

A farmer-centric approach to decision-making and behaviour change: unpacking the ‘black-box’ of decision-making theories in agriculture

Lyndal-Joy Thompson

Institute for Social Research

Swinburne University of Technology

ljthompson@swin.edu.au

Abstract

Addressing behaviour change in agriculture has tended to rely on top-down, logical-choice agricultural extension theory and decision-making models. Agricultural extension research has been attempting to introduce alternative agricultural extension practice for over a decade without, it would seem, much practical effect. A potential reason for this is that the ‘black box’ of assumptions made by researchers and extension agents about farmers’ personal perceptions, socio-cultural influences and learning preferences is rarely unpacked. Research conducted in Australia examined farmer perceptions of a new, integrated, approach to parasite control for sheep that requires more complex management than the application of chemicals. This research, founded in Kelly’s Personal Construct Theory, indicated there are several overarching socio-cultural factors that influence decision-making for worm management. These include uncertainty, self-identity; and management control and comfort. It is suggested that agricultural research, development and extension would benefit from a deeper understanding of the socio-cultural and psychological factors that impact on farmer decision-making for the adoption of innovations by better understanding the role of uncertainty and how to ameliorate this for innovations extended to farmers.

Keywords: Agricultural Extension, Decision Analysis, Risk Perception, Personal Construct Theory

Introduction

This research focuses on the decision-making models and agricultural extension approaches traditionally used to predict and encourage farmer adoption of innovations. The research arose out of Australian Wool Innovations Ltd’s (AWI) Integrated Parasite Management in sheep project (IPM-s), which involved the investigation and trialing of parasite control methods alongside the use of drenches and other chemical applications for internal and external parasites. This project was prompted by increasing parasiticide resistance, particularly in worms, and the rising costs of control - last estimated at about AUD550m (McLeod 1995). The project was

funded by AWI and involved several research and academic institutions, including the University of New England, the University of Melbourne, the Western Australian Department of Agriculture and Food, and the Queensland Primary Industries and Fisheries. Aside from the scientific and on-farm investigations of IPM strategies, the project also featured a socio-economic component, part of which is the basis of this paper.

This research proposes that current agricultural decision analysis, and in particular the focus on calculating subjective expected utility and risk probability within the decision-making context, does not meet the needs of the more informal and qualitative approaches many farmers bring to decision-making (as indicated also by Gladwin 1979; Gladwin 1980; Murray-Prior 1994; Salmon 1980; and Wright 1983). An attempt is made to highlight why greater attention needs to be paid to eliciting the cognitive and socio-cultural influences on individual decision-making in the context of agricultural extension, rather than just placing them into an unexplored 'black box' that exists as part of the logical choice models.

IPM-s context

The adoption of principles being developed by the IPM-s project requires producers to make incremental, but significant, changes in their management approach. These changes may require farmers to utilise a broader range of management practices for parasite control than that to which they are accustomed under a drench-reliant system. As with any innovation, whether a product or a management tool, there may also be uncertainties associated with the production and business aspects of sheep production associated with the implementation of IPM-s. All of these factors will have an impact on the adoption of integrated parasite management practices and the ultimate success

of the project. Extension of the IPM-s project will not be easy as the approach is multi-faceted and requires the learning of new information, and the acceptance of new, non-chemical, management practices, some of which, from a psychological and socio-cultural perspective, may prove very challenging for producers.

Decision-making in agricultural adoption literature

The analysis of farmer decision-making can be approached in various ways. In the context of Australian agriculture, the dominant academic approach has been the use of decision analysis (Anderson et al. 1977; Hardaker et al. 2004). Decision analysis is a quantitative, logical choice model that focuses on eliciting risk probabilities and calculating subjective expected utility values for farmers using a formalised decision-tree process for choosing the right decision for the farmer. Hardaker et al. (2004) define uncertainty as imperfect knowledge; while risk is defined as uncertain consequences (i.e. imperfect knowledge about the consequences), with a particular focus on exposure to unfavourable consequences.

Hardaker et al. (2004) detail the process of decision-making and risk management as a series of sequential steps (Figure 2). This model is based on several assumptions, including:

- in this context, that farmers in fact should, or would want, to employ; or are capable of employing, a formal, quantitative decision-making process; and
- that subjective expected utility (SEU) values and risk probabilities for all factors and perceptions affecting decision-making can be calculated – and that these truly reflect a farmer’s worldview to the extent that they are actually meaningfully used by the farmer in adoption decisions.

