Adoption of conservation practices by rural landholders


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Much of the focus of government policy for land and water conservation is on changing the behaviour and management practices of rural landholders. However, these policies often neglect the large body of evidence about what it takes to achieve such changes. This paper is a selective review and interpretation of the literature, conducted by a team from three relevant disciplines: agricultural and resource economics, rural sociology and social psychology.

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 landholder within their social and economic environment, and the characteristics of the practice. These three elements are considered in detail in the following three sections. The last section discusses the implications of the review for various stakeholders: researchers, extension agents, and policy makers.

The process of learning and experience to inform adoption decisions

Adoption is a learning process with two distinct aspects. One is the collection, integration and evaluation of new information to allow better decisions about the innovation. Early in the process, the landholder’s uncertainty about the innovation is high, and the quality of decision making may be low. As the process continues, if it proceeds at all, uncertainty is reduced and better decisions can be made (Marra et al. 2003). At least for relatively simple innovations, a landholder’s probability of making a good decision – one that best advances their goals – increases over time with increasing knowledge of, and perhaps experience with, the practice.

The other aspect of learning is improvement in the landholder’s skills in applying the innovation to their own situation (Tsur et al. 1990). Most farming innovations require a certain level of knowledge and skill to apply them in practice and there can be a wealth of choices in the method of implementation (e.g. timing, sequencing, intensity, scale). Through learning-by-doing, as well as by reading, listening and watching, the necessary skills can be established and enhanced.

The dynamic learning process has been broken down into stages or phases in a number of different (though similar) ways. One typical description of the sequence follows.
(i) Awareness of the problem or opportunity.
(ii) Non-trial evaluation.
(iii) Trial evaluation.
(iv) Adoption.
(v) Review and modification.
(vi) Non-adoption or dis-adoption.

Prior to trialing, the landholder’s assessment of a technology or practice relies strongly on information from outsiders. At this stage, social and information networks would be important influences on the decision to proceed to trial, but after trialing has commenced, personal experience is likely to be the main influence on further decisions (Dong and Saha 1998; Marsh et al. 2000).

There is no guarantee that a landholder’s subjective beliefs will ultimately lead them to a final decision that is actually the one most likely to best achieve their goals. Reasons include that some conservation practices are relatively complex and that the benefits and costs of some conservation practices are not clearly observable. An example of a prominent conservation-related learning failure is provided by Pannell et al. (2001). They noted that many landholders (as well as scientists and policy makers) came to believe that successful prevention of dryland salinity on a farm would generally depend on cooperation from neighbours. While this is true in some cases, in many it is not.

Social, cultural and personal influences on adoption decisions

Although, for convenience, we will often refer to the (singular) landholder or farmer, the reader should bear in mind that for many decisions, particularly larger ones, the decision-making unit can be a team, so that individual perceptions and goals influence a consensus rather than leading directly to a decision.

Phillips (1985) found that a typical dairy farmer may embark on anything up to 30 learning projects in one year. A landholder (or landholding family) has limited learning time, and each project must compete with the others for that limited time. A minor decision will receive minimal information time, sufficient to achieve an acceptable solution, which is not necessarily the best possible solution. For more important decisions, the dairy farmers in Phillips’ (1985) study sought information from up to 40 people.

The goals of landholder families or individuals are heterogeneous, and can include the following: (i) material wealth and financial security; (ii) environmental protection and enhancement (beyond that related to personal financial gain); (iii) social approval and acceptance; (iv) personal integrity and high ethical standards; and (v) balance of work and lifestyle.

One issue of long-standing discussion and debate has been the relative importance of economic factors as drivers of adoption. The debate started early, with contributions by some of the first researchers in the area (Griliches 1960; Havens and Rogers 1961). To this day, not surprisingly, economists tend to put greater emphasis on the influence of economic factors than do sociologists. In our judgment, there are several important influences on adoption, and economic benefit (broadly defined) is one of them.

