in the videos to convert to *this practice*.

  Strongly discouraged | *Discouraged* | *Ambivalent* | *Encouraged* | *Strongly encouraged*

- **[Normative 3]** My family will ... me converting to *this practice*. .

  Strongly discourage | *Discourage* | *Be ambivalent about* | *Encourage* | *Strongly encourage*

- **[Normative 4]** Other farmers I respect will ... me converting to *this practice.*

  Strongly discourage | *Discourage* | *Be ambivalent about* | *Encourage* | *Strongly encourage*

- **[Control 1]** I have all the necessary skills to adopt *this practice.*

- **[Control 2]** My farm would support the adoption of *this practice*.

- **[Control 3]** Switching to *this practice* wouldn't require much change to my current operation.

- **[Control 4]** I could afford to adopt *this practice*.

- **[Control 5]** I could cope with the future financial risk of adopting *this practice.*

To test for behavioural intention subjects were asked to agree or disagree with the following statement based on the recommendations of Herring (2008).

- **[Intention]** I would recommend this practice to other farmers.

A positive correlation between *Normative 1*, *Plan to Change* and *Intention* in the absence of other behavioural correlations with *Plan to Change*, would confirm that the virtual peer group had been influential.

Negative case sampling

To rule out other possible causal factors, subjects were asked to agree or disagree with the following five statements to retrospectively assess their adoption history using Bennett's Hierarchy (Bennett, 1975). A lack of correlation with *Plan to Change* would disconfirm that the predictive influence of Bennett's Hierarchy. Likewise, a lack of correlation between *Internet use* and uptake of *Precision Ag* with *Plan to Change* and *Intention* would also disconfirm the predictive influence of DoI.

These questions were adapted from the Polson (1999) instrument, which was used to measure the degree of adoption after farmers watched a video of a *'master farmer'*. These questions were only asked of farmers who had identified one or more practices in the video clips they were planning to try out on their farms.

- **[Hierarchy 1]** I am interested in finding out more about *this practice*.
- **[Hierarchy 2]** I have sought advice about *this practice*.
- **[Hierarchy 3]** I have attended training on *this practice*.
- **[Hierarchy 4]** I know how to implement *this practice* on my farm.
- **[Hierarchy 5]** I have already adopted *this practice* on my farm.

The results of *Hierarchy 5* are also useful because they indicated the number of farmers who had already implemented the practice on their farms.

Instrument validation

The survey instrument was tested to confirm face and content validity with the first two groups of farmers who participated in the study. That is, these group helped to evaluate the instrument's ease of use, clarity, and readability, as well as the relevance, accuracy and appropriateness of its measurement scales (Burton & Mazerolle, 2011).

The first group of farmers, from Mossman were presented with each question and asked to discuss the range of answers that might be relevant in their district. A number of new concepts emerged from these discussions, which were used to rectify problems with the survey instrument. This led to the inclusion of one additional question (*Contact presenter*) and the revision of how several questions were worded.

The second group of farmers were asked to complete the survey instrument, but in this case, after each question was answered, the researcher prompted them the comment on how well their answers aligned with the expected answers given by the first group. One question was altered based on the second group's responses (as a result, the second group's answers to this altered question were left out of final data set used for analysis). Due to time constraints, the second group were only able to answer the first 18 questions. The validated survey instrument was then used with the remaining groups of farmers who participated in the study.

4.2.6 Qualitative data analysis

The facilitated ad-hoc discussions described earlier in Section 4.2.4 were recorded, and later transcribed and analyzed. Because of the nature of the research questions being asked, this analysis proved to be relatively straightforward. The transcripts were divided into units, categorised and then coded. Discrete *thought units* were chosen as the most appropriate unit of analysis. Thought units are comprised of a single idea, regardless of whether it is expressed as a full sentence, a '*verb-object*', a single word, or utterance (Srnka & Koeszegi, 2007). For example, '*I agree*', and '*yeah*' both denote agreement within a statement.

RSQ3: Does farmer self-disclosure allow evidence-of-adoption validity claims to be accepted?

This research sub-question developed in Section 3.3 has the following proposition.

P1: Self-disclosure leads to an implicit acceptance that the statements made are sincere and truthful, as well as revealing the adoption characterises of the farmers who make them.

To test this proposition, *thought units* were categorised based on whether the farmers in the group discussions questioned the validity claims of descriptive concepts from the video clips or trusted them on face value. Neutral statements were ignored and negative cases analysed.

RSQ4: Do farmers favour operational detail over generalised abstractions when communicating about innovations?

This research sub-question developed in Section 3.3 has the following proposition.

P2: Operational detail is the language though which farmers convey meaning with one another about farming technologies and practices.

To test this proposition, *thought units* were categorised based on whether the speaker described concepts using abstractions of operational details. Once again, neutral statements were ignored and negative cases analysed.

After being categorised, the data was coded and tabulated. Simple descriptive statistics were used to report the results, accompanied by verbatim quotes, to provide low inference examples of the units of analysis and their categorisation. Throughout the quantitative data analysis in the next chapter, relevant descriptive concepts are also quoted to provide additional interpretive value.

4.2.7 Quantitative data analysis

Data was exported from the ARS software and imported into Excel to perform descriptive analysis and to prepare the data for graphs. Statistical analysis was carried out using JMP 9.0 from the SAS Institute. The ARS tabulated the data collected, which was exported in

standard comma delimited spreadsheets. This eliminated the possibility of data entry errors, and made it easy to import the data into other software packages.

Non-parametric tests were used for the data analysis. Statistical tests used included Spearman's Rank Correlation analysis, the Kruskal-Wallis H test and the Wilcoxon Signed-Rank test (Gravetter & Wallnau, 2008). These tests were chosen because most of the survey questions used a five-level Likert-type scale, and non-parametric tests are an appropriate choice (Gravetter & Wallnau, 2008, pp. 665-666) for this type of ordinal scale (Jamieson, 2004). Variables also demonstrated excessive skewness and/or kurtosis risk in about a third of cases, meaning their distribution was not normal, another reason non-parametric tests were appropriate. Factor analysis revealed that the variables were largely independent, given that 20 factors for 40 variables were required for Eigen values to fall below one. Therefore, correlations between pairs of variables were selected as the most appropriate form of analysis.

4. 3 Justification of the methodology

This justification begins by testing both phases of this study's methodology against Johnson's (1997) general list of strategies used to promote research validity. This is followed by an examination of the methodology presented in this chapter against quality criteria for research within the realism paradigm (Healy & Perry, 2000; Trochim & Donnelly, 2007).

4.3.1 Research validity strategy

Johnson's (1997) list of strategies used to promote research validity and a description of how they were addressed by this study are as follows:

Researcher as 'detective': In this metaphor, the researcher searches for evidence of cause and effect by systematic consideration of potential causes and elimination of alternative explanations. During the first phase of this study, this researcher systematically built theory

though iterative exploratory research and critical insights from self-reflecting on what had been learned. These insights informed the second phase of this study, allowing the researcher to apply a more focused and target approach. This strengthens internal validity, where results justify conclusions that the observed relationships were causal (Johnson, 1997).

Extended fieldwork: In phase one of this study, this researcher visited dozens of farms, amassing over 50 hours of videoed farmer interviews and related coverage. In the process this researcher collected valuable insights '*in the field*' over an extended period, strengthening the theoretical validity of this research (Johnson, 1997).

Low inference descriptors: Both the farmer video clip interviews and the facilitated group discussions were recorded and transcribed. Example of these interviews and discussion appear as '*verbatim*' direct quotations, strengthening the descriptive validity of these accounts (Johnson, 1997).

Triangulation: Johnson (1997) recommends some combination of data, method, or theory triangulation. This methodology employed data and theory triangulation. For data triangulation, which strengthens internal validity, multiple perceptions following three different video treatments were sought from facilitated group discussions. While a combination of qualitative and quantitative methods was used to collect data, the data being tested and analysed did not overlap significantly, however descriptive concepts were used to strengthen the interpretation of quantitative results. In the theoretical framework being tested, multiple theories were combined. This not only strengthens the theoretical validity that the explanation provided by the framework fits the data, but also leads to greater insights into the research questions being answered (Johnson, 1997).

Participant feedback: By using the Audience Response System, participants were provided feedback after each question with a graph showing aggregated results. This gave participants and opportunity to comment on the data and its interpretation prior to its analysis, strengthening its interpretive validity (Johnson, 1997).

Peer review: Throughout the course of this study, the researcher sought peer review by presenting aspects of this work at successive annual sugar industry conferences (Thomas, 2009; Thomas, 2010; Thomas, 2011). Presentations were also given to QPIF staff at the Bundaberg Research Station (2009) and the Farm Management Systems committee meeting in Mackay (2010).

Negative case sampling: In order to reduce the likelihood of confirmation bias (Nickerson, 1998) this methodology employed negative case sampling. During the facilitated group discussions, a *mind map* of descriptive concepts was traversed to ensure that a diversity of themes were discussed, giving negative cases every opportunity to be aired. Commonly used program logic and adoption theories, namely *Bennett's Hierarchy* (Bennett, 1975) and *Diffusion of Innovation* (Rogers, 2003) where tested against the *Theory of Planned Behaviour* (Ajzen, 1991) to rule out alternative causal factors and competing explanations.

Reflexivity: Through systematic critical self-reflection, this researcher was aware of how his predispositions and biases may have affected this research, its data collection methods, analysis and conclusions. These sources of bias and mitigation strategies employed to lesson their impact were covered in Section 2.2.3.

4.3.2 Quality criteria for research within the realism paradigm

The appropriateness of this methodology for research within the realism paradigm can be justified on the quality criteria established by Healy and Perry (2000). These were addressed by this study are as follows:

Ontology

Ontological appropriateness: Realism is an appropriate paradigm because this study deals with complex social science phenomena involving reflective human subjects.

Contingent validity: This research has contingent validity because it emphases the description of broad influences where causality is contingent on context. That is, evidence-of-adoption communicated through self-disclosure and operational detail, is not expected to influence all farmers equally. Instead, evidence-of-adoption is only expected to influence the decisions of a limited number of farmers who's cultural-historical farming contexts are compatible with specific innovations. As such, it is anticipated, that broader impacts will come from gathering and communicating industry-wide evidence-of-adoption covering a diversity of themes.

Epistemology

Multiple perceptions: Realism relies on multiple perceptions of a single imperfectly knowable reality. The use of triangulation provides multiple perceptions of this reality. This study is epistemologically appropriate because it began with an iterative exploration, which sought multiple perspectives. It then built a theoretical framework from multiple theoretical perspectives, and finally tested that framework by seeking multiple perceptions from facilitated group discussions following three different treatments along with a survey that tested multiple behavioural influences.

Methodology

Methodological trustworthiness: This stems from the use of low inference descriptors. Both the farmer video clip interviews and the facilitated group discussions were recorded and transcribed, and example of these interviews and discussion appear as direct quotations.

Analytic generalisation: This research has analytic generalisability, because its results are primarily theory building. That is, elements in the heuristic model, which lead to the theoretical framework, were iteratively built and confirmed or disconfirmed before being formally tested. Later, quantitative analysis, provided external validity about the generalisability of this theoretical framework to the research population.

Construct validity: The extended fieldwork undertaken in the development of the treatments lead to insights grounded in practical experience. These insights informed the theoretical triangulation and synthesis from which the theoretical framework was developed. This combination of iterative exploratory research followed by theory building and testing provides construct validity, by ensuring that the data collected measures the theoretical constructs they were intended to measure.

4. 4 Ethical considerations

The University of Southern Queensland Human Research Ethics Committee approved this study design and methodology. In accordance with the principals of ethical conduct, all participants were treated in a dignified manner with integrity and respect. This project was informed by the active participation of farmers, and farmers stand to benefit from its outcomes. This study observed the principals of ethical conduct as follows:

Integrity: In designing the video clips, it is particularly important to ensure that any new beliefs promoted by them are accurate (Ajzen, 2006). Beliefs provide the foundations of behaviour, providing information about potential outcomes, peer expectations and likely performance. While the video clips were designed to enable vicarious learning opportunities to take place, in the process they also promoted new beliefs that influence farmers' intentions. For these reasons it was important that information presented in the video clips is as accurate as possible.

To ensure a high level of accuracy, CANEGROWERS organised a panel to review each video clip included on the Virtual Bus Tour DVDs. This panel included researchers, agronomists and extension agents familiar with the Australian sugar industry. Their comments were used to edit the content of the published DVDs. In some cases controversial sentences were removed. In a few cases entire video clips were left out.

Respect for persons: It is possible that some of the questions that were being asked – like whether farmers work off-farm – could make the participants feel depressed about their present circumstance. While this was possible, it was considered unlikely to have any lasting impact. The session provided farmers with an opportunity to observe a range of farming practices that could benefit their farming operations and provide a positive outlook for the industry.

A similar problem of pro-innovation bias has already been noted with DoI theory. In this study, every effort was made to remove any emotional bias from discussions of adoption, so rather than implying that *Innovators* are good and *Laggards* are bad, discussions centred on the strength of evidence presented and the farming contexts most suited to different practices.

Beneficence: Aside from the indirect benefit from the new knowledge gained from the findings from this report, the participants in this study benefited directly from the opportunity to observe first-hand accounts of the latest farming practices from across the Australian sugar industry. The knowledge gained from this experience would require a significant investment of time and effort if it were to be obtained on an individual basis.

Participants also spent considerably more time watching these video clips and debating the merits of the practices they had observed with each other than they spent answering questions. In many cases these discussions continued long after the presentation and survey had ended.

Social Justice: If widely adopted, the approach presented in this report should improve social justice for innovative farmers. These farmers, championed by extension programs, are often called upon to provide access to their farms for bus trips, field days and shed meetings. As such, they shoulder a disproportionate burden of voluntary responsibility for encouraging best-practice adoption within the industry. The techniques employed by this study significantly reduce the burdens imposed on these farmers.

Procedure: Each presentation started with an introduction to the research project, a statement of its aims, and a disclosure of the methods employed. Farmers were invited to participate in the study and provided with a one-page description of the study and a one-page consent form. After reading the description of the study, farmers were told that they were not required to participate in the study in order to watch the presentation, and even if they decided to participate in the study they could withdraw at any time without prejudice.

4. 5 Conclusion

Figure 4.1 summarises how the hypotheses and propositions tested by the methodology presented here relate back to the theoretical framework.

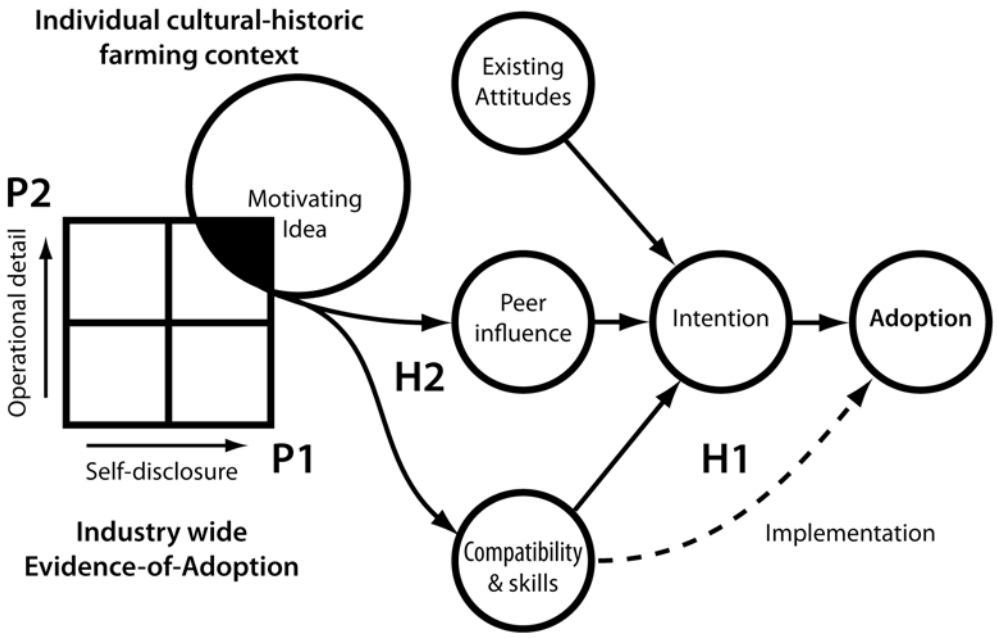

Figure 4.1 –Hypotheses and propositions mapped to the theoretical framework.

This chapter began by considering the problem of measuring the specific impacts of extension programs. Realism was introduced as the research paradigm. Next, the research procedures were presented, including the treatments, sample, design, and the administration of group discussions and the survey instrument. The design of the survey instrument and data analysis procedures followed, mapping the research questions and hypotheses to the survey questions and propositions to the qualitative data and its analysis. Negative case sampling to

minimise confirmation bias was also discussed. Next, the methodology was justified using validity and quality criteria for research within the realism paradigm. Finally, a description of how methodology observed the principals of ethical conduct was presented. Having detailed and justified the methodology used to collect data and test it, the next chapter presents its analysis.

5 ANALYSIS OF DATA

5. 1 Introduction

In this chapter the analysis of data, collected using the methodology of the previous chapter is presented. This analysis begins with the quantitative data and is followed by the qualitative data. Throughout the quantitative analysis, relevant descriptive concepts or *thought units* are quoted to further strengthen the interpretive value of the results. Only the results of analysis are presented here, a discussion of these findings within the context of the literature appears in the final Chapter 6.

This chapter begins with a description of the survey subjects; it then enumerates each of the hypotheses and propositions, developed in Section 3.3, and analyzes relevant results to draw inferences about causal relations. The word '*farmers*' is used in the descriptive narrative of this chapter to replace the terms '*survey subjects*' and '*survey respondents*' to improve readability and succinctness. Readers are reminded that not all survey participants answered each question, thus the word '*farmers*' should be interpreted to mean the sub-set of survey subjects who answered a particular question.

This analysis primarily uses three types of evidence to draw inferences about causal relations: associative variation, the sequences of events, and the absence of other possible causal factors (Green et al., 1988, pp. 107-110). To test for associative variation, this analysis primarily uses Spearman's ρ (also known as Spearman's Rank Correlation analysis).

Network graphs are commonly used in analysis to map relationships between large numbers of variables. For instance, King *et al*. (2009) used network graphs to map knowledge sharing relationships between farmers. In this analysis, network graphs are used to map causal relations between variables. The network graph in Figure 5.1 provides a summary of the very

statistically significant correlations ($p < 0.01$) that were found to exist between pairs of variables in this study.

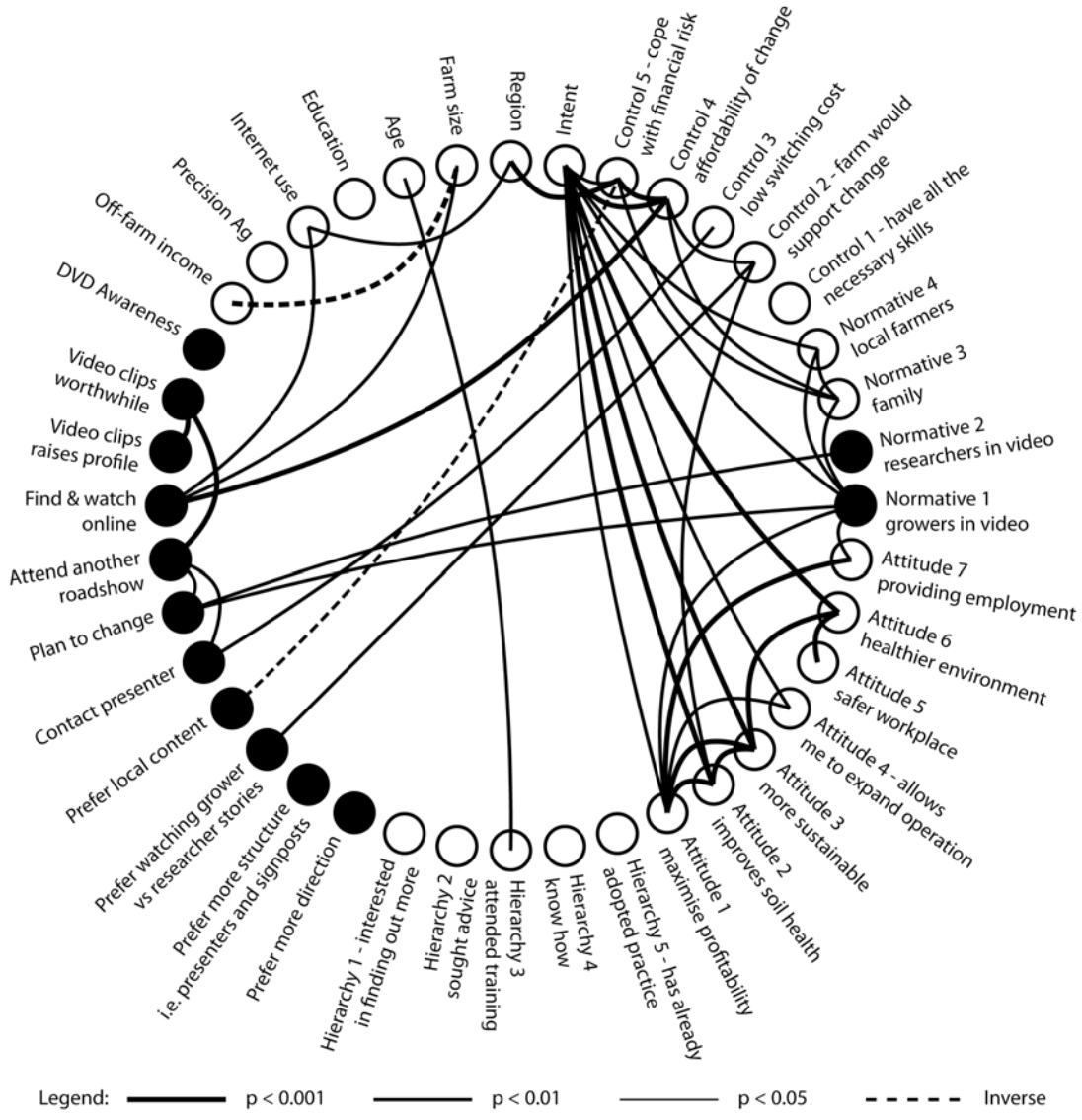

Figure 5.1 – A network graph showing the very statistically significant Spearman's ρ correlations between pairs of variables

Network graphs, used throughout this chapter, illustrate the statistically significant Spearman's ρ correlations between pairs of variables. Each line between two variables in the network graphs represents a correlation. That is, as the value of one variable increases, the other also tends to increase. Dashed lines represent inverse correlations; where as one variable increases the other tends to decrease. The thickest lines represent highly significant

correlations where $p < 0.001$, the next thickest lines represent very significant correlations where $p < 0.01$, and the thinnest lines represent significant correlations where $p < 0.05$.

Given that each variable is largely independent and needs to be considered separately, the network graphs help to draw attention to variables with larger numbers of significant correlations. These variables proved to impart greater interpretive value to this analysis than those linked to fewer significant correlations.

There are 13 variables in the network graph (Figure 5.1) where circles representing variables are filled in. In the *sequence of events* starting with watching the video clips on the DVDs and ending with participation in the survey, the filled in variables are the only dependent variables, whose associative variation resulted from exposure to the video clips and thus, their correlations are the only ones that can be used to infer causal relations.

5. 2 Subjects

The first seven questions in the survey were used to collect demographic information about the survey subjects. Not all participants were cane farmers; nine of the 78 participants were agronomists, extension agents and staff of regional CANEGROWERS offices. These non-farmer participants were instructed to only answer the 14 questions that did not specifically relate to farming.

5.2.1 Regional Differences

The '*Video Roadshow*', as it was known, was held in 12 regional cane growing centres starting at Mossman in Far North Queensland and finishing up in Maryborough in the Southern district (Figure 5.2). The distribution of respondents across cane growing districts was relatively even (Figure 5.3). The smaller number from Tableland balances the larger number from Cairns, while the small number from Bundaberg can be added to Maryborough. The Burdekin district (Ayr) is possibly the most under represented relative to its size and

importance. However, given the distribution of subjects across districts is relatively even (balancing like with like), it was not considered necessary to weight any of the responses relative to their place of origin (Kish, 1995).

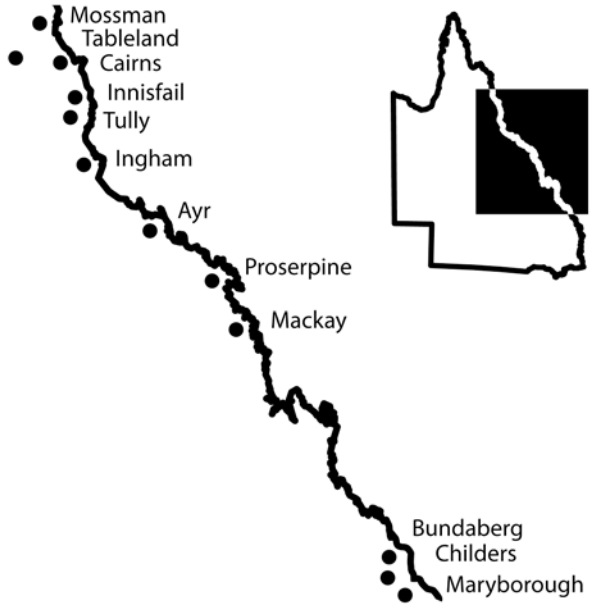

Figure 5.2 – A map of Queensland showing the location of each region

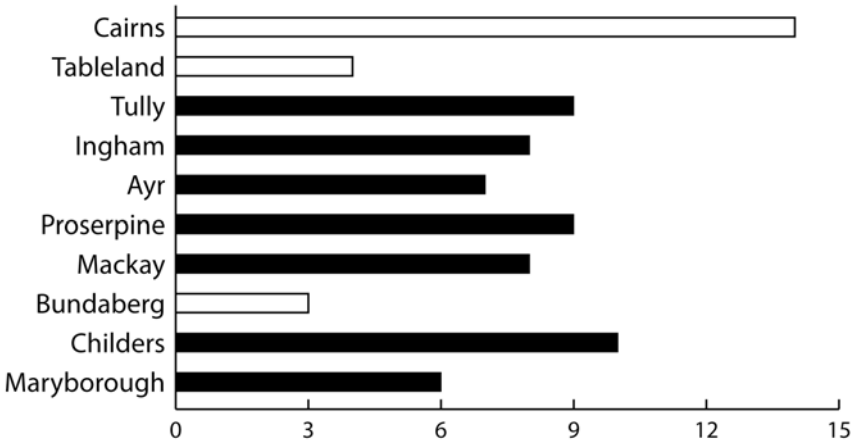

Figure 5.3 – The number of survey participants by *Region* (n = 78)

The unshaded bars in Figure 5.3 (Cairns, Tableland and Bundaberg) represent survey subjects that were only asked the first 18 questions in the survey. In the case of the Cairns group, this was because they were part of the survey instrument validation. In the case of the Tableland and Bundaberg groups, this was because too few survey participants identified a

farming practice in the videos they planned to try out on their farms (only one and zero respectively).

