

# **Understanding Land Manager Constraints to the Adoption of Changed Practices or Technological Innovations: Literature Review**

Jeanette Stanley, Beth Clouston and Ray Baker

**Working Paper No. 1 from the Project “Impediments to the Uptake of Market Based Instruments”**

## **About the Authors**

Dr Jeanette Stanley is a senior social scientist in the Department of Natural Resources, Mines and Water (Queensland).

Dr Beth Clouston is a senior economist in the Department of Natural Resources, Mines and Water (Queensland).

Ray Baker is Acting Director Economic Services, Sustainable Landscapes, Department of Natural Resources, Mines and Water (Queensland).

## **Impediments to the Uptake of Market Based Instruments: Project Description**

This project is funded by Land and Water Australia under their Social and Institutional Research Program. Support for this project is also being provided by the North Coast Catchment Management Authority (NSW), Central West Catchment Management Authority (NSW), Queensland Department of Natural Resources, Mines and Water, Charles Sturt University and CSIRO.

The project seeks to provide information about how to design and implement incentives and market based instruments to increase participation of farmers.

The project team is being lead by Mr Ray Baker and Associate Professor Mark Morrison. Other members of the project team include Dr Jeanette Stanley (Queensland Department of Natural Resources, Mines and Water), Dr John Ward (CSIRO), Ms Jenni Greig (Charles Sturt University) and Professor Eddie Oczkowski (Charles Sturt University).

Correspondence relating to this working paper should be directed to Dr Jeanette Stanley, Phone: 07 3896 9645, Email: [jeanette.stanley@nrm.qld.gov.au](mailto:jeanette.stanley@nrm.qld.gov.au)

### **Other working papers from this project:**

Mark Morrison and Jenni Greig, *Encouraging Participation in Market Based Instruments and Incentive Programs*, Working Paper No. 2.

## **Abstract**

The purpose of this working paper is to review the literature to identify what has been learnt about the social and economic factors that constrain land managers from participating in natural resource management activities or adopting changed practices and technological innovations.

The paper explores two distinct categories of constraints. The first category includes the characteristics of the innovation or practice itself that might influence participation including the methods of implementing the innovation. The second category explores the characteristics of the individuals or communities expected to implement the innovation or changed practice. The factors explored range from socio-demographic characteristics, attitudinal factors, knowledge constraints, the practice of succession, a land manager's financial 'health', and the stock of social capital residing at the community scale, and how each of these factors more or less influences adoption of changed practices at the land manager level.

The working paper is the first in a series of papers tackling the issue of land manager participation in market-based instrument (MBI) or other incentive programs. The assumption on which this paper is based is that the first step in designing any incentive program to facilitate change is developing an understanding of the factors that are constraining a land manager from adopting the desired behavioural or practice change independently of institutional interference. It is these constraints that can then be addressed with an incentive program.

The findings suggest that a mix of policy tools that are directly targeted at the social and economic factors that influence land manager behaviour, can begin to address those that act as constraints, promote those that act as positive drivers and ultimately increase the likelihood of land managers engaging with natural resource management or adopting changed practices.

While there are MBIs and other instruments available to achieve these objectives, involvement in these programs remains low, so the environmental objectives are often not achieved. Understanding *why* participation remains low, and using this

information to inform the design, and promotion of MBI or other incentive programs are the key objective of this research project. Hence, the second paper in the series explores the emerging literature to identify what has been learnt about how to design and implement MBIs and incentive programs to achieve maximum participation of farmers.

## **1. Introduction**

This paper investigates the factors that act as constraints and barriers to landholders adopting changed practices or technological innovations. Understanding these factors is fundamental to understanding how we can use policy tools or instruments to influence behavioural change for sustainable outcomes.

Market-based instruments (MBIs) and other non-market based incentive programs represent some of the available tools to manage these constraints. Fundamental to the success of any incentive program is an implicit assumption that landholders will change farm practices for natural resource management outcomes if there is an incentive to do so. However, landholder involvement in incentive programs often remains low; hence the opportunities and benefits that they potentially offer are not being fully realised.

This paper is the first in a series of papers emerging from a research project investigating the constraints and impediments to land managers uptaking MBIs and other incentive programs designed to influence the adoption of changed practices. Part of the reason for the reluctance of many land managers to participate in incentive programs is that they frequently do not serve to counteract the influence of constraining factors. This is because incentive providers frequently fail to design incentive programs with a full understanding of the myriad of factors that might influence the adoption of a changed practice. For example, if the factor that is constraining a land manager from adopting a changed practice is a lack of confidence in the technology, then it is unlikely that offering a financial incentive will serve to influence land manager adoption of the practice.

So, in order to design incentive programs that target the intended recipients, we must first understand the complexity of economic and social factors influencing land managers' adoption of natural resource management innovations or recommended changed practices. These factors can be separated into two distinct categories: the characteristics of the innovation or practice itself that might influence uptake including the methods of implementing the innovation; and the characteristics of the individuals or communities expected to implement the innovation or changed practice.

The second paper in the series – “Encouraging Participation in Market Based Instruments and Incentive Programs” – then explores the emerging literature on the constraints and impediments to maximizing land manager uptake of both MBI’s and incentive programs.

## **2. Characteristics of the innovation**

The characteristics of natural resource management practices or innovations may pose barriers to their adoption. Characteristics that have been shown to influence or encourage adoption include *relative advantage*, the associated *risk*, the *complexity*, the *compatibility*, the *trialability* and the *observability* of a given practice (Cary, Webb and Barr, 2002; Rogers, 2003).

Agricultural practices or innovations that are believed to be profitable have an increased likelihood of adoption, while those that are considered to primarily produce public benefits – that is, for society as a whole – are less likely to be adopted (Barr and Cary, 1992; Cary *et al.*, 2002; Vanslebrouck, van Huylenbroeck and Verbeke, 2002; Webb, 2004). Many land managers will chose not to adopt sustainability practices if they calculate that it is not in their own best interests; that is, if the *relative advantage* is low (Pannell, 2001). On the other hand, if a land manager feels that by the nature of the practice design they and their family will benefit, adoption is much more likely (Vanslebrouck *et al.*, 2002). The relative advantage is innovation specific and will vary between individuals.

The degree of *risk* associated with a new practice is another motivating factor for land manager willingness to adopt changed practices. There is a large degree of variation across individuals regarding their willingness to adopt practices that are perceived as risky (Cary *et al.*, 2002). However, it is reasonable to assume that sustainable practices which are perceived as relatively risky will be less likely to be adopted by land managers. This will likely vary according to differences in income, needs, personal adversity to and perception of risk, and profit motivation.

The *complexity* of an innovation may also influence the likelihood of its uptake (Cary *et al.*, 2002). Complexity refers to the degree of knowledge or information needed to

implement an innovation, the level of change required for adoption, and the ease of use, speed and reliability of an innovation (Vanclay and Lawrence 1995; Webb, 2004). The more complex an innovation, the less likely it is to be adopted, as complexity increases the risk of failure as well as the knowledge investment needed to adopt changed practices (Vanclay and Lawrence, 1995; Cary *et al.*, 2002).