The validity of these assumptions is questionable.

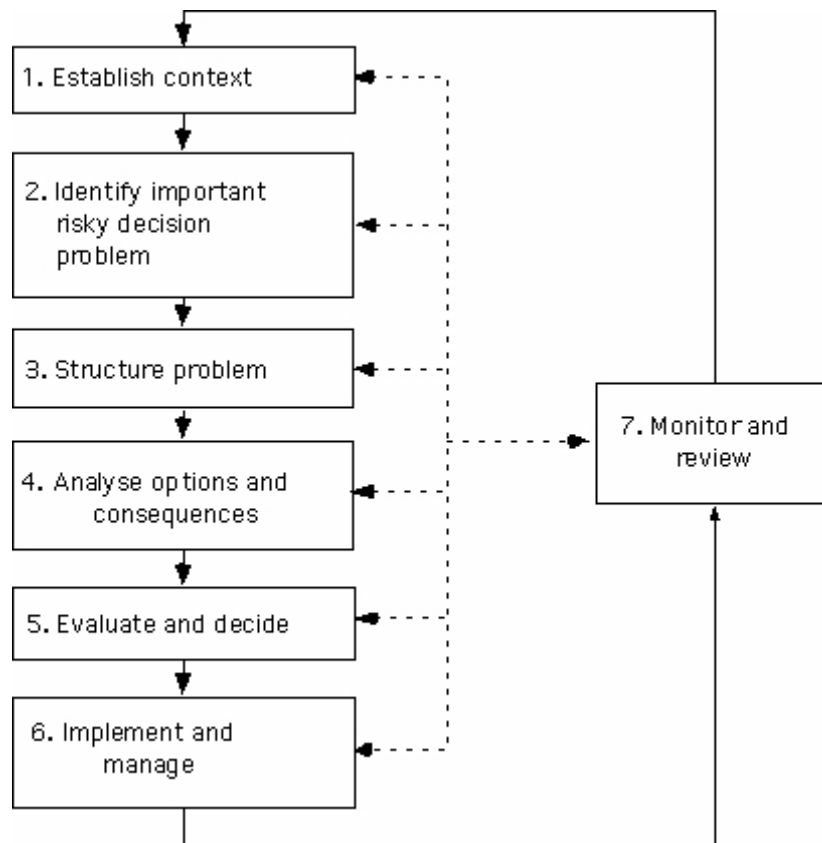


Figure 1: Steps in risk management (Hardaker et al. 2004)

Alternative economic decision-making approaches

Pannell , Marsh and Lindner (Marsh and Pannell 2000; Marsh, Pannell *et al.* 2000; Marsh, Pannell *et al.* 2004) have proposed a decision-making approach that differs from Anderson et al. (1997) and Hardaker et al. (2004) by incorporating personal, social and cultural (as well as economic) aspects of decision-making into the decision analysis model. Pannell et al. (2006) have attempted to draw the many disciplinary approaches to extension and adoption together and sum up the major findings of adoption research over the past few decades in the following way:

The core common theme from several decades of research on technology adoption in agriculture is that landholder adoption of a conservation

technology depends on them believing or expecting that it will allow them to better achieve their goals... Adoption is based on subjective perceptions or expectations rather than on objective truth. These perceptions depend on three broad sets of issues: the process of learning and experience, the characteristics and circumstances of the land manager within their social environment, and the characteristics of the technology. (Pannell et al. 2006: 2)

These authors see adoption as reflecting the landholder's attainment of goals – whether personal or other. The non- or dis-adoption of an innovation is therefore due, in part, to the innovation not progressing the landholder's goals. Pannell et al. (2006) highlight four main goals of landholders and their families, including:

- material wealth and financial security;
- environmental protection and enhancement (beyond that related to personal financial gain);
- social approval and acceptance; and
- personal integrity and high ethical standards.

Not surprisingly these closely mirror the goals identified by Maslow (1943) in his hierarchy of human needs. Theories from sociology and social psychology have also attempted to investigate how people perceive and calculate risk for decision-making.

Risk perception research

Approaches to understanding risk not focussed on economic aspects are offered by risk perception research. There is a large body of sociological research into risk perception; however four of the most fundamental in the context of this research are outlined below.