Correlations relating to region

There were numerous significant correlations that paired with *Region*, predicting nonzero correlations in the population. These correlations are illustrated in Figure 5.4, where positive correlations are more southern (represented by solid lines), and inverse correlations are more northern (represented by a dashed lines).

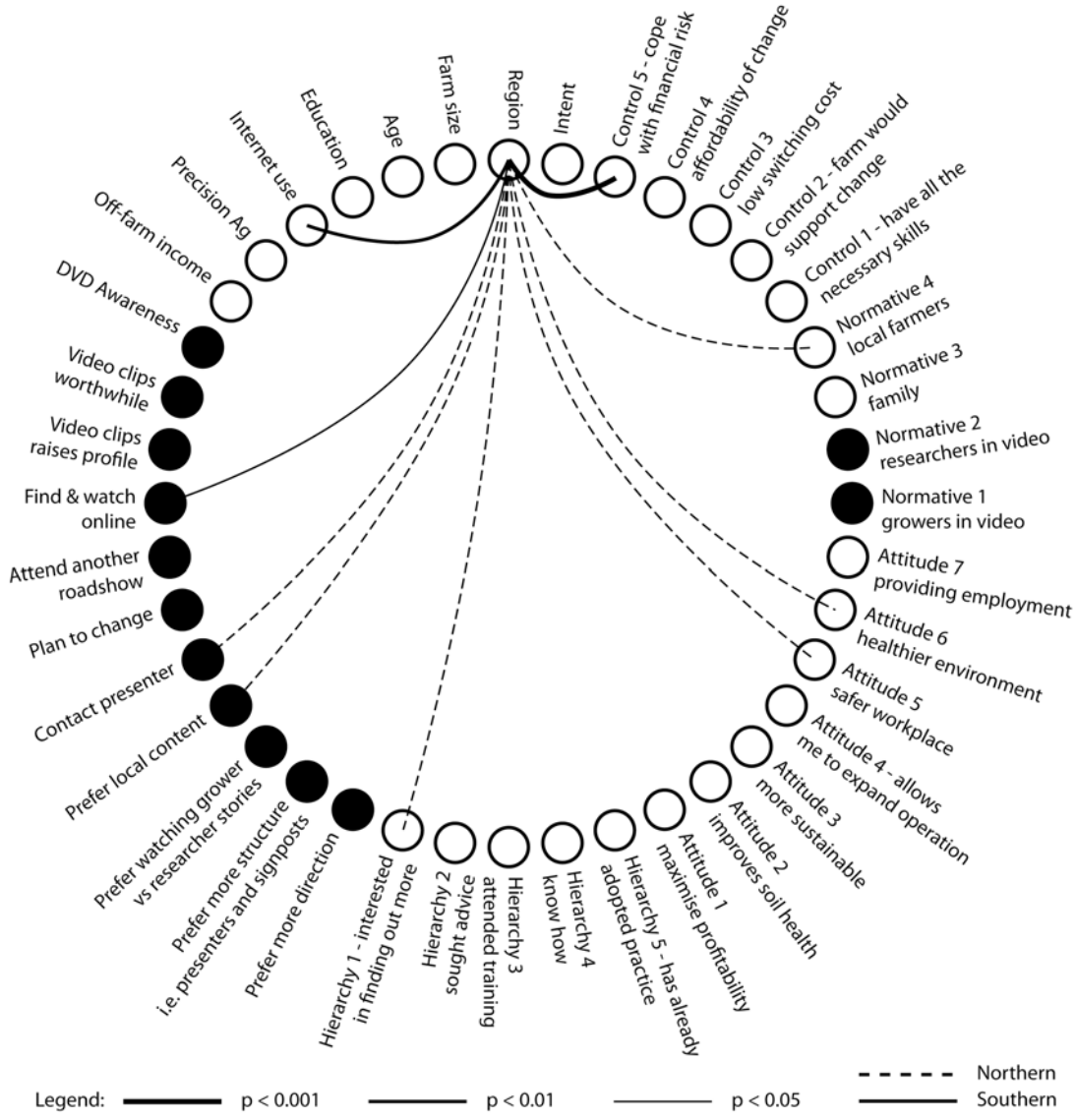

Figure 5.4 – Spearman's ρ correlations between *Region* and other variables

Southern farmers:

- believed they could cope with the financial risk of adopting the practice they planned to adopt from the videos;
- were more regular users of the Internet; and,
- were more interested in finding and watching new grower video clips online.

Northern farmers:

- were more interested in contacting one or more of the presenters in the video clips;
- felt more encouraged to change by other farmers they respected;
- had a stronger preference for local content; and,
- believed the practice they planned to adopt from the videos:
    - would provide a healthier environment; and,
    - would provide a safer workplace.

Descriptive concepts relating to region

Northern farmers described a sense of frustration, even anger, that many of the farming practices were unsuitable for them. It appears that many of the practice changes that have come out of the Sugar Cane Yield Decline Joint Venture (SYDJV) are more suitable for districts south of Townsville. These practices, including green cane trash blanket, controlled traffic, minimum till and legume fallow, were featured heavily in the DVDs and video presentation developed for this study. Northern farmers felt overlooked and wanted to see examples of practices that were better suited to their regions.

SYDJV practices have been actively promoted by regional Natural Resource Management (NRM) groups to improve the water quality of the creeks and rivers that feed into the Great Barrier Reef lagoon. At the same time, the Queensland state government has introduced new Reef Regulations to achieve similar objectives through enforcement. There was a strong

concern expressed by northern farmers that policy makers and politicians in Brisbane – who had little understanding of the differences between cane growing regions – would legislate the use of SYDJV farming practices, requiring northern farmers to implement practices that they believe weren't suitable for their soils, terrain and rainfall patterns. As a consequence, northern farmers wanted video clips of practices that were successful in their region to be promoted as best practices to counter what they perceived as a *southern practice* bias.

Example 1:

> *[FARMER1] But what if they turned up at your place and said, your not going to grow cane unless you grow soybeans, what are you going to say? They are trying to get one system that fits everyone from New South Wales to Cairns.*

Example 2:

> *[FARMER2] There are about 240 farmers in this district, just an approximate figure I have plucked out of the air, so there are probably 400 different systems, because there are a couple on each farm, and none of them are wrong […] you can't tell someone that their wrong if their not wrong.*

Example 3:

> [*FARMER*3] *The other problem that we see is that the government is giving these innovators money to look into these schemes, and if the government decides that what he is doing is really good, they want everybody to do the same thing without giving them the money to do it. [LOTS OF AGREEMENT]*

This might explain the stronger preference for local content amongst northern farmers.

5.2.2 Farm size

Farm size was the first of the demographic questions to be asked. The median farm size range was 101 to 300 hectares, which accounted for 42% of survey participants (Figure 5.5). This is consistent with the industry average of about 100 hectares. It leads to the conclusion that the distribution of farm sizes amongst participants in this survey was not inconsistent with the average sugarcane farm size, indicating that the sample is reasonably representative of the population. That being said, there may be a small bias towards larger farms in the survey population.

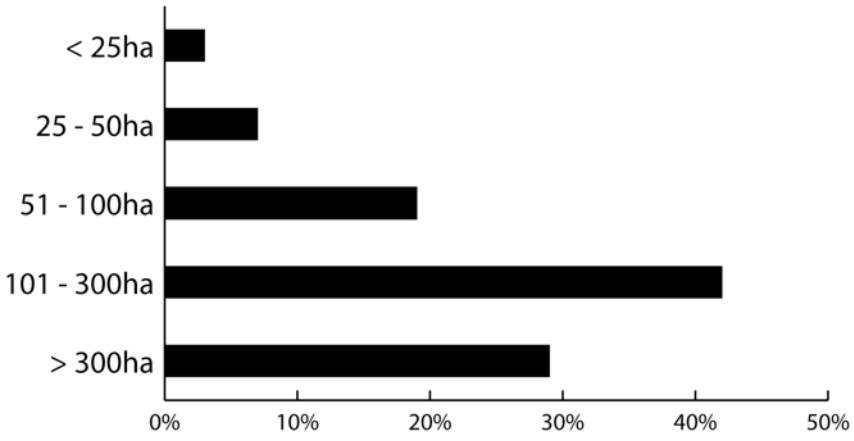

Figure 5.5 –Frequency of responses for *Farm Size* (n = 69)

Correlations relating to farm size

There were several significant correlations that paired with *Farm Size* (Figure 5.6), predicting nonzero correlations in the population.

Farmers with smaller farms:

- earned a larger proportion of their income off-farm.

Farmers with larger farms:

- were more interested in finding and watching new grower video clips online; and,
- believed the practice they planned to adopt from the videos would improve soil health.

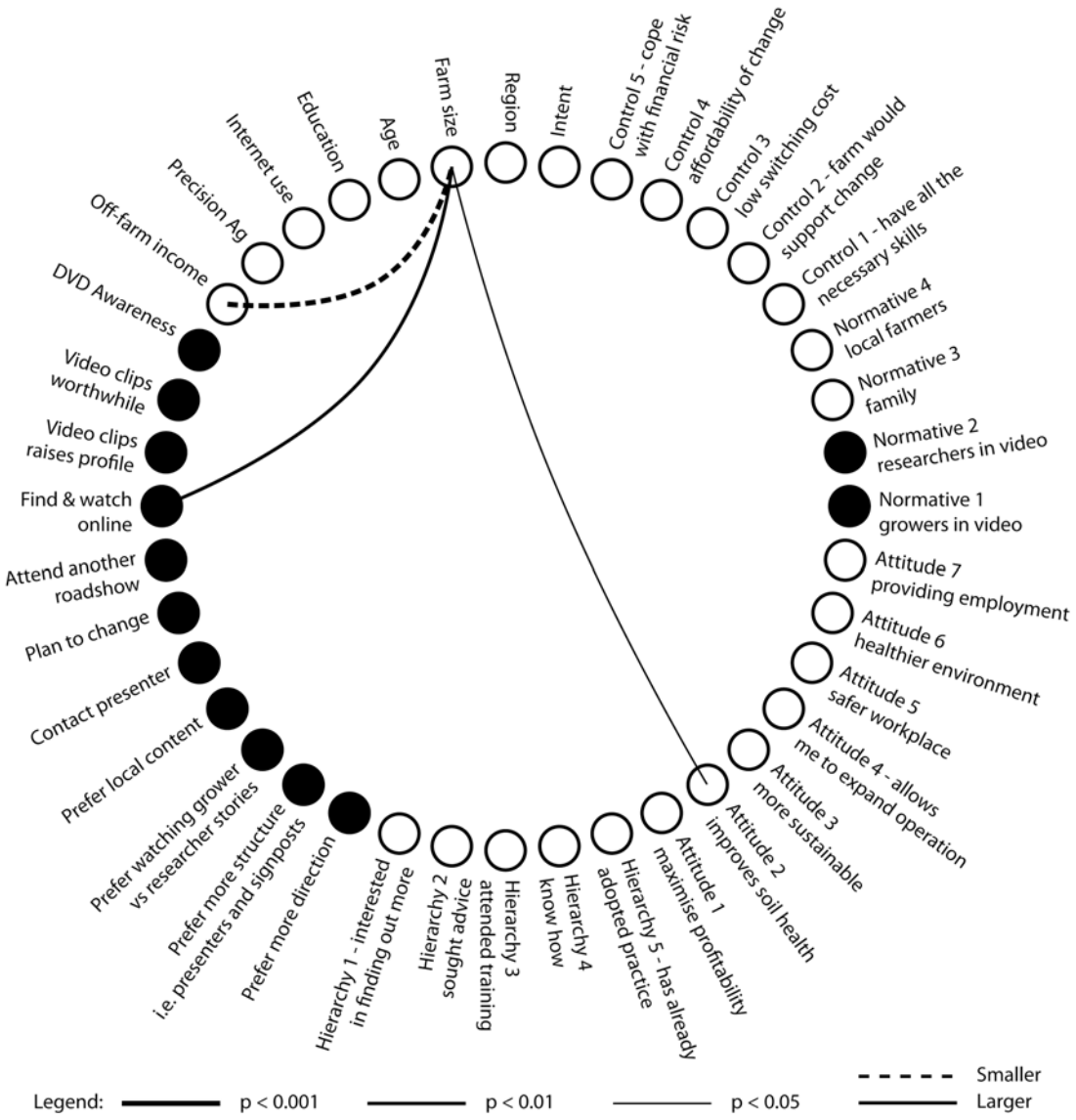

Figure 5.6 – Spearman's ρ correlations between *Farm Size* and other variables

Descriptive concepts relating to farm size

Several farmers with larger farms commented that in conducting research for their own business operations they had visited many of the farms and farmers whose practices were featured in the video clips. This was no small undertaking on their part. It had taken many years and involved research, planning and the expense of travel and time away from their businesses. With the Virtual Bus Tour DVDs, they expressed sentiments of envy because all farmers now had access to the kind of information that they had invested significant amounts of time and effort obtaining. That being said, they expressed very positive views about the

benefits these videos would have. However, they also noted that in some cases, the videos didn't present as much information as they had been able to obtain in person. These comments were made outside of the facilitated group discussions and were not recorded.

5.2.3 Age

The median age range was 51 to 65, which accounted for 46% of survey participants (Figure 5.7).

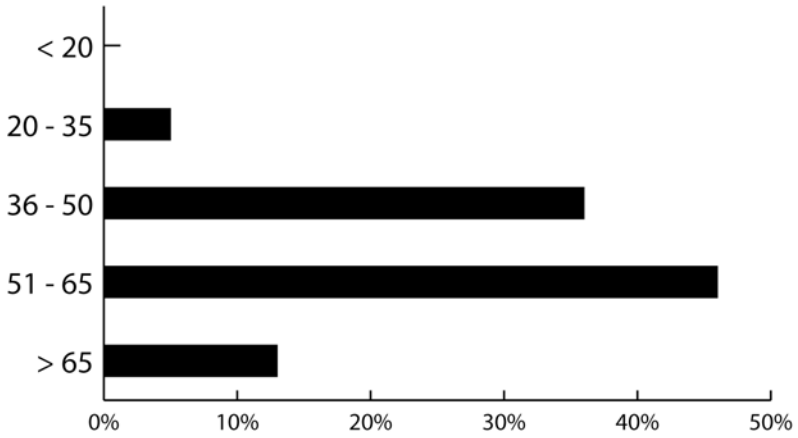

Figure 5.7 – Frequency of responses for *Age* (n = 78)

Correlations relating to age

There were only a few significant correlations that paired with *Age* (Figure 5.8), predicting nonzero correlations in the population.

Older farmers:

- were more likely to have attended training about the practice they planned to adopt from the videos; and,
- preferred a more scripted interview style in the video clips.

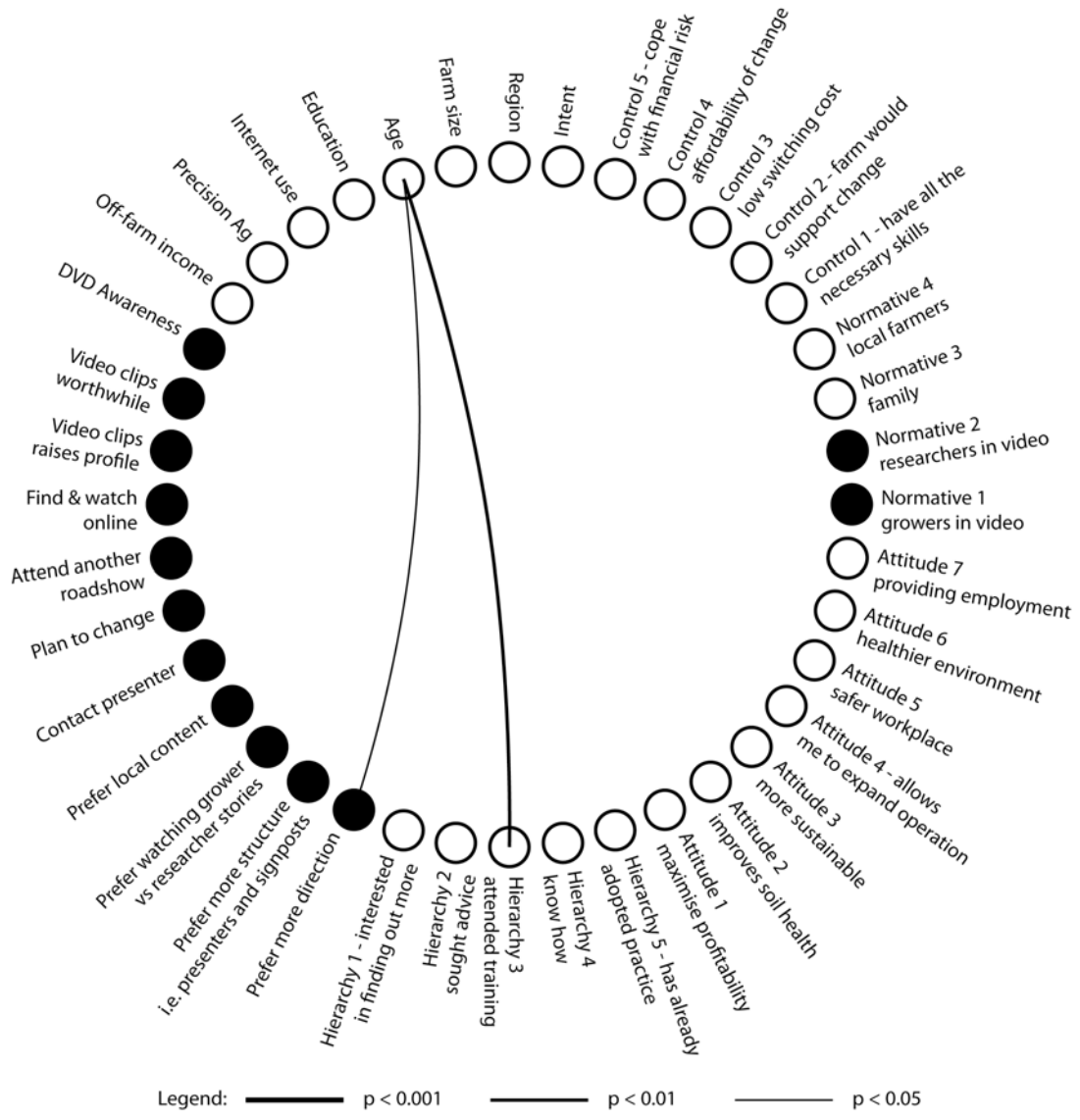

Figure 5.8 – Spearman's ρ correlations between *Age* and other variables

Descriptive concepts relating to age

Several older farmers indicated that they disapproved of the presentations given by some of the younger farmers appearing in the video clips. They were acutely aware that these videos clips would be seen by people outside of the industry and felt that some of the younger farmers made a bad impression. This was not so much a criticism of the younger farmers farming practices, but more a criticism of their presentation skills, choice of words, grammar and in one case, lack of eye contact with the camera.

For example:

[FARMER1] I'm not happy with that guy, it looks bad, makes us look bad…

[RESEARCHER clarifies who and what he is talking about]

[FARMER1] … like growers are all cowboys, he can't even remember what ratoon we're looking at. I'm not happy about it.

5.2.4 Education

Survey participants were asked to characterise their education. The largest group were high school educated, accounting for 43% of responses (Figure 5.9).

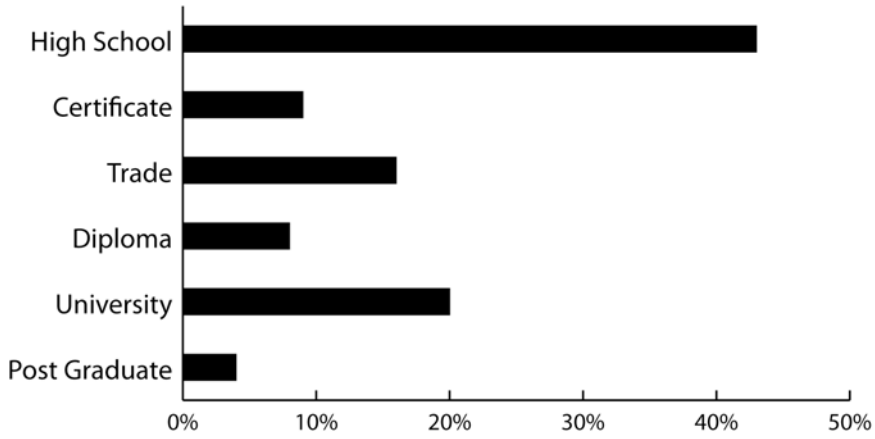

Figure 5.9 – Frequency of responses for *Education* (n = 75)

Correlations relating to education

There were several significant correlations that paired with *Education* (Figure 5.10), predicting nonzero correlations in the population.

Tertiary educated survey participants:

- were more regular users of the Internet.

High school educated farmers:

- were more likely to recommend the practice they planned to adopt from the videos to other farmers;
- were more likely to have watched one or more of the DVDs;
- believed more strongly that video clips of farmers implementing best practices would improve the industry's public image and raise its profile with government; and,
- were more likely to have already adopted the practice from the videos.

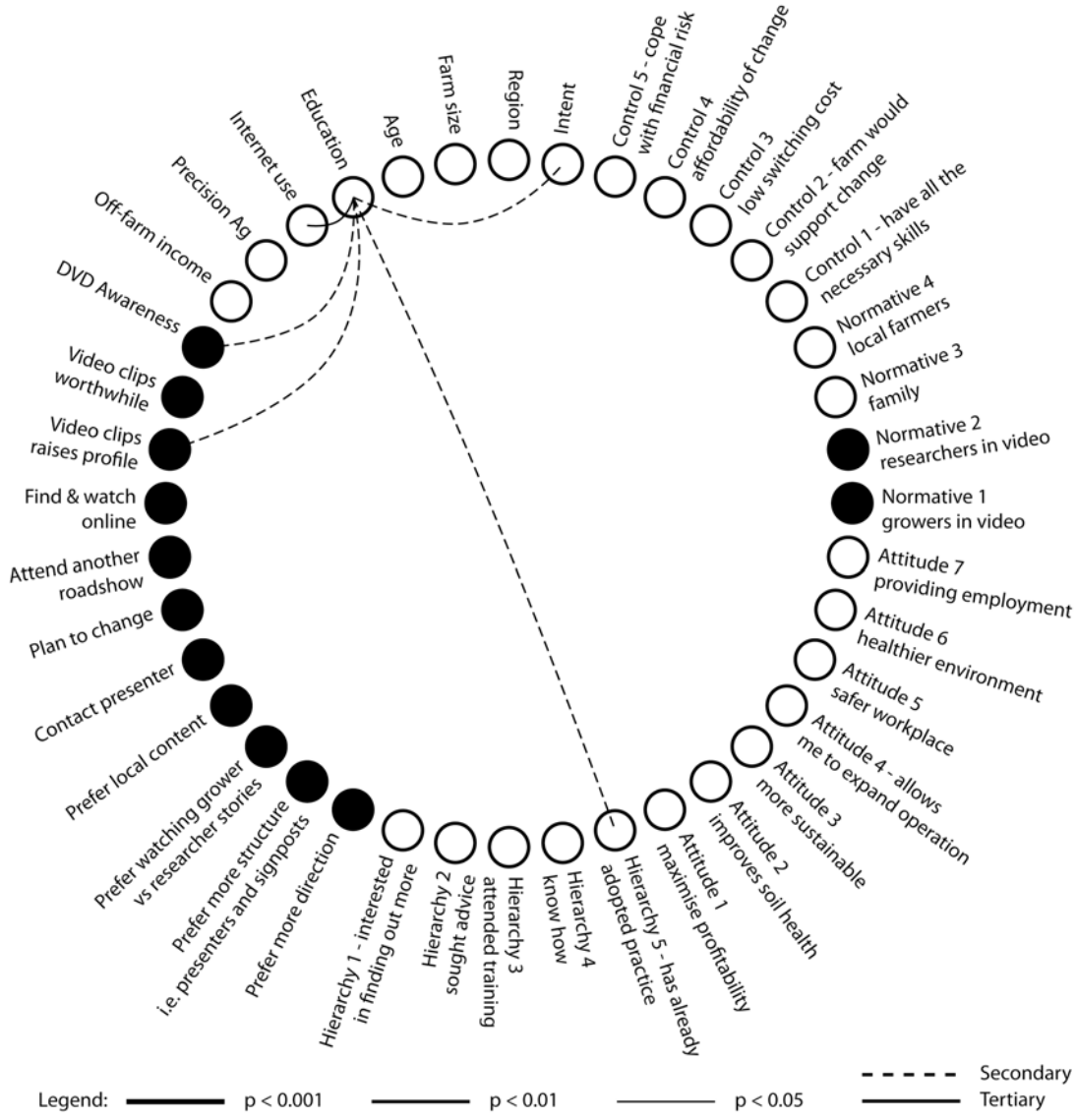

Figure 5.10 – Spearman's ρ correlations between *Education* and other variables

At first glance, this last correlation appears to be inconsistent with DoI theory (Section 3.2.2), where early adopters are characterised as having a high level of education. However, in reality, the practices adopted by farmers from the videos clips covered mainstream technologies as well as early stage innovations, so adopters of these practices are not expected to be all '*Innovators*' and '*Early adopters*' per se.