When adoption is viewed as a social process, it becomes clear that one should expect adoption behaviour to be influenced by the personality of the decision maker, their social networks, personal circumstances and family situation. It seems that in the empirical literature every measurable characteristic of farms and farmers has been found to be statistically related to some measure of adoption of some innovation (e.g. Rogers 2003). This reflects the heterogeneity of adoption study settings, the very large size of the literature, and the variable quality of empirical studies (as noted, for example, by Lindner 1987; Vanclay 1986).
Personality may potentially play a major part in the style of decision making used by landholders, though because of measurement complexity, it has rarely been studied. Important personality traits may include the ‘locus of control’ (an individual’s degree of belief in their own ability to influence the circumstances of their lives), attitude to risk, and introversion-extroversion. Shrapnel and Davie (2001) examined the personality profile of a sample of Queensland graziers. Of 14 general personality styles expected in the wider community, graziers were found to generally fall into a limited suite of 5 styles. ‘Our findings indicate that they are indeed a special breed, with characteristic[s] that set them apart from members of an urban community’ (Shrapnel and Davie 2001, p. 177). These characteristics include a tendency to introversion and discomfort within group situations.

A widely discussed and long-standing concept is categorisation of people across a spectrum from innovators to laggards (Rogers 2003). People do indeed have personal characteristics that influence their adoption decisions fairly consistently. However, the concept of adopter categories suggests that innovativeness is a personal characteristic that people apply equally to every adoption decision that they make. This is not so. People who adopt one innovation early are not necessarily early adopters of all innovations. It may be that the innovation in question is particularly attractive in their individual circumstances, whereas the same decision maker when considering a different innovation that is less attractive to them than to others may behave as a slow adopter or non-adopter.

Several aspects of the linkages between landholders and others may affect the adoption decision:
(i) The existence and strength of landholders’ social networks and local organisations (e.g. Sobels et al. 2001) and membership of organisations such as catchment groups;
(ii) The physical proximity of other adopters (e.g. Hagerstrand 1967; Ruttan 1996);
(iii) The physical distance of the property from sources of information about the innovation is important (e.g. Lindner et al. 1982);
(iv) A history of respectful relationships between landholders and advocates for the innovation, including scientists, extension agents, other landholders, and private companies (e.g. Marshall 2004, 2005; Anderson 1981);
(v) Ethnic and cultural divisions within a landholder population (Stoyles 1992);
(vi) Extension, promotion and marketing programs by government workers and/or the private sector.

Demographic and situational variables are judged to be important because they will influence the goals of the landholder and potentially influence the capacity to adopt an innovation. Some examples of these variables are listed below.
(i) Lack of financial viability would be expected to inhibit adoption of innovations by reducing the capacity to adopt, rather than the benefits of adopting Cary et al. (2001).
(ii) Access to and reliance on off-property income may increase financial security but also may decrease the tendency to adopt some practices that would involve greater management demands (Kebede 1992).
(iii) Property size is often, but not always, related to innovation adoption – larger areas tend to increase the overall benefits of adoption of beneficial innovations and so increase the likelihood of adoption.
(iv) The evidence of a relationship between adoption and age, stage of life or experience is mixed. The most extensive meta-review of socio-economic factors influencing adoption found both positive and negative relationships between age and adoption (Rogers 2003).
(v) There can sometimes be relationships between education and the adoption of conservation practices (e.g. Feder et al. 1985), although the evidence is again somewhat mixed (e.g. Marsh et al. 2006).
(vi) The reason for holding land (e.g. agricultural production vis a vis lifestyle) can influence adoption decisions.

Attributes of practices that affect their adoption

We consider that there are two broad categories of characteristics of a technology or practice that drive its adoption or non-adoption: its relative advantage and its trialability.
**Relative advantage**

Relative advantage means “the degree to which an innovation is perceived as being better than the idea [or practice] it supersedes” (Rogers 2003, p. 229). Relative advantage depends on the landholder’s unique set of goals and the biophysical, economic and social context where the innovation will be used. Relative advantage is the decisive factor determining the ultimate level of adoption of most innovations in the long run.

