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1. Introduction

As consumers we are all constantly exposed to new ideas and products. An extensive literature has developed about the decision making and purchasing behaviour of consumers. Surprisingly little of the principles, concepts and constructs in this literature appear in the agricultural adoption and extension literature despite the fact that the technology transfer model (Rogers 1983) that has dominated in agricultural extension (Black 2000) was originally formulated to explain the diffusion of innovations in consumer markets. One reason for this was that disappointingly low rates of adoption of many agricultural innovations were generally interpreted as reflecting inadequacies in the technology transfer model (Black 2000). This prompted extension personnel to seek alternatives based on participatory methodologies.

The criticisms that agricultural researchers and extension personnel levelled at the technology transfer model were often misplaced. The technology transfer model as proposed by Rogers (1983) was simply a description of the key factors that influence the diffusion of an innovation among a population of adopters. The model is predicated on the assumption that the population of potential adopters has already been correctly identified. As such the technology transfer model does not provide a theoretical foundation for identifying the adopters of an innovation. Rogers' (1983) model, along with other models of decision making about the adoption of new technologies, contain a general description of the processes or stages that individuals may follow in making a decision about adopting an innovation. These models do not provide predictions of the outcomes of these decisions – they only indicate the processes that are involved.

All the various models of adoption behaviour recognise that the fundamental factor influencing the decision to adopt an innovation is the extent to which the innovation can contribute to better satisfying the needs of the purchaser. In the case of agricultural innovations, this means evaluating the extent to which an innovation can better meet the needs of the primary producer as the manager of an agricultural enterprise. The key to predicting who potentially will adopt an agricultural innovation is to identify precisely what need an innovation can satisfy and under what circumstances the innovation is likely to satisfy that need better than the alternatives.

In the absence of information on the population of likely adopters of an innovation, researchers, policy makers and extension staff do not have sound basis for making judgements about rates of adoption. Similarly, they lack a sound basis for making judgements about the relative success of extension programs and the causes of any differences in the apparent success of extension programs. In this paper I draw on the conceptual foundations of consumer behaviour theory and farm management theory to outline a theoretically sound basis for determining how innovations can contribute to

satisfying the needs of primary producers as managers of agricultural enterprises and to develop a procedure for identifying the population of potential adopters of an innovation.

There are three reasons for using consumer behaviour theory as the starting point for developing a procedure for determining how innovations can contribute to satisfying the needs of primary producers as managers of agricultural enterprises. First, consumer behaviour theory recognises that there are a variety of types of decisions and that different decision processes are invoked in different circumstances. Second, consumer behaviour theory provides criteria for identifying the type of decision process that is invoked in a particular circumstance. Third, the theory explicitly recognises that different individuals purchase the same product to satisfy different needs. Taken together, these mean that consumer behaviour theory can accommodate in a parsimonious way the variety in the motivations of individuals.

In the next section I will outline consumer behaviour theory in relation to product purchasing and discuss its application to the adoption of agricultural innovations. I will then develop a process for identifying the potential population of adopters of an innovation. I will discuss the consistency between this process and the findings of studies into the adoption of agricultural innovations. I conclude with a discussion of the implications for agricultural extension.

2. Consumer purchase behaviour

Consumers make purchase decisions in a variety of ways depending on circumstances as illustrated in figure one. The way in which a decision to purchase is made is determined by two key factors. These are the level of consumer involvement in the product and the degree of effort the consumer is willing to invest in making a purchase decision (Assael 1998). When involvement is high consumers tend to engage in complex decision making process or brand loyalty depending on the degree of effort they invest in the purchase decision (Assael 1998). When involvement is low consumers tend to engage in variety seeking behaviour or habit depending on the degree of effort they invest in the purchase decision (Assael 1998).

2.1 Involvement and effort

Consumer involvement depends on how important the purchase is to the consumer (Arora 1982, Kapferer and Laurent 1985, Kapferer and Laurent 1986, Celuch and Evans 1989, Assael 1998, O'Cass 2000). High involvement purchases are purchases that are important to the consumer. High involvement products are generally expensive, rarely or

infrequently purchased and closely tied to self-image and ego. High involvement purchases usually involve some form of risk - financial, social or psychological. Where this is the case the consumer is more likely to devote time and effort to careful consideration of alternatives before making a purchase. Typical high involvement purchases are homes, motor vehicles, white goods, clothing and perfumes (Kapferer and Laurent 1986).