Descriptive concepts relating to education

There were a few of farmers who indicated that the range of answers provided with the survey question was inadequate because they had not attended high school.

5.2.5 Internet use

Survey participants were asked to characterise their Internet use. The majority use the Internet on a daily basis, accounting for 68% of responses (Figure 5.11).

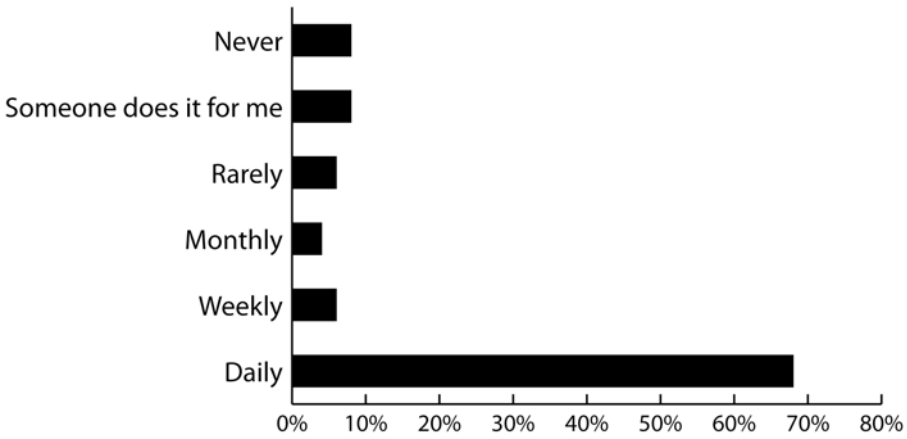

Figure 5.11 – Frequency of responses for *Internet Use* (n = 78)

Correlations relating to Internet use

There were several significant correlations that paired with *Internet Use* (Figure 5.12), predicting nonzero correlations in the population.

Survey participants who use the Internet regularly:

- were more interested in finding and watching new grower video clips online;
- were more interested in videos clips from outside their local area;
- came from more southern districts; and,
- were more likely to be tertiary educated.

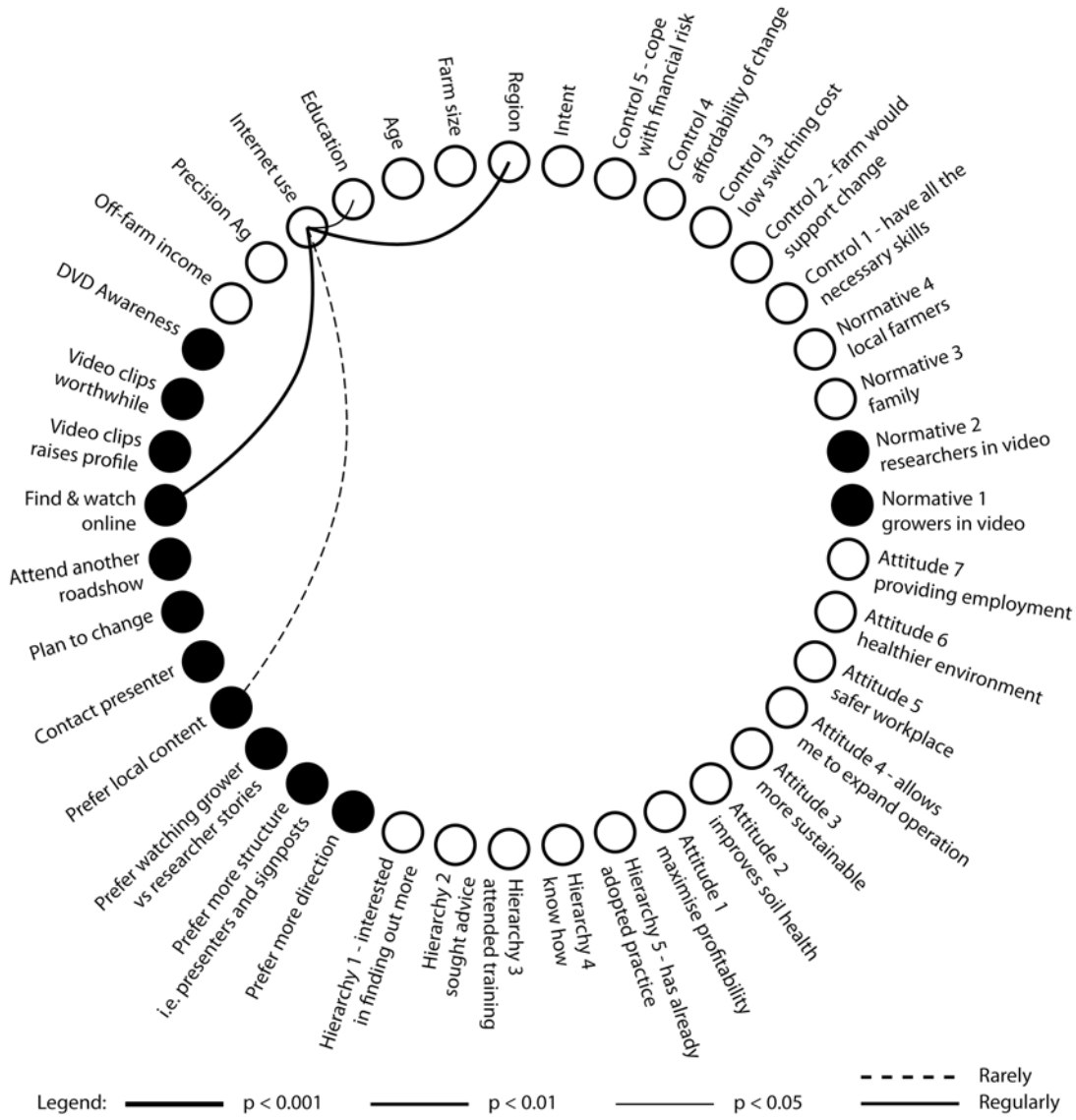

Figure 5.12 – Spearman's ρ correlations between *Internet Use* and other variables

Descriptive concepts relating to Internet use

Farmers indicated that they generally use the Internet for email and browsing specific websites. The types of websites most often mentioned related to weather forecasts, sugar market forecasts and sugar price information. Some farmers also accessed milling information online, which provided the tonnage and sugar content of their harvested crop. This information provided them with an estimate of their potential income. Some farmers indicated that they accessed the mill website three times a day during the crushing season. Aside from these specific uses, farmers did not mention accessing any other types of information from these or any other websites.

5.2.6 Precision Agriculture

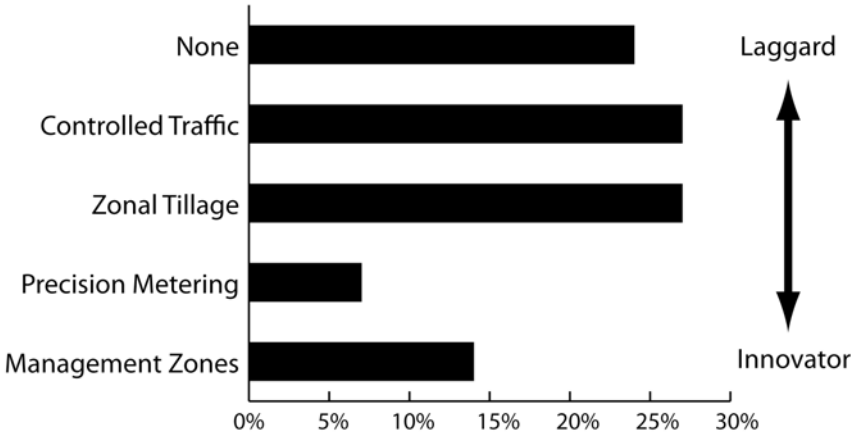

Figure 5.13 – Frequency of responses for *Precision Agriculture* (n = 70)

Farmers were asked about the degree of Precision Agriculture (PA) that had been applied in their farming operation to gauge the farmer's propensity towards adoption by identifying their position on the PA adoption lifecycle. From visual inspection the distribution of survey responses (Figure 5.13) from *management zones* (being innovators) to *none* (being laggards), appears to loosely conform to the bell curve described in DoI theory (Figure 3.2, Section 3.2.2). While the scale is only a rough approximation, it does suggest that the sample distribution is reasonably representative of each adoption group within this adoption lifecycle of precision agriculture.

Correlations relating to precision agriculture

There were several significant correlations that paired with *Precision Agriculture* (Figure 5.14), predicting nonzero correlations in the population.

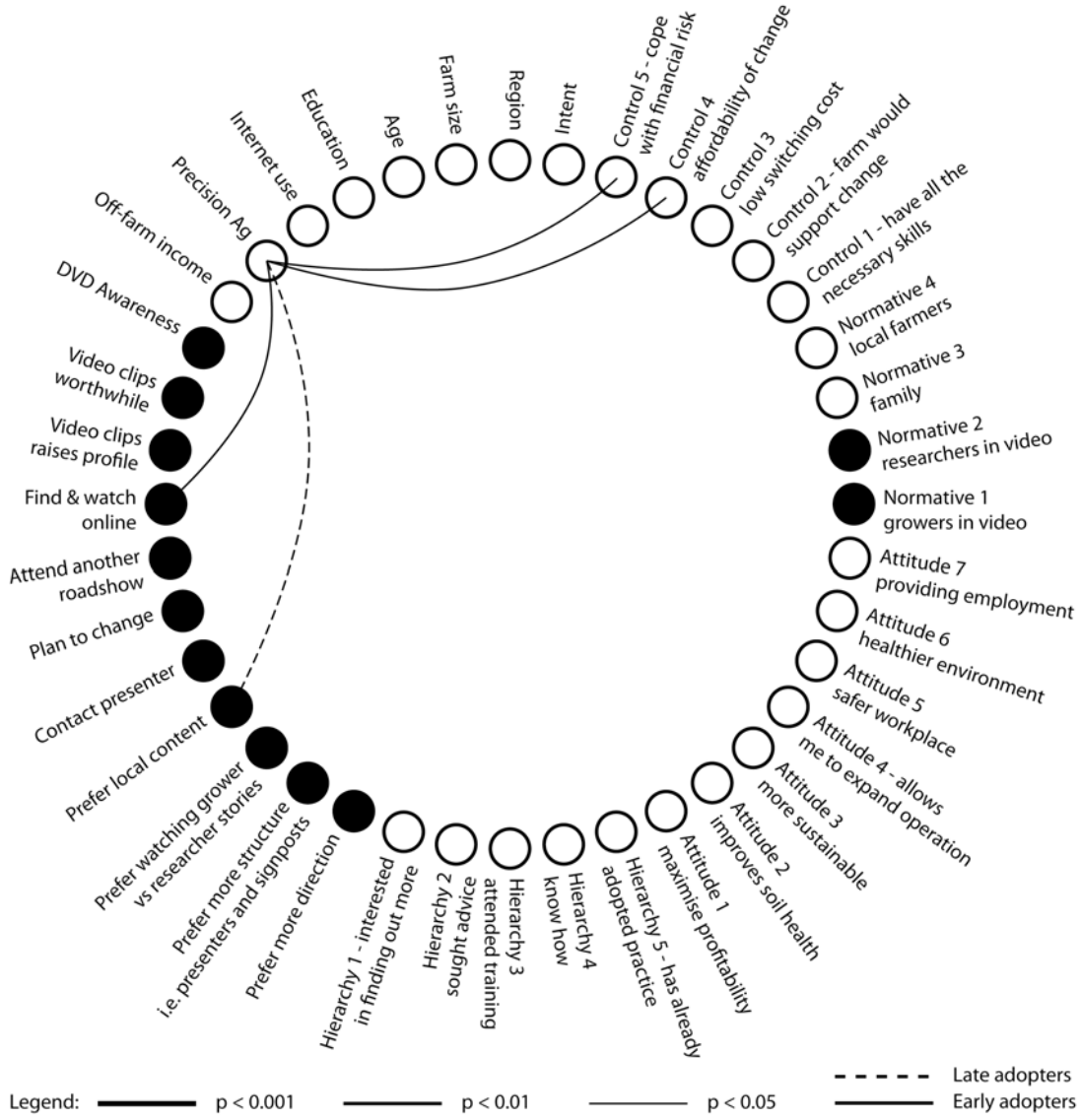

Figure 5.14 – Spearman's ρ correlations between *Precision Agriculture* and other variables

Farmers who were early adopters of PA:

- were more interested in finding and watching new farmer video clips online;
- believed the practice they planned to adopt from the videos was affordable; and
- believed they could cope with the future financial risk of adopting it.

Farmers who were late adopters of PA:

- were more interested in video clips of farmer experiences from their local region.

These correlations appear to be consistent with DoI theory (Section 3.2.2), where *Early Adopters* are described as having greater wealth, and a '*venturesome spirit*', whereas the *Late Majority* wants evidence of the general acceptance of a new practice by their local farming community.

Descriptive concepts relating to precision agriculture

Some farmers indicated that the order of answers provided with this question were imprecise. They felt that in some cases, zonal tillage preceded controlled traffic.

For example:

> *[FARMER] My definition of minimum till and the boffins definition is probably different. You don't actually need GPS to get started.*

5.2.7 Off-farm income

Farmers were asked what proportion of their time was spent earning income off-farm. The majority of farmers earn over 90% of their income on-farm, accounting for 58% of responses, however a significant proportion, the remaining 42% did not (Figure 5.15). This question was asked because it was anticipated that working off-farm would make it harder for these farmers to participate in more traditional group-based extension activities like bus trip, field days and shed meetings.

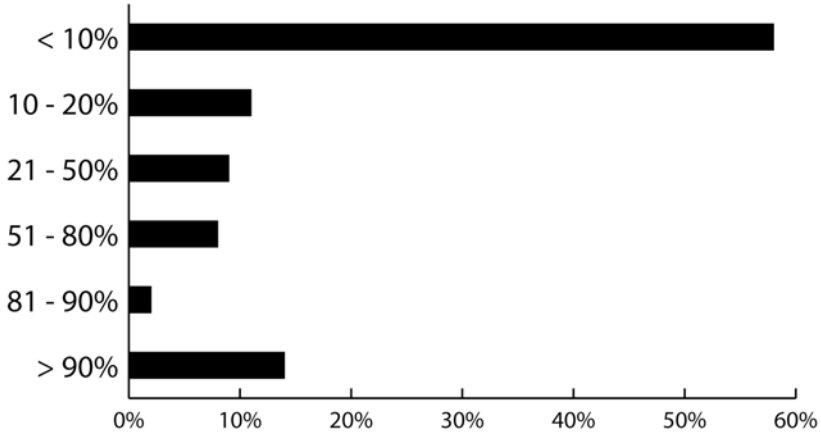

Figure 5.15 – Frequency of responses for *Off-farm Income* (n = 66)

Correlations relating to off-farm income

There was only one significant correlation that paired with *Off-farm Income*, predicting a nonzero correlation in the population.

Farmers who earned more of their income off-farm

- had smaller farms.

Descriptive concepts relating to off-farm income

Many farmers worked off-farm as part of a harvest group, or other farm based contracting work, so essentially they were still performed farming related activities. As such, the type of off-farm work they did would not necessarily make them any less capable off attending group-based extension activities than farmers who worked exclusively on their own farms.

Some farmers felt they were just too busy to attend all the extension activities that were available to them. This was especially true when these activities were scheduled outside the traditional slack period. The slack period varies by region. In the north, it occurs during the wet season from December through to March, whereas in southern districts this is actually a busy time of year because they grow and harvest their fallow crops during this period. Southern farmers tend to favour April and May.

Some farmers felt that extension activities scheduled during the slack period were crowding each other out. It seemed like there were too many activities competing for farmers' time and attention leading to a sense of option paralysis and fatigue from information overload.

5.2.8 Conclusion about the subjects

Reviewing the demographic data collected, in terms of *Age* and *Farm size* the distribution of survey subjects appears to be representative of the larger sugarcane farming population. The uptake of *Precision Ag* is also consistent with DoI theory. Combined these observations suggest an absence of selection bias across the survey subjects.

5. 3 Content

Given that the assumptions on which the video clip treatments were based had not been formally tested, the next ten questions in the survey were used to confirm some of these assumptions. The answers to these questions provide a more complete picture of the video clips' influences, including DVD awareness and perceived social impacts along with information seeking, information source and subject content preferences.

5.3.1 DVD Awareness

The majority of farmers had watched one or more DVDs, accounting for 77% of responses (Figure 5.16). Early on, there had been some concern expressed by CANEGROWERS board members that farmers might just put the DVD on a shelf and never watch it. Clearly, this was not the case. Interestingly, an internal unpublished membership survey conducted by CANEGROWERS three months prior to this study's data collection corroborates these results, reporting an 82% '*awareness'* of the DVDs among members (n=101).

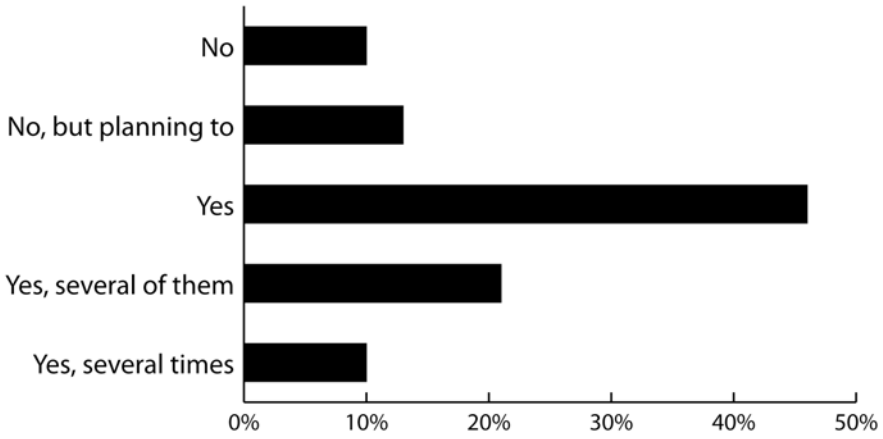

Figure 5.16 – Frequency of responses for *DVD Awareness* (n = 78)

The high percentage of farmers reporting they had watched the DVD surprised agronomists and extension officers who mentioned that they expected the opposite, having experienced low uptake of CDs and DVDs in the past. Some farmers believed word-of-mouth played a role. A few mentioned they had discussed practices on the DVD with other farmers, prompting those farmers to watch it. In addition, farmers who had watched the first DVD had been keen to watch the second one when it arrived in the mail.

5.3.2 Video clip impacts

Farmers were asked if they felt the video clips were worthwhile, and whether they would improve the industry's public image and raise its profile with government.

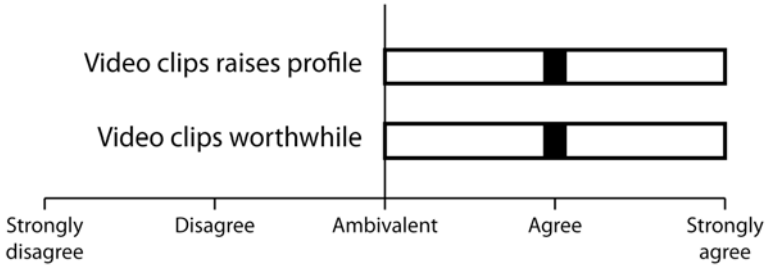

Figure 5.17 – Range and median of responses for *Video clips worthwhile* and *Video clips raises profile* (n = 77)

Overall, attitudes toward the video clips were positive. Median responses agreed with both statements, that the video clips were worthwhile and that the video clips raised the public profile of the industry (Figure 5.17).

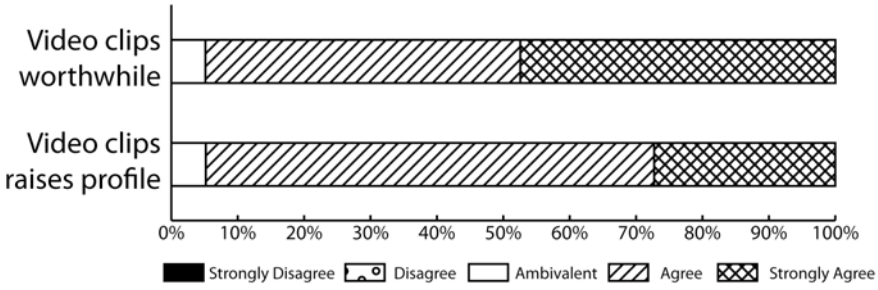

Figure 5.18 – Proportion of responses for *Video clips worthwhile* and *Video clips raises profile* (n = 77)

The majority of farmers (95%) thought the video clips were worthwhile (Figure 5.18). A similar majority (95%) also thought the video clips raised the industry's public profile.

Descriptive concepts relating to the video clip impacts

The group discussions identified two things that they felt made the DVDs particularly worthwhile. Firstly, the considerable time saving watching DVDs represented; in 60 minutes, at a time and place of their choosing, farmers could watch a DVD and visit more farms than they could on a day-long bus trip. Secondly, farmers liked the fact that they got to see machinery in operation and up close. Something that occupational health and safety restrictions would prevent them from doing at a field day.

Example 1:

> *[FARMER1] I think its brilliant, there it is, he's explaining it while you watch it, up close, normally all you'll see is… it'll be in the shed or parked in some field… on a headland.*

Example 2:

[FARMER2] You know, its good to see all this stuff because it gives you ideas.

Some farmers were mindful of the fact that other stakeholders outside the industry, like policy makers and legislators would have access to the video, and wanted to know who decided which video clips were selected and why. When it was explained that an expert panel had been used to review the material before it was published, these farmers felt relieved that a process had been put in place to vet the material.

Another farmer was more cynical, wondering aloud whether policy makers and legislators would ever pay any attention to the evidence of best practice presented in the video clips. He wondered whether raising the public profile would make any difference given the poor perception he believed policy makers and legislators had of the sugarcane industry.

5.3.3 Information seeking preferences

Three questions were asked to assess farmers' information seeking preferences.

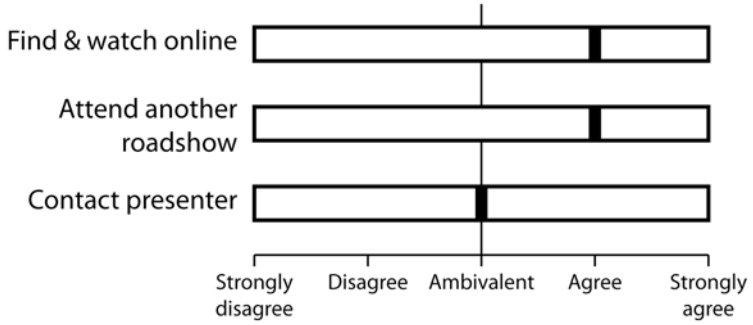

Figure 5.19 – Range and median of responses for *Find & watch online*, *Attend another roadshow* and *Contact presenter* (n = 64)

Responses to *Find & watch online* and *Attend another roadshow* were both positive, with median responses agreeing with both statements (Figure 5.19), however the median response to *Contact presenter* was ambivalent.

Here is an example of one farmers comments about the roadshow:

> *[FARMER] Well it was good. The description said that it would be as good as a bus tour and it was. The only thing with a bus tour is you hear a few more questions getting thrown around, where as with this one it was only at the end with you, but I thought it was very good.*

The majority of farmers (77%) responded that they would like to be able to find and watch new grower video clips online. The majority of farmers (88%) were also interested in attending another video roadshow (Figure 5.20). Only a minority of farmers (42%) were interested in contacting one or more of the presenters in the video clips, with another 47% indicating they were ambivalent, and the remaining 11% being disinterested.

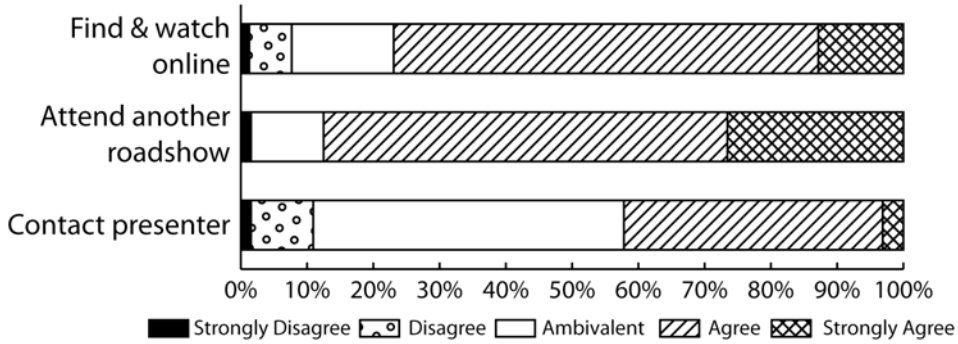

Figure 5.20 – Proportion of responses for *Find & watch online, Attend another roadshow* and *Contact presenter* (n = 64)

There were numerous significant correlations that paired with the variables *Find & watch online* (Figure 5.21) and *Attend another roadshow* (Figure 5.22). Together these correlations identify two information seeking archetypes described here as the *introverted information seeker* and the *social information seeker*.