*Compatibility* refers to the extent to which an innovation is compatible with existing agricultural practices, knowledge systems and social practices – if an innovation ‘fits’ with the needs and values of a land manager it is more likely to be adopted (Cary *et al.*, 2002; Rogers, 2003; Webb, 2004)

The *trialability* and *observability* of a natural resource management innovation are also important as a lack of confidence in recommended practices is identified as an important constraint affecting adoption (Curtis and Robertson, 2003; Byron, Curtis and MacKay, 2005). First, if innovations can be trialed on a small scale and shown to be successful, the perceived risk of failure will decrease. Similarly, if others can observe changes as a result of innovative practices, they are also more likely to be adopted (Cary *et al.*, 2002; Rogers, 2003). Alternatively, if a trial does not produce observable results in the short-term it may prevent the adoption of good practices with long-term outcomes (Webb, 2004).

### *Methods of implementing the innovation*

When a technological innovation is developed, the way in which it is introduced or communicated to the potential users has the potential to significantly influence the rate of its adoption. One of the most influencing factors is the degree to which the community are consulted and the degree to which they feel ownership of the problem.

There has been much research into the importance of involving rural communities in decision-making processes. It is argued that decision-making processes that involve the end-users are more likely to lead to better social outcomes and more satisfied communities. These arguments apply also to the development of agricultural innovations. Essentially, an innovation is more likely to be accepted by the community if they are involved in the development and trial stages to ensure its

compatibility with their current land management systems (Cox and Miers, 1995). As well as creating a sense of ownership, this consultation can also lead to improved design of a technology or innovation.

Promotion of the innovation at the implementation stage is also important to lower perceptions of risk and complexity.

### **3. Individual and social characteristics**

There are a range of individual characteristics that will influence the rate of adoption of innovations or changed practices. Government agencies or other institutions attempting to influence adoption will have little or no control over several of these factors. However, it is important that consideration of these characteristics is built into the design of MBIs and other incentive programs as it will influence the mechanism chosen, the audience targeted and any necessary modifications to the incentive program.

#### ***Lack of confidence in the technology***

While a lack of confidence in an innovation or technology is related to the features of the innovation already discussed, such as its complexity, innate riskiness and trialability, it may also arise from personality traits such as an individual's adversity to risk or personal experiences with the proponents of the change, such as government agencies, and their past policies.

#### ***Level of adversity to risk***

One personality trait that is likely to influence the adoption of a changed practice or innovation is an individual's adversity to risk. As mentioned earlier, the perceived riskiness of an innovation influences adoption, so it follows that an individual's adversity to risk is of significance. An individual's personal adversity to risk is exacerbated by uncertainty, particularly about the potential 'payback', or about market prices (Khanna *et al.*, 2001). The ABARE Resource Management Supplementary (RMS) survey for the 2001/2002 financial year for Queensland identified that 38% of respondents felt that it would be a major risk if they changed

the way they do things on the farm. This suggests that some land managers are not willing to accept the risks associated with change.

While most people are willing to take a *reasonable* amount of risk, what is reasonable differs between people. Some people are risk takers, while others are less likely to engage in activities that fall outside their own experiences. Changed practices or technological innovations are new and may not be taken up by those who are more adverse to risk, at least in the early stages of their release. As those around them adopt the change and positive results become observable, the risk factor decreases and adoption becomes more likely.

### *Past experience with government policies and advice*

Finlay (2004) in a study examining land manager attitudes towards land management, uncovered a belief that governments were 'two-faced' in their approach to land management: ignoring natural resource problems when they arise on public lands, while imposing initiatives that cost time and money on private land managers. This belief contributes to a general feeling of distrust and animosity towards government policies.

A lack of confidence in an innovation or changed practice might emerge from an individual's past relationship with government. This influence may be strong even when the relationship is indirect. For example, a previous generation's lack of trust in government agencies over poor land management advice is likely to be handed on to the next generation, particularly where farm succession has occurred. Vanclay (2004) makes a pertinent point that many of the land degradation issues being experienced today are largely caused by the adoption of previously promoted practices. Historically, government agencies have been responsible for closer settlement schemes, such as the soldier settlement schemes, leading to intensive land clearing and cultivation (Reeve, 1988; Lines, 1991; Dovers, 1992), tax concessions for clearing (Beale and Fray, 1990; Dovers, 1992), and poor advice based on incomplete science or other government objectives (Goldney and Bauer, 1998). Many current policies are in direct contrast to these former policies and, from a land manager's perspective are considered to be something of a 'back flip', which has inevitably led

both to confusion and distrust amongst the farming sector. Moreover, contemporary government policies, especially those pertaining to water allocations and vegetation management, have created high levels of friction and distrust amongst the farming sector.

The result of this relationship is that innovation or land practices driven by government agencies may be viewed somewhat suspiciously by land managers, potentially reducing the rate of adoption.

### ***Knowledge constraints***

A lack of understanding or knowledge about the influence of land management practices on the landscape is often cited as a strong barrier to the adoption of changed practices or innovations. Indeed the Landcare movement in Australia was predicated on the belief that providing access to scientific information and support would result in behavioural change.

While general understanding of land degradation problems has increased in recent years, land managers may have limited understanding of the extent of their own problems (Vanclay, 1992a; McDonald and Hundloe, 1993). Several studies have identified a lack of land manager knowledge both of the seriousness of the problem on their own properties, as well as a lack of appreciation of the off-site ramifications of farm-level decisions (Vanclay, 1992a; Vanclay and Lawrence, 1995; Richards, Lawrence and Kelly, 2003; Lockie and Rockloff, 2004). Ironically, this may in part be a result of the severity of media images designed to promote understanding of land degradation, which tend to be the more dramatic examples, or worse-case-scenarios, of land degradation (Vanclay, 1992a). In reality, it is unlikely that many land managers actually experience land degradation to this extent, creating a belief that *“because they do not have land degradation like those images they must not have a problem”* (Vanclay, 1992a, p107). In essence, land managers are only likely to fix a problem if they recognize it exists.

Further, the beliefs of some land managers are not consistent with current scientific knowledge. For example, in a study conducted by Richards *et al.* (2003), graziers did

not support the commonly accepted science that tree coverage prevents erosion, arguing instead that it is grasses that hold the soil together, and trees that stop the growth of grasses. This suggests that personal experiences, in addition to a strong commitment to local knowledge, act as drivers for some land managers to make decisions contrary to scientifically endorsed land management practices (Richards *et al.*, 2003). Science needs to be consistent with a land manager's 'world view' to be accepted. Vanclay (1992a) further supports this, suggesting that even when land managers agree with scientific knowledge on acceptable practices, they often disagree on the extent to which it should be adopted. This suggests a gap between what scientists consider reliable information and what land managers consider *reliable enough* to invest future production outcomes on – this is directly related to perceptions and personal adversity to risk discussed earlier. Moreover, a Khanna *et al.* (2001) study found that a lack of information about benefits of a new technology, such as input saving effects, was a reason given by land managers for the non-adoption of such technologies.