Figure 1: Consumer purchase behaviour

	High involvement purchase decision	*Low involvement purchase decision*
Decision making (More effort)	Complex decision making (e.g. cars) • High motivation to search for information • High effort into learning and discovery • Evaluation both prior to and after purchase	Variety seeking (e.g. snack foods) • Low motivation to search for information • Some effort into learning and discovery • Evaluation after purchase
Habit (Less effort)	Brand loyalty (e.g. athletic shoes) • Less effort into learning and discovery as consumer already has a product they are satisfied with • Evaluation based on experience with the product	Inertia (e.g. laundry detergent) • No motivation to search for information • No effort put into learning and discovery • Evaluation after purchase

Low involvement purchases are purchases that are unimportant to the consumer (Assael 1998, O'Cass 2000). These purchases are commonly inexpensive products that are routinely purchased and involve little risk. The consumer is unlikely to devote

much, if any, time and effort to consideration of alternatives for low involvement purchases before making a decision. Typical low involvement purchases for many consumers are groceries, toiletries, and laundry products (Kapferer and Laurent 1986). Note that involvement has a number of dimensions such as interest, risk, symbolic value and reward or benefit (Kapferer and Laurent 1986). Hence consumers can vary both in terms of the magnitude of their involvement with a product and the basis for that involvement.

Involvement can also be categorised into situational and enduring components (Arora 1982). Enduring involvement has two major elements – experience with a product or situation and the relationship of the product or situation to centrally held social or personal values. In essence, considerable experience with an issue or product that is strongly associated with social and personal values generates a high level of enduring involvement (Arora 1982).

Situational involvement also has two components – functional and social-psychological. Functional characteristics of the product that increase effort and risk such as complexity and novelty increase situational involvement (Arora 1982). Situational involvement also increases when the product is purchased or consumed in circumstances that increase psychological risk (such as when the expectations or behaviour of others is a critical factor in product choice).

The level of effort that consumers devote to a purchase decision increases with both situational and enduring involvement. For instance, products that are costly or complex such as consumer durables evoke a greater investment of time and energy in the search for a suitable purchase (Arora 1982). In contrast, most consumers expend little effort on typical low involvement products such as groceries which involve little risk and are only distantly related to social and personal values.

The level of effort expended on a purchase also depends on the individual's familiarity with the product and their perception of differences in the performance of different brands. As a general rule, consumers devote less effort to making decisions to purchase products with which they are thoroughly familiar compared to products that they are not familiar with. Also, consumers will expend less energy on making decisions between brands of a product when they do not perceive any difference among brands in product performance (Assael, Reed and Patton 1995).

By definition the adoption of an agricultural innovation involves consideration of the novel and unfamiliar. Usually the adoption of a new agricultural practice or technique has significant consequences for the future financial performance of the farm enterprise. The new technology or practice must be integrated into the existing mix of technologies, practices and resources that exist on the farm (Crouch 1981; Kaine and Lees 1994).

This means, generally speaking, the likely outcomes of adopting a particular technology or practice are difficult to predict as the compatibility of the technology or practice with the existing farm system, and the resulting benefits, depends on a range of contextual factors that are specific to the circumstances of each farm enterprise. Consequently, the decision to adopt an agricultural innovation is often financially risky. As such they entail social risks and psychological risks for the individual in that the outcomes affect the wellbeing of family members and can influence producers' feelings of achievement and self-fulfilment. The adoption of most agricultural innovations can be characterised then, as a form of high involvement purchase for primary producers that has enduring and situational components that are likely to encourage an extensive search for information before a decision is made.

2.2 Complex decision making

Consumer behaviour theory suggests that consumers follow either a complex decision-making process or exhibit brand loyalty with high involvement purchases (Assael 1998). Complex decision-making is a systematic, often iterative process in which the consumer learns about the attributes of products and develops a set of purchase criteria for choosing the most suitable product (see figure two). In complex decision making the consumer is portrayed as attempting to make the best product or brand choice.