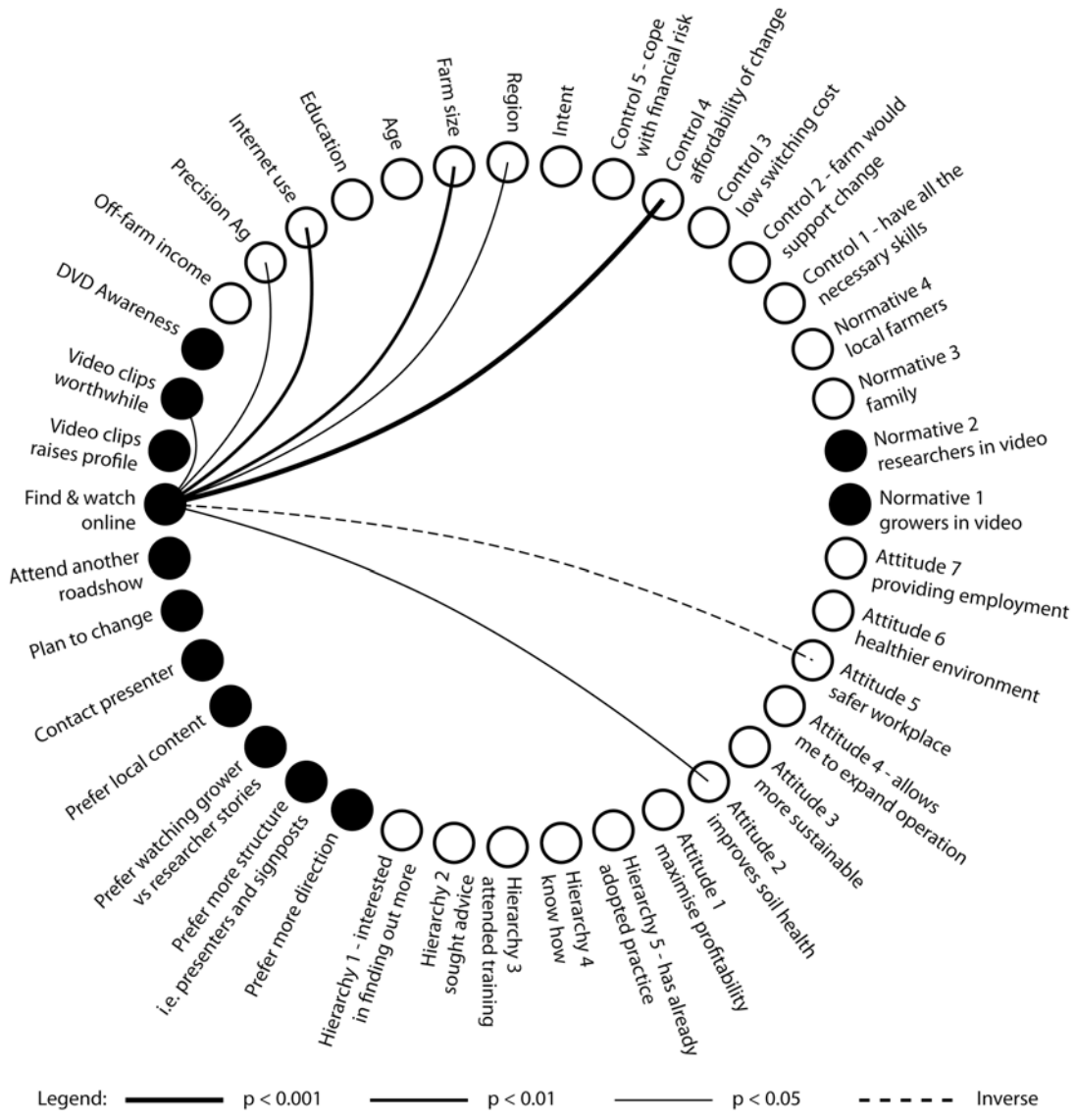

Figure 5.21 – Spearman's ρ correlations between *Find & watch online* and other variables identify the *introverted information seeker* farmer archetype

The introverted information seeker: characterised by farmers wanting to find and watch new grower video clips online:

- had larger farms;
- used the Internet more regularly;
- had applied a higher degree of precision agriculture to their farms,
- came from more southern districts;
- found the video clips more worthwhile; and,

- believed the practice they planned to adopt from the videos:
    - was affordable;
    - would <u>not</u> create a safer workplace; and,
    - improved soil health.

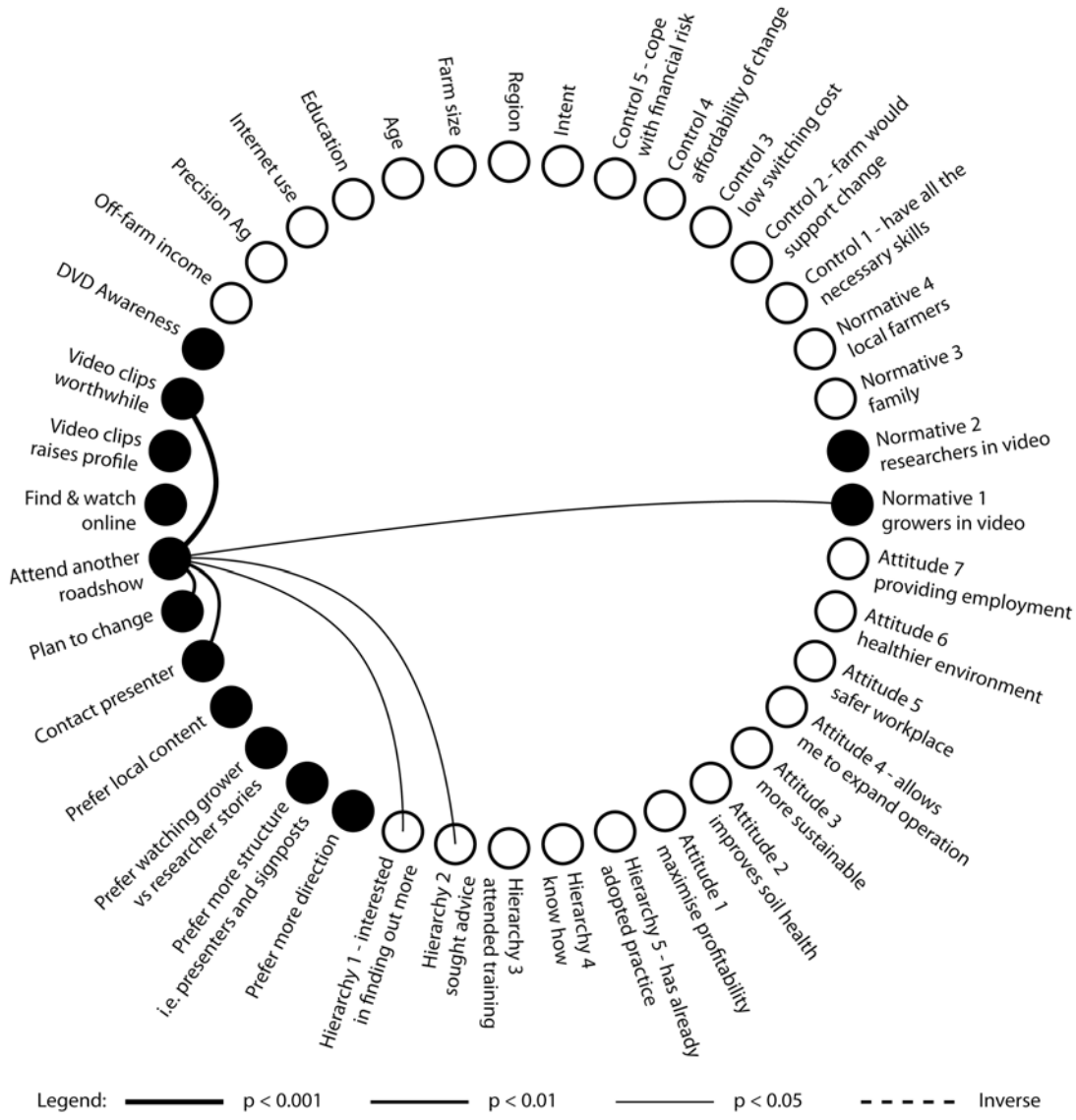

Figure 5.22 – Spearman's ρ correlations between *Attend another roadshow* and other variables identify the *social information seeker* farmer archetype

The social information seeker: characterised by farmers wanting to attend another video roadshow:

- found the video clips more worthwhile;

- were more likely to change one or more of their practices after watching the videos;
- were more interested in contacting one or more of the presenters in the videos;
- were more likely to have sought advice about the practice they planned to adopt from the videos;
- felt more encouraged to change by farmers in the video clips; and,
- were interested in finding out more about the practice they planned to adopt from the videos.

Prior to the video roadshow, it was not known how favourable farmers would be to this presentation format, so its interesting to see that farmers' preferred to seek information in different ways. While some appear to be more introverted and favour the Internet and DVDs, others were more extroverted and favour social engagement, still others were happy to combine both approaches.

5.3.4 Preferred information sources

Farmers were asked to assess their preferences towards local content.

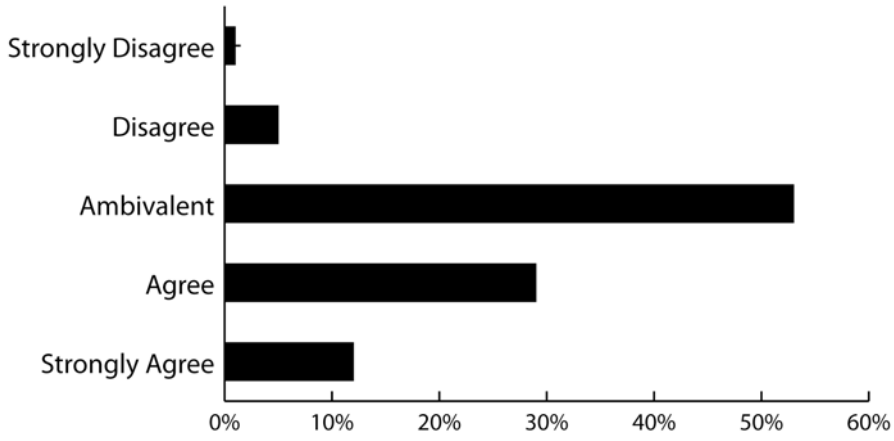

Figure 5.23 – Frequency of responses for *Local content* (n = 64)

The majority of farmers were ambivalent towards the statement, indicating they preferred content from all regions, accounting for 53% of responses, with a further 41% preferring local content (Figure 5.23).

Farmers were also asked to assess the their preferences towards information sources.

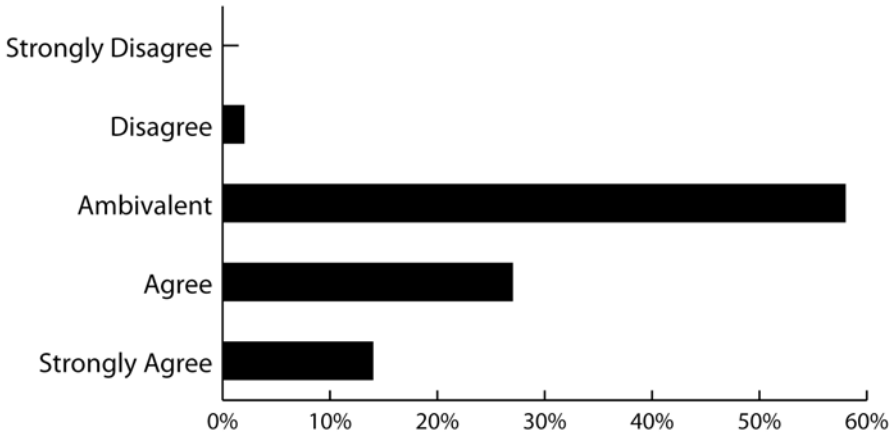

Figure 5.24 – Frequency of responses for *Grower vs. researcher* (n = 64)

The majority of farmers were ambivalent towards the statement, indicating they preferred video clips of both farmers and researchers, accounting for 58% of responses (Figure 5.24). A further 41% indicated they did prefer grower stories.

5.3.5 Content preferences

Farmers were asked two questions to assess their content preferences and determine which if any of these elements they preferred. To minimise any practice effects, the video clips used in the presentation did not include any of these elements. To make sure farmers were familiar with what these elements meant, they were shown examples of signposts, which are text overlays highlighting what is coming up next, and presenters introducing topics.

The first assumption to be tested was whether farmers preferred more structure in the content. The median response was *present each topic, signpost each video clip* (Figure 5.25).

This preference matched the structure that was used in the DVDs. However, this preference only accounted for a minority (36%) of responses.

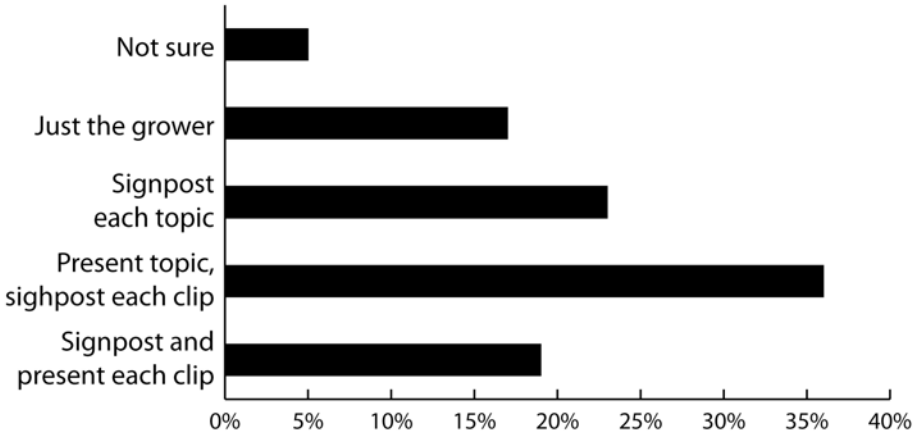

Figure 5.25 – Frequency of responses for *Prefer more structure* (n = 78)

The second assumption to be tested was whether having farmers speak directly to the camera in their own words about their own experiences was preferable. The alternative would be to have a more scripted presentation. The median response was *unscripted conversations with some direction* (Figure 5.26). This preference also matched level of direction that was used in the DVDs. However, this preference also only accounted for a minority (41%) of responses.

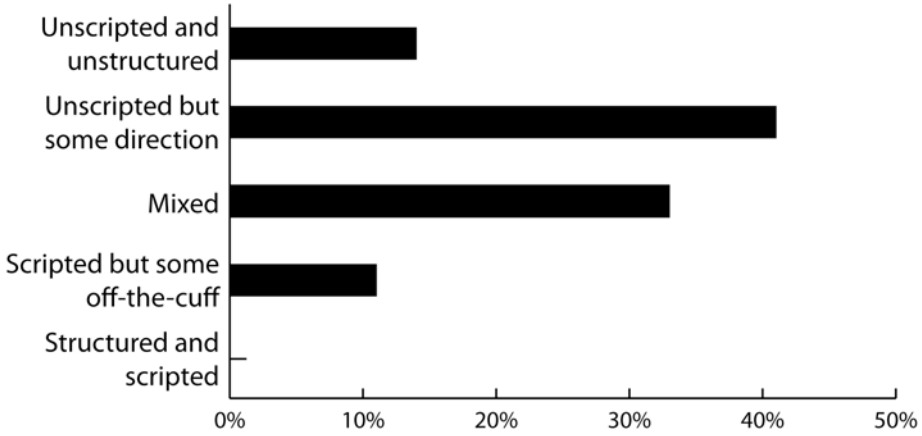

Figure 5.26 – Frequency of responses for *Prefer more direction* (n = 63).

One problem emerged with these two questions. The term '*presenters*', used to describe the farmers and researchers in the second question, was inconsistent with the way it was used as

an answer choice in the first question, where a '*presenter*' would introduce each topic. When answering the second question, farmers may have been referring to the '*presenter*' from the previous question. The results are confusing. When responses to the first variable were grouped according to the second, there was an inverse relationship between grouped variables (Figure 5.27), that is, farmers who preferred more structure, tended to prefer less direction and vice-versa. This inconsistency was only identified part way though the data collection. As a result, some group discussions with the remaining farmers were used to understand what might have been meant by the answers given.

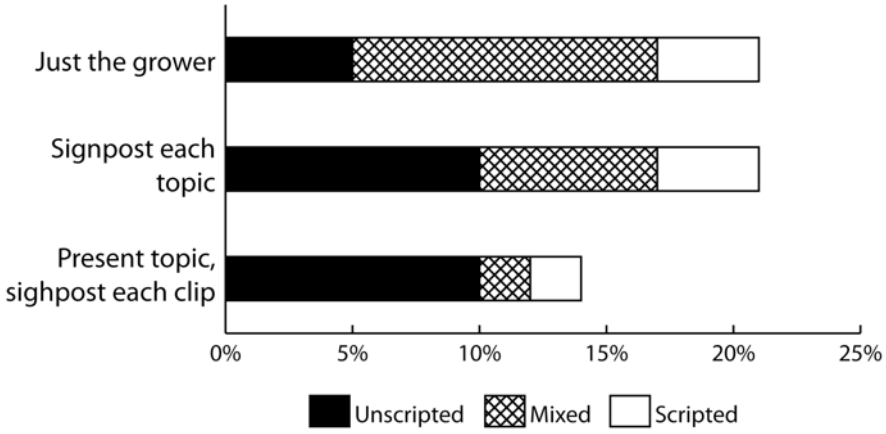

Figure 5.27– Proportion of *Prefer More Direction* grouped according to *Prefer More Structure*

Farmers did find these questions more challenging to answer. One farmer summed it up by saying "*there isn't an option to describe what I … how I'd like it*". He was asked what he meant, and those farmers who responded agreed (1) topics should be introduced with scripted presenters, while (2) farmers' and researchers' interviews should be unscripted, with some direction to keep discussions focused on the topic being presented. In reality, this was accomplished during editing without the need to '*direct*' the farmers being interviewed. The only direction that occurred came from the selection of questions that were asked. However, farmers unaware of how these video clips were produced assumed that when farmers spoke articulately, it must have required some direction in order to achieve those results. Perhaps in future, questions like this would provide a short montage to visualise all these types of

concepts before questions are asked so farmers have a better understanding of which processes result in the desired outcome.

5.3.6 Conclusion about the video clip content

Overall, the videos were well received. When farmers discussed the video clips they had just watched, it was clear that they had genuine emotional connections and feelings of empathy towards the farmers they had observed.

For example:

> *[FARMER] "We're laughing… but with him, cos we've all made that type of mistake… somewhere in the past"*

The DVD's had been watched by the majority of farmers and they held positive views about it. Farmers also indicated that they would be interested in accessing this type of content online, and found the '*Video Roadshow*' worthy of repeat attendance. The content design of video clips featuring farmers and researchers from across the industry was also favourable, as was the interview technique and DVD structure.

5. 4 Patterns of data for each hypothesis and proposition

Having reviewed farmer demographics and their views about the video clip content, we now turn our attention to the formal hypothesis testing.

5.4.1 H1: Farmers exposed to industry-wide evidence-of-adoption are influenced to adopt new technologies and practices.

To test this hypothesis, farmers were asked two questions. Firstly, whether they planned to change a practice after watching the Virtual Bus Tour DVDs or the Video Roadshow presentation, and secondly, what area of practice they planned to change.

Plan to change

The majority of farmers agreed with the statement that they planned to change one or more of their practices after watching the Virtual Bus Tour DVDs or the Video Roadshow presentation, accounting for 60% of responses (Figure 5.28). It is also interesting that only four percent of farmers disagreed with this statement, leaving 36% who were ambivalent.

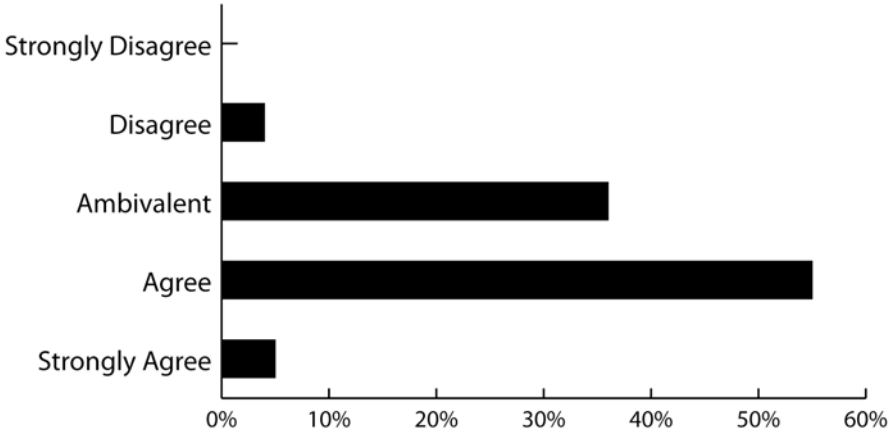

Figure 5.28 – Frequency of responses for *Plan to change* (n = 63)

Farmers were asked what they meant by the ambivalent responses. The farmers who replied stated that while they may have already made the decision to adopt, the video clips did help with this decision by providing useful additional information. If this interpretation is true of the general case, then in some way, the video clips may have supported or facilitated practice change in 96% of farmers.

Area of change

Farmers were asked which area of practice they were planning to change (Figure 5.29). Video clip '*themes*' ranged from *Green Cane Trash Blanket*, which is a mature technology to others like *Compost* and *Spray Application* which were innovative, while the rest were largely mainstream (a list of the video clips used in these treatments appears in APPENDIX A).

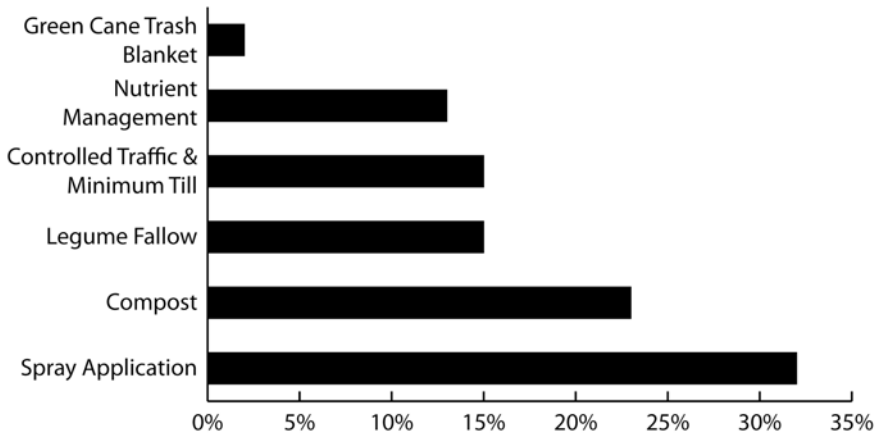

Figure 5.29 – Frequency of responses for *Area of change* (n = 53)

Of all the areas, green cane trash management had the least influence, accounting for just two percent of responses. This area also had the smallest number of video clips, totalling two, one by a researcher and another by a farmer. However, this is a very mature practice in the Australian sugarcane industry, which has been widely adopted in most regions. By contrast, spray application was the most influential area, accounting for 32% of responses, yet it also had relatively few video clips, four in total. However, these presentations were all given by farmers. In fact, several farmers reported that they planned to adopt shielded spray technology on the strength of watching a single video clip during the Video Roadshow.

For example:

> *[FARMER] Cause, I trailed the [OTHER MANUFACTURERS] hoods, and you can see the yield loss, the trouble is that none of those hoods track, unless you are going dead straight, you have only got to move a fraction this way and before you know it you are up on the stools. With roundup you don't need much chemical on a plant and you get significant losses. But don't get me wrong I am looking to do it with those ones there that you showed us. I will trail em and if I'm happy with it…I have seen em before and they look really good.*

The shielded spray video clip was somewhat unique in that it was longer than most of the other video clips and went into a considerable amount of detail about the practice.

Nevertheless, some important details, like chemical group rotation using knock down sprays to prevent herbicide resistance were missing from the video clip narrative. These were covered in the group discussion as a detail introduced by the researcher (see Section 4.2.4 for an example). The shielded spray example demonstrates that a single comprehensive video clip by a farmer can be enough to influence practice change.

In an effort to better understand the role evidence-of-adoption video clips played in farmers' decision making, two analogous case histories, are presented.

Case 1: One farmer had been attempting to adopt controlled traffic, but was having problems with plant cane establishment. The wide throat billet planter he was using was having problems with clumping, causing poor soil contact with the cane billets and uneven plant establishment. This farmer saw a video clip of another farmer who had used a simple 100mm diameter tube running down the centre of his wide throat planter. This caused the billets to fall on either side, prevented clumping in the centre. The farmer in the video clips had been using this design with great success to achieve even plant establishment with fewer billets. Upon observing this solution, the observing farmer made the decision to make similar changes to his planter, which would enabled him to adopt controlled traffic row spacings on his farm.

Case 2: A second farmer was using a conventional tip truck to apply mill mud on his farm. This method applies the mud across the entire paddock, unevenly and at rates that are too high. This second farmer saw a video clip of a tip truck with a hydraulic spinner and tails on the back that directed the mud into bands so that it was applied over the top of the crop, and at more appropriate rates. After watching the video clip the farmer planned to make the change to his truck that weekend. He requested the url of the video clip on YouTube so he could show it to his son, who he was going to ask to help him with the fabrication and welding.