Indeed, Pannell, Marshall, Barr, Curtis, Vanclay and Wilkinson (2006) argue that a landholder's probability of making a good decision increases over time with increasing knowledge of, and perhaps experience with, the practice or technology. Pannell *et al.* (2006) argue that land managers go through a typical sequence of acquiring and applying new knowledge, beginning with becoming aware of the technology or innovation, progressing through to a (non-trial) evaluation stage, where they collect information and begin to assess its usefulness in their own context, a stage of small-scale trial evaluation, and then if this is successful, adoption, review and modification and finally either fully adopting or dis-adopting the innovation (Pannell *et al.*, 2006). Through this process a land manager is acquiring knowledge based on a mixture of scientific information, personal experience, and cultural influences. Essentially though, this process is imperfect, and decisions are often made without full information or knowledge (Pannell *et al.*, 2006).

So, poor access to ongoing professional advice, including advice on potential benefits of change, is a constraint to changing land management practices or adopting technological innovations (Byron, Curtis and MacKay, 2004; Lockie and Rockloff, 2004). To understand the complexity of a farm system, to overcome local biases and

misinformation, and to identify appropriate management actions, land managers need access to reliable, useful and readable information, both on the problem to be addressed as well as the proposed technology or changed practice (Robertson and Pratley, 1998; Lockie and Rockloff, 2004). Further, it has been shown that land managers who participate in property management planning activities show a greater capacity to adopt more sustainable land management practices, indicating a link between knowledge and skills, and capacity to change (Taylor, Lockie, Dale, Bischof, Lawrence, Fenton and Coakes, 2000).

### ***The influence of land manager attitude***

Attitudinal factors are frequently cited as the most significant barrier to widespread adoption of sustainable land practices. Farmers are presented as conservative, suspicious of innovative farming methods and resistant to change – especially change initiated by government, resulting in the lack of a strong stewardship ethic<sup>1</sup> among Australian land managers (Conacher and Conacher, 1995). Indeed, it has been assumed that sustainable land management will ensue by developing land managers' stewardship ethic (Curtis and Lockwood, 1998; Lawrence, Richards and Herbert Cheshire, 2003). However, it seems that this correlation is quite weak, with emerging evidence that land managers already have strong values regarding their duty of care to the land (Vanclay, 1992a; Cary, Webb and Barr, 2001; Lawrence *et al.*, 2003; Finlay, 2004). The widespread embracing of the Landcare movement is likely a reflection of stewardship values with Australians being among the highest participators in community conservation efforts in the world (Davidson and Stratford, 2000).

But possessing a stewardship ethic does not necessarily equate with sustainable land management practices. In an attitudinal study conducted in the Darling Downs region in the 1980s (Vanclay, 1992a; 1992b; Vanclay and Lawrence, 1995), almost all respondents defined themselves as having a strong stewardship ethic in regard to soil conservation. However, most farms still had inadequate soil conservation (Vanclay and Lawrence, 1995).

---

<sup>1</sup> *Stewardship* as used here refers to the concept of responsible care-taking of natural resources, so as to pass healthy ecosystems to future generations.

Attitudes also did not emerge as a reliable or useful basis on which to predict potential implementation of changed practices or new technologies in a Lockie and Rockloff (2004) study and a Vanslebrouck *et al.* (2002) study. It is likely that Australia has already achieved a realistic level of stewardship ethic among our rural land managers, and that attempts to increase this will not lead to an increased adoption of changed practices (Vanclay, 1992a; Vanclay and Lawrence, 1995; Curtis and Lockwood, 1998; Gray, Phillips and Dunn, 2000; Lawrence *et al.*, 2003). As Lawrence *et al.* (2003) suggests, the ‘right’ attitude might be a necessary factor, but it is not in itself a *sufficient* factor for changing land management practices.

There are a number of reasons for the lack of a direct link between the ‘right’ attitude and the adoption of sustainable practices. First, stewardship attitudes are potentially biased by social desirability – publicly, land manager attitudes may reflect what they perceive the remainder of the community expects of them (Vanclay, 1992a; Vanclay and Lawrence, 1995). Second, interpretations of ‘stewardship’ may differ. Land managers may simply interpret stewardship to fit their own ideas of good farm management, which may not correlate with society’s expectations for environmental sustainability (Vanclay and Lawrence, 1995). The problem becomes less about ‘attitude’ and more about a conflict of ideas about what constitutes good farm management or even what constitutes degradation (Vanclay, 2004).

Further, individuals might value different aspects of their landscapes to a greater or lesser extent. Without an understanding of biodiversity, for example, people will value components of an ecosystem over others and seek only to protect those. For example, some charismatic species easily capture support (e.g. koalas) as do landscapes or ecosystems that fit cultural expectations of beauty, such as rainforests (Williams, 2003). However, these values may not match the priorities of scientists. Personal values therefore play a role in how willing a land manager might be to protect or restore components of their landscapes.

Moreover, different temporal discount rates between individuals means that some land managers will place a higher value on the immediate rewards of exploiting land than they do on the potential future value of protecting their land. A survey of land managers in the Queensland Murray-Darling region found that two-thirds of

respondents did not believe that a short-term loss in productive capacity could be justified by long-term natural resource management benefits (Byron *et al.*, 2004). This same study also identified the presence of a strong stewardship ethic, demonstrating that this does not overcome the need to maintain short-term productivity. Particularly in times of economic uncertainty, land managers may choose short-term economic gain over long-term sustainable farming practices.

As discussed previously, land managers may also be wary of policies and management tools that require collaboration between private land managers and government given the lack of trust that the rural sector has in government. Early government advice helped to create the natural resource management problems we face today, and government agencies have not always successfully engaged the rural sector in decision-making surrounding natural resource management, giving little credence to the value of local knowledge and the responsibility placed on the rural sector to implement Australia's natural resource management agenda. Given both of these factors the reluctance of the rural sector to embrace government advice, which is frequently labeled an 'attitudinal' problem, is probably not an unreasonable response.

So, while attitudes towards conservation and the adoption of innovative practices play a role in shaping behaviour, the significance of attitude is perhaps overestimated (Vanclay, 1992a; Cary, *et al.*, 2001; Lawrence *et al.*, 2003). As a result, the role of education in changing behaviour is perhaps also overestimated, suggesting the need to develop a mix of tools including MBIs and other incentives.

### ***The role of tradition***

Tradition plays an important role in influencing a land manager's decision-making, including their likelihood of adopting changed practices. While traditions will differ between individuals and regions, it is clear that tradition underpins the "*social organisation of agriculture*" (Dunn *et al.*, 2000, p22). Traditions are formed over generations because they are believed to be the best or most appropriate way of doing something (Dunn, Gray and Phillips, 2000). As such, there is much resistance to discarding long-held traditions, both for sentimental as well as purely practical reasons.