Relative advantage depends on a range of economic, social and environmental factors, such as:

(i) The short-term input costs, yields and output prices of the innovation or of other activities that it affects.

(ii) The innovation’s impact on profits in the medium-to-long term.

(iii) The innovation’s impacts on other parts of the system within which it will be embedded.

(iv) Adjustment costs involved in adoption of the innovation.

(v) The innovation’s impacts on the riskiness of production (Marra et al. 2003; Abadi Ghadim et al. 2005).

(vi) The innovation’s compatibility with a landholder’s existing set of technologies, practices and resources (Kaine and Lees 1994).

(vii) The innovation’s complexity (Wilkinson 1989).

(viii) Government policies.

(ix) The cost or profitability of the traditional practice which the innovation would replace.

(x) The compatibility of a practice with existing beliefs and values.

(xi) The impact of the innovation upon the family lifestyle.

(xii) Self-image and brand loyalty.

(xiii) The perceived environmental credibility of the practice.

The crucial role of ‘relative advantage’ as a driver of adoption, and the importance of profit as one of the drivers for most farmers has strong implications for conservation practices. Among those farmers with a focus on profit, the farm-level economics of a proposed conservation practice will be important. Those conservation practices that are not profitable at the farm level will tend to be adopted only by farmers with stronger conservation goals. Unprofitable conservation practices are likely to be more widely adopted if they are able to generate conservation benefits when adopted at a small scale. Conservation land uses that require adoption at large scale to generate conservation benefits will probably not be adopted sufficiently if they are perceived to be less profitable than the land uses they replace.

Some conservation-related practices have been adopted very widely and over very large areas in Australia, most notably reduced tillage and liming of acid soils (e.g. Mues et al. 1998). These are practices that contribute positively to farmers’ economic goals in the medium term in many locations. This highlights that the relative advantage that drives adoption may not necessarily relate to the environment. Indeed, environmental benefits can often be most readily achieved by developing conservation practices that provide a commercial advantage to farmers.

In contrast to the above examples, the scale of adoption of perennial plants for salinity abatement in low- to medium-rainfall areas has been much less than needed to significantly reduce the salinity threat (e.g. ABS 2002; Kington and Pannell 2003). A recent comprehensive review of the economics of salinity abatement measures available to grain growers provides a convincing explanation for this, as there were few examples of locations and practices where the economics favoured high levels of adoption (Kingwell et al. 2003).

Other factors that tend to reduce the relative advantage of at least some conservation practices are as follows.

(i) High establishment costs.

(ii) Long time lags between establishment and environmental benefits.

(iii) Riskiness and uncertainty about benefits.
(iv) Complexity of the practice.
(v) Spillovers from neighbours being perceived as the source of environmental degradation.

**Trialability**

Earlier we discussed a number of social, cultural and personal factors that influence learning about an innovation. Here we consider characteristics of the innovation itself that affect how easily the landholder can learn about its performance and optimal management – in other words, the trialability of the innovation. Trialability does not merely refer to the ease of physically establishing a trial, but encompasses factors that influence the ability to learn from a trial, such as the complexity of the issue being addressed.

Trialing an innovation provides information that reduces uncertainty about the relative advantage of the practice. Thus, trialing is important because it can increase the probability of the landholder making a correct decision. Trialing also provides an opportunity for the landholder to learn the skills needed to apply the innovation. The small-scale nature of a trial allows the landholder to avoid the risk of large financial costs if the practice turns out to be uneconomic or fails due to inexperience.

The trialability of a practice is affected by a number of factors, including those listed below. Note that several of these factors were also listed as influences on relative advantage. These factors influence adoption through both channels.