Tversky and Kahneman's prospect theory

Tversky and Kahneman pioneered research into describing the heuristics people use to make decisions and assign risk; as well as examining the biases inherent in these heuristics. They are critical of modern theories of decision-making under risk (such as decision analysis), stating that the invariance axiom inherent to the rational theory of choice; the model of an idealised normative decision-maker; and the focus on a logic of choice do not accurately describe “the behaviour of real people” (Tversky & Kahneman 1986:S251). Tversky and Kahneman’s Prospect Theory, which is an attempt to account for psychological principles of perception and judgement, uses framing to contextualise these. Whilst delving into the ‘black box’ of logical choice decision-making models, using a ‘framing’ approach, Prospect Theory is still a formalized approach to decision-making that is not necessarily representative of farmer decision-making processes.

Slovic and risk perception

Paul Slovic, sees the imperceptible nature, and frequently delayed consequences of modern hazards, as characteristics that make them difficult to assess using statistical analysis. He defines risk perceptions as the ‘intuitive risk judgements’ made by lay people (Slovic 1987: 280). Slovic’s work on risk perception is founded on the use of psychometric analyses based on scaling and multivariate techniques that can be used to ‘produce quantitative representations or “cognitive maps” of risk attitudes and perceptions’ (Slovic 1987: 280). Within this psychometric paradigm people are asked to ‘make quantitative judgments about the current and desired riskiness of diverse hazards and the desired level of regulation of each’ (Slovic 1987: 282). This is ultimately a quantitative approach to risk perceptions, which does not truly account for the underlying socio-cultural factors influencing the risk perceptions identified.

Despite this, it does move closer to attempting to identify some of the perceptions that people utilise in order to ‘make sense out of an uncertain world’ (Slovic 1987: 281).

Social representations theory

Joffe views approaches such as Slovic’s as likening human thinking ‘to erroneous information processing’ and she proposes a new ‘psychology of risk’ based on Moscovici’s social representations theory (Moscovici 1998, 2001; Joffe 2003). Joffe adopts a definition of risk proposed by Douglas (Douglas 1994), who defines risk as ‘danger from future damage’. Joffe conceptualises risk as being comprised of two different aspects (i) material phenomenon, and (ii) social constructions. This is a material-discursive position originally proposed by Yardley (1997 in Joffe 2003). Although the type of risk referred to by Joffe and Douglas is focused at a broader societal level and involves risk associated with danger, rather than more individualistic, business and management risk, it is instructive to refer to the social representations perspective on risk since it attempts to encapsulate the broader socio-cultural aspects of decision-making.

Joffe notes an apparent re-evaluation of work by Slovic in 2000, where he appears to recognize the ‘emotional and affective processes’ at work in human thought processes (Joffe 2003: 59), however she criticizes this approach also, claiming that its inclusion of emotions is limited to the positive or negative feelings that people associate with a particular hazard – called the ‘affect heuristic’. She maintains that Slovic, and others of the cognitive perspective, continue to hold onto rationalist assumptions and thereby downplay the validity and reasonableness of emotions.

Personal construct theory

A theory similar to that of SRT from the field of Personality Psychology that focuses on the idea of social construction is George Kelly's Personal Construct Theory (PCT) (Kelly 1963). PCT is focussed at the individual level and is designed to elicit the mental models or personal constructs that underlie the ways in which an individual may think about or perceive a particular element (event, person etc.).

PCT is based on the concept of Constructive Alternativism, which refers to the philosophical position that "We assume that all of our present interpretations of the universe are subject to revision or replacement" (Kelly 1963:15). PCT is an attempt to look at the ways in which people try to predict and control their lives. It postulates that people try to fit different "transparent patterns or templates" (Kelly 1963: 8) over the realities of life in order to find the best fit. These patterns, or constructs, can be altered to some degree as the person encounters new experiences, however Kelly believes most people will not change without major psychological upheaval of their broader super-ordinate construct system. Kelly is suggesting that though constantly seeking improvement, people are hampered by an already existing construct system that might prevent change even in the light of new information. Such an idea has important implications for the adoption of new technology or methods of approach in agriculture that go beyond the scope of risk as a major player in decision-making.

Starting at the level of the construct when investigating farmers' adoption of agricultural innovations should provide solid groundwork for rethinking some of the assumptions historically made about producer decision-making. In this way, we may attempt to more effectively understand why a seemingly relevant and scientifically sound product or method is rejected by, often, the majority of producers – without assuming it is risk aversion in the utilitarian sense or due to flawed decision-making processes. Those inconsistencies, which may seem like anomalies, may in fact be

perfectly ‘logical’ when viewed in light of the person’s construct system. This is especially relevant when considering that construct systems have ranges of convenience and foci of convenience which “are points within its realm of events where a system or a theory tends to work best” (Kelly 1963: 44).