Further, there is strong resistance in the rural sector to change from modes of production that have created wealth, or at least subsistence for generations, to adopt uncertain and potentially risky alternatives (Lawrence *et al.*, 2003). With strong investments of both skills and resources in current practices, there may not be a strong enough incentive to change production practices.

### ***Volunteer burnout***

Volunteer exhaustion or ‘burnout’ may be a constraint to land manager uptake of innovations or changed practices. Individuals are increasingly expected to implement natural resource management activities, placing demands on their resources and time. The burnout or exhaustion that may result is exacerbated by perceptions that their involvement did not result in biophysical improvements anyway, or that funding was not extended for a long enough period of time to achieve change. This trend has been explored in detail by Curtis (2000, 2003), Byron and Curtis (2001) and Byron, Curtis and Lockwood (2001), in various studies exploring volunteer exhaustion and burnout in Australian Landcare groups.

This constraining factor is often neglected when attempting to encourage the uptake of innovations or changed practice. Theoretically land managers may support a change, but in practice may have simply reached their limits because of previous demands. Hence, it is important for the success of initiatives to change land management practices to understand both the current and historical demands placed on the target participants so as to provide the necessary support to engender change or to modify expectations.

### ***Socio-demographic factors***

Demographic factors such as education, age and gender, all have varying degrees of influence over the adoption of changed practices.

#### ***Education***

It has been assumed that formal educational levels are directly correlated with willingness to adopt new practices; however, some evidence suggests that there is

little direct relationship and that the possession of formal education qualifications does not increase the likelihood of an individual adopting a changed practice (Curtis, MacKay, van Nouhuys, Lockwood, Byron and Graham, 2000; Cary *et al.*, 2002). Alternatively, some studies have found that willingness to participate in environmental practices is influenced by education, with the higher the education level, the more likelihood of participation in some practices (Vanslebrouck *et al.*, 2002). Finlay (2004) further found that the likelihood of participating in Landcare is associated with education levels, so where it can be assumed that Landcare membership is correlated with an increased adoption of new practices, then the influence of education is strong. Further, participation in training courses and field days does appear to increase adoption of natural resource management practices (Cary *et al.*, 2002). Indirectly, education may be important in enabling land managers to seek off-farm income, and may therefore increase their financial capacity to invest in changed practices (Cary *et al.*, 2002). However, as will be discussed the relationship between financial capacity and adoption of changed practices is not clear anyway.

### *Age*

The age of land managers is often considered to be an indicator of willingness to adopt changed practices, with the assumption that younger land managers are more likely to adapt to change. However, there is conflicting evidence on this relationship, with some researchers finding no significant relationship between age and adoption rates of changed land management practices (Guerin and Guerin, 1994; Curtis *et al.*, 2000; Cary *et al.*, 2001, 2002; Lockie, Lawrence, Dale and Taylor, 2002; Byron *et al.*, 2005). To further confound the matter, a Byron *et al.* (2005) study found a converse relationship between age and adoption rates, revealing that the age group most likely to identify stage of life as a constraint was those under 30 due to emerging family commitments, savings and debt.

However, others have found a more direct relationship between adoption rates and age. Khanna *et al.*, (2001) found that younger farmers were more likely to adopt new technologies, while a Belgian study (Vanslebrouck *et al.*, 2002) investigating the willingness of farmers to participate in agri-environmental measures, found that as the age of land managers increased, there was a corresponding decrease in their

willingness to participate in environmental schemes. Moreover, while Solutions (1999, cited in Cary *et al.*, 2002) found no significant relationship between land manager age and the adoption of most practices, they did find significant relationships between age and the adoption of tree planting and actions to treat erosion. It was found that adoption rates increased for tree planting to a maximum adoption rate at ages 45-55, and then decreased for age cohorts beyond this. The pattern for the adoption of erosion actions was similar with the peak occurring in the 35-44 age group (Solutions, 1999, cited in Cary *et al.*, 2002).

A study conducted in the Burdekin Dry Tropics region also found age to be correlated with land manager willingness to adopt innovative practices, with the older the manager, the less likely is adoption (Greiner, Stoeckl, Stokes, Herr and Bachmaier, 2003). Further, Byron *et al.* (2004) found that people over the age of 65 are significantly more likely to identify their stage of life as an important factor affecting their decision-making about changing management practices. It is believed that the long-term commitment necessary to implement changed practices, combined with short-term economic costs, provides little incentive for land managers approaching retirement. Under this argument, as changed land management practices often require a huge knowledge and attitudinal shift, the 'age barrier' may become a significant constraint to encouraging widespread change.

So, the relationship is unclear, however, as Cary *et al.* (2002) argue whatever relationship does exist is unlikely to be linear, and will likely be confounded by other factors.

### *Gender*

The relationship between gender and the adoption of changed practices is also unclear. There is certainly evidence that women are a driving force for natural resource management (Davidson and Stratford, 2000). Additionally, Elix and Lambert (cited in Davidson and Stratford, 2000) argue that rural women are under-represented in formal arenas of power, with the implication that women's real contribution to natural resource management is underplayed. Indeed, Vanclay (2004) suggests that the complexity of modern farm management partnerships, where women

play a major role, is often ignored by extension programs that are targeted predominantly towards male farmers. Certainly if extension or incentive programs are to be successful their proponents need to be cognisant of the changing role of women and the emerging issues (Vanclay, 2004).

Westermann, Ashby and Pretty (2005) suggest that women play a significant role in natural resource management groups, and found that collaboration, solidarity, and conflict resolution all increased in groups where women were present. The capacity for self-sustaining collective action was also found to have increased with the presence of women, demonstrating “*the importance of gender analysis for collective NRM and particularly the role of women for collaboration in and sustainability of NRM groups*” (Westermann *et al.*, 2005, p1783).

### ***The practice of succession***

While succession is a common practice in rural cultures, the role that succession plays in influencing the adoption of changed practices is unclear with evidence that it has both a positive and negative influence on land manager uptake of changed practices.

The probability of a farm being transferred to the next generation may encourage longer-term planning, with more likelihood of adopting new farm practices or agricultural innovations (Gray *et al.*, 2000; Cary *et al.*, 2002; Byron *et al.*, 2005). The transfer of a property may also introduce a younger farm manager, more likely to embrace changing farm practices (although as discussed earlier the relationship between age and the adoption of changed practices is unclear). Also, producers with well-established farm/family links (i.e. generational farmers) may display a greater capacity to implement sustainable farming practices (Taylor *et al.*, 2000).

However, successors may be more likely to maintain traditional farming values, where “*good farming is defined in traditional rather than modern conservation terms*” (Gray *et al.*, 2000:37) suggesting a negative relationship between succession and the uptake of new practices. However, these same authors conclude by stating that:

*“Stronger relationships appear between conservation and some attributes of cultural tradition – succession and community ties – than between conservation and structural and demographic factors – equity, age, and education. Of all these factors, succession has the greatest impact on conservation” (Gray et al., 2000:43).*

In contrast to both of these positions, Sinden (1988, cited in Gray *et al.*, 2000) found no relationship between succession and uptake of conservation farming practices. Also, Guerin and Guerin (1994), while acknowledging that a relationship might exist between these factors, concluded that it was not supported by evidence, and should not be a high priority for future research.