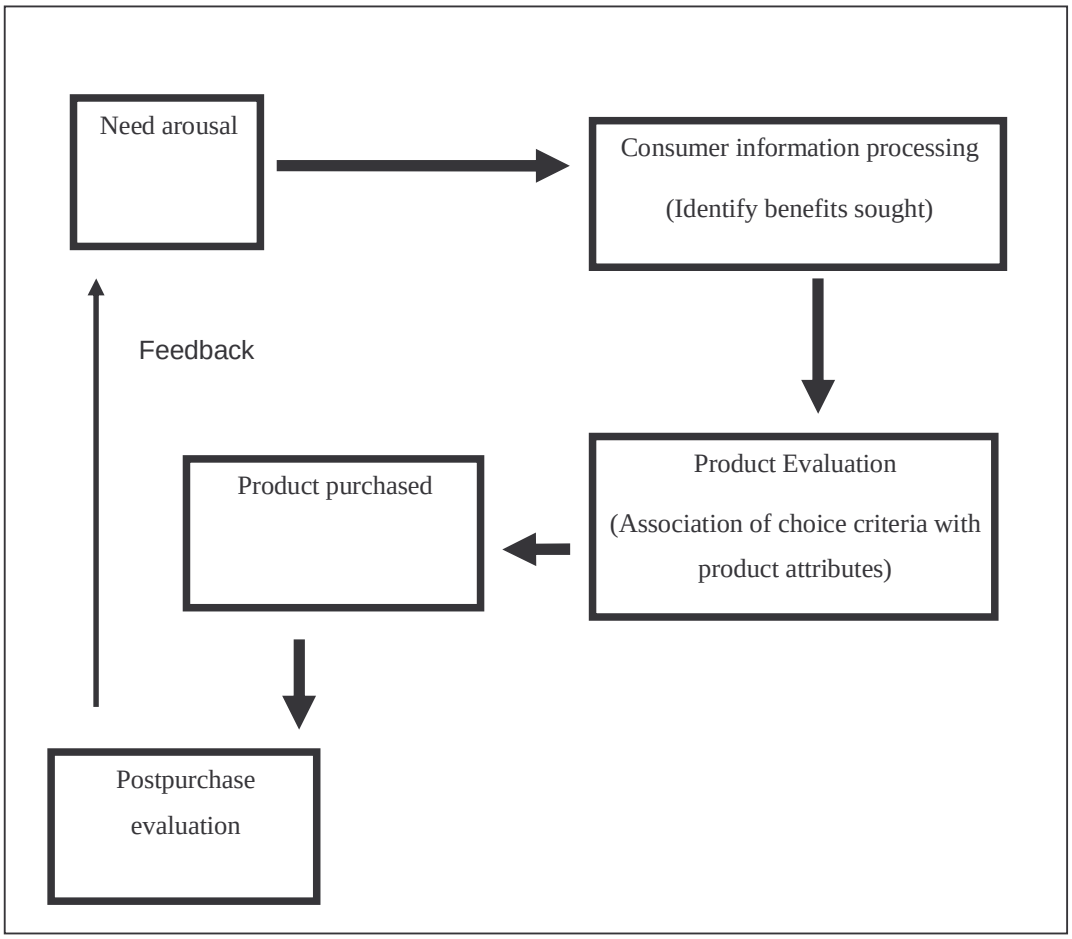
The first step in complex decision making, need arousal, is the recognition of a need for a product or brand. The recognition of a need can be triggered by many causes including experiences, an immediate cue, new information, or a change in circumstances or the environment (Assael, Reed and Patton 1995). The next step, information processing, is the process of noticing relevant stimuli, understanding and interpreting them, and retaining the stimuli in memory. This step captures the searching for, screening and gathering of information about products that the consumer perceives as relating to satisfying their need. The next step, product evaluation and purchase, encompasses the association of product characteristics with the benefits the consumer seeks, the selection and purchase of a product.

In the final stage following purchase, post-purchase evaluation, the consumer evaluates the performance of the product. Satisfaction is likely to result in repurchase and eventually brand loyalty. If the expectations of the consumer are not met then the consumer will be dissatisfied and unlikely to purchase the product again. The stages in complex decision making are not intended to be mutually exclusive, nor strictly sequential. The parallels to the technology transfer model of the adoption of innovations are obvious.

Given need arousal, the key to understanding the purchase decisions of consumers is to understand the key benefits consumers are seeking and how those benefits translate

into a set of criteria that consumers use to make their decisions. Generally speaking, consumers' purchase criteria reflect their usage situation. In the case of consumer goods the usage situation is often a function of the consumer's past experiences, their lifestyle and their personality (Assael, Reed and Patton 1995). For example, economy, dependability and safety are key purchase criteria for many consumers with families that are buying motor vehicles that will be used daily to transport family members, especially children. Having settled on a set of purchase criteria for deciding between products, the consumer then evaluates the products against the criteria and makes a choice.

Figure 2: Stages in complex decision making



Adapted from Assael (1998)

Consumers can be grouped into market segments, in this case benefit segments, on the basis of similarities and differences in the key purchase criteria that they use to evaluate a product(Assael, Reed and Patton 1995). Knowledge of the key purchase criteria that will be used by consumers in a segment can be employed to tailor products to meet the specific needs of consumers in that segment and promote products accordingly.

Complex decision making is a decision making process consistent with explanation based decision theory (Pennington and Hastie, 1989). Complex decision making is facilitated when there is adequate time for extensive information search and processing (Beatty and Smith 1987), adequate information is available on product characteristics and the consumer has the ability to process the available information (Greenleaf and Lehmann, 1995). These are all conditions which would appear to be satisfied in commercial family farming in advanced economies.