Research method

A series of 62 personal interviews based on Personal Construct Theory were conducted in Victoria and the New England region of NSW to explore the role of risk perception and uncertainty in farmer decision-making. These interviews explored current practices employed by farmers using open-ended questions, followed by a repertory grid interview with constructs and elements supplied. The RepGrid technique traditionally allows for the elicitation of constructs by participants, however time constraints (farmer availability) and a desire to standardise across the groups led to the supply of both. This was justified on the basis of having already conducted focus groups and pilot interviews with producers that allowed the selection of relevant constructs and elements (Tables 1 and 2).

Table 1: Bipolar constructs used in repertory grid interviews

| CONSTRUCT NUMBER | POSITIVE CONSTRUCT POLE (RATED AS 5) | NEGATIVE CONSTRUCT POLE (RATED AS 1) |
|------------------|---|---|
| 1 | Clear benefit in doing this | Don’t believe the benefits are proven |
| 2 | Feel I have more control when I | Don’t feel I am in control when I |

| | do this | do this |
|---|-------------------------------------|---|
| 3 | Financial Benefits are clear | Too much financial risk involved |
| 4 | Has a positive impact on production | Could affect production levels negatively |
| 5 | I am comfortable doing this | I am not comfortable doing this |

Although a robust methodology in the setting of clinical psychology, there have been only a handful of studies that have employed personal construct theory to producer decision-making, including Salmon (Salmon 1980; Salmon et al. 1973), Murray-Prior (1994) and Abel et al. (2007). All of these studies however modified the use of the repertory grid technique in different ways – Salmon to create a ‘dynamic’ decision analysis system using a computer-simulated program, while Murray-Prior combined PCT with hierarchical decision analysis, and Abel et al. (2007) utilised a combination of mental models and PCT concepts.

PCT was also modified for the purposes of this research through simplification of the repertory grid process. However, the fundamental tenets of the theory have been adhered to, as is the use of traditional approaches to analysis. A further modification involves analysing the repertory grid data at a group rather than individual level using SocioGrids (Gaines and Shaw 2005). This is not a traditional application of the repertory grid in the clinical setting; however, the repertory grid has been used successfully in the field of marketing to elicit producer perceptions of products, such as fruit (Jaeger et al. 2005). It has also been utilized in eliciting competencies for

employee position descriptions in the workplace, as well as in the identification of expert knowledge (Fransella et al. 2004; Fransella 2005; Jankowicz 2004).