While the relationship is unclear, the provision of appropriate resources and support to promote improved succession planning will likely increase the positive relationship (Taylor *et al.*, 2000).

### ***Financial constraints***

Past research indicates that financial constraints are self-reported by land managers as an important barrier to the adoption of changed management practices (Cary *et al.*, 2002; Greiner *et al.*, 2003; Byron *et al.*, 2004; Lockie and Rockloff, 2004). For example, a study of land manager attitudes in the Burdekin Dry Tropics region in northern Queensland (Greiner *et al.*, 2003) found that operational and financial constraints are perceived as the most important impediments to the adoption of natural resource management activities or changed practices. Similar surveys in the Burnett Mary and Queensland Murray Darling regions found that 76% and 81% of respondents respectively identified cash flow as the highest rated constraint. If the level of discretionary income available to invest in new practices is insufficient, land managers are unlikely to invest in natural resource management, constraining the adoption of more sustainable management practices (Webb, 2004). *“It is hard to be green when you are in the red”* (Campbell, 1992, p8).

There are a number of indicators that suggest that land managers have been facing financial pressure in recent years. These include, declining commodity prices and terms of trade, declining farm cash income and increasing farm debt levels. However, it remains unclear the extent to which the adoption of changed practices is influenced by financial pressure as there have been few definitive studies that link objectively

measured financial indicators to the adoption of sustainable practices (Cary *et al.*, 2002). Further, since it is likely that financial constraints are just one factor influencing adoption decisions, even if it can be addressed through financial support, land managers may still be constrained from adopting a changed practice because of other factors.

Some studies have found that financial resources may not be the main limiting factor when land managers consider adopting new technologies or changed practices. Rendell, O'Callagan and Clark (1996), using the FM 500 benchmark, suggested that a disposable family income exceeding \$50,000 per year was required to sustain a household and invest in a farm's natural and capital resources. Rendell *et al.* suggested that where it can be shown that farm family income exceeds this level then the constraints for undertaking changed practices are not necessarily financial. One suggestion is that land managers may be constrained by the perception that improved practices provide greater benefit to society at large than to the individual.

For example, a study of land managers in the Burnett Mary (Byron *et al.*, 2005) found that 64% of respondents believed that they should be paid to provide ecosystem services that benefit the wider community. This compliments a further study by Byron *et al.* (2004) in the Queensland Murray Darling region where 76% of land managers surveyed felt that they should be paid for environmental services that benefit the community. Only 30% agreed that loss in productive capacity could be justified by long-term improvements in the environment.

Both of these studies suggest that it is not just available cash that limits the uptake of practices but also the perception that large private costs to the land manager cannot be justified by mostly public benefits from improved environmental quality. One of the most important characteristics of many natural resources is their public nature, as they provide benefits (mostly as products or services) that are generally available for society at large. Land managers will have little incentive to use their land to supply more public goods when the additional private benefit of so doing is less than their additional private cost. Similarly, there is little incentive to mitigate actions that cause damage to public goods if there is insufficient private benefit. This leads to market failure in the form of externalities: where the external costs of activities are not

accounted for in production decisions there is no incentive to mitigate these effects or invest in ways to do so. That is, the cost to land managers of mitigating externalities exceeds the on-farm benefit both in the short term and possibly the long term (Cary *et al.*, 2002).

Also, as Cary *et al.* (2002) note it is often a land manager's *perception* of their financial outlook which has more influence than an *objective* measure of their financial outlook. So, land managers who feel confident about their future financial position are more likely to adopt changed or innovative management practices. Thus an individual's subjective assessment of their financial situation may be a better predictor of adoption than objective measures such as income and debt levels.

Additionally, even if a land manager is not limited by financial barriers, they may simply choose not to adopt a changed practice because it does not fit with their values, or vision for their farm environment. As has been discussed in this paper, there are a variety of sociological and societal factors that influence a land manager's decision-making in combination with their financial outlook.

So, while limited financial resources will almost certainly act as a constraint to the uptake of new practices, the removal of this barrier by the provision of financial incentives will not necessarily increase uptake of the changed practice. Farmers who are struggling financially are highly unlikely to adopt changed practices. However, even if a farmer's income increases to the point that they are no longer constrained financially, they still may choose not to adopt due to a range of other factors, most notably, if it is perceived that the benefits from changed management are largely public then there may be little incentive to adopt a changed practice. Moreover, as has been suggested in this paper, there are a number of factors that combine to influence land manager decision-making, not least of which is the complex factor of social capital.

### ***The influence of social capital***

The role that social capital plays in creating community driven initiatives for changed behaviour or natural resource management activities is complex. Gray *et al.* (2000)

suggest that explanations for land manager behaviour often lies in the relationships among or between individuals and the larger society, or the social context of the decision-making environment. To fully understand why decisions are made, we need to understand how a surrounding community influences an individual; that is, how a community's stock of *social capital* influences individual decision-making regarding natural resource management. This section will explore the concept of social capital and its role in contributing to land management changes. Social capital is composed of social norms, networks and trust.

*Social norms* are those informal rules in a society that 'govern' how an individual should act in particular social contexts, for example surrendering a seat on a train to a pregnant or elderly person, or, joining the end of a queue and not pushing your way to the front. There may not be a formal law dictating these behaviours, but there is a societal expectation that people will follow them. *Suasive* refers to the peer pressure that a community exerts over an individual to conform to social norms. Suasive pressure can be conducive to natural resource management if community values or norms fit with sustainable land management. So, when a new technology or innovation is promoted, its rate of adoption will be closely linked to the degree to which it matches with the existing culture of 'the way things are done'. Suasive pressure can therefore provide opportunities for natural resource management by harnessing the power of the community to change an individual's perceptions and priorities about the environment (Finlay, 2004).

However, suasive pressure can also be detrimental to the introduction of innovative ideas that lie outside of a community's social norms. When this happens, those individuals who do change to more innovative farming practices are treated suspiciously by the remainder of the community: "*those who do break away from the dominant productivist paradigm risk facing social sanctions*" (Richards *et al.*, 2003). This can create social isolation, decrease social influence and diminish community respect (Goreham, Young and Watt, 1992; Guerin and Guerin, 1994). People may then be reluctant to engage in natural resource management from a fear of risking conflicts and being ostracized from community life (Buchecker, Hunziker and Kienast, 2003). This may be particularly evident in small communities, especially

those that appear to hold highly homogenous values acting as a strong disincentive to adopting changed practices.