2.3 Brand loyalty

When repeated purchasing of a chosen product consistently generates a high degree of satisfaction then, over time, complex decision making may be replaced by brand loyalty. Brand loyalty is the second approach to purchasing high involvement products. Brand loyalty is more than just habitual purchasing of a brand. It represents a personal commitment to repeatedly purchase a brand on the basis of favourable attitudes towards the brand (Assael 1998). In situations where the purchase of a product entails a high level of risk, then brand loyalty may be an effective strategy for reducing risk. Brand loyalty does not equate with habit (Assael 1998).

Brand loyal consumers may change brands for three reasons. First, because they experience a change in their needs and the original product does not satisfy or match new needs. Second, brand loyal consumers may be forced to change brands because of dissatisfaction with the favoured product due to continually poor performance of the product over a period of time. Finally, brand loyal consumers may be induced to change brands because they learn of an alternative which is demonstrably superior.

In the case of agricultural innovations, brand loyal behaviour translates into a personal commitment to the use of an agricultural technology or practice that has been proven through experience to be successful, especially in situations where failure can have serious consequences. This means that producers are likely to be particularly unwilling to change technologies in situations where the failure of a technology can have serious consequences for the farm enterprise and existing technologies and practices have proved to be reliable. In such situations the rate of adoption and diffusion of alternative technologies is likely to be exceedingly low unless a change in circumstances leads to the failure of the traditional technology. The loyalty of producers to traditional technologies and practices in this type of situation is a structured, strategic response to risk. Kaine and Niall (2001a) found that wool producers' approach to sheep breeding and their choice of stud for purchasing rams resembled brand loyal behaviour. Evidence of brand loyal behaviour has also been identified with respect to pest and disease

management in horticulture and animal health management in dairying, cattle and sheep production (Bewsell and Kaine 2004, Kaine, Tarbotton and Bewsell 2003).

In conclusion, the application of consumer behaviour theory to the adoption of agricultural innovations suggests that primary producers are likely to be motivated and discriminating purchasers of new technologies who actively seek information on, and systematically learn about, innovations that are highly relevant to their needs. In circumstances where the failure of an innovation can have serious consequences for the farm enterprise, and existing technologies and practices have proved to be reliable, producers will sensibly resist the introduction of an innovation. This behaviour can be interpreted as resembling brand loyalty and is a rational and strategic response to risk.

3. Purchase criteria and farm context

In the case of agriculture the purchase criteria that producers use to evaluate new technologies should reflect the key benefits the technology offers given producers' usage situations. The mix factors that define the usage situation for an innovation will vary across innovations and among farm managers. In many instances the usage situation is likely to be a function of the farm context into which a new technology must be integrated. Generally speaking, the farm context is the mix of practices and techniques used on the farm, the skill base of the farm manager and the biophysical and financial resources available to the farm business that influence the benefits and costs of adopting an innovation (Crouch 1981; Kaine and Lees 1994). The usage situation for an innovation describes the aspects of the farming system that are functionally related to the innovation (Rogers 1983).

However, for some innovations the farm managers' perceptions of relevant risks and the management strategies that have been implemented to ameliorate those risks may be the relevant contextual variables that define the usage situation. In some instances, the usage situation for an innovation could even be defined by the social and personal values of the farm manager. Hence, the notion of farm context can at times encompass the personal and social values of the farm manager and their perception of relevant risks and associated management strategies. Similarities and differences among farm contexts for an agricultural innovation will translate into similarities and differences in the key purchase criteria that producers will use to evaluate that innovation.

Given that the usage situation for agricultural innovations is defined by farm contexts, differences in farm contexts will result in different market segments for an innovation. Logically, the market for an innovation (i.e. the population of potential adopters) will be defined by the set of farm contexts for which the innovation generates a net benefit ((see

Kaine and Bewsell (2002a); Kaine and Bewsell (2003a); Kaine and Niall (2001b) and Kaine, Court and Niall (2002) for examples).

As is the case with consumer products, knowledge of similarities and differences in the key purchase criteria that will be used by producers to evaluate an innovation can be used to classify producers into segments, to tailor the innovation to meet the specific needs of producers in a segment, and to promote the innovation accordingly.

To the degree that the mix of farm practices, technologies, resources, risks and values that influence the benefits and costs of adopting an innovation are different for different innovations, the purchase criteria used to evaluate innovations will change accordingly. This means purchase criteria are frequently innovation specific and often cannot be generalised across innovations. Gibon (1999), Dorward et al (2003) and other farming system researchers have also observed that the adoption of an innovation within a farming system often depends on a set of technical, economic and social characteristics that tend to be highly specific to the innovation.

This means the circumstances in which an agricultural innovation will be adopted can only be identified, in practice, by observation and inference. This means that in most cases the adopters of an agricultural innovation cannot be deduced from the spread of other innovations through the farming community, from the characteristics of the adopters of other innovations, or from the characteristics of the innovation itself.