Table 2: Elements used in repertory grid interviews

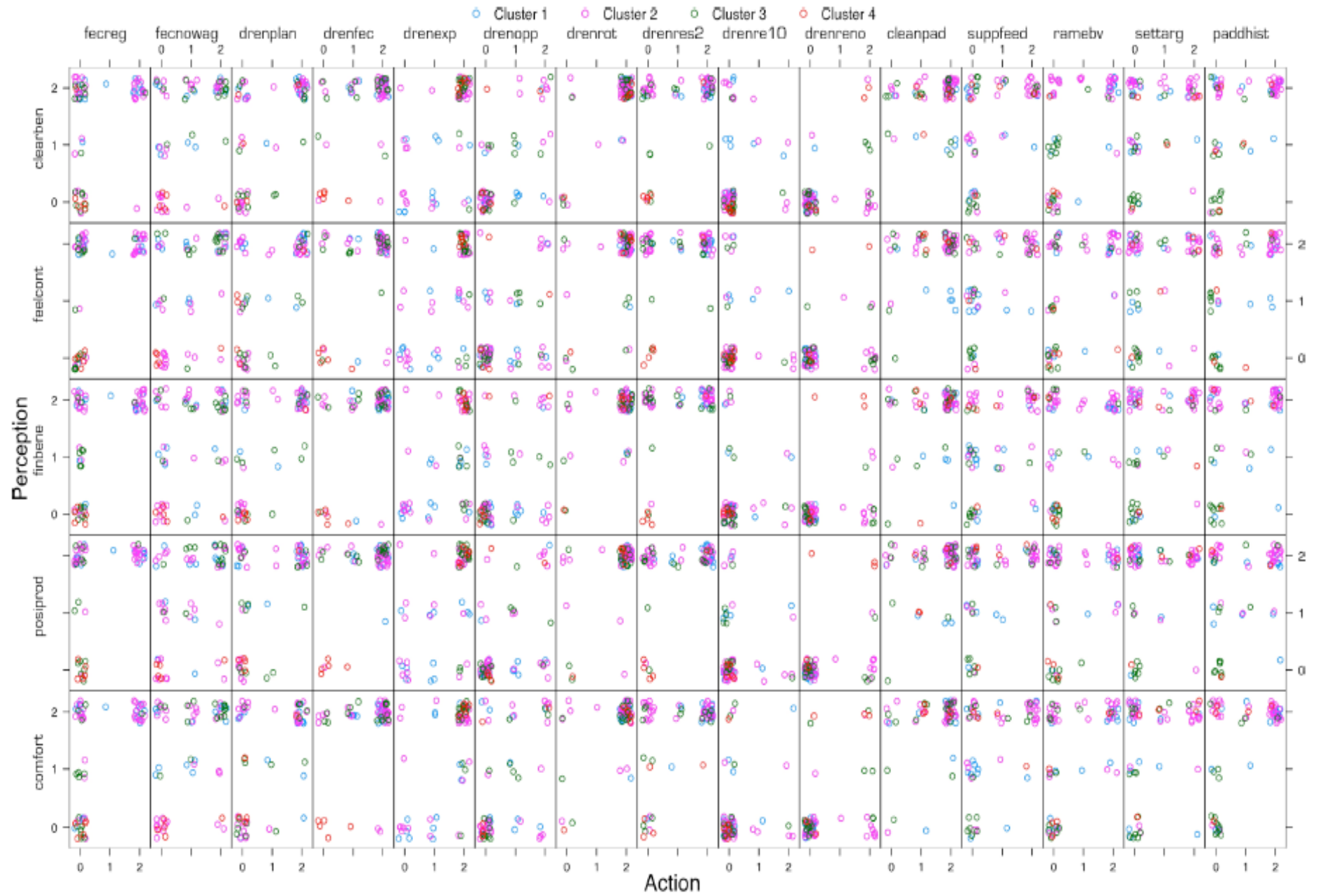
| MNEMONIC | ELEMENT |
|-----------|---|
| FECREG | Doing FEC tests regularly |
| FECNOWAG | Doing FEC tests every now and then |
| DRENPLN | Following an approved drench plan |
| DRENFEC | Drenching based on FEC results |
| DRENEXP | Drenching based on experience and visual assessment |
| DRENOPP | Drenching based on opportunity |
| DRENROT | Rotating drenches to maintain efficacy |
| DRENRES2 | Doing drench resistance tests every 2-3 years |
| DRENRE10 | Doing drench resistance tests every 10 years |
| DRENRENO | No drench resistance testing |
| CLEANPAD | Cleaning paddocks |
| SUPPFEEED | Supplementary feeding to manage worms |

| | |
|---------|--|
| RAMEBV | Selecting EBV tested rams to manage worms |
| SETTARG | Using set targets for ewes and weaners to monitor weights and condition scores |
| PADHIST | Keeping written paddock histories to help manage worms |

Research outcomes

For this research farmer perceptions and actual use of a range of worm control skills and practices were compared and represented as a discrepancy matrix (Figure 2). An average of 64 per cent of interviewees were consistent in their perception and their actions for the 15 worm management KSPs presented to them. For these practices, people who had a positive perception about a practice tended also to do it or be positive about implementing it. Those who were negative about a particular practice also tended not to practise it. For the remaining interviewees however, there were inconsistencies between perception and practice, with much of the inconsistency above the diagonal, indicating either neutral/somewhat positive or wholly positive perception coupled with not using the KSP.

Figure 2: Discrepancy matrix of farmer perceptions and actions



Practices for which the majority of interviewees showed positive consistency between perception and action include:

- regular faecal egg count (FEC) testing
- drenching based on FEC tests
- rotating drenches
- drench resistance testing (DRT) every two years, and
- cleaning paddocks.

Practices which received mostly negative consistency between perception and action, included:

- drench resistance testing every ten years,
- no drench resistance testing.

Practices for which inconsistencies between perception and practice were obvious, with a positive perception and positive action tendency (i.e. above the diagonal) included:

- FEC testing now and then
- following a drench plan
- supplementary feeding to manage worms
- using estimated breeding value (EBV) tested rams
- using set targets for monitoring, and
- keeping written paddock histories.