The other elements of social capital, *networks* and *trust*, give communities the ability to coordinate action to achieve collective benefit (Coleman, 1988; Falk and Guenther, 1999; Giorgas, 2000; Serageldin and Grootaert, 2000; Kilpatrick and Falk, 2001; Cox, 2002; Oxendine, Borgida, Sullivan and Jackson, 2003; Pretty and Smith 2004). “*Working together is easier in a community blessed with a substantial stock of social capital*” (Putnam, 1993). A Pretty and Ward (2001) study concluded that the success of agricultural projects (or the introduction of landuse change), has a clear relationship with the strength of local community institutions, suggesting that social capital as experienced in group-based programs can lead to environmental improvements. Coordinated activity drawing on collective resources can achieve greater outcomes more efficiently than the same number of individuals tackling the problem on their own (Ostrom, 2000; Lin, 2001). For natural resource management, collective resources include physical resources, human resources and information resources. As Lin (2001) suggests, personal resources confer certain benefits to individuals, however for most individuals these are limited. By embedding themselves in networks individuals have access to the resources of other members and indirectly to the resources of their networks. These collective resources include knowledge, skills, expertise and support (Hofferth and Iceland, 1998; Lin, 2001; Kilpatrick, Loechel, Thomas and Woinarski, 2002; Kilpatrick, Field and Falk, 2003). Networks therefore serve two motives: to protect resources and to gain access to additional ones (Lin, 2001). Hence, social capital plays a significant role in solving collective-action problems such as natural resource management challenges (Ostrom and Ahn, 2001). Social capital is also important where actions/inactions of individuals create externalities (such as weed spread, sediment runoff), as strong social capital may promote a sense of civic responsibility.

There is clearly a relationship between social capital and an individual’s capacity to adopt changed land management practices. However, like many social factors a direct cause and effect relationship has not emerged. We can conclude however, that a lack of social capital within a community almost certainly reduces the capacity of individuals to work collectively and to access group resources, knowledge and skills.

## 4. Summary and Implications

This paper demonstrates that a variety of social and economic factors may interact to drive or constrain land managers from engaging in natural resource management – either through the adoption of changed practices or involvement in natural resource management activities. The constraining factors discussed in this paper can be divided into those factors that have been found to have minimal influence despite widely held assumptions that the influence is strong, those factors for which the evidence is inconclusive, and those factors for which the influence on land manager adoption of changed practice appears to be strong.

Much emphasis has been placed on several social factors as being important constraints to land managers changing land practices – namely *formal education*, an *ageing population*, and *poor NRM attitudes*. However, there is little evidence to suggest a direct relationship between formal education and the adoption of changed practices, although participation in training courses and field days does appear to increase adoption (Cary *et al.*, 2002; Curtis *et al.*, 2000). Similarly, while it has been believed that older farmers are less likely to adopt changed practices the evidence suggests that older farmers do not adopt at a slower rate, and that stage of life has a much more significant relationship than age. In fact, Byron *et al.* (2005) stressed that the age group where this was most likely to emerge as a constraint was those less than 30 years due to family commitments and debt. Realistically, the relationship is unclear, and will likely be confounded by other factors.

Perhaps one of the most poorly interpreted social factors affecting change is landholder attitude, with attitudinal constraints frequently cited as the most significant barrier to widespread adoption of changed practices. However, the evidence suggests that most land managers already hold strong stewardship ethics but that this may not lead to any changes on ground due to other constraining factors. So, having a positive attitude towards change may be a *necessary* but not *sufficient* condition for change.

Secondly, the paper explores a number of factors – *succession*, *social capital* and *financial factors* – for which the evidence is inconclusive. In respect to succession, some evidence suggests that those land managers who plan on bequeathing their

properties to the next generation display a greater capacity to implement sustainable farming practices. However, it has been found that ‘successors’ are more likely to maintain traditional farming values and may not be open to innovation. Nevertheless despite the lack of clarity on this issue, succession planning should be encouraged to facilitate long-term planning.

Social capital can also exert opposing influences on the willingness of landholders to adopt changed practices. For example, social pressure – an outcome of strong social capital – can deter innovative action as innovators may be looked at suspiciously by the community. However, this pressure can become a positive influence once a practice is accepted as mainstream. Social capital also can play a significant role in solving collective-action problems such as natural resource management challenges, by increasing the range of knowledge, skills, expertise, and support available to individuals, increasing their capacity to implement changed practices.

Perhaps the most interesting observation to emerge from the literature is the overemphasis that is often placed on the influence of financial factors on land manager behaviour. The “*it’s hard to be green when you are in the red*” notion, lies at the heart of a commonly held belief that if only land managers were more financially secure they would operate their farm businesses in a more sustainable manner. Certainly, if land managers do not have sufficient resources to meet their own needs they will be unlikely to make the investments required for changed practices. Poor or low financial viability may therefore constrain the adoption of more sustainable management practices.

However, the literature reveals that the relationship is far more complex. Although available evidence demonstrates the financial pressure that land managers face from declining terms of trade and the increased reliance on off-farm income, there have been few definitive studies that link objectively measured financial indicators to the adoption of sustainable practices. Indeed, even if farm income does increase it does not necessarily lead to investment in natural resource management or an inclination to adopt changed practices. Rather farm profits must compete with all investments available to land managers (on and off-farm), including retiring debt. As for any individual, the priorities for spending will depend on personal preferences. There is

no reason to expect that land managers would have a greater preference for spending available income on contributing to natural resource management outcomes than for any other individual. Further, although financial indicators suggest there may be some improvement in farm financial performance land managers may not hold this optimistic view. As one author noted it is often a land manager's *perception* of their future financial situation that has more influence over their decision-making than an objective measure of their future financial situation.

This suggests that while financial viability and economic factors most certainly have a role to play, it is only one of a myriad of factors that influence a land manager's decision-making such that its extent, in relation to social factors, is unclear. Indeed, an overemphasis on economic conditions as a key driver, underestimates the role that social and cultural factors play in driving decision-making at the property level (Lockie *et al.*, 2002; Richards *et al.*, 2003). So, while some level of financial security might be a necessary condition for investing in change, it is not a sufficient condition for change.

The paper also explored a number of factors for which the evidence suggests a strong correlation with the uptake of changed practices – the ***characteristics of the practice itself, a lack of land manager confidence in the practice or in the proponents of the change, and, poor access to information*** all act as barriers for some land managers to adopt changed land practices.

The paper explored the specific attributes of land management practices – relative advantage, riskiness, complexity, compatibility, trialability and observability – which may constrain some land managers from adopting them. Put simply, the less a land manager has to spend, change, adapt, learn and risk, the more likely they are to adopt a given practice (Webb, 2004).

A lack of confidence in a recommended practice or simply in the proponents of change, such as government agencies, emerged from the literature as strongly correlated with non-adoption of changed practices. The lack of confidence can arise from attributes of the practice itself or simply from an individual's personal adversity to risk. Furthermore, distrust of government agencies due to poor advice in the past or

previous policies that have contributed to the current state of land degradation, also leads to a lack of confidence in the practice.