4. Identifying farm contexts

The use of complex decision making in high involvement purchasing implies that the purchaser develops explicit chains of reasoning to guide their decision making. This is consistent with explanation-based decision theory, where the focus is on “reasoning about the evidence and how it links together” (Pennington and Hastie 1989). The idea is that farmers gather ‘evidence’ on the attributes of the technological alternatives available to them. This evidence is processed into a coherent causal model, or explanation, which is used to evaluate the extent to which the alternatives will meet their farming needs and upon which a decision is finally made (Cooksey 1996).

If the purchase criteria that producers use to evaluate innovations are defined by farm contexts, and if producers do base their evaluations of innovations on explicit chains of reasoning, then there should be shared and complementary patterns of reasoning among producers that adopt a technology and those that do not, and there should be an accompanying consistency in the decisions they reach. In other words, producers with similar farming contexts will offer similar explanations for the decision making, and these explanations will differ from those of producers whose farm contexts are dissimilar.

Furthermore, the differences in the reasoning of producers from different segments should follow logically from differences in their farm contexts.

Consequently, the factors influencing producers' decisions to adopt an innovation should be discoverable using a convergent interviewing process (Dick 1998). Convergent interviewing is unstructured in terms the content of the interview. The interviewer employs standard laddering techniques (Grunert and Grunert 1995) to systematically explore the reasoning underlying the decisions and actions of the interviewee.

Given a limited set of different farm contexts for an innovation then, in principle, that set can be identified by interviewing producers from each context. That the set has been identified can be known by the fact that the same patterns of reasoning keep recurring in interviews. All that is required is undertaking enough interviews to span the set of contexts. As the set of relevant contexts cannot be known in advance 'snowballing' sampling techniques (Cooper and Emory 1995) must be employed. As interviews progress the various characteristics that define different farm contexts for an innovation will emerge. Confirmation of the relevance of those characteristics, and the manner in which they influence the adoption of the innovation, is obtained by identifying and interviewing producers that differ on those characteristics as they are isolated.

In practice, the interview process can be shortened to some degree by beginning the interviewing with producers that have adopted the innovation of interest, producers that have not, and producers that have tried and abandoned the innovation, if they exist. The process may also be shortened by including producers that differ in their demographic characteristics and the scale and location of their agricultural enterprises early in the interviewing. In addition, the robustness of the process can be increased by interviewing researchers, extension and advisory staff to test interpretations of interview outcomes against their particular perspectives.

If producers' decisions to adopt an innovation are systematically related to salient factors that define the farm context for an innovation, the relationship between adoption and the presence or absence of those factors should be capable of statistical validation. This means the findings of the interview process should be verifiable using methodological triangulation (Denzin 1997). In other words, a quantitative method can be used to verify the information obtained using qualitative methods. Consequently, the existence of the various farm contexts for an innovation can be checked by gathering quantitative information on these contexts and criteria from a statistically representative sample of producers. For example, by distributing a mail questionnaire to producers, quantitative data can be gathered to statistically test hypotheses about relationships between farm contexts and the incidence of adoption, and to quantify the size of segments and so provide an estimate of the population of likely adopters.

5. Applications

The process I have described here has been used successfully in a number of studies. The process has been used to identify segments for innovations such as irrigation systems in the horticultural, viticultural, vegetable and dairy industries in Australia, breeding practices and animal health practices in sheep and cattle in Australia and New Zealand, and pest and disease management practises in horticulture and viticulture in Australia and New Zealand among others (see Kaine and Bewsell (2002b); Burrows et al (2002); Bewsell and Kaine (2002); Kaine and Bewsell (2000); Kaine and Niall (2001); Kaine, Tarbotton and Bewsell (2003); Kaine and Bewsell (2003a) and Bewsell and Kaine (2003) respectively).

In most of these studies the purchase criteria that were identified as constituting the farm context relevant to a particular innovation were concrete biophysical elements of the farm environment that are often used to classify enterprises into farming systems – topography, soil type, climate, type of enterprise, scarcity of natural resources such as water. However, in most studies some of the criteria were more socio-economic in nature and so less likely to be included in a classification of farming systems, though often no less concrete than biophysical criteria. Such criteria included the length of time needed to irrigate a property, the period of time taken to spray an orchard, the availability of labour, and the layout of channels on a property. Often there are relatively subtle interactions between an innovation and these criteria. For example, the impact of property layout can have a critical impact on the benefits of automatic irrigation (Kaine and Bewsell 2000), or the choice of spray irrigation technology (Kaine and Bewsell 2002d). Property layout, as well as topography, also influences the effectiveness of pheromone mating disruption in controlling orchard pests (Kaine and Bewsell 2003b).