A smaller number of interviewees responded in the negative portion below the diagonal, tending to indicate neutral/somewhat positive or negative perceptions and some or no use of the KSP. This was particularly relevant to:

- drenching based on experience and visual assessment
- drenching based on opportunity.

The latter two practices in particular posed issues for interviewees, since as mentioned above, many of the interviewees used these practices but also knew that they are not considered best practice – hence a larger proportion of interviewees with negative or neutral perceptions, but still using the practice.

The practices that received the most mixed responses are indicative of those about which there is the most uncertainty for their value in worm control. This indicates further, the areas where the IPM-s program will have to work hardest to convince people of the value of these practices. An advantage of the discrepancy matrix being presented in this way is that it allows visualisation of where producers need to be moved in terms of actions and perception in order to achieve adoption of the different IPM practices. For instance, from the discussion of results provided above, it can be seen that even when people have a negative perception of a practice, they may still use it as part of their management. In this way, we can see that where participants have indicated they have a negative perception and no action or use of the practice, it may still be possible to convince them to move towards some action, either ‘do it always’ or ‘do it sometimes’ without first having to change their perception of the practice. This is in-line with modern theories of cognitive dissonance for example (Cooper 2007) and works around the need to fundamentally change people’s super-ordinate personal constructs.

Super-ordinate socio-cultural factors affecting adoption

A principal components analysis of the repertory grid data based on construct loadings indicated that there was a weak rank order of constructs within this dimension for nearly 50 per cent of interviewees, and that specifically, constructs 5 (level of comfort) and 2 (sense of control over worm management) were the

constructs most likely to rank higher than the other three. The more frequent higher loadings for level of comfort and sense of control on the first dimension suggest that, for many producers, whether or not they feel comfortable with particular practices is related to the extent that they feel that the practice gives them control over their management.

For those respondents who had less than 10 per cent loading on the 1st construct, analysis was conducted of the 2nd and 3rd dimensions, showing that Level of comfort, Proven Benefit and Sense of control were ranked higher by more respondents. Although weak, the preliminary indication of the existence of a hierarchy has a number of implications for the importance of issues such as control, certainty and self-identity. It suggests that a repertory grid more focussed on these issues could produce a more detailed and accurate hierarchy of the factors that contribute to, or the attributes for producers of aspects of farming related to maintaining a sense of control over their management, what contributes to a feeling of certainty/uncertainty in management and what aspects of their self identity are represented by their farming approach.

Overview and conclusions

There is a growing trend in the extension industry to acknowledge the importance of socio-cultural factors in decision-making. This has been accompanied by a growing acknowledgement by agricultural extension about the importance of several other key areas affecting adoption decisions, including broadly:

- the importance of farmer's local knowledge (Kloppenborg 1991; Arce and Long 1992; Flora 1992; Murray-Prior 1994; Vanclay and Lawrence 1994;

Glyde and Vanclay 1996; Pannell 1999; Vanclay 2002; Pannell, Marshall et al. 2006).

- increased awareness about the value of involving farmers in research (Kelly 2001; Lees, Reeve et al. 2006; Crawford, Nettle et al. 2007), and more participatory approaches to agricultural extension (Jennings 2005).
- the importance of farmers' learning and training preferences (Kilpatrick 1996; Kilpatrick and Rosenblatt 1998; Kilpatrick 2000; Kilpatrick and Johns 2003).

There has been less research into how and why farmers make adoption decisions outside of the formalized logical-choice models employed by agricultural economists such as Anderson, Hardaker and Pannell (Anderson et al. 1977; Pannell 1997; Pannell 1998; Pannell 1999; Hardaker et al. 2004).

In the context of adoption and extension it is potentially more useful to assess how producers are actually making decisions and ways in which we can work with that process rather than attempting to mould their process to one of our own design. This is not to suggest that farmers should not be encouraged to adopt more formalised decision analysis procedures and given basic tools to do this. However, based on the current intuitive decision making approaches employed by producers, such tools would necessarily have to allow for qualitative and descriptive analysis, not formalised numerical equations. From this perspective, the use of a repertory grid framework allows researchers or extension agents to take a more qualitative approach to decision-making and perceptions of risk, uncertainty or other aspects of farming.

Figure 3 is an attempt to conceptualise what is happening in an intuitive decision making process. This conceptualization is based on the current logical choice decision-making models, in order to show where in these models research into

adoption and extension requires more attention i.e. in the area before the assignment of risk probabilities.