A lack of understanding of both the problem itself, and potential solutions or management strategies, will also provide a barrier to the adoption of changed land practices. Hence, poor access to sound advice, based on trusted and reliable science, is a constraint to changing land management practices or adopting technological innovations.

This paper provides an indication of the range of factors that may influence a land manager's capacity and willingness to adopt more sustainable practices. It is imperative that we clearly identify these factors before applying economic or social tools as incentives. By applying an incentive mechanism that does not actually address the constraints we are unlikely to achieve any sort of change. Further, we risk alienating the public by demonstrating a lack of understanding of their social, cultural and economic contexts. However, by examining these characteristics, and understanding the influence that they may have for specific natural resource management issues or challenges, we can begin to develop strategies to overcome these. So, the important lesson that emerges from this examination of the literature is that by implementing a mix of policy tools that are directly targeted at these issues, we can begin to address these constraints and significantly increase the likelihood of land managers engaging with natural resource management or adopting changed practices.

So, when the drivers, constraints and barriers to change are understood, MBI or other incentive programs can be developed to facilitate change. However, landholder involvement in MBI or other incentive programs often remains low; hence the opportunities and benefits that they potentially offer are not being fully realised. The following working paper in this series, – “Encouraging Participation in Market Based Instruments and Incentive Programs” – explores the emerging literature on the constraints and impediments to maximizing land manager uptake of MBI's and incentive programs to facilitate changed practice for natural resource management outcomes.

## References

- Barr, N.F. and Cary, J.W. 1992: *Greening a brown land: the Australian search for sustainable land use*, Melbourne, Macmillan.
- Beale, B. and Fray, P. 1990: *The vanishing continent: Australia's degraded environment*, Hodder and Stoughton, Sydney.
- Black, A. and Reeve, I. 1993: Participation in Landcare Groups: The relative importance of attitudinal and situational factors, *Journal of Environmental Management*, 39, 51-71.
- Buchecker, M., Hunziker, M. and Kienast, F. 2003. Participatory landscape development: overcoming social barriers to public involvement, *Landscape and Urban Planning*, 64, 29-46.
- Byron, I. and Curtis, A. 2001. Landcare in Australia: burned out and browned off, *Local Environment*, 6(3), 311-326, August.
- Byron, I., Curtis, A. and Lockwood, M. 2001. Exploring burnout in Australia's Landcare program, *Society and Natural Resources*, 14(10), 901-910, December.
- Byron, I., Curtis, A. and MacKay, J. 2004: *Providing social data to underpin catchment planning in the Queensland Murray-Darling region*, Bureau of Rural Sciences, Canberra. <http://www.affashop.gov.au/product.asp?prodid=13217>
- Byron, I., Curtis, A. and MacKay, J. 2005: *Draft: Providing social and economic data to support regional natural resource management in the Burnett Mary*, Bureau of Rural Sciences, Canberra.
- Campbell, A. 1992: *Taking the long view in tough times... Landcare in Australia*, National Soil Conservation Program, ACT.
- Cary, J., Webb, T. and Barr, N. 2001: *The adoption of sustainable practices: some new insights. An analysis of drivers and constraints for the adoption of sustainable practices derived from research*, Land and Water Australia, Canberra.
- Cary, J., Webb, T. and Barr, N. 2002: *Understanding land managers' capacity to change to sustainable practices: insights about practice adoption and social capacity for change*, Bureau of Rural Sciences, Canberra.
- Coleman, J. 1988: Social capital in the creation of human capital, *American Journal of Sociology*, 94 (supp.) 95-120.
- Conacher, J. and Conacher, A. 2001: *Policy responses to land degradation in Australia*, in Conacher, A. (ed.) *Land degradation*, Kluwar Academic Publishers, Dordrecht.
- Cox, E. 2002: Australia: Making the lucky country, in Putnam, R (ed.) *Democracies in flux: the evolution of social capital in contemporary society*, Oxford University Press, New York.
- Cox, G. and Miers, S. 1995. *Social impact assessment for local government: a handbook for councillors, town planners and social planners*, NSW Government Social Policy Directorate, Sydney.

Curtis, A. 2000. Landcare: approaching the limits of voluntary action, *Australian Journal of Environmental Management*, 7(1), 19-28.

Curtis, A. 2003. The Landcare experience, in Dovers, S. and Wild River, S (eds) *Managing Australia's environment*, Federation Press, Annandale, NSW.

Curtis, A. and Lockwood, M. 1998: Natural resource policy for rural Australia, in Pratley, A. and Robertson, A. (eds) *Agriculture and the environmental imperative*, CSIRO, Collingwood.

Curtis, A., MacKay, J., van Nouhuys, M., Lockwood, M., Byron, I. and Graham, M. 2000: *Exploring land manager willingness and capacity to manage dryland salinity: the Goulburn Broken Catchment*, Charles Sturt University, Albury.

Curtis, A. and Robertson, A. 2003: Understanding landholder management of river frontages: the Goulburn Broken, *Ecological Management and Restoration*, 4(1), 45-54.

Davidson, J. and Stratford, E. 2000: *Building the knowledge base of the social and institutional dimensions of natural resource management*, a University of Tasmania report for Land and Water Resources Research and Development Corporation, Tasmania.

Dovers, S. 1992: The history of natural resource use in rural Australia: practicalities and ideologies, in Lawrence, G., Vanclay, F. and Furze, B. (eds) *Agriculture, environment and society: contemporary issues for Australia*, Macmillan, Melbourne.

Dunn, T; Gray, I. And Phillips, E. 2000: From personal barriers to community plans: a farm and community planing approach to the extension of sustainable agriculture, in Shulman, A. and Price, R. (eds) *Case studies in increasing the adoption of sustainable resource management practices*, LWRRDC, Canberra.

Falk, I. and Guenther, J. 1999: *Role of situated trust in rural sustainability*, Paper D7/1999 in the Centre for Research and Learning in Regional Australia Discussion Paper Series, University of Tasmania, Launceston.

Finlay, R. A., 2004, *Understanding Land Managers Attitudes Using Focus Groups*, Proceedings of Refereed Papers, AFBMNetwork Conference 2004

Giorgas, D. 2000: *Community formation and social capital in Australia*, Paper delivered to the 7<sup>th</sup> Australian Institute of Family Studies Conference, Sydney, 25 July.

Goldney, D. and Bauer, J. 1998: Integrating conservation and agricultural production: fantasy or imperative? in Pratley, A. and Robertson, A. (eds) *Agriculture and the environmental imperative*, CSIRO, Collingwood.

Goreham, G., Youngs, G. and Watt, D. 1992: Conventional and alternative farmers' participation in community organisations, *Impact Assessment Bulletin*, 10, 87-100.

Gray, I., Phillips, E. and Dunn, T. 2000: Aspects of rural culture and the use of conservation farming, in Shulman, A. and Price, R. (eds) *Case studies in increasing the adoption of sustainable resource management practices*, LWRRDC, Canberra.