In some studies perceptions of risk and the strategies used to ameliorate risk were key purchase criteria. Perceptions of risk in regard to the performance of rams in different environments, and the strategies for avoiding this risk, are the key factors influencing the way wool producers choose studs to purchase rams from and use performance data to select rams (Kaine and Niall 2001a). Producers' perceptions of price and business risk and the business strategy they used to mitigate these risks appear to influence producers' propensities to adopt financial management aids (Kaine, Lees and Sandall 1994). Perceptions of risk in regard to predictions of pest infestations relative to the capability of fruit growers to respond quickly to an infestation are a key factor influencing the adoption of integrated pest management techniques (Kaine and Bewsell 2003b).

These studies highlight the point that different mixes of farm practices, technologies, resources, risks and values influence the benefits and costs of adopting different innovations and that the purchase criteria used to evaluate innovations will change accordingly. These studies confirm that purchase criteria are frequently innovation specific and often cannot be generalised across innovations. Hence, attempts to seek general relationships across innovations are problematic.

6. Discussion

I opened this paper arguing that the technology transfer model of Rogers (1983) was simply a description of the key factors thought to influence the diffusion of an innovation among a population of adopters and the model is predicated on the assumption that the population of potential adopters has already been correctly identified. As such the technology transfer model does not provide a theoretical foundation for identifying the adopters of an innovation.

In this paper I have described a theoretically sound process for identifying the potential adopters of an innovation. In principal, this process complements Rogers' (1983) model of innovation diffusion. The process is centred on the idea that the fundamental factor influencing the decision to adopt an innovation is the extent to which the innovation can contribute to better satisfying the needs of the purchaser. This is consistent with Rogers (1983) conceptualisation of economic advantage as a key factor influencing innovation diffusion. It is also consistent with the observations of Lindner (1987) in regard to the findings in the agricultural economics literature that:

> *"… there is compelling empirical support for the emerging consensus that the final decision to adopt or reject is consistent with the producer's self-interest.*
>
> *The finding that the rate of adoption as well as the ultimate adoption level is determined primarily by the actual benefits of adoption to the potential adopters is by far and away the most important result to be culled from the empirical literature on adoption and diffusion."*

The process is consistent with the evidence from a number of reviews of studies into the adoption of agricultural innovations, such as Black (2000) and Guerin and Guerin (1994), that the major determinants of adoption are the attributes of innovations themselves.

The consumer behaviour approach, by taking the needs of producers as the starting point for evaluating the advantages and disadvantages of innovations, is consistent with

participatory approaches to research and extension such as the 'farmer first' approach espoused by Chambers *et al* (1989):

> *"Instead of starting with the knowledge, problems, analysis and priorities of scientists, it starts with the knowledge, problems, analysis and priorities of farmers and farm families. Instead of the research station as the main locus of action it is now the farm."*

Furthermore, in the consumer behaviour approach the producer is explicitly assumed to actively search for information and to devote a great deal of thought and consideration to making decisions. Hence, the approach assumes the producer possesses key knowledge and learning skills and has some capacity for adaptation and change. This is consistent with Salmon's (1981) cognitive approach to attitude change which views farmers as self-directed learners who seek out knowledge that is most relevant to their current needs and problems and integrate that knowledge into their own frame of reference.

This work holds a number of implications for agricultural research and extension. First, this work offers extension planners and evaluators a more rigorous means of assessing the success of extension programs. In the absence of information on the criteria producers use to evaluate an innovation, extension planners have little to guide them in terms assessing the extent to which an innovation has diffused among a population of adopters.

A relatively small number of adopters may actually represent a high level of diffusion if the population of potential adopters is relatively low. On the other hand, a relatively high number of adopters may actually represent a low level of diffusion if the population of potential adopters is relatively large. Similar logic can be applied to judging the success of extension programs by levels of attendance at events such as field days and workshops. The procedures described in this paper provide a means of estimating the population of potential adopters and, therefore, provide a benchmark for judging relative rates of adoption.

Second, this work also offers extension evaluators a more defensible method of assessing changes in the participation of producers in an extension program. In the absence of comprehensive information on the factors motivating adoption of an innovation the task of identifying the causes of changes in the rate of adoption of an innovation, or the causes of changes in participation rates in extension activities, becomes problematic. For example, a change in the rate of participation in an extension program may be provoked by a change in the producers' environment that substantially changes the attractiveness of an innovation. The rapid diffusion of biological control of mites and pheromone mating disruption techniques for codling moth in fruit growing in

Australia was triggered by severe problems with chemical resistance (Kaine and Bewsell 2003b). It would be easy to form the impression that the institution of novel extension program was responsible for the rapid adoption of these technologies. Such an impression confuses the factors motivating change with the factors motivating participation in a change management program.