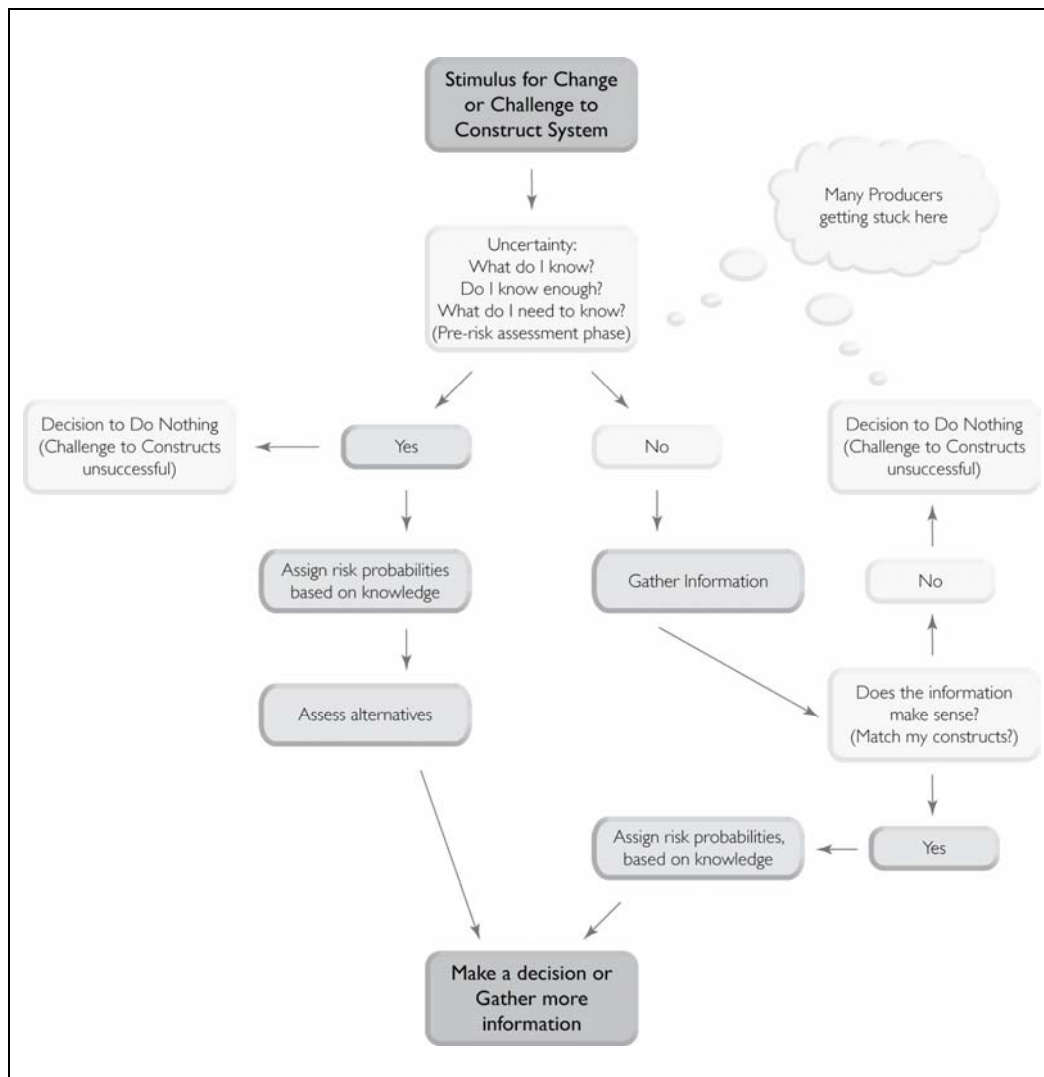


Figure 3: Role of uncertainty in decision-making for the adoption of innovations

Part of farmer decision-making process involves accessing prior knowledge and experience of aspects of the innovation – including the source of information and the promoter and/or developer of the innovation. As can be seen from Figure 3, this pre-risk assessment phase can be an obstacle to decision-making, because if a person decides they do not have enough information, or they don't trust the source, they are likely to reject the innovation. Alternatively, rejection may also occur if they decide

they do have enough information but it does not match their experience of current understanding (i.e. runs contrary to their construct system).