(i) The divisibility of an innovation refers to its use on a small scale, or the use of a sub-component of an innovation package (positively related to adoption) (Leathers and Smale 1992);
(ii) The observability of results from a trial (positive);
(iii) The time lag between adoption and eventual benefits (negative);
(iv) The complexity of an innovation (negative);
(v) The cost of undertaking a trial (negative);
(vi) Risks of trial failure (e.g. due to threats such as drought, diseases, pests, and establishment failure) (negative);
(vii) Quality of trial implementation (positive);
(viii) Similarity in behaviour of the innovation to a familiar practice (positive), allowing the landholder to extrapolate more readily from a small number of observations of the new practice (Abadi Ghadim et al. 2005);
(ix) Perceived spillovers from neighbours (negative).

**Implications**

**Implications for research and extension**

We provide the following suggestions for biophysical scientists to help them achieve greater adoption by landholders of conservation practices being researched (based on Marsh, 1998).

(i) Be conscious of the type of practices that landholders adopt more readily – those with high relative advantage and high trialability. Appreciate that landholders have legitimate reasons for non-adoption.
(ii) Encourage a participatory process. Working with landholders forces researchers and extension workers to recognise that their own goals may be different to landholders’ goals, and reduces the risk of them making incorrect or over-simplified assumptions about what landholders’ goals really are. Such interaction also increases landholders’ knowledge of the research and their ownership of, and faith in, the results.
(iii) Look constructively at what landholders are doing already. Work with them where possible rather than against them. This suggestion acknowledges the importance of local knowledge in landholders’ decision making, and the importance of respecting their personal goals and perceptions.
Adoption of conservation practices by landholders is not solely a biophysical issue, it is also an economic, social and psychological issue, so biophysical researchers can benefit from working closely with economists, sociologists and psychologists, from an early stage in the project.

Given the importance of trialability for adoption of an innovation, it may be useful for researchers and extension agents to consider ways in which landholder learning from trials can be enhanced. One possibility suggested is to provide information about the trial performance of familiar reference land uses or practices that are as similar to the innovation as possible, in conjunction with information about the performance of the innovation. It may be feasible to facilitate physical observation, or at least present results of physical measurements, of important processes that are not readily visible (e.g. groundwater processes). Perhaps it is possible to provide rules of thumb about final yields based on the early growth rates of plants that have long lags before harvest (e.g. woody perennials). Similarly, where a novel land-use requires large-scale adoption to achieve environmental benefits, ways to predict those benefits based on performance in small-scale trials may be helpful.

A criticism of traditional extension is that it viewed the extension process primarily as a matter of communication. Lack of adoption was blamed on a failure of the extension communication process. The solution was to better target extension and to improve the methods of information delivery. The assumption was that farmers were information-deprived and relatively passive recipients of knowledge. In reality, farmers have excessive information (e.g. from consultants, banks, accountants, agronomists, agribusiness firms, other landholders), some of which is conflicting, and they are almost never passive recipients. Recognising its place within this complex web of information sources, extension needs to be more focused on credibility, reliability, legitimacy, and the decision-making process. Features of current conservation-related extension that mitigate against the development of credibility include: short-term funding, rapid turnover of staff, the youthfulness and inexperience of many staff, and the lack of technical farming expertise of many staff.

Even with the most expert and persuasive extension, landholders are not likely to change their management unless they can be convinced that the proposed changes are consistent with their goals. Therefore, expectations about the extent of change that is likely to result from extension need to be realistic. Large changes made by large numbers of landholders are not likely to be attributable to extension in most cases. For one thing, landholders and their lands are highly heterogeneous. Any given practice only advances the goals of some landholders, and often only on some of their land.

It is likely that the main contributions of extension will be through raising awareness and, to some extent, changing perceptions of the relevance and performance of an innovation. It is much more difficult (and sometimes ethically contentious) to change the goals of people. It seems that the Landcare movement in Australia has increased the emphasis given to conservation goals by landholders, but the extent of increase has been modest for most landholders.