A third, related implication is that the potential population of adopters can be highly dynamic. Where the factors that create a need for the innovation involve a change in circumstances or the environment then the population of potential adopters will alter over time as circumstance or the environment change. For example, a key factor influencing the adoption of micro-irrigation technology for some fruit and grape growers is the opportunities to save labour (Kaine and Bewsell 2002b, Kaine and Bewsell 2002c). Hence, the retirement of a senior family member from active participation in orchard activities is key a trigger for the adoption of this technology. It would be easy to misinterpret such timing as evidence that the senior family member was a traditionalist who was actively preventing younger, apparently more innovative members of the family, from adopting the technology.

A fourth implication relates to the role, design and evaluation of extension programs. Given the portrayal of producers as active, self-directed learners and seekers of information, the purpose of extension programs is to facilitate and accelerate change by reducing the effort that producers must invest in searching for information and, when required, acquiring new skills. This means that, to be successful, extension programs must signal their relevance to producers, provide information in an accessible, timely and useful way, and offer appropriate training. While there is a substantial literature in extension devoted to providing information and training, there is little on the notion of signalling relevance.

Another implication concerns the recruitment of producers as collaborators in research and development activities. The needs of the producer are the starting point in the consumer behaviour approach. Hence, the participation of producers is obviously critical to the successful conceptualisation, development and commercialisation of innovations. However, the consumer behaviour approach highlights the fact that the benefits producers seek from an innovation differ across farm contexts. This can mean that producers from different contexts may favour different attributes in the innovation. If this is the case then producers from each of the target farm contexts must be recruited to collaborate in the development of the innovation. Hence, conducting the type of market research described in this paper is a prerequisite for identifying the set of contexts the innovation is to target and to ensure collaborating producers are recruited from each context in that set.

This raises an issue in regard to the importance of participation in the adoption and diffusion of innovations. Clearly, the participation of producers is fundamental to the successful conceptualisation, development and commercialisation of innovations. The consumer behaviour approach is similar to the more moderate variants of the participatory model in which producers are involved as both consultative participants in the research process by providing information about their needs and as functional or interactive participants in the research process through contribution of local knowledge to the development of innovative solutions to those needs (Pretty *et al* 1995).

Advocates of the more radical variants of the participatory model argue that the appropriate form of participation by the individual producer is self mobilisation (Pretty *et al* 1995). The proponents of these variants tend to take the view that inter-personal communication between producers and extension personnel is a necessary and sufficient condition for behaviour change and adoption to occur (Black 2000). While this could be argued to be consistent with the learning approach to attitude and behaviour change (Salmon 1981) it is not consistent with the consumer behaviour model and the cognitive approach to attitude and behaviour change.

In relation to the diffusion of innovations, the model I have presented in this paper is largely consistent with the classical model proposed by Rogers (1983). However, it differs in that the adopter category in which an individual might fall for an innovation will be driven partly by characteristics of the individual such as innovativeness and locus of control (Kaine, Sandall and Bewsell 2003, 2004) and partly by individual differences in the farm context that defines a segment. This raises the possibility that contextual pressures, as measured by relative advantage, may be strong enough to motivate producers to over ride producer's predisposition to innovativeness. Furthermore, given that relative advantage will vary between innovations for a producer, the chances are that producers will shift between adopter categories from one innovation to the next.

Individual variations in the farm contexts that constitute a segment will alter the degree of relative advantage to be had from an innovation (see Kaine and Lees 1994, Kaine and Niall 2001b). Where these variations significantly increase the relative advantage of an innovation to producers they may be motivated to adopt the innovation earlier than they otherwise would have. Where these variations significantly reduce the relative advantage of an innovation to producers they may adopt the innovation later than they otherwise might have. In other words, contextual pressures can be strong enough to motivate producers to adopt an innovation earlier, or later, than their personal predisposition to innovativeness might have indicated.

Another implication concerns producer participation in extension activities. In the absence of comprehensive information on the needs motivating adoption of an

innovation and the criteria used to evaluate an innovation, the program planner cannot selectively attract producers to an extension activity. Participating producers will self-select on the basis of their perceptions of the potential relevance of the innovation being promoted. Such perceptions may, naturally, be based on a partial understanding of the technology, and participation may be subject to producers' judgements about the credibility and utility of extension activities based on past experience. Such judgements may be mistaken but the producer has no other information on which to make a quick, effortless assessment of the activity.