These two examples illustrate that for some farmers, the video clips were effective because they provided important details about how practices were implemented. The farmers were ready to make the changes necessary to adopt these practices, but in each case, were missing important information, without which, they had been unable to make the change. By watching the videos they gained this information from a source they implicitly trusted and the decision to change was triggered (in these two cases instantly) because farmers saw the farmers in the video clips achieve an outcome they desired with components that they could readily adapt to their own farming systems. This gave them a high degree of confidence they could successfully adopt the practice on their farms.

In conclusion, farmers were influenced to adopt new technologies and practices by industry-wide evidence-of-adoption video clips. The area of change that was influenced also varied amongst farmers, indicating that each farming context was different, and thus, the suitability of innovations varied from farmer to farmer. One farmer summed it up this way: '*Not many people have the same farming system across their whole farm ... let alone across farms and across districts*'. In aggregate, industry-wide evidence-of-adoption was influential, with 60% of farmers indicating they planned to change one or more of their practices after watching the Virtual Bus Tour DVDs or Video Roadshow presentation. These results confirm the hypothesis by providing associative variation from the sequence of events in the absence of other causal factors.

5.4.2 H2: Farmers exposed to other farmers' evidence-of-adoption, identify with this virtual peer group, leading to strong positive normative beliefs, encouraging them to adopt suitable innovations.

To test this hypothesis, farmers were asked 17 *Theory of Planned Behaviour* (ToPB) questions designed to measure their attitudes, subjective norms and perceived behaviour control towards the practice they planned to change after watching the video clips.

There were several significant correlations that paired ToPB variables with the dependent variable *Plan to change* (Figure 5.30), predicting nonzero correlations in the population.

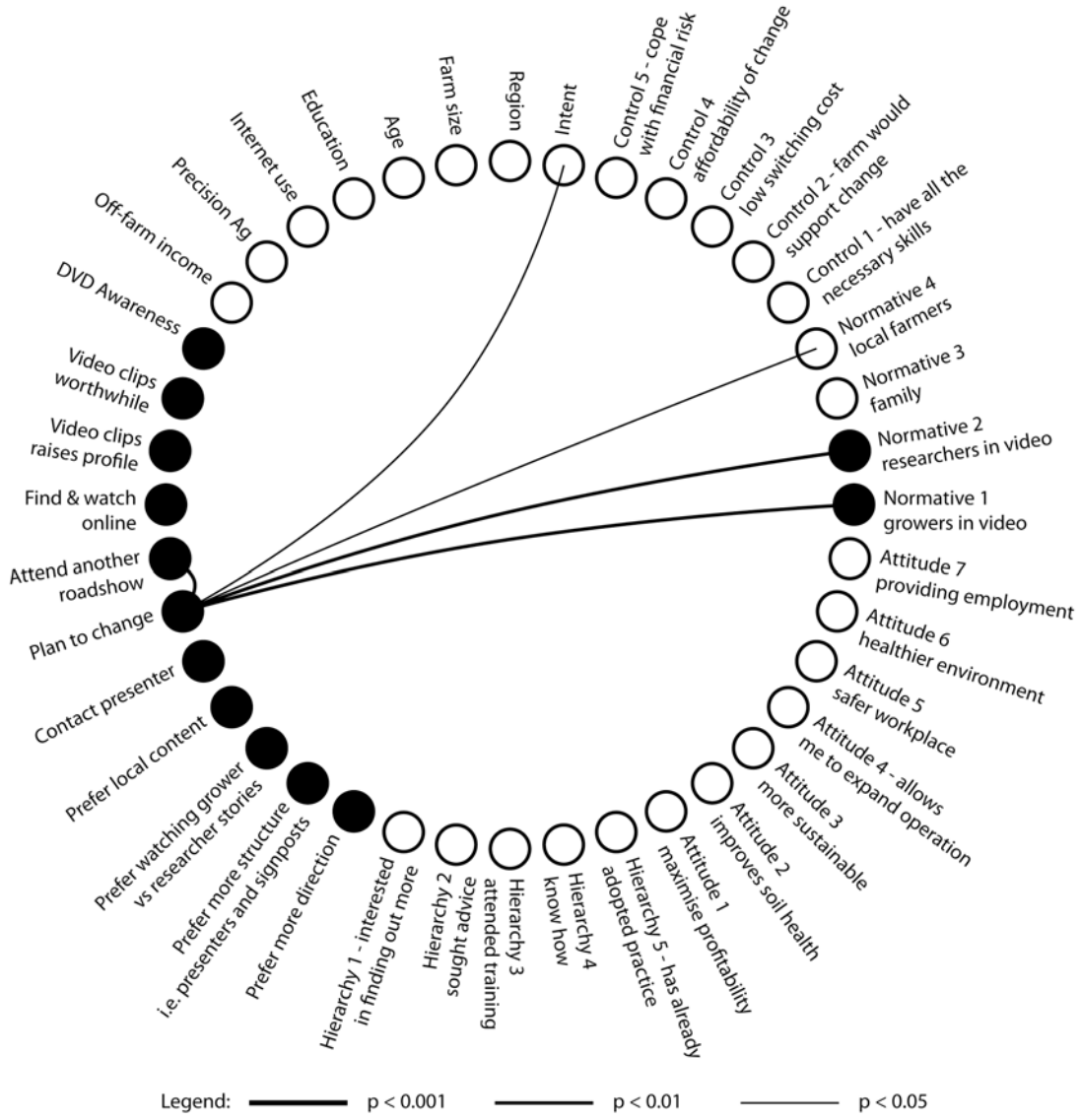

Figure 5.30 – Spearman's ρ correlations between *Plan to change* and other variables

Farmers who planned to change one or more practices after watching the video clips:

- were more interested in attending another roadshow next year;
- were more likely to recommend the practice to other farmers;
- felt more encouraged to convert to the practice:
    - by the growers in the videos;

- by the researchers in the videos; and,
- by other farmers they respected.

The only statistically significant Spearman's ρ correlations found to exist, were between *Plan to change* and the *Normative 1*, *Normative 2*, *Normative 4*, *Intent* and *Attend roadshow* variables, predicting nonzero correlations in the population (Table 5.1).

Table 5.1 – Spearman's ρ correlations between *Plan to change* and these other variables

1st variable	2nd variable	n	R	t	p-value
Plan to change	**Normative 1**	48	0.407	3.021	0.004
Plan to change	**Normative 2**	48	0.377	2.759	0.008
Plan to change	**Normative 4**	48	0.290	2.054	0.046
Plan to change	**Intent**	48	0.351	2.540	0.015
Plan to change	**Attend roadshow**	56	0.410	3.305	0.002

The correlation between *Plan to change* and *Normative 1* can be stated formally as:

- **H_0**: There is no correlation (no monotonic relationship) between the variables for the population i.e. $\rho s = 0$.
- **H_1**: A nonzero correlation exists in the population i.e. $\rho s \neq 0$.

The resulting p-value of 0.004 (which is very significant) confirms the alternative hypothesis, predicting a nonzero correlation in the population.

Note: for the sake of brevity, having stated the null and alternative hypotheses for Spearman's ρ formally here, all future references to correlation analysis, which is used extensively throughout this chapter, will state the results with less formality.

This p-values in Table 5.1 suggested that farmers felt more encouraged to change by the farmers in the video clips, than they did by the researchers in the video clips, their own families or other farmers they respected. Two non-parametric analyses were performed to test the significance of these differences. The Kruskal-Wallis H test was used to confirm that

there was a statistically significant difference in the ranked values of groups from Normative 1 to Normative 4. The resulting H statistic of 12.485 and p-value of 0.006 (which is significant) confirms the alternative hypothesis that there were differences between normative beliefs.

Table 5.2 –Wilcoxon Signed-Rank test between *Normative 1* and the three other normative variables (n = 48)

1st variable	2nd variable	T	z	p-level
Normative 1	**Normative 2**	24	-2.524	0.012
Normative 1	**Normative 3**	48	-3.128	0.002
Normative 1	**Normative 4**	23	-3.838	0.000

Building on the positive result from the previous test, the Wilcoxon Signed-Ranked test was used to compare individual scores between each variable (Table 5.2). The results showed that differences between Normative 1 and the other three normative variables were significant, confirming the alternative hypothesis that there is a difference between these pairs of variables. These two tests confirm that farmers felt significantly more encouraged to change by the farmers in the video clips than by any of the other normative influences measured.

Having examined the correlations that paired with the dependent variable *Plan to change*, each of the three ToPB predictors, attitudes, subjective norms and perceived behavioural control, are now examined in detail.

Attitudes

Farmers were asked to agree or disagree with seven statements to assess their attitudes towards the practice.

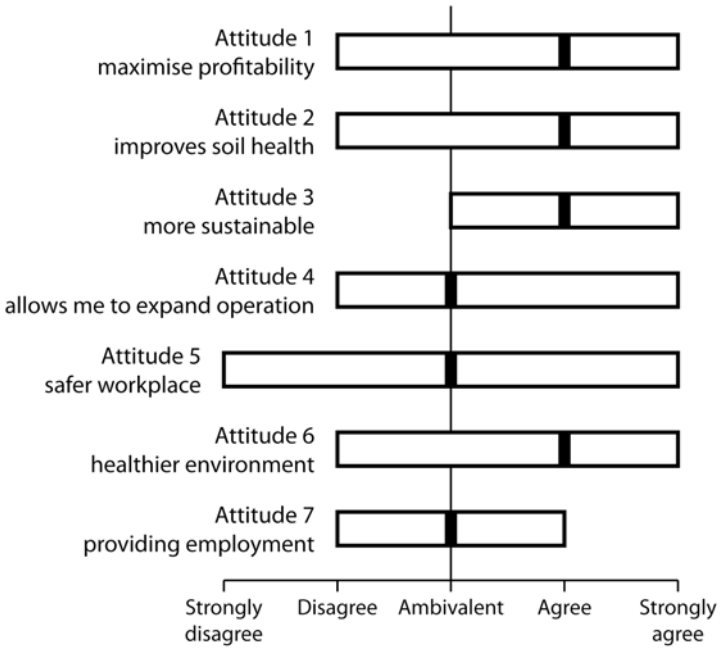

Figure 5.31 – Range and median of responses for *Attitude 1* to *Attitude 7* (n = 48)

Overall, responses to attitudes were mixed, with median responses agreeing with *maximise profitability (Attitude 1)*, *improves soil health (Attitude 2)*, *more sustainable (Attitude 3)* and *healthier environment (Attitude 6)* statements, while *allows me to expand operation (Attitude 4)*, *safer workplace (Attitude 5)* and *providing employment (Attitude 7)* received ambivalent median responses (Figure 5.31).

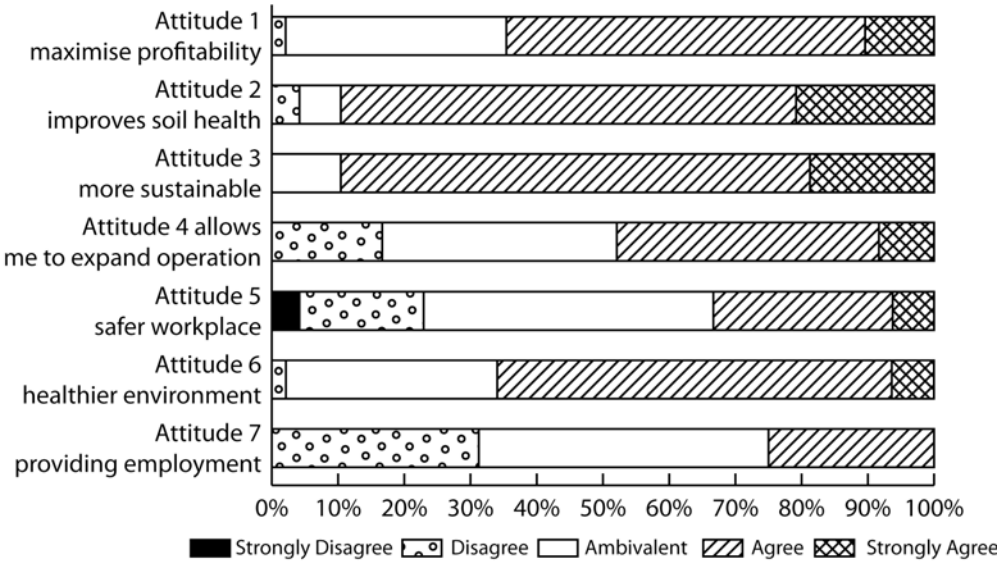

Figure 5.32 – Proportion of responses for *Attitude 1* to *Attitude 7* (n = 48)

The majority of farmers believed the practice was likely to maximise farm profitability (*Attitude 1*), accounting for 64% of responses (Figure 5.32). The majority of farmers (90%) also believed the practice would lead to improved soil health (*Attitude 2*). A similar majority (90%) believed the practice was more sustainable (*Attitude 3*). Only 48% of farmers believed the practice would allow them to expand their operations (*Attitude 4*), with a further 35% being uncertain, and the remaining 15% disagreeing. Most farmers were ambivalent as to whether the practice created a safer workplace (*Attitude 5*), accounting for 44% of responses. The majority of farmers (66%) believed the practice would provide a healthier environment for them and their families (*Attitude 6*). Finally, only 25% believed the practice would increase the possibility of their farm providing employment (*Attitude 7*), with the largest group (44%) being uncertain, and the remaining 31% disagreeing.

Subjective norms

Farmers were asked to agree or disagree with four statements to assess their normative beliefs towards the practice.

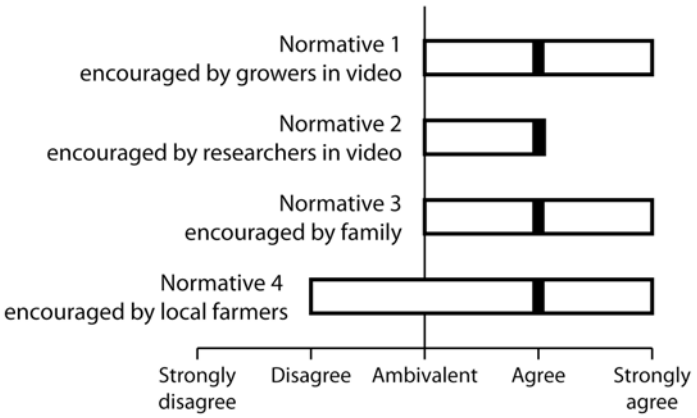

Figure 5.33 – Range and median of responses for *Normative 1* to *Normative 4* (n = 48)

Overall, responses to normative beliefs were positive, with median responses agreeing with all the normative belief statements (Figure 5.33).

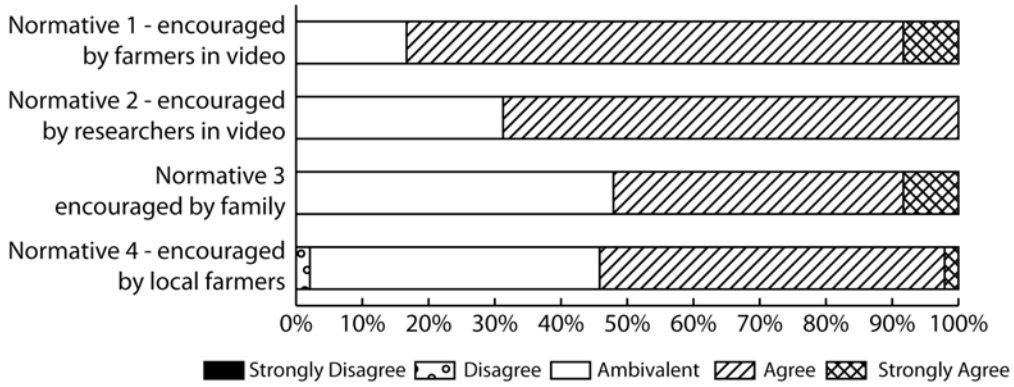

Figure 5.34 – Proportion of responses for *Normative 1* to *Normative 4* (n = 48)

In Figure 5.34 above, the strength of Normative 1 compared to the other normative beliefs, which was confirmed earlier, is visually apparent. The majority of farmers felt encouraged to convert to the practice by the farmers in the video clips (*Normative 1*), accounting for 83% of responses. The majority of farmers (69%) also felt encouraged by the researchers in the video clips to convert to the practice (*Normative 2*). A smaller majority (52%) felt their family would encourage them to convert to the practice (*Normative 3*), while a similar small majority (54%) felt encouraged by other farmers they respected (*Normative 4*).

Perceived behavioral control

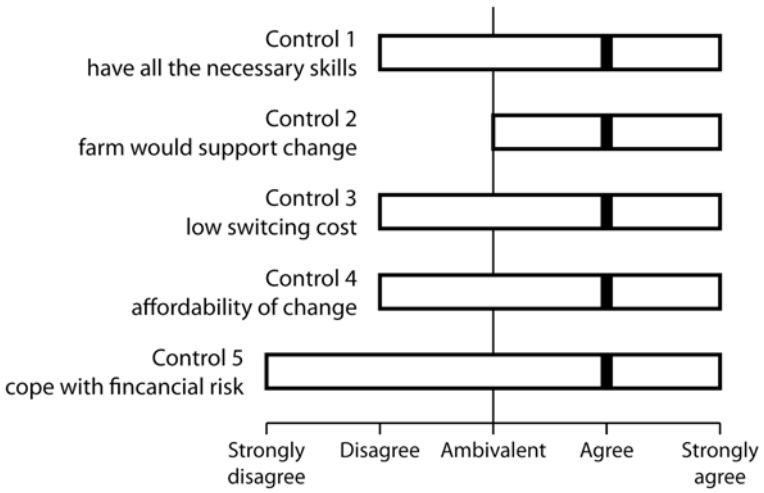

Figure 5.35 – Range and median of responses for *Control 1* to *Control 5* (n = 48)

Farmers were asked to agree or disagree with five statements to assess their control beliefs towards the practice. Overall, responses to control beliefs were positive, with median responses agreeing with all of the control belief statements (Figure 5.35).

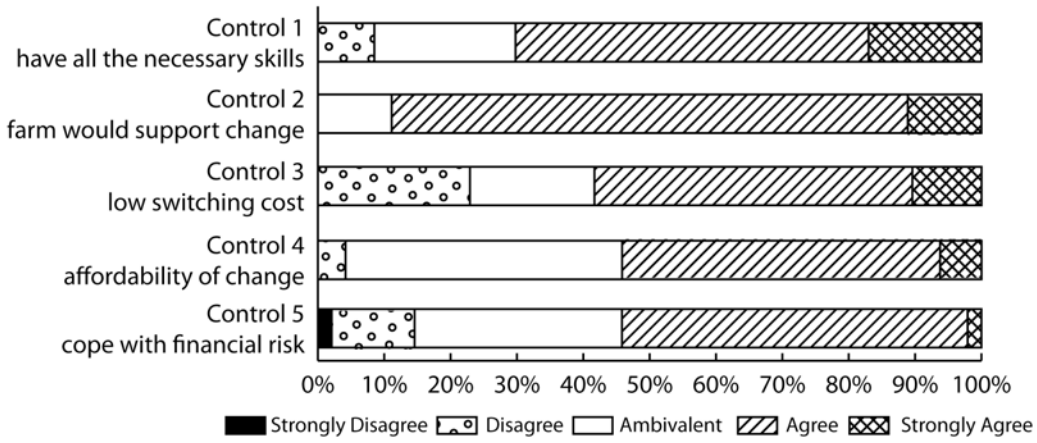

Figure 5.36 – Proportion of responses for *Control 1* to *Control 5* (n = 48)

The majority of farmers believed they had all the necessary skills to adopt the practice (*Control 1*), accounting for 70% of responses (Figure 5.36). The majority of farmers (89%) also believed their farm would support the adoption of the practice (*Control 2*). A smaller majority (58%) also believed switching to the practice would not require much change to their current operations (*Control 3*). A small majority (54%) believed they could afford to adopt the practice (*Control 4*), with a further 42% remaining uncertain. A similar small majority (54%) believed they could cope with the future financial risk of adopting that practice (*Control 5*), with a further 31% being uncertain, while the remaining 15% indicated they could not cope with the risk.

Intent

Herring (2008) claims that asking farmers whether they would recommend a practice to other farmers is an accurate measure of farmers' intention to make these changes themselves. Given the numerous very significant correlations that were found to exist between *Intent* and the other ToPB predictors, attitude, subjective norms and perceived behavioural control

(Figure 5.37), this study adds weight to Herring's view. In the light of this finding, it would be interesting to see if asking farmers whether they had already recommended the practice to other farmers provided a stronger correlation with implementation intentions.

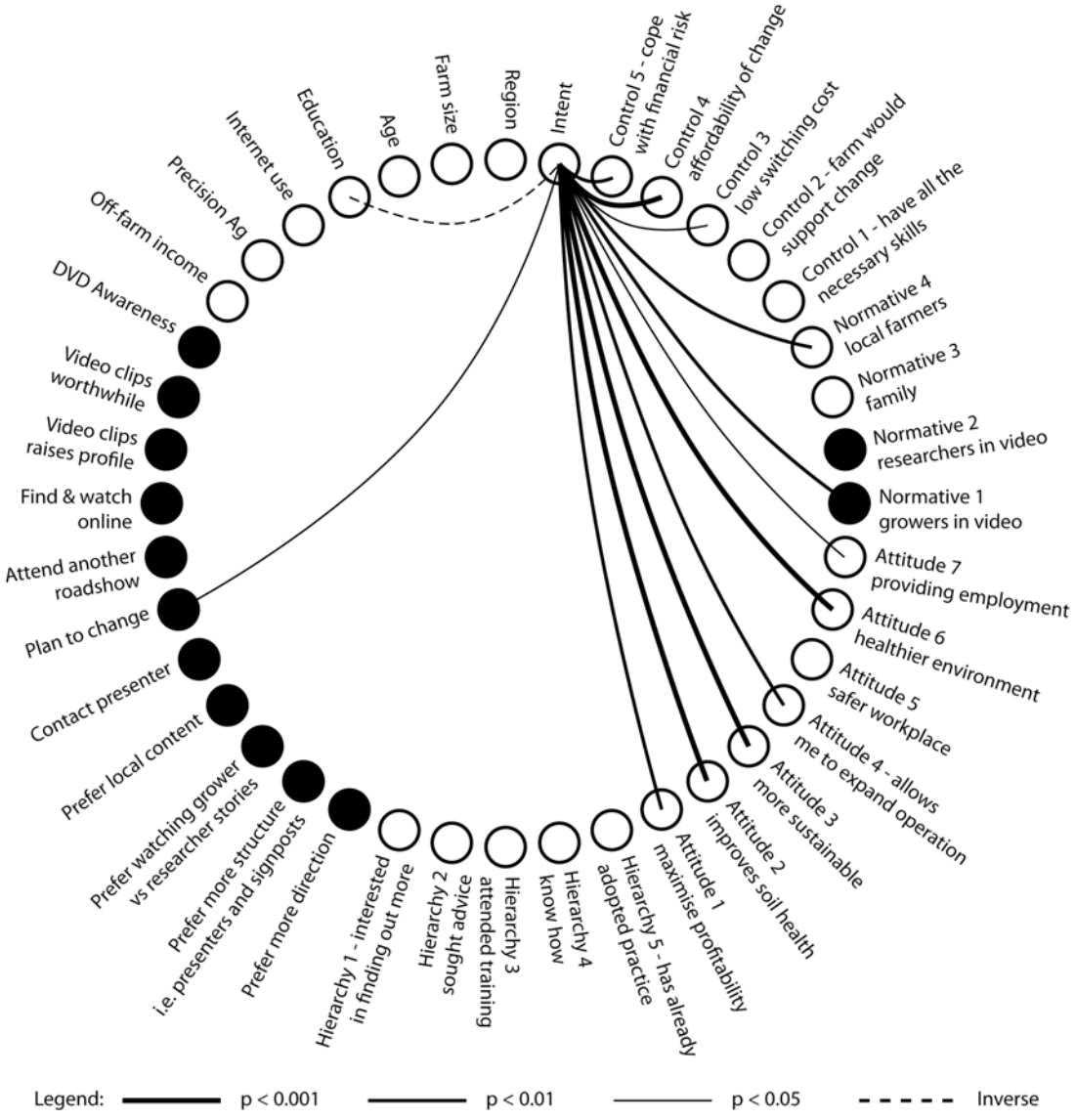

Figure 5.37 – Spearman's ρ correlations between *Intent* and other variables.

Overall, responses to intent were positive, with median responses agreeing with the statement (Figure 5.38).

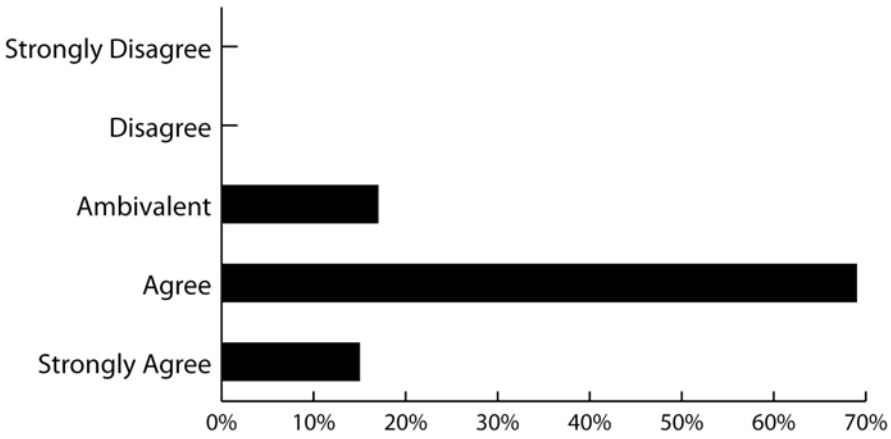

Figure 5.38 – Frequency of responses for *Intent* (n = 63)

The majority of farmers, who planned to change a practice after watching the video clips, would recommend that practice to other farmers, accounting for 83% of responses (Figure 5.38).