Greiner, R., Stoeckl, N., Stokes, C., Herr, A., Bachmaier, J. 2003: *Natural resource management in the Burdekin Dry Tropics: social and economic issues*, a report for the Burdekin Dry Tropics NRM Board, CSIRO, Townsville.

- Guerin, L. and Guerin, T. 1994: Constraints to the adoption of innovations in agricultural research and environmental management, *Australian Journal of Experimental Agriculture*, 34, 549-571.
- Hofferth, S. and Iceland, J. 1998: Social capital in rural and urban communities, *Rural Sociology*, 63(4), 574-599.
- Kilpatrick, S. and Falk, I. 2001: *Benefits for all: how learning in agriculture can build social capital in island communities*, Discussion Paper D2/2001 in the Centre for Research and Learning in Regional Australia Discussion Paper Series, University of Tasmania, Launceston.
- Kilpatrick, S., Field, J. and Falk, I. 2003: Social capital: an analytical tool for exploring lifelong learning and community development, *British Educational Research Journal*, 29(3), 417-433.
- Kilpatrick, S., Loechel, B., Thomas, S. and Woinarski, Z. 2002: *Generating jobs in regional Tasmania: a social capital approach*, University of Tasmania, Tasmania.
- Lawrence, G., Richards, C. and Herbert Cheshire, L. 2003: *The environmental enigma: why do producers professing stewardship continue to practice poor natural resource management*, paper presented at the Xth Agrifood Research Network Meeting and Biotechnology Symposium, Canterbury, New Zealand, April.
- Lin, N. 2001: *Social capital: a theory of social structure and action*, Cambridge University Press, Cambridge.
- Lines, W. 1991: *Taming the great south land: a history of the conquest of nature in Australia*, The University of Georgia Press, Georgia.
- Lockie, S., Lawrence, G., Dale, A. and Taylor, B. 2002: Capacity for change: testing a model for the inclusion of social indicators in Australia's National Land and Water Resources Audit, *Journal of Environmental Planning and Management*, 45(6) November, 813-826.
- Lockie, S. and Rockloff, S. 2004: *Landowner attitudes to wetlands and wetland conservation programs and incentives*, draft report for Coastal CRC.
- McDonald, G. and Hundloe, T. 1993: Conserving Australia's future, in McTainsh, G. and Broughton, W. (eds) *Land degradation processes in Australia*, Longman Cheshire, Melbourne.
- Ostrom, E. 2000: Social capital: a fad or a fundamental concept? in Serageldin, I. And Dasgupta, P. (eds) *Social Capital: a multifaceted perspective*, World Bank, Washington.
- Ostrom, E. and Ahn, T. 2001: A social science perspective on social capital: social capital and collective action, a paper presented at the *Social capital: interdisciplinary perspectives*, European Research Conference, Exeter, United Kingdom, 15-20 September 2001.
- Oxendine, A., Borgida, E., Sullivan, J. and Jackson, M. 2003: The importance of trust and community in developing and maintaining a community electronic network, *International Journal of Human-Computer Studies*, 58, 671-696.

Pannell, D. 2001: Explaining non-adoption of practices to prevent dryland salinity in Western Australia: implications for policy, in Conacher, A. (ed.) *Land degradation*, Kluwar Academic Publishers, Dordrecht.

Pannell, D., Marshall, G., Barr, N., Curtis, A., Vanclay, F. and Wilkinson, R. (forthcoming): Understanding and promoting adoption of conservation practices by rural landholders, submitted to *Australian Journal of Experimental Agriculture*.

Pretty, J. and Smith, D. 2004: Social capital in biodiversity conservation and management, *Conservation Biology*, 18(3), 631-638.

Pretty, J. and Ward, H. 2001: Social capital and the environment, *World Development*, 29(2), 209-227.

Putnam, R. 1993: *The prosperous community: social capital and public life*, The American Prospect, 13, Spring, 35-42.

Reeve, I. 1988: *A squandered land: 200 years of land degradation in Australia*", The Rural Development Centre, University of New England, Armidale.

Rendell, R., O'Callagan, P. and Clark, N. 1996: *Families, Farming & the Future*. Agriculture Victoria, Bendigo.

Richards, C., Lawrence, G. and Kelly, N. 2003: *Is it hard to be green when you are in the red? A sociological account of primary production and environmental sustainability*, paper presented to the 'New times, new worlds, new ideas: sociology today and tomorrow', Conference of the Australian Sociological association, University of New England, Armidale, December.

Robertson, A. and Pratley, J. 1998: From farm management to ecosystem management, in Pratley, A. and Robertson, A. (eds) *Agriculture and the environmental imperative*, CSIRO, Collingwood.

Rogers, Everett M. 2003: *Diffusion of Innovations*, 5<sup>th</sup> ed, Free Press, New York.

Serageldin, I. and Grootaert, C. 2000: *Defining social capital: an integrating view*, in Serageldin, I. And Dasgupta, P. (eds) *Social Capital: a multifaceted perspective*, World Bank, Washington.

Taylor, B., Lockie, S., Dale, A., Bischof, R., Lawrence, G., Fenton, M. and Coakes, S. 2000: *Capacity of farmers and other land managers to implement change*, Theme 6, Fitzroy Implementation Project, National Land and Water Resources Audit.

Vanclay, F. and Lawrence, G. 1995: *The environmental imperative: eco-social concerns for Australian agriculture*, Central Queensland University Press, Rockhampton.

Vanclay, F. 1992a: The social context of farmers' adoption of environmentally sound farming practices, in Lawrence, G., Vanclay, F. and Furze, B. (eds) *Agriculture, environment and society: contemporary issues for Australia*, Macmillan, Melbourne.

Vanclay, F. 1992b: Farmer attitudes or media depiction of land degradation: What is the barrier to adoption? *Regional Journal of Social Issues*, 26.

Vanclay, F. 2004: Social principles for agricultural extension to assist in the promotion of natural resource management, *Australian Journal of Experimental Agriculture* 44(3): 213–222.

Vanslebrouck, I., Van Huylenbroeck, G., and Verbeke, W. 2002: Determinants of the willingness of Belgian farmers to participate in agri-environmental measures, *Journal of Agricultural Economics*, 53 (3), 489-511

Webb, T., 2004: *Understanding Behaviour: Social and Economic Influences on Land Practice Change*, Discussion paper for Land Management Practices Information Priorities, Classification and Mapping – Towards an Agreed National Approach, Canberra.

Westermann, O., Ashby, J. and Pretty, J. 2005: gender and Social capital: the importance of gender differences for the maturity and effectiveness of natural resource management groups, *World Development*, 33(11), 1783-1789.

Williams, K. 2003: The biodiversity we want to maintain and the reasons we want to maintain it, in Crosthwaite, J., Farmar-Bowers, Q. and Hollier, C. (eds) *Land Use Change – YES! – but will biodiversity be OK?: Proceedings of a conference at Attwood, Victoria, August 2002*. Department of Sustainability and Environment, Melbourne (CD ROM).