On the other hand, knowledge of the needs motivating adoption and the criteria used to evaluate an innovation provides the program planner with information to design a signal, or message, indicating which producers would find the activity relevant. This enables the target audience to easily and rapidly identify themselves and correctly self-select. For example, micro-irrigation was promoted to grape growers in northern Victoria, Sunraysia and Murrumbidgee Irrigation area as a means of saving water. Given that many growers in these areas had ample water supplies participation in extension programs was limited. Growers were adopting micro-irrigation to save labour and to create capacity to improve grape quality. Hence, efforts to attract growers to extension activities would be more successful if these activities were promoted, and conducted, as opportunities for growers to learn how to improve grape quality (Burrows, Boland and Putland 2003, Kaine and Bewsell 2002c).

Another implication in relation to the evaluation of extension programs concerns distinguishing market saturation from signal or delivery failure. Producers may stop attending an extension program for three reasons. First, most potential adopters may have acquired the information and skills required to adopt and the extension program is no longer required. Second, the planner has made a mistake in signalling the relevance of the program to the target audience of producers. Third, the program does not meet producers' learning and training needs. While the planner may be able to identify the third possibility using commonly accepted evaluation procedures, the planner cannot distinguish between the first and second possibilities in the absence of information on the factors motivating adoption and estimates of the population of potential adopters. This does raise the interesting possibility that the best measure of success of a program is popularity, that is, numbers participating relative to the population of potential adopters.

As a final point in relation to extension, the consumer behaviour approach highlights the limits to the effectiveness of extension as a policy instrument. Extension can facilitate or accelerate change by reducing the effort and time producers need to spend in searching for information and acquiring skills. In other words, extension can disseminate

information and skills more rapidly than would otherwise be the case resulting in higher rates of diffusion. Extension does not, of itself, change the population of potential adopters. This requires other policy interventions such as taxes and subsidies, though only if sufficiently large, or changes in property rights, or changes in regulations.

Outside agriculture, in professions such as health, psychological models such as the Theory of Reasoned Action (Fishbein and Ajzen 1975) and its variants are the most popular models of behaviour change. In these models a change in behaviour, such as the adoption of an innovation, is thought to be influenced by behavioural intentions which, in turn are a function of personal attitudes towards the innovation and social norms about the adoption of the innovation. The variants of the model differ in the other factors that are thought to include intention and behaviour such as locus of control, self-efficacy and habit (see Ajzen 1991 and Ajzen 2001). In principle, these models are similar to the complex decision making model in their conceptualisation of the types of factors that influence behaviour. There are, however, some important differences.

First, these psychological models do not explicitly recognise the possibility that an innovation may suit, differentially, a range of farm contexts. As a consequence, the quantitative specification of the relationship between attitudes and intentions in these models is linear when the presence of a variety of contexts suggests that these relationships will be non-linear (at least across the potential population of adopters as whole).

Second, these models do not clearly distinguish between different types of decision making models and the circumstances that elicit particular styles. For example, they do not distinguish readily between complex decision making, brand loyalty and inertia. This adds to the difficulty of identifying and interpreting relationships between behaviour, intentions, attitudes and norms.

Third, there is a tendency with these models to focus on identifying and describing individual's attitudes and social norms towards an innovation without a corresponding effort to identify the contextual factors that are the source of the differences in individuals' attitudes (see Ajzen 1991, Armitage and Conner 2001, Sparks and Guthrie 1998). To the extent contextual factors are incorporated in these models, they are often treated as explaining variation in intentions beyond that explained by beliefs and norms rather than antecedents of beliefs (Perugini and Bagozzi 2001, Kuther 2002). This limits the practical contribution these models can make to planning extension programs.

Models of the type proposed by Fishbein and Ajzen (1975) would complement the approach described in this paper if they were employed to investigate and quantify the relative influence of the factors governing the adoption of an innovation within a market segment as defined by a particular farm context.

7. Conclusion

In the absence of information on the population of likely adopters of an innovation, researchers, policy makers and extension staff do not have sound basis for making judgements about rates of adoption. Similarly, they lack a sound basis for making judgements about the relative success of extension programs and the causes of any differences in the apparent success of extension programs.

In this paper I have drawn on the conceptual foundations of consumer behaviour theory and farm management theory to outline a theoretically sound process for determining how innovations can contribute to satisfying the needs of primary producers as managers of agricultural enterprises and, by extension, how the factors motivating or inhibiting adoption can be identified. The application of this process leads to a procedure for identifying the population of potential adopters of an agricultural innovation.

The process I have described here has been used successfully to identify segments for a range of agricultural technologies and practices such as irrigation systems in the horticultural, viticultural, vegetable and dairy industries in Australia, breeding practices and animal health practices in sheep and cattle in Australia and New Zealand, and pest and disease management practises in horticulture and viticulture in Australia and New Zealand.

The process is consistent with, and complements, the classical model of innovation diffusion, farming systems theory and the participative approaches to agricultural extension. I believe the process I have described here can be used by researchers, policy makers and extension staff to design more effective research and extension programs.

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