Table 5.3 – Spearman's ρ correlation between the *Plan to change* and *Intent* variables

1st variable	2nd variable	n	R	t	p-value
Plan to change	**Intent**	48	0.364	2.647	0.011

A statistically significant Spearman's ρ correlation was found to exist between the *Plan to change* and *Intent* variables (Table 5.3), predicting a nonzero correlation between these two variables in the population. These results also confirm that ToPB is an appropriate predictive model for evaluating adoption campaigns.

In conclusion, combining these results confirms the hypothesis, that farmers felt significantly more encouraged to change by the farmers in the video clips than by any other behavioural influence measured.

5.4.3 Negative case sampling

Measures from *Bennett's Hierarchy* (Bennett, 1975) and *Diffusion of Innovation* (Rogers, 2003) were included to rule out other possible causal factors as alternative explanations.

Bennett's Hierarchy

Farmers were asked to agree or disagree with five statements to retrospectively assess their adoption history with the practice. These statements used Bennett's Hierarchy to measure their progress toward adoption from *interest* through *seeking advice* and *attending training* to *know-how* and actual *adoption*.

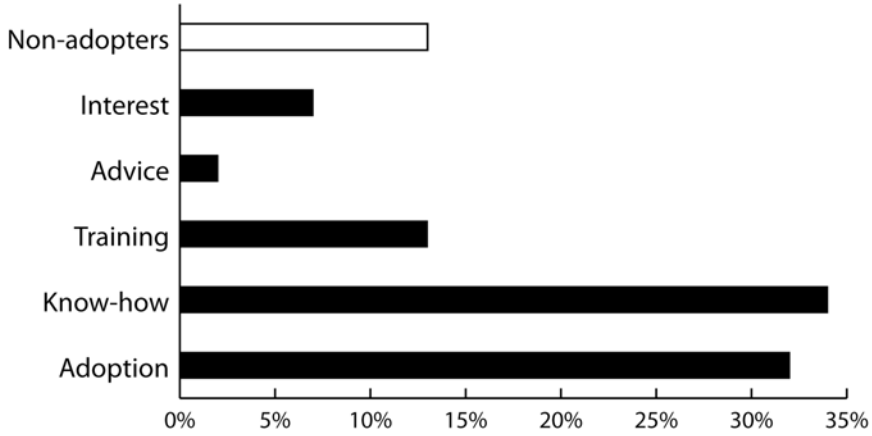

Figure 5.39 – Adoption scores in Bennett's Hierarchy (n = 56)

Figure 5.39 shows a graph of these adoption scores. In this graph, individuals were allocated the highest score they gave a positive response to. The largest group was those farmers were ready-to-adopt the practice, accounting for 34% of responses. While another substantial group of farmers (32%) had already adopted the practice on their farms.

Figure 5.40 – Range and median of responses for *Hierarchy 1* to *Hierarchy 5* (n = 48)

Overall, Bennett's Hierarchy responses were positive, with median responses agreeing with *interest (Hierarchy 1)*, *sought advice (Hierarchy 2)*, *attended training (Hierarchy 3)* and *know-how (Hierarchy 4)* statements, while *adoption (Hierarchy 5)* received an ambivalent median response (Figure 5.40).

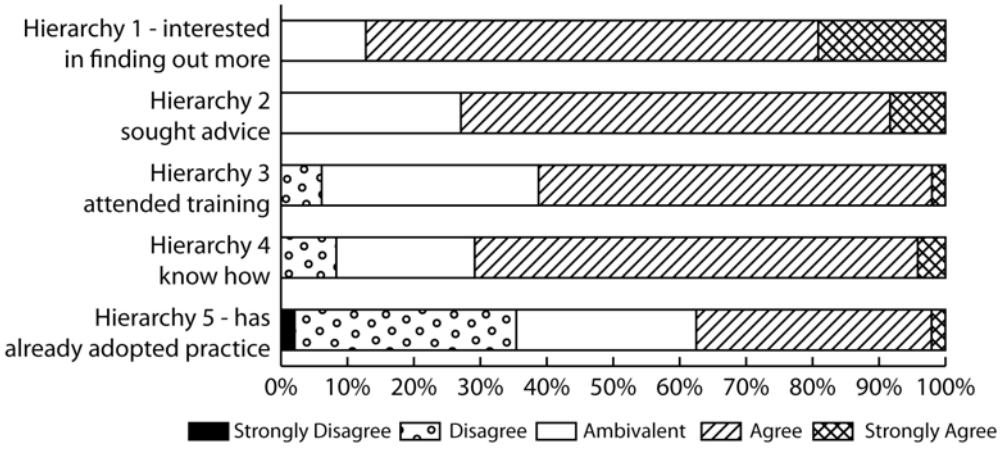

Figure 5.41 – Proportion of responses for *Hierarchy 1* to *Hierarchy 5* (n = 48)

The majority of farmers were interested in finding out more about the practice they had identified in the video clips and were planning to try out on their farms (*Hierarchy 1*), accounting for 87% of responses (Figure 5.41). The majority of farmers (73%) had also sought advice about the practice (*Hierarchy 2*). A smaller majority (61%) had attended training about the practice (*Hierarchy 3*), while a majority (71%) also believed they knew how to implement the practice on their farms (*Hierarchy 4*). Only a minority of farmers (37%) reported that they had already adopted the practice (*Hierarchy 5*), with another 27% indicating they were some way toward adopting the practice, and the remaining 35% indicating they hadn't (these figures differ from Figure 5.39 because they only include farmers who planned to adopt, not the non-adopters).

Diffusion of innovation

Returning to the variable *Area of change* (Section 5.4.1), the majority of farmers in each theme reported being at the *know-how* or *already adopted* stages in *Bennett's Hierarchy* for

each of these themes (Figure 5.42), aside from *Green Cane Trash Blanket*, which is an outlier given that it accounted for only one response.

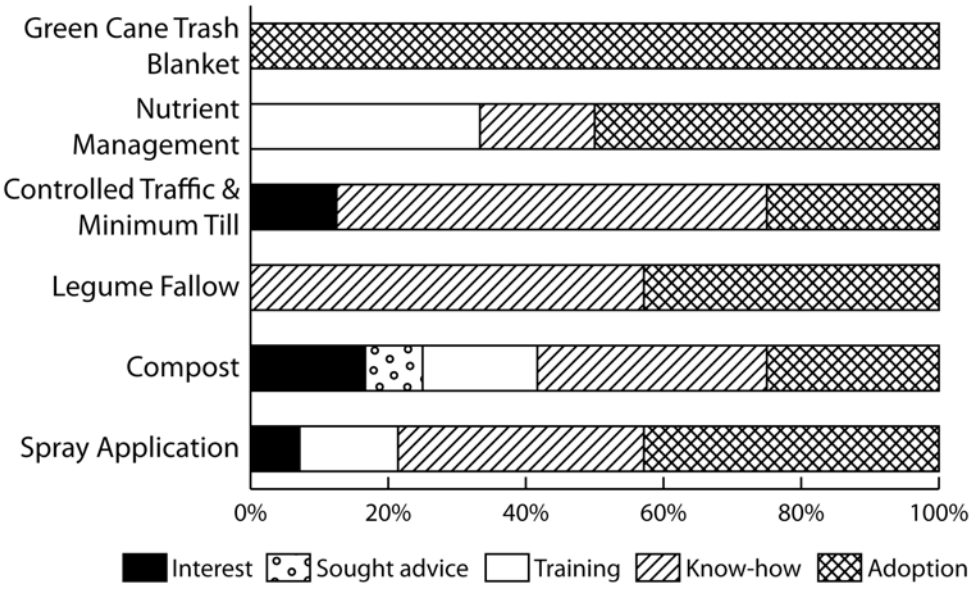

Figure 5.42 – Proportion of responses in *Bennett's Hierarchy* for each *Area of Change* (n = 54)

There was no statistical test used to confirm this observation for two reasons. Firstly, the count for each group was too small, and secondly, the measurement was imprecise given that numerous farmers reported that they planned to adopt more than one practice from different areas. In this case, farmers had been instructed to choose the practice that was of most importance to them. Interestingly, Figure 5.42 confirms that the themes represented different stages in the adoption lifecycle. *Compost* and *Spray application*, were more innovative themes, and had a significant proportion of lower level activities like seeking advice and training. On the other hand, *Legume fallow* and *Controlled traffic & minimum till* are more mainstream themes and had more high level activities.

The variables *Precision Ag*, a measure of adoption propensity (Gloy *et al*., 2000), and the variable *Internet Use*, a measure of technology uptake were compared to other variables relating to adoption attributes. Two statistically significant inverse Spearman's ρ correlations were found to exist. The first was between the *Local content* and *Precision Ag*. The second

between *Local content* and *Internet use*. Both predict a nonzero correlation in the population (Table 5.4).

Table 5.4 – Spearman's ρ correlation between *Local content*, *Precision Ag* and *Internet use* variables

1st variable	2nd variable	n	R	t	p-value
Local content	**Precision Ag**	70	-0.284	-2.441	0.017
Local content	**Internet use**	78	-0.255	-2.304	0.024

These correlations can be interpreted as follows: farmers who were late adopters were more interested in observing evidence of local farmers' adoptions whereas farmers who were early adopters have no regional preference. These inverse correlations confirm *Chasm* theory (Moore, 1999), which predicts that late adopters want evidence of the general acceptance of new practices by their local farming community and therefore have a stronger preference for local content than early adopters.

Table 5.5 – Spearman's ρ zero correlation between the *Precision Ag* and *Plan to change* variables

1st variable	2nd variable	n	R	T	p-value
Precision Ag	**Plan to change**	55	-0.006	-0.046	0.963

The *Internet use* and *Precision Ag* variables were also tested for correlations with *Plan to Change*, *Intention* and *Bennett's Hierarchy*. No statically significant correlations were found to exist between these variables. However a statistically significant zero correlation was found between *Precision Ag* and *Plan to change* (Table 5.5), which confirms the null hypothesis that that there is no correlation between these two variables in the population i.e. $\rho s = 0$. This result suggests that evidence-of-adoption did not favour one group in the adoption lifecycle over any other. However, this result rests on Gloy et al.'s (2000) assumption that *Precision Ag* is a valid measure of propensity for adoption.

Given that no significant correlations were found to exist between any of these variables and the *Plan to change* or *Intent*, these variables can be ruled out as other possible causal factors.

5.4.4 P1: Self-disclosure leads to an implicit acceptance that the statements made are sincere and truthful, as well as revealing the adoption characterises of the farmers who make them.

Once transcripts of the recorded group discussions were divided discrete *thought units*, each unit was categorised and given a pair of codes, one signifying that validity claims were implicitly accepted or questioned, and the other signifying whether the statement conveyed operational detail or abstract concepts (which is covered in the next Section 5.4.5).

Table 5.6 – A summary of codes for questioned vs accepted validity claims by region

	Questioned	Accepted	Total
Ayr	1	138	139
Childers	2	150	152
Ingham	1	145	146
Mackay	3	198	201
Maryborough	2	162	164
Mossman	4	168	172
Proserpine	2	182	184
Tully	1	131	132
Bundaberg	1	100	101
Tableland	2	91	93
Cairns	5	174	179
	1%	**99%**	

In the majority of statements, validity claims were implicitly accepted, accounting for 99% of coded *thought units* (Table 5.6). Even when validity claims were not accepted, farmers would often detail their reasons.

Example 1:

> *[FARMER1] One of my concerns is with that guy that says he only does two passes going from one cane crop to the next. If you have some problem within your soil that is endemic there and you want to give that soil a bit of a spell, trying to get rid of it, if you don't open it up to the air at all, or plough it or something like that your going to continue on with the soil being sour. Around [THIS AREA] if you get a nice dry season where your soil structure remains in good shape, well I have no doubt that you can do that, but if you get a year like this one at the moment that's really wet, the actual soil turns a sort of bluey rotten colour and it has a smell to it. If you plant straight back into that, you are going to kill it.*

In the above example, the farmer speaking does not accept that the practice is suitable for his area. However rather than simply discounting it out of hand, he details his reasons.

Example 2:

> *[FARMER2] There he said that [the shielded spray] was shooting it under the stool, now if you're getting roundup shooting under the stool, which I find it very hard to believe, knowing what roundup can do, that he's not getting any losses? What rate are they using?*

In the second example above, the farmer does not accept that the farming practice achieves the stated outcomes. However, rather than discounting it out of hand, his response is to request additional information.

Example 3:

> *[FARMER3] That dual row system, I can't work out why that bloke's rows are further apart right down the middle, because ours are completely closed up, you can't even tell them apart.*

[FARMER4] Yeah?

[FARMER3] Ours closes-up and you wouldn't know.

[FARMER4] Ours is almost there, but you can still see a little wheel track in the middle.

[*FARMER*3] *We are 1.8 and 500 […] We fertilise down the middle, I think it grows to the fertiliser. If he's fertilising on the outside, it could be a problem with his fertiliser.*

In this third example above, the first farmer can't reconcile the differences between his dual row farming system and one presented in the video clips. However, the second farmer confirms that he has experienced similar problems to those in the video, beginning a discourse between the two farmers about the problem, leading to a possible explanation.

Example 4:

*[FARMER5] What most growers are saying now is, as soon as you see someone and say that's a reasonable idea and everything like that the next question is, how much money did the government give them. The figures are generally not quite correct, they are a little bit stretched, oh I wouldn't say stretched, but they're … they have added the government money in, and they have been able to build it on that. If I go out there and try to build it, and I have done that, been out there on my own, building all this stuff, at the end of the day I have gone s**t I'm out of pocket, what's gone wrong here?*

In the fourth example above, the farmer is questioning the inter-subjective social acceptability of the innovation. He has identified that an innovation discount (public R&D investment) has skewed the evidence of economic potential. This is of concern to him because a large capital investment in equipment was required to adopt the innovation.

Example 5:

> *[FARMER6] That soybean, the next person who tries to tell me that soybeans are the answer, I'm gonna punch him in the nose.*
>
> *[FARMER7] Your not going to be like everyone else and tell everyone to put an extra bag of fertiliser on are you?*
>
> *[FARMER6] No I am not, but what about last year? That was the first time I ever lost plant cane in my life.*

In the final example above, the first farmer rejects the practice out of hand. However, after doing so, a second farmer articulates a negative value judgment about him based on his statement. The first farmer responds by clarifying his reasons for rejecting the practice. This example demonstrates social acceptance within farmer-to-farmer learning exchanges is predicated on participants being cogently truthful and sincere. That is, it is socially unacceptable to simply be dismissive; instead, farmers are expected to provide their reasons, and in this case, these reasons reflect firsthand experiences.

In conclusion, through self-disclosure the video clips reveal enough about the farmers who appear in them for validity claims about the statements they made to be implicitly accepted, confirming this proposition. In the cases where validity claims were not fully accepted, the sincerity of the farmers in the video clips was never called into question. When the '*truth*' of an account was rejected, it was most often because the innovation was unsuitable. However, by explaining their reasons for rejection, farmers tacitly acknowledged that there could be more that one '*truth*'. One farmer summed it up by saying '*There is no right or wrong here, is there!*' Farmers also demonstrated an awareness of the inter-subjective social acceptability of innovations by groups of adopters with characteristics similar to their own. Meaning was conveyed between farmers efficiently, with almost no time wasted arguing over opposing

views. Instead, farmers built meaning by revealing the narratives of objects, processes and events that reflected their own firsthand experiences.

5.4.5 P2: Operational detail is the language though which farmers convey meaning with one another about farming technologies and practices.

In the majority of statements, operational detail was used to convey meaning, accounting for 94% of coded *thought units* (Table 5.7). Even when abstract concepts were expressed, farmers still used operational detail to convey what was meant.

Table 5.7 – A summary of codes for general concepts vs operational detail by region

	General	Detailed	Total
Ayr	7	132	139
Childers	8	144	152
Ingham	6	140	146
Mackay	12	189	201
Maryborough	11	153	164
Mossman	9	163	172
Proserpine	7	177	184
Tully	13	119	132
Bundaberg	8	93	101
Tableland	5	88	93
Cairns	7	172	179
	6%	**94%**	

Example 1:

> *[FARMER1] We dual row, we've been dual row for a long time now, we've got 1.8 metre centres, and it doesn't save any money – fair-dinkum – because the new technology, new ideas, department of main roads, trying to get wide implements up the road, everything has got to be folded up, everything costs and those costs add up.*

[RESEARCHER] Switching costs?

[FARMER1] Switching costs! There is a lot more... like that fella's saying there, the dual row cane doesn't grow into the centre, he's right, it doesn't do it ever, it always wants to grow out.

In the first example above, the researcher clarifies his understanding of what meant by introducing an abstraction, the farmer confirms the abstraction, but in the next sentence, switches straight back to operational detail.

Example 2:

[FARMER2] There are some things that are missing here now and that is about 10% of the growers in Queensland have gone to 1.8 dual row or 1.9. You have the other 90% still sitting on 1.65 or five feet, they have already marched off, they've built their machines and their going on to their own. You wouldn't call it controlled traffic but their own minimal workings and there is this big void out there that no-one is taking notice of these fella's and they're already well ahead of all this other stuff. […]

[FARMER3] I think [FARMER2] hit it on the head there with the first comment. In that it is so expensive to go from your 1.5 or 1.6 up to your 1.8 or 1.9 or whatever you want to go to that a lot of growers are sitting back waiting for the innovators to try and if they can see that there is a big increase in productivity or increase in savings, that would cover the cost of implementing this system then everybody else would have a go at it. But because there is no real incentive there, the cost outweighs the benefits with everything we've done so far, and that's why everyone hasn't bothered changing.

In the second example above, the farmers discuss switching costs and alternative minimum till approaches. However, many of these thoughts are expressed as clusters of operational details that signify concepts, rather than specifically naming these concepts.

Example 3:

> *[FARMER4] Can I just add a bit to that. I think it's horses for courses. It comes down to individual taste, and you get dry years and wet years. There are some areas talking about zero till, just double disk opener direct injection of soybeans, then double disk opener planting and then not touching it. Other than renovating the beds for controlled traffic situation, but that doesn't mean it's going to be happening all over the sugar industry. There are some areas where they will be able to do that, but there are some areas that are impossible to do that. So its a range of things, and […] I've heard and seen all the arguments fore and against, and I think its a case of individuals doing what's best on their property.*

In the third example above, this farmer articulates recognised concepts, like zero till and controlled traffic, as he seamlessly switches between operational detail and abstraction.

Example 4:

> *[FARMER5] Yeah, we started making fold up machines and we took them out to the paddock, and yeah they last one or two years and then the fatigue starts cracking, starts coming in really heavy. So there is nothing better than a big solid bar across the front that doesn't have any welds on it and you build it with that. Folding up machines just wear out.*

In the final example, we see the how the concept of metal fatigue in folding frames is expressed through a narrative of events that reflect the personal experience of the farmer. Each event, paints a mental picture of the farmers experience with metal fatigue, so that by the last statement, we accept the statement is both sincere and truthful. In this sense, validity claims conveyed through self-disclosure and operational detail are interdependent constructs; one does not exist without the other.

In conclusion, operational detail was the preferred language through which farmers conveyed meaning, confirming this proposition.

5. 5 Conclusion

In summary, the farmers who found the video clips most worthwhile believed they had all the necessary skills to adopt practices they had identified in the video clips. Most of farmers were either ready-to-adopt (34%) the practice or had already adopted it (32%). However, while the video clips had influenced adoption, this did not correlate with farmers' attitudes or perceived behavioural control beliefs. Instead, farmers felt significantly encouraged to change by the farmers in the video clips, more so than by any other behavioural influence measured.

Table 5.8 – A summary of hypotheses, propositions and results.

No.	Hypothesis	Results
H1	*Farmers exposed to industry-wide evidence-of-adoption are influenced to adopt new technologies and practices.*	Confirmed
H2	*Farmers exposed to other farmers' evidence-of-adoption, identify with this virtual peer group, leading to strong positive normative beliefs, encouraging them to adopt suitable innovations.*	Confirmed
P1	*Self-disclosure leads to an implicit acceptance that the statements made are sincere and truthful, as well as revealing the adoption characterises of the farmers who make them.*	Confirmed
P2	*Operational detail is the language though which farmers convey meaning with one another about farming technologies and practices.*	Confirmed

The chapter began with descriptive data about the subjects and video clip content. This was followed by an enumeration of each research hypothesis and proposition, with analysis of relevant results to draw inferences about causal relations. A summary of these results appears in Table 5.8. Frequent summary tables and figures were used throughout this chapter to illustrate patterns in the data. However, only results of applying analysis techniques were reported here, a discussion of these findings within the context of the literature appears in the next and final chapter.

6 CONCLUSIONS AND IMPLICATIONS

6. 1 Introduction

This research makes a distinct contribution to knowledge by explaining and testing-out behavioural mechanisms in farmer-to-farmer learning exchanges that trigger change.

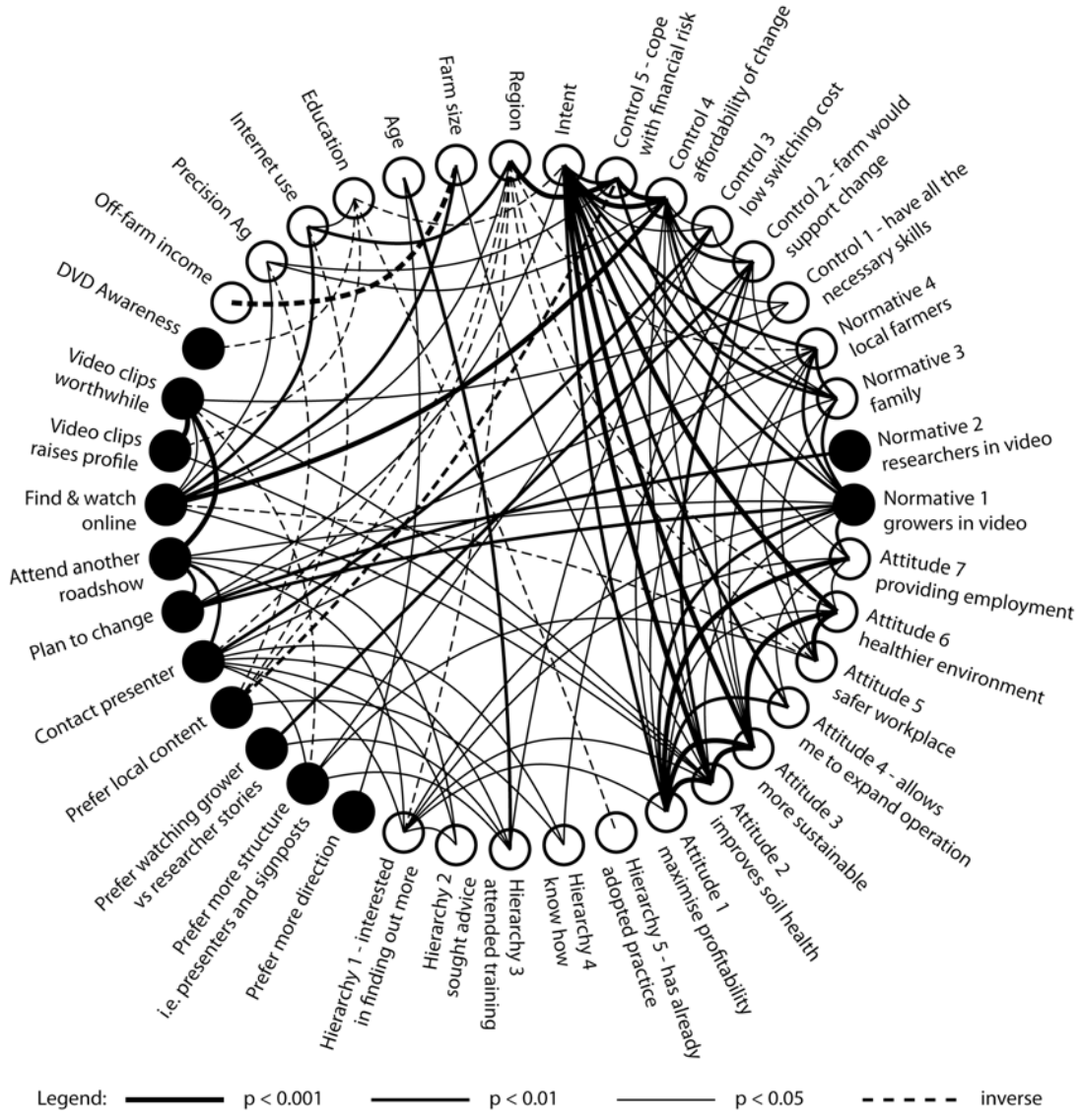

Figure 6.1 – All the statistically significant Spearman's ρ correlations between pairs of variables

While extension practitioners have recognised the benefits of farmer-to-farmer learning (Manjala, 2009), little has been previously written about the precise behavioural influences

that are at work (See Section 1.2 for a summary). The theoretical framework developed at the end of Chapter 3 proposed mechanisms by which farmer learning interactions lead to adoption decisions. These mechanisms were tested with empirical data, collected using the methods presented in Chapter 4 and analysed in Chapter 5. This analysis revealed a large number of mostly independent variables, which were found to have numerous statistically significant correlations (Figure 6.1). This chapter interprets the analysis of these correlations to draw conclusions about the salient research questions by relating these results back to the body of knowledge, to infer implications for theory, policy and practice.