Furthermore, sources of knowledge (or information), are important to producers. More specifically, whether information derives from self or external sources, or both, can affect producers' perception and potentially acceptance or trust in the information since these relate at a broader conceptual level to issues of self-identity and control over management. Figure 4 is an attempt to represent the interrelationship between personal constructs and the factors of decision making which it has influence on, and how these factors may also influence personal constructs. This is the type of framework I would propose research and development organizations, researchers, and extension agents consult when planning for extension, and/or the agenda, for their research. This diagram, can act as a reminder of the potential factors that will require attention when thinking about the adoption of research.

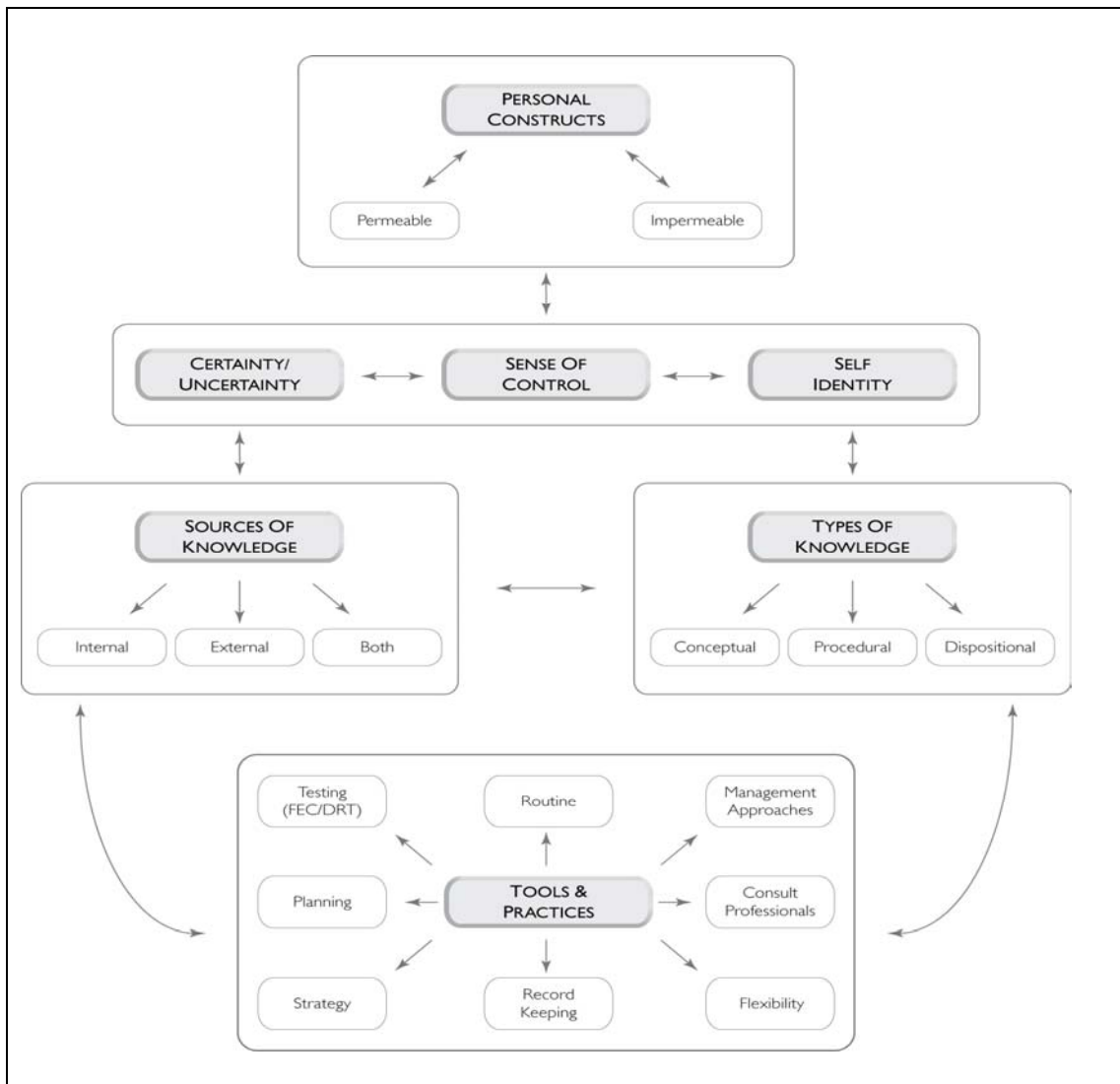


Figure 4: Interrelationship between factors influencing producer decision-making

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