Extension is unlikely to persuade landholders to make greater use of a practice with which they already have personal experience, unless the extension provides new information about a change that increases the attractiveness of the innovation (e.g. new information about how to better implement the innovation, or about new incentive payments to encourage adoption).

Another important issue for extension (as for science) is that it does not have automatic legitimacy and credibility – these have to be earned. The key determinant of an adviser’s credibility to a farmer is trust. Trust is, in turn, strongly related to the extent a farmer believed an adviser understands and respects the goals of the farmer.

We note that, while group-extension approaches are undoubtedly useful, the swing from individuals to groups in recent years may have gone too far. For example, the introverted personality profiles of graziers described in the work of Shrapnel and Davie (2001) indicate the continued importance of one-on-one extension. Noting the importance of credibility in effective extension, Vanclay (2004, p. 221)
observed that, “Credibility is developed over time through the provision of credible, practical, useful answers that assist farmers in [their] day-to-day operations. Group facilitators who never provide on-farm advice rarely develop credibility and their ideas are easily dismissed.”

A history of valuable advice relevant to a landholder’s goals is probably the single most important source of credibility, but it can be enhanced to some extent by a wide range of factors, including: (i) authority and technical expertise of the extension agent; (ii) perceived similarity of the extension agent to their audience; (iii) local profile of the extension agent (e.g. local residence); (iv) communication skills of the extension agent; (v) personal relationships between the extension agent and landholders; and (vi) extension-agent acknowledgement of/empathy with the circumstances and problems of landholders.

Adviser credibility and trust is a valuable commodity, but it is only earned slowly. Adviser credibility and trust can be easily lost by the support of an innovation or practice clearly unsuited to local circumstances, or through the evangelical promotion of a practice that is clearly in conflict with the goals of landowners. In the past two decades, the role of government extension agents in many states has changed away from that of supporting landholders in making good decisions to achieve their own goals, towards encouraging landholders to make decisions that achieve outcomes for the public good. In many situations, this has the potential to reshape the social contract between adviser and landholder. The importance of this changed social relationship is not recognised by the relevant public agencies, which publicise their programs using the rhetoric of community development, yet place clear requirements for technology transfer outcomes upon their agents.

**Implications for policy and for regional bodies**

Some government officers express frustration at the lack of adoption by landholders of conservation practices and call for additional social research to better understand adoption. Sometimes it can be helpful to better understand the adoption of specific practices, but the influences on adoption in general have been studied intensely and we believe that they are sufficiently well understood. Rather than more research into adoption, the more pressing need is to apply what is already well established in the adoption literature.

If a practice is not adopted in the long term, it is because landholders are not convinced that it advances their goals sufficiently to outweigh its costs. A consequence of this is that we should avoid putting the main burden for promoting adoption onto communication, education and persuasion activities. This strategy is unfortunately common, but is destined to fail if the innovations being promoted are not sufficiently attractive to the target audience. The innovations need to be ‘adoptable’. If they are not, then communication and education activities will simply confirm a landholder’s decision not to adopt, as well as degrade the social standing of the field agents of the organisation. Extension providers should invest time and resources in attempting to ascertain whether an innovation is adoptable before proceeding with extension to promote its uptake.

For some environmental issues, the real challenge is to find or develop innovations that are not only good for the environment, but also economically superior to the practices they are supposed to replace. If such innovations cannot be identified or developed, there is no point in falling back onto communication. Promoting inferior practices will only lead to frustration for all parties.

Sometimes unattractive practices can be made sufficiently attractive by the provision of financial incentive payments (e.g. through economic policy instruments). However, it is important to be realistic about the potential of this approach. In some cases, the level of payment required to achieve sufficient adoption would be more than can be justified by the resulting environmental benefits (e.g. Pannell 2001). In some situations, the most sensible strategy is not to attempt to encourage uptake of existing technologies or systems. Rather, it may be more sensible to attempt to develop better practices (more effective and/or more adoptable), or it may be that research and policy needs to address the task of living with the problem.
References