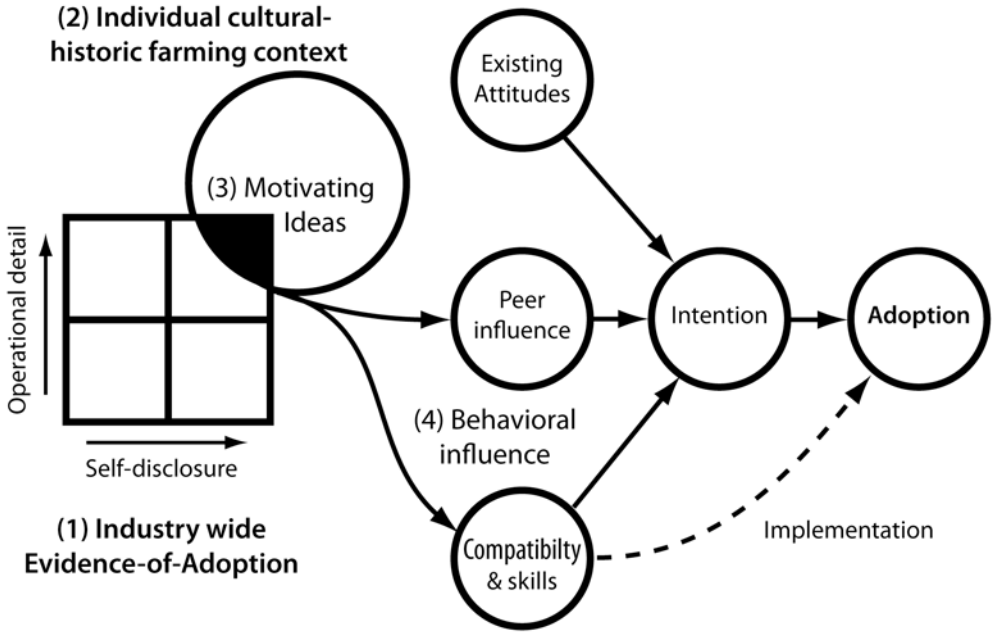

Figure 6.2 – A theoretically and empirically founded framework explaining the mechanisms by which farmer-to-farmer learning exchanges influence adoption.

The principal contribution made by this research is its confirmation of the role of these elements in the *Evidence-of-Adoption Framework* that was proposed in Chapter 3. This framework consists of four elements (Figure 6.2), (1) beginning with industry-wide evidence-of-adoption, mediated by the validity claims derived from self-disclosure and operational detail. At the intersection between evidence-of-adoption and (2) the individual cultural-historic context of the farmer, (3) motivating ideas are formed. These motivating

ideas lead to (4) behavioural change when farmers observe sufficient evidence to influence intentions to towards adoption.

This research demonstrated that industry-wide evidence-of-adoption was influential. It resulted in 60% of farmers who participated in the study, planning to change, with half of those having already made those changes over the course of the year in which the study took place. Farmers were also found to already have positive attitudes and control beliefs towards making these changes. Evidence-of-adoption allowed farmers to implement motivating ideas by providing the needed peer support, evidence of compatibility and perceptions of skill that were missing. Combined, these influences triggered the intentions to adopt, leading to the actual implementation of the innovation, resulting in adoption.

Operational detail and self-disclosure were found to be important interdependent factors. This research showed that farmers build meaning by sharing narratives about objects, processes and events that reflect firsthand experiences. This led to an efficient transfer of knowledge because validity claims were implicitly accepted. It was also shown that operational detail was the language through which these shared meanings were conveyed.

Having introduced the principal finding, the discussion now draws conclusions about the contributions these results made.

6. 2 Conclusions about each research sub-question

This section summarises the results for each research sub-question and compares them with the expectations from extant literature to identify contributions. A summary of these contributions appears below (Table 6.1) including an assessment of the degree to which the extant literature explicitly addressed them.

Table 6.1 – The list of '*new*' themes for each research sub-question and the degree that extant literature explicitly addressed them

Question	Theme	Extant Literature
RSQ1	Industry-wide evidence-of-adoption influenced farmers decisions to adopt new technologies and practices.	Some theory & some evidence
	Influence occurred at the intersection between industry-wide evidence-of-adoption and the cultural-historic context of individual farmers.	
RSQ2	Peer influence was more significant in encouraging change than any other behavioural influence.	Limited theory
RSQ3	A tacit social contract to be truthful and sincere lead to efficient dialogic exchanges because validity claims were implicitly accepted.	Limited theory
RSQ4	Operational detail was the preferred language through which farmers shared understandings about innovations.	Limited theory

6.2.1 RSQ1: Does video mediated industry-wide evidence-of-adoption influence farmers' decisions to adopt innovations?

Yes, this research confirms results reported by Gandhi *et al*. (2007) and Polson (1999) that video is an effective and influential conduit for farmer-to-farmer learning. However, this research went further by providing a theoretical framework to explain the mechanisms by which these farmer-to-farmer learning exchanges influenced change. In testing this hypothesis that evidence-of-adoption was influential, the role of this element in the framework was confirmed.

The area-of-change that was influenced by the video clips was also shown to vary amongst farmers, indicating that each farming context was different, and thus, the suitability of innovations varied from farmer to farmer. This shows that decisions to adopt occurred at the intersection between evidence-of-adoption, and the individual cultural-historic context of the farmers who watched them, confirming the role of both of these elements in the framework.

6.2.2 RSQ2: Are farmers' decisions to adopt innovations significantly influenced by the subjective norms of peers?

Yes, decisions to adopt were found to be more influenced by the farmers in the video clips than by any other behavioural influence measured. In testing the hypothesis that subjective norms significantly influenced adoption decisions, the role of this element in the framework was confirmed.

The influence of subjective norms in agricultural behavioural research has been reported in other findings (Fielding *et al*., 2008; Kaufmann *et al*., 2009). The account by Brennan *et al*. (2007), which is particularly relevant, indicated that learning interactions between farmers can be extremely effective. Tutkun and Lehmann (2006) tested for an analogous interpersonal communication construct in a hybrid DoI/ToPB model and found it to be influential, accounting for 76% of the variation in adoption behaviour. However, the approach taken by this study was to use evidence-of-adoption video clips as the mechanism for normative influence. The degree to which these video clips influenced the behavioural intentions of the farmers who watched them, demonstrated the merit of this approach.

Ajzen (1991) predicted that behavioural researchers would combine ToPB with other factors to customise ToPB for specific purposes. Extensions to ToPB have been theorised for agricultural behavioural research (Jackson *et al*., 2006) but empirical results are limited (Tutkun & Lehmann, 2006). While the use of ToPB to predict the outcomes of agricultural behavioural interventions has been previously reported (Burton, 2004; Edwards-Jonesa, 2006) and applied (Kaufmann *et al*., 2009; Tutkun & Lehmann, 2006), this study appears to be the first to evaluate evidence-of-adoption using a ToPB methodology in an agricultural setting.

Finally, the finding that the measure for *Intent* had significant positive correlations with numerous behavioural predictors and farmers' plans to change, confirms the utility of this measure recommended by Herring (2008).

6.2.3 RSQ3: Does self-disclosure allow evidence-of-adoption validity claims to be accepted?

Yes, self-disclosure by farmers in the video clips provided enough information for the farmers who watched them to implicitly accept their validity claims, confirming the role of this element in the framework. This connection between self-disclosure (Jourard, 1971; Luft, 1969) and the implicit acceptability of validity claims (Habermas, 1984) in learning exchanges between farmers – to the best of the researcher's knowledge – has not been previously made.

This perspective provides a different interpretation of the role of intimacy in farmer communication than that of Phillips (1985). Phillips observed that when farmers seek information, the degree of influence the information they obtain has, varies according to the level of social intimacy they had with the information source. By contrast, the findings of this study suggest that it is the variability of communication styles employed by different information sources that accounts for these differences. Clearly there was no prior social intimacy between the farmers in the video clips and the farmers who watched them, yet the farmers in the videos clips turned out to be more influential in supporting decisions to change than any other behavioural influence measured, including researchers, local farmers and family members. Intimate self-disclosure conveyed though video clips was also found to result in the same implicit acceptance of validity clams as was observed in farmer-to-farmer learning exchanges in Phase I (Section 2.4.3).

6.2.4 RSQ4: Do farmers favour operational detail over generalised abstractions when communicating about innovations?

Yes, operational detail was shown to be the preferred language through which shared meaning was conveyed between farmers, confirming the role of this element in the framework. Farmers were shown to build meaning by revealing the narratives of objects, processes and events that reflected their own firsthand experiences. These concepts stemmed from the notion that farming activities create knowledge artefacts, which function as both a *thinking device* and *generator of meaning* (Lotman, 1988). The operational detail of these knowledge artefacts can then be seen as the language through which shared *structures of meaning* about the activity of farming are expressed and efficiently conveyed between farmers. This explanation of the role and function of operational detail through the lens of cultural-historic activity theory – to the best of the researcher's knowledge – has not been previously made.

6. 3 Conclusions about the research problem

Having summarised the results and contributions for each research sub-question, this section draws conclusions from these findings about the research problem.

> ***When farmers interact and learn from one-another what behavioural influences trigger decisions to adopt new technologies and practices and can these influences be effectively conveyed via electronic means?***

When combined, the research results already discussed, confirm the role of each element in the theoretical framework consisting of (1) industry-wise evidence-of-adoption, (2) the individual cultural-historic farming context, (3) motivating ideas, and (4) behavioural influences, leading to implementation intentions and ultimately adoption. Not only has this research generated plausible and insightful results confirming the role of these elements, it also confirms the suitability of this framework for electronic delivery, with the majority of

farmers (77%) indicated that they would like to be able to find and watch these types of video clips online.

This approach to technology transfer sees it transformed from an archaic legacy of the positivist era into a bottom-up participatory approach that enables change by facilitating the transfer of innovations between farmers using video. From the perspective of extension programs engaged in technology transfer, this framework provides solutions to some of the problems presently being encountered with low uptake of useful research outcomes. This approach works in part because it acknowledges that the suitability of innovations is highly dependent on individual farming contexts. This will require many extension agents to re-examine commonly held views about adoption.

While many criticisms of DoI theory have already been raised (Brennan *et al*., 2007; Fichman & Kemerer, 1999; Lyytinen & Damsgaard, 2001), it seems the most significant problems comes from the way it is applied. Stephenson (2003) singles out the *progressive farmer approach* as a common fault with DoI application. This is where agents believe their job is done once a few progressive farmers have adopted a new technology, the logic being that the new practices will invariably diffuse out to the majority of farmers. This approach is clearly an over-simplification. Other problems come from overestimating the population of potential adaptors for an innovation (Kaine, 2008), or overestimating actual uptake based on purchases that do not result in actual deployments (Fichman & Kemerer, 1999).

This study provides a new perspective for conceptualising the application of DoI theory. Drawing from Moore's (1999) ideas about distribution channels from *Chasm* theory, farmers can be seen as system integrators. That is, because individual farms have different resources and constraints, farmers have to customise their farming system by choosing from a potentially large set of components and options. As such, their knowledge needs exceed what they need to know to simply operate their farms with existing farming systems.

By using behavioural models to understand adoption, this research revealed farmers already possessed many positive attitudes in common, which provided strong motivations for change. However, the critical lever for self-efficacy turned out to be the specific operational details that came from a trusted peer group of model farmers. This differs from conventional approaches used in extension where *Diffusion of Innovation* theory is applied (Hubbard & Sandmann, 2007), and farmers' *knowledge*, *attitudes*, *skills* and *aspirations* (Bennett, 1975) are expected to be changed for adoption to occur. In this study, the barrier to adoption came from a lack of evidence of the suitability of a given technology or practice to their particular circumstance, rather than the farmers' lack of skill, attitudes or motivation to change.

This approach lifts the burden of blame for non-adoption from the shoulders of farmers and places it on those responsible for gathering and communicating evidence. In doing so it overcomes *pro-innovation bias*, a strong criticism previously levelled against DoI theory (Stephenson, 2003). Importantly, it reveals that adoption facilitation should be an active and ongoing process that occurs at an industry level, rather than at an individual project level. To be effective applying this new approach, agencies responsible for agricultural R&D will have to rethink how adoption campaigns are structured and funded.

6. 4 Implications for theory

This research's findings have two implications for theory: firstly the evidence-of-adoption framework which explains mechanisms by which farmer-to-farmer interactions influence change at the micro level, and secondly, the concept of a *Video Mediated Social Network*, which explains how industry-wide evidence-of-adoption advances farming systems across an industry at the macro level.

The evidence-of-adoption framework has already been described in detailed at the beginning of this chapter so will not be discussed any further here.

The *Video Mediated Social Network* (Figure 6.3) explains the mechanism by which industry-wide evidence-of-adoption captured and communicated using video clips like those created for this study, provides an effective adoption pathway for technology transfer across an industry. This is achieved by providing individual farmers with a larger pool of readily adaptable components from which to advance their farming systems. Individual farmers then mitigate the risks associated with individual development efforts and benefit from the combined knowledge that a network of individuals bring to bare with different expertise and experiences.

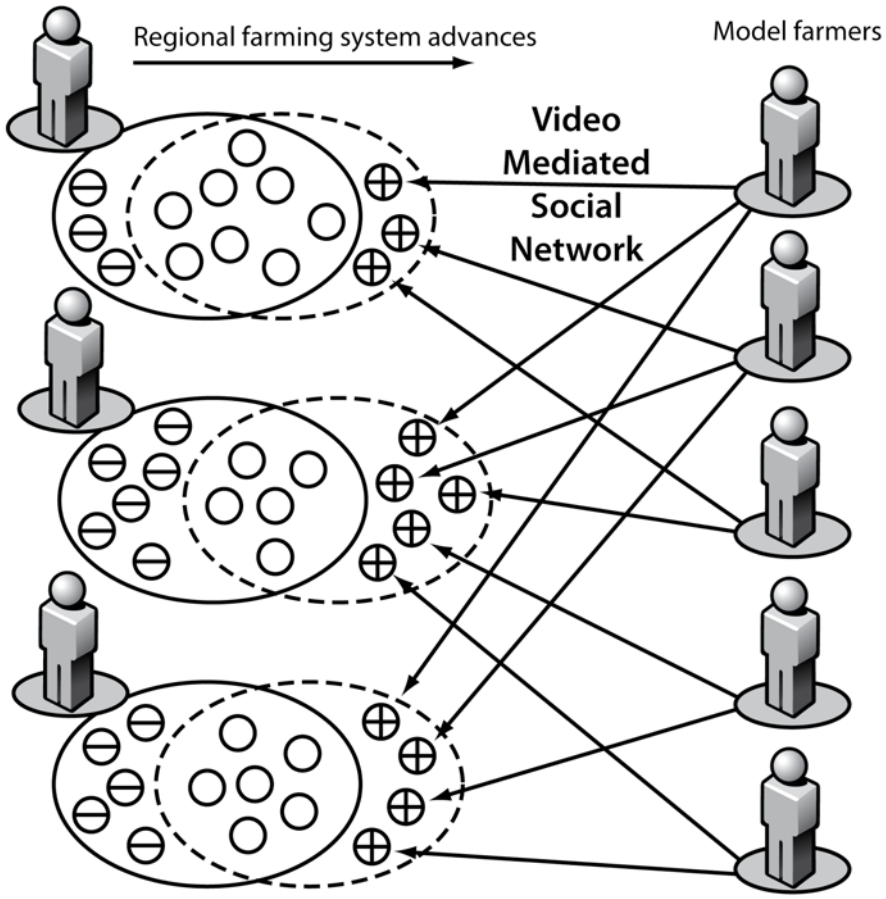

Figure 6.3 – The *Video Mediated Social Network* extends the reach of innovation clusters by sharing farmers' experiences across an entire industry

From Metcalfe's Law (Metcalfe, 2006) it can be deduced that the impact of a *Video Mediated Social Network* is likely to be proportional to the square of the number of farmers who participate in it. Thus, while only a comparatively small number of farmers may share their experiences in the video clips, the impact on the industry can be exponentially larger.

For instance, in this study, less than 60 farmers participated in the video clips, yet DVDs were mailed out to over 4000 farmers, resulting in 32% of those surveyed adopting a practice. However the point of Metcalfe's Law is not so much the absolute number of participants in the social network, but the idea that there is a '*critical mass*' after which beneficial '*network effects*' out-way the cost of participation.

Returning to Rodgers' (2003) theory of perceived attributes, we are reminded that innovations with high complexity have lower adoption potential. While this may be an apt description, it provides little assistance to practitioners looking to increase the adoption of technologies that are merely components in larger and more complex interdependent systems. For example, changing from a conventional planting system to a single pass plant and fill-in approach (like the Mizzi mound planting system) assumes that GPS guidance, controlled traffic and reduced tillage components are already in place. Adoption of these types of components are complicated by the possibility that they may have unanticipated impacts on the entire system, much like case of the extended elevator described in Section 2.4.5. The *Video Mediated Social Network* is able to overcome this tyranny of complexity by providing the farming systems integrator a broader palette of options to choose from, with a greater awareness of their strengths and weaknesses in real operational settings.

6. 5 Implications for policy

The critical questions for policy are:

1. what is the '*critical mass*' for a social network to exhibit beneficial '*network effects*'; and,

2. how does the cost benefit of the *Video Mediated Social Network* compare to other more traditional group-based extension activities that provide farmers with similar opportunities for social interaction.

To calculate this critical mass, Metcalfe's Law (Metcalfe, 2006) provides the formula N=C÷A, where N is the critical mass, C is the cost of participation and A is the '*affinity*' value per connection. Rather than attempt to quantify the cost in terms of actual expenditure, which is more likely to vary with time, this analysis uses person-hours as the measure of currency.

The values in this first analysis provide a useful estimate of the critical mass at which beneficial network effects might occur (Table 6.2). Here it is assumed that each practice takes about a week (40 hours) for farmers to master. This research found that when farmers watched about 40 video clips (2 DVDs worth), 32% of them adopted a practice. It is then conservatively assumed that this will save them about 50% of the time that it took the original farmers to master the practice (in reality this figure could be potentially be much greater). Using Metcalfe's formula the result is a critical mass of about 250 participants. If the time saving were greater, N would be smaller and vice versa.

Table 6.2 – The '*critical mass*' for a *Video Mediated Social Network* to exhibit beneficial '*network effects*'

Innovation time	40
Video clips	40
C (cost)	1600
Actual adoption	32%
Time saving	20
A (affinity)	6.4
N	250

In the second analysis, the DVD and Roadshow is compared with the time spent organising and participating in a grower bus trip (Table 6.3). These calculations include estimates of the time farmers spend participating in each of the different activities in order to make the relative opportunity-cost for all participants more realistic. It should however be emphasised that these cost comparisons are only a guide, because they assume that other costs like hiring

the bus or travelling to the farms and videotaping farmers are comparable; which may not be the case.

In the case of the bus trip, 4 days are allocated to organising a daylong event. The five farmers who are the presenters each loose a day as they prepare for and participate in the event. The audience members also each spend a day participating in the event. This leads to a total of 400 hours for five information exchange opportunities, arriving at one person-hour per individual information opportunity for the group. If for the sake of convenience, the value placed on an hour of time is $60, then each information opportunity cost $60 per individual.

Table 6.3 – A cost benefit analysis comparison

	Bus Trip	DVD	Roadshow
Pre	32	160	16
Production	8	80	8
Post		400	
Presenters' time	40	20	
Total fixed hours	80	665	24
n	40	3080	20
Audience time	8	1	2
Total variable hours	320	3080	40
Total hours	400	3745	64
Information ops	5	20	20
Person-hours per op.	1:00	0:04	0:10
Relative cost per individual info op.	$60	$4	$10

In the case of the DVD, the costs are based on the following assumptions.

An efficient production team should expect to spend two weeks organising their schedule, at least a week at a time videotaping farmers. During videotaping they should plan to visit two to three farms each day and videotape five stories each day. Each story takes about an hour to complete. Logistically, it is more efficient to videotape multiple stories at each farm,

however not all farms will have multiple stories to tell. For each week of videotaping, production teams should expect to spend five additional weeks editing video clips. They should expect 80% of the stories they record to be usable, leading to 20 completed video clips averaging three minutes in duration. Thus, efficient and adequately skilled production teams working in this way should be expected to produce one 60-minute DVD in eight weeks.

Based on these assumptions, pre-production with two people for two weeks takes 160 hours; production takes 80 hours, and post-production takes an additional 400 hours. When the combined presenters' time of 25 hours is added, this arrives at a total cost per DVD of 665 hours. From the research results it can be extrapolated, that of the 4000 farmers who received the two DVDs, 3080 of them (77%) may have spent at least one hour watching the DVD. This leads to a total of 865 hours for approximately 20 information exchange opportunities, arriving at 4 person-minutes per individual information opportunity. Using the same hourly rate, each information opportunity cost $4 per individual, which is an order of magnitude improvement over the $60 cost of each information opportunity from a bus trip. The major cost difference comes from the fact that the DVD can be distributed to a much larger audience of farmers than can participate in a single bus trip.

In the case of the Video Roadshow, if it is assumed that the cost of producing the DVD has already been covered, then the marginal cost each additional information opportunity is only $10 per individual.

To put these figures in perspective, the five information opportunities provided by the bus trip cost $300 per individual whereas the DVD cost only $80 for four times as many opportunities. Perhaps more importantly, **from a farmer's perspective, the DVD provides four times the information, in an eighth of the time, for about a quarter of the cost**. Online assess could potentially be even more time efficient because farmers have more control over what they choose to watch, potentially reducing the individual cost further.

While it is acknowledged that these figures are only a guide, they are intended to show that farmers' time is valuable to farmers and should be accounted for in any calculation that compares the relative cost benefit of extension activities, particularly when farmers' levies contribute to their funding. These calculations illustrate that *Video Mediated Social Networks* have a clear advantage in this regard.

Given the relative cost of putting on the video roadshow, its worth considering whether activities like it, which are designed to complement online access to video clips are necessary. While a majority of farmers surveyed (77%), indicated they were interested in finding and watching new grower video clips online, a slightly larger majority (88%) indicated they would attend a future video roadshow event. This suggests that the value of the roadshow format was highly regarded. In addition, two information-seeking typologies were loosely identified by this study, the social information seeker, which was centred around the attending future roadshows, and the introverted information seeker, which was centred around online access. Both of these perspectives suggest that facilitating social information seeking by providing roadshow will benefit programs employing this approach. What is not known, but would be useful to know, is the impact the roadshow had on the adoption decisions of farmers who attended it. In any event, probably the most useful aspect of the roadshow, from a program perspective is that it can be used to simultaneously promote and evaluate an ongoing industry-wide adoption campaign.

6. 6 Implications for practice

These findings have four implications for practice:

1. adoption facilitation should be seen as an active and ongoing process that occurs at an industry level;

2. peak-industry bodies are well placed to collaborate in development and coordination of industry-wide adoption campaigns;

3. RD&E institutions face significant cultural and skills development challenges in implementing *Video Mediated Social Networks*; and

4. With the advent of YouTube's partnership program, and other revenue sharing services like it, new business models for rural consultants may be possible.

Adoption Facilitation

Industry competitiveness benefits when farming practices continuously improve across an industry. Here the *progressive farmer approach* (Stephenson, 2003) is slow and inefficient because it targets just a small number of larger farms. By comparison, the benefit of using evidence-of-adoption is that *it provides an equal opportunity for all farmers to benefit*. Thus, adoption facilitation should be seen as an active and ongoing process that occurs at an industry level, something more akin to publishing a magazine rather than printing a single brochure. This requires investment managers to take a long view of the benefits to an industry.

Rather than trying to pick winners by focusing on an individual researcher's discrete innovations, it is recommended that programs aggregate the experiences of many farmers with numerous useful innovations across a diversity of farming systems. These systems should also reflect different scales and classes of enterprise as well as the climatic, edaphic and operational constraints imposed by each region. In essence, technology transfer campaigns should not attempt to pick and fund winners, but report on the evidence-of-adoption of numerous potentially useful innovations across an industry, and let innovations live or die in this marketplace of ideas and successful implementations. A great deal of detail and diversity is needed to accomplish this, and this breadth and depth of information cannot be produced as cost effectively by traditional extension activities as it can by *Video Mediated Social Networks*.

Peak-industry bodies

This study's collaboration with CANEGROWERS proved to be very effective. Peak-industry bodies can be well placed to collaborate in development and coordination of industry-wide adoption campaigns using *Video Mediated Social Network*s. For starters, they have large representative memberships, with a clear understanding of the research and development issues and their controversies. Peak bodies are also industry focussed and mindful of the practical and tangible benefits of research outcomes for their membership.

RD&E institutions

Resistance to the Video Mediated approach, particularly in the context of online service delivery is more likely to come from the significant cultural shift that must occur within RD&E institutions, than from farmers' lack of acceptance; a conclusion shared by Schmidt et al. (2003). The two main challenges that face practitioners are obtaining the necessary creative and technical skill sets to form efficient production teams, and more broadly, re-thinking how scientific information is communicated to farmers.

From the perspective of production teams, there are three important skill sets that are.

1. The technical and creative skills to videotape farmers and edit results into video clips.

2. In-depth knowledge of the agricultural industry, its practices, its controversies, its most promising areas of future innovation, and the farmers and researchers who are leading this innovation.

3. Coordination and logistical skills to organise travel, accommodation and the numerous farm visits that will need to occur each day in a multi-day schedule.

Given these skill requirements, production teams should consist of at least two people with overlapping skill sets, one creative and technical, the other logistical and experienced with extension practice.

In terms of the technical skills, these can be obtained in several ways. Most large regional centres will have creative types who work on a freelance basis and can be hired on a project-by-project basis. The benefit of this approach is that these freelancers will already possess the technical and creative skills that can be adapted to the communication style prescribed by this study. However, collaborating extension agents will need to ensure upfront that the prescribed communications style is followed as a condition of the work to avoid '*creative*' disputes later on.

