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Voluntary Cooperation in the Commons? Evidence from a Survey of Farmers in the Murray Region's Land and Water Management Planning Districts

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1. Introduction

The causes of agriculture-related conflicts over environmental goods are typically diffuse, making their governance costly compared with point-source conflicts (Wills, 1997). Over the last couple of decades, moreover, there has been a noticeable acceleration in the onset of these 'agri-environmental' conflicts as more and more of the environmental goods relied upon by agriculture have become fully committed (Reeve, in press). As this transition from a 'frontier' into a 'mature' agricultural economy proceeds, the need for agri-environmental governance can be expected to continue to accelerate (Syme, 1993).

This transition has been accompanied in many countries by a realisation that the relevant government agencies are never likely to be granted sufficient resources to satisfy more than a small share of the need for agri-environmental governance (Batie, 1986). A major part of the response to this has been to shift the load of governance away from the planned order sought by formal institutions towards the unplanned order offered by informal institutions. This is implicit in the rhetoric of 'community ownership', 'community empowerment' and 'peer pressure' associated with the 'participative' agri-environmental programs initiated by Australian governments over the last 15 years (e.g. Total Catchment Management, and the National Landcare Program) (Marshall, 1999).

These participative initiatives have yielded notable successes, including the volunteer conservation work organised by landcare groups and the