Some organisation will find that they already have individuals who possess these skills in-house. In this case, arrangements for their secondment to adoption campaigns will need to be made. Alternatively, individuals with the prerequisite skills can be recruited to permanent positions. Given that the idea is to pair creative, technical, logistical, and extension skill sets into a production team, the creative and technical skills are more important requirement of the job description if the new recruit is being paired with existing extension agents. Finally, and probably the slowest and most costly approach is to retrain existing extension agents within an organisation. Nevertheless, this may be necessary with tenured staff and limited funds to hire in new skill sets.

From the perspective of how scientific information is communicated to farmers, the heuristic model of farmer-to-farmer communication (Section 2.5.2) explains why current approaches, where general principals are dispassionately communicated, have been shown to have such little impact on farmers' actual decision making (Phillips, 1985). Clearly scientific research by its nature, will continue to provide objective and generalised principals, however as agricultural research is developed and localised in regional settings, its adoption will benefit significantly from capturing and communicating the experiences of collaborating farmers involved in its development. This research has demonstrated that the narrative of the objects, processes and events that reflect farmers own firsthand experiences is as important as the suitability of the innovation itself, in furthering its adoption. This will require RD&E institutions and the bodies that fund them, to re-examine commonly used program logics in

the light of this study's findings. Clearly effective lower cost adoption pathways would be possible if industry-wide evidence-of-adoption were used, from the development phase onwards; to facilitate video mediated social networks. This study also demonstrates how the video roadshow could also be employed to evaluate the effectiveness of such an adoption campaign.

New business models

Finally, changes brought about in the global media landscape by video streaming websites like YouTube are transforming the economics if niche broadcasting. With the advent of YouTube's partner program in 2007, it is not only possible for content creators to distribute video clips online, but also share in the advertising revenue they generate. This requires content channels to have millions of views to be economically viable, and no agricultural related content has presently achieved anything like this. However, the potential is there for new business models to deliver agricultural information online. Thus, there are real opportunities for private Agricultural consultants to generate alternative sources of income form new types of information resources, like those used in this study.

6. 7 Implications for methodology

This research used an Audience Response System (ARS) to administer it survey instrument. While these are commonly used in a classroom setting, there are few reports of their use in conducting quantitative research. One important benefit from using an ARS is that participants were provided feedback after each question with a graph showing aggregated results. This gave participants an opportunity to comment on the data and its interpretation prior to its analysis, strengthening its interpretive validity (Johnson, 1997). The ARS also eliminates potential errors that result from data entry. Results are available straight away, and can be quickly imported into statistical analysis software.

In this research, the question ‘would farmers recommend the practice they were planning to adopt to other farmers’ was used as a measure of intent, based on the recommendation of Herring (2008). This measure of intent proved to have numerous significant correlations with attitudes, subjective norms and perceived behavioural control, Ajzen’s (1991) three predictors of behavioural change. It also had a significant correlation with farmers stated plan to change. Given the apparent strength of this measure, it would be interesting to see whether by asking ‘had farmers already recommended a practice to other farmers’ provided any stronger correlation to implementation intentions. Either way, this measure might provide a useful shorthand for assessing the strength of implementation intentions towards specific innovations in an industry-wide technology transfer program.

6. 8 Limitations and further research

This final section of this thesis aims to answer the following question.

Given what this study has learned, what questions remain unanswered?

In answering this question this section will examine limitations in the theory, methods to collect data, and analysis used by this study, and recommend what are hoped to be productive and fertile avenues for further research. While limitations in this study are acknowledged, they do not detract from the strength of its contributions. However, to be completely circumspect, program managers are reminded that this study only proves with certainty what worked for sugarcane farmers in the Australian sugar industry.

To begin with, the choice of a post-test only design is a limitation because no baseline data was collected prior to farmers watching the video clips. However, when asked, farmers were able to identify and describe specific ideas they got from watching the video clips that motivated them to change. The limitation of most concern with this post-test design is that it may have masked changes in attitudes and control beliefs. However, even here, the confounding variables that would have affected alternative approaches like time-series

designs would have been just as problematic. During the treatment period when subjects were watching the videos, their beliefs may have been influenced by other external factors like concurrent extension activities, reading agricultural publications and discussions with other farmers. This is what makes measuring the specific impacts of extension efforts so difficult. Given the impact of widespread adoption of this study's approach could have far reaching impacts on RD&E staff and their activities, program managers would be prudent to follow Tilley's (2000) advice and perform pilot studies first to evaluate the suitability of this approach for other industries.

In relation to theory, specifically ToPB, problems encountered in Section 4.2.5 stem from assumptions surrounding its interpretation and application rather than the behavioural model itself. Ajzen (2006) assumes that the ability to communicate new salient beliefs is limited. There is a presumption here that only a few new beliefs will be identified that are accessible to the entire research population, as opposed to tailoring new beliefs to each individual. This study's approach was not restricted by this limitation. Instead, there was a clear benefit from communicating a diversity of successful approaches in considerable detail. It is perhaps the level of detail needed in the communication of highly contextualised beliefs where Ajzen's recommendations were most deficient. In this respect, ToPB has not been adequately adapted to evaluating behavioural interventions like the one conducted for by study.

Independently measuring the presence of beliefs as well as positive or negative consequences would have also overcome one limitation that was encountered by this study's use of a five level Likert-type scale, which ultimately limited this study's analysis to non-parametric tests. The product of separate behavioural measures and judgement scales would have resulted in variables with a range of 25 rather than five, which may have reduced the number of non-normal distributions encountered. The reason for not choosing this approach for this study (justified in Section 4.2.5) was that it would have lead to too many questions being asked. However, most of the attitude and control belief questions, along with Bennett's Hierarchy turned out to be unnecessary. Future survey instruments could build on these

findings by asking fewer questions about these beliefs and instead focus on greater fidelity by using separate behavioural measures and judgment scales, as per Ajzen's (2006) original recommendation.

Future work might consider extending the evaluation procedure of Bennett's Hierarchy (Bennett, 1975), which is very popular amongst extension practitioners, to include the normative influences from ToPB that are currently absent. Thus Knowledge, Aspirations, Skills and Attitudes (KASA) might be renamed KASAP, with the addition of Peer influences (subjective norms). A revised Bennett's Hierarchy procedure might also adapt KASAP to not only measure changes in these beliefs, but also positive or negative judgements about their consequences, as per Ajzen's (2006) recommendations. In addition, such a revised evaluation procedure could integrate *Video Mediated Social Networking* as both the conduit for communication between farmers, as well as the '*hard*' evidence of adoption for the program's evaluation. Such a revised evaluation procedure built on these theoretical foundations would make a valuable contribution to future extension practice given the clear need for more robust evaluation identified by the Productivity Commission (2011).

In relation to subjects, this study assumed that the members of an industry would be willing to share their knowledge and experiences for the greater benefit of their industry. In some classes of rural commodities, this may not be the case, because farmers may perceive the market as a net sum gain, where they only benefit if other farmers loose. In these industries, farmers perceive they are competing with each other at an individual level, rather than competing as a product class against alternatives for consumer choice in their shopping baskets. However even in these situations, improvements in productivity and quality at an industry level can improve product availability and consistency, increasing market share and ultimately growing markets at an industry level.

In industries where trust and cooperation between farming enterprises are less common, it would be interesting to see whether the willingness of some farmers to share their '*secrets*'

impacted on other farmers' willingness to participate. One of the intriguing aspects of this project was that some farmers, who had no interest in participating initially, after seeing other prominent farmers participate, wondered why they hadn't been approached. Some combination of status or pride may be a motivating factor here, and it would be fascinating to see how strong this might be in farming communities that are less inclined to share.

In relation to the treatments, the six rules for videoing farmers, proposed and evaluated by this study assumed that all the following steps were necessary: (1) a model farmer gave the presentations; (2) the presentations were given on their farms; (3) the model farmers spoke directly to the camera in their own words about their own experiences; (4) the model farmers demonstrated the sequences of actions involved in the practices; (5) important aspects of the practices, particularly those that were difficult to describe verbally, were illustrated visually; and, (6) each video clip presented a single practice or technology. While the results confirmed this approach was effective, it is not clear whether all the steps are actually required, or whether some have a greater importance than others. Furthermore, this communication style was limited to gathering and communicating operational details, not abstraction concepts like strategic thinking, management styles and critical analysis. Future research might isolate and measure the different elements used in this approach to assess their actual influence, and see whether this it can be extended to encompass the communication of abstract concepts and problem solving strategies in some way. However, given that operational detail was shown to be the preferred language of farmer-to-farmer communication, these abstractions may need to be signified through the groupings of operational detail that define them.

In relation to technology transfer, this research investigated the nature and effect of evidence-of-adoption across a spectrum of technologies at different stages in the adoption lifecycle. Therefore, it may be of limited benefit to practitioners interested in developing a technology transfer strategy for a specific technology or practice. That is, it does not reveal how to promote adoption of specific technologies, rather how to improve the level of

innovation uptake across an industry. Nevertheless, it may still be of some use in these circumstances, as the case of the shielded spray application demonstrated. A single detailed video about a an innovation can influence adoption decisions.

In conclusion, four insights relating to farmer-to-farmer learning emerged from this research. Firstly, a tacit social contract amongst farmers to be truthful and sincere, which made their communication style efficient and egalitarian. Secondly, the social acceptance of innovations by successive groups of adopters was an intrinsic aspect of their discourse about innovations, even if not overtly stated. Thirdly, evidence-of-adoption allowed farmers to mitigate risks associated with individual development efforts by aggregating risk across a network of individuals who possess different expertise and experience. Finally, operational detail was the language through which farmers communicated with one another about farming technologies and practices. These insights reveal how highly evolved farmer-to-farmer learning exchanges are, with social mores that regulate conditions for egalitarian dialogue to occur. Few other business environments share knowledge for the common good in such an altruistic way. Clearly, much can still be learnt about the nature of these exchanges.

Finally, it is important to note, that this research displayed an inherent respect for farmers, which they responded to favourably. Farmers opinions were sought, their accomplishments valued, the technique developed was sympathetic to their learning styles, and the overall approach was designed to improve the equity and social justice of service delivery. Farmers have been appreciated for who they are and what they have accomplished, which has fed back into their appreciation of the content that was created for them. In doing so, this research reminds us that farmers should each be given an equal opportunity to benefit from the research outcomes their levies contribute to. This research provides the promise of more equitable adoption pathways for all farmers in the future.

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APPENDIX A: LIST OF VIDEO CLIPS IN TREATMENTS

DVD 1: Sugarcane BMP

- The four principals of the new farming system
- Combating nematodes with the new farming system
- Principals of controlled traffic
- Row space comparison research results
- Introduction to controlled traffic
- Problems with soil compaction
- Benefits of controlled traffic
- Changing row spacings
- Introduction to GPS guidance
- GPS retrofitted tractor
- GPS retrofitted tracked harvester
- Benefits of GPS guidance
- Introduction to minimum till
- 1.9m minimum till cultivator
- 2.0m minimum till ripper
- 1.8m minimum till cultivator
- Bed renovation
- Introduction to legume fallow
- Improved soil structure with legume fallow
- Tips for growing soybeans
- Precision planter
- Integrated pest management
- Basic insect identification
- Introduction to green cane trash blanket
- Alternate row trash raking for furrow irrigation
- Conclusions about the new farming system
- Examples of improved soil structure
- Closing remarks

DVD 2: Nutrient BMP

- Introduction
- Hydraulically driven precision applicator
- Efficient bulk surface application
- Watering-in with a centre pivot
- Stool splitting
- Sub-surface side dressing applicator
- Trash incorporater side dressing applicator
- Checking calibrated application rates
- Fertiliser box calibration
- Calculating rates on ground driven rigs
- GPS precision fertiliser applicator
- Liquid one-shot fertiliser applicator
- Sub-surface mill ash application
- 3 row zonal mill mud applicator
- 2 row zonal mill mud applicator
- Sediment management
- Laser levelling blocks
- Soybean companion planting
- Winter soybean trail
- 2 row sub-surface compost applicator
- 3 row sub-surface compost applicator
- Farm scale composting

Video Roadshow: Segment 1

- Base cutter height
- Self levelling harvester
- Auto-reversing GPS haul-outs
- Super-single 1.9m row configuration
- Burnt, mud and minimum till soybean fallow
- Burning vs cultivation in fallow preparation
- Research results from various trash management strategies
- 1.8m minimum till cultivator
- 2.0m minimum till ripper
- 1.9m parra plough bed renovator

Video Roadshow: Segment 2

- Shielded spray application
- Camouflaged spray rig
- Innovative high-rise spray rig
- Weed management strategy

Video Roadshow: Segment 3

- 3 bin precision bulk fertiliser applicator
- Research accounting for nitrogen in irrigation water
- Powered coulters for stool splitting heavy clay
- Banded mill mud application using trucks
- Zonal mill mud applicator
- Liquid one-shot fertiliser applicator
- Farm scale composting
- Compost trial - preliminary results
- Municipal large scale composting
- Municipal compost trial

APPENDIX B: SURVEY INSTRUMENT

[Farm Size] What is your farm size in hectares?
< 25ha | 25-50ha | 51-100ha | 101-300ha | > 300ha

[Age] What is your age?
< 20 | 20-35 | 36-50 | 51-65 | > 65

[Education] Which answer best describes your education?
High School | Certificate | Trade | Diploma | University | Post Graduate

[Internet use] Which answer best describes your Internet use?
Never | Someone does it for me | Rarely | Monthly | Weekly | Daily

[Precision Ag] What degree of precision agriculture has been applied in your farming operation?
None | Controlled Traffic | Zonal Tillage | Precision Metering | Management Zones

[Off-farm income] What percentage of your time is spent earning income off-farm?
< 10% | 10-20% | 21-50% | 51-80% | 81-90% | > 90%

[DVD Awareness] Have you watched any of the CANEGROWERS Virtual Bus Tour DVDs?
No | No, but planning to | Yes | Yes, several of them | Yes, several times

[Video clips worthwhile] I think watching video clips of growers experiences implementing new technologies and farming practices is worthwhile.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Video clips raises profile] I think clips of growers implementing best practices will improve our industry's public image and raise its profile with government.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Find & watch online] I would like to be able to find and watch new grower video clips via the Internet.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Attend another roadshow] I would like to attend another Video Roadshow presentation next year.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Plan to change] I plan to change one or more of my practices after watching the Virtual Bus Tour DVDs and/or today's presentation.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Area of change] Which area of practice are you planning to change?
Green Cane Trash Blanket | Nutrient Management | Controlled Traffic & Minimum Till | Legume Fallow | Compost | Spray Application

[Contact presenter] I would like to contact one or more of the presenters in the video clips to get further information.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Prefer local content] I prefer video clips of grower experiences from my local region.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Growers vs. researchers] I prefer video clips of grower experiences to those given by researchers.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Prefer more structure] How much structure and formality would you prefer?
Not sure | Just the grower | Signpost each topic | Present topic, signpost each clip | Signpost and present each clip

[Prefer more direction] I prefer unscripted interviews where presenters drive the conversation and tell-it-as-they-see-it.
Unscripted and unstructured | Unscripted but some direction | Mixed | Scripted but some off-the-cuff | Structured and scripted

[Hierarchy 1] I am interested in finding out more about this practice.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Hierarchy 2] I have sought advice about this practice.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Hierarchy 3] I have attended training on this practice.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Hierarchy 4] I know how to implement this practice on my farm.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Hierarchy 5] I have already adopted this practice on my farm.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Attitude 1] This practice is likely to maximise farm profitability.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Attitude 2] This practice leads to improved soil health.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Attitude 3] This is a more sustainable farming practice.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Attitude 4] This practice will allow me to expand my farming operation.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Attitude 5] This practice creates a safer workplace.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Attitude 6] This practice provides a healthier environment for me and my family.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Attitude 7] This practice will increase the possibility of my farm providing

employment.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Normative 1] I feel ... by the farmers in the videos to convert to this practice.
Strongly discouraged | Discouraged | Ambivalent | Encouraged | Strongly encouraged

[Normative 2] I feel ... by the researchers in the videos to convert to this practice.
Strongly discouraged | Discouraged | Ambivalent | Encouraged | Strongly encouraged

[Normative 3] My family will ... me converting to this practice.
Strongly discourage | Discourage | Be ambivalent about | Encourage | Strongly encourage

[Normative 4] Other farmers I respect will ... me converting to this practice.
Strongly discourage | Discourage | Be ambivalent about | Encourage | Strongly encourage

[Control 1] I have all the necessary skills to adopt this practice.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Control 2] My farm would support the adoption of this practice.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Control 3] Switching to this practice wouldn't require much change to my current operation.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Control 4] I could afford to adopt this practice.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Control 5] I could cope with the future financial risk of adopting this practice.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

[Intention] I would recommend this practice to other farmers.
Strongly disagree | Disagree | Ambivalent | Agree | Strongly agree

APPENDIX C: INFORMATION SHEET

Diffusion of Innovation Through Video Mediated Social Networks

The study will investigate whether videotaping farmers' adoption of new farming practices and sharing these experiences online is an effective strategy for promoting their uptake. The agricultural extension is undergoing substantial change. The number of extension agents is declining and there is an expectation that more services will be delivered online. At the same time a sustained low sugar price have forced many cane farmers to supplement their incomes off farm. As a consequence it is no longer convenient for many of these farmers to attend bus trips and field days. We are interested in finding out if video that captures what a farmer would expect to see and here on one of these occasions is as effective as being there in person.

Invitation

You are invited to participate in a research study. The study is being conducted by Henry Thomas as part of a postgraduate research project funded by the Sugar Research and Development Corporation with support from Canegrowers.

What is the purpose of this study?

The purpose of this study is to investigate whether videotaping farmers' evidence-of-adoption and sharing these experiences online is an effective technology transfer strategy. The aim of the study is to provide guidelines for the creation of web based video resources for extension, and investigate whether the use of these resources is worthwhile.

What does this study involve?

You will be shown a number of different video clips of cane farmers describing practices they have implemented on their farms. In-between watching videos you will be asked to answer one or more survey questions. To accomplish this you will be provided with a device that looks a like a TV remote control. To answer the survey questions you simply press the corresponding key on the remote. All the answers you provide are anonymous.

You will be asked to provide a contact email, address or phone number, so we can follow up with you in a few months time about the results of the study.

It is important that you understand your involvement in this study is voluntary. While we would be pleased to have you participate, we respect your right to decline. There will be no consequences if you decide not to participate in the study, you may still attend the session and have access to any resources provided. If you wish to discontinue participation at any time, you may do so without providing an explanation, simply stop answering the questions. All information will be treated in a confidential manner, and your name will not be used in any publication arising out of this research. All of the research will be kept securely stored by Shedmeeting Pty. Ltd. at 2 Dunk St, Bargara, Queensland.

What if I have any questions about this research project?

If you would like to discuss any aspect of this study, feel free to contact me (Henry Thomas) on 0405 707 179. I will be happy to discuss any aspect of the research with you. Once I have analysed the information I will be mailing / emailing you a summary of my findings.

The University of Southern Queensland Human Research Ethics Committee has approved this study. If you have any concerns or complaints please contact the USQ Ethics Officer via email at ethics@usq.edu.au or telephone on (07) 4631 2690.

Thank you for taking the time to consider this study. If you wish to take part in it, please sign the attached consent form.

APPENDIX D: CONSENT FROM

Diffusion of Innovation Through Video Mediated Social Networks

1. I have read and understood the '*Information Sheet*' for this project.

2. Any questions that I have asked have been answered to my satisfaction.

3. I permit the research data gathered from me for the study to be published provided that I am not and cannot be identified as a participant.

4. I understand the study involves me providing a contact email, address or phone number, so I can be contacted about the results of the study.

5. I understand that the researchers will maintain my confidentiality and that any information I supply to the researcher will only be used for the purposes of research.

6. I understand that all the data I provide will be securely stored by Shedmeeting Pty. Ltd. for five years, and will then be destroyed.

7. I agree to participate in this investigation and understand that I may withdraw at any time without any effect, and if I so wish, may request that any data I supply be withdrawn.

Name of Participant: _____

Signed: _____ Date: __ / __ / 2010

Contact email or address: _____

Statement by Investigator: I have explained the project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

Name of Investigator: _____

Signed: _____ Date: __ / __ / 2010

Principal Researcher: Henry Thomas
PO Box 8086, Bargara QLD 4670
Email: henry@shedmeeting.com.au
Mobile: 0405 707 179

APPENDIX E: DISCUSSION FORUM TRANSCRIPT

This discussion was referred to in Section 2.4.5

[FARMER1] said...

Question to Farmers that have Dual rows. Has anyone noticed a loss of stool as ratoons get older? I have, and I call it "Harvester operator disease" I can't seem to get them to cut at ground level. Can anyone provide any info on this matter? If I can't change this problem, I may have to go back to single rows.

[TECHNICAL OFFICER1] said...

[FARMER1], On the family farm we noticed that our 1.8m duals were getting knocked around as you suggest. Part of the problem is that with a wheeled harvester as the elevator slews the base cutter on the elevator side is cutting deeper than the other side. Essentially one side was "mined" whilst the other was cut at the right height. Our solution was to go back to 1.8m singles. Not sure of what engineering solutions are out there - maybe talk to BSES engineering.

[THIS RESEACHER] said...

[FARMER1], I recently videotaped [LOCAL FARMER]’s 3M dual row harvester (I will post the video soon), he has independent hydraulic rams on each rear wheel, so can adjust the base cutter height on each row. It appears to work well.

[FARMER1] said...

[TECHNICAL OFFICER1], I was afraid you might say that I should go back to single rows on 1.83m. I am concerned of less production in plant cane because I still use a full stick dual

row planter with double discs. At present I constantly grow plant crops about 200t/ha using irrigation. My new farming system uses a wide bed for soy bean fallow, 3 rows on each bed. Plus I don't cultivate after soy has been harvested. I am also concerned about water lateral soak into these wide beds on some soils in the first watering. I have seen research that shows a drop of production in plant cane in single row but catches up in ratoon cycle. Are there any ideas on "having my cake and eating it too"? [THIS RESEACHER], I am a small farmer which has no influence on the harvester or operator but I understand the idea. I await your video. Has anyone else got any ideas?

[TECHNICAL OFFICER1] said...

[FARMER1], It sounds like you have got everything heading in the right direction. You are right [RESEACHER1]'s early work did show a reduction in plant cane yield on 1.8m singles however we didn't see that with our Bundy site. We had 4 varieties on 1.5m singles, 1.8m singles, 1.8m duals (500mm apart), 2.0m duals (800mm apart)- all whole stick planted and a 1.8m single billett planted and we couldn't demonstrate a row configuration effect on yield between the whole stick planted treatments. It would be worth talking to [RESEACHER2] for he leads this work currently. Also it might be worth chatting to [ENGINEER1] re: base cutter hight automation.

[ENGINEER2] said...

Hi all. This issue of stool damage/removal is something which I've discussed with a number of growers in the Burdekin recently. One issue impacting on basecutter damage is matching row profile to the basecutter setup. Achieving a row shape to suit the harvester can be more complicated in a dual row system, especially if beds are shaped to suit other activities such as harvesting beans. A discussion with your harvester operator about his basecutter angle and your row profile can help achieve a better match. The other issue of the harvester laying over due to elevator weight is a more complicated one. A grower/harvesting group I spoke to last week had initiated a discussion with [ENGINEERING FIRM] in Mackay (who produce

BSES gathering fronts, wider basecutter boxes for dual row, etc) about the development of a 'self leveling' system using the harvester lift rams to ensure the basecutter box remains level, thus minimising stool removal. This would be a great benefit to growers moving into dual rows. Just a quick question for [TECHNICAL OFFICER1], with your billet planted 1.8m single row, how wide was the planting chute? The reason I ask is there are a number of people trialing a 'wide swath' planting approach to 1.8m rows, I guess to boost stalk numbers and canopy development in the plant crop. At the end of the day, matching row spacing to machinery is the number one aim, whatever configuration works for individuals. In terms of automatic basecutter height control, we have a number of [MANUFACTURER] systems working in the Herbert and Burdekin regions with promising results so far. I think that if this technology proves to be robust and effective it will be well accepted by the industry.

[TECHNICAL OFFICER1] said...

[ENGINEER2], The billett planter had a 14 inch planting chute.

[FARMER1] said...

Thank You all for your input. I will be talking to the harvester operator about better basecutter angle to suit dual rows and conversely how I can improve my row profile. After converting to a new farming system over 10 years ago, I can see soil health benefits, including an increase in soil carbon, and cost and labour benefits so I won't be going back but we need more work done to fine tune the systems. There are a number of things I want to improve.

1. Reduce loss of stool in later ratoons.

2. Using double discs planter, I want to place the mother plant as deep as possible.

3. Ways to build soil carbon in the stool area.

4. Reduce water deep peneration in our high infiltration soils.

5. Try to improve nutrient uptake using soil microbes and such.

6. Change the mentality of resistance to change.

7. Better sharing of experences, good and bad, about farming practices.

8. I know answering these will be a tall order but we need to set the bar high to achieve more.

[FARMER2] said...

Guys, just in relation to going back to single row in 1.8m centres. The need for a wide chute is not necessary and I have seen excellent results with a single row double disc opener (narrow point). Although plant quality needs to be quite good. But planting rates of around 5t/ha are quite acceptable with a single row disc opener and trial work done has shown no loss of yield with these lower planting rates. This trial shown on the hyperlink below was done with a wide chute, but the lower rates used (5.5 & 3.7t/ha) can be put through a single row double disc.

http://www.google.com.au/search?q=planting+rate+trial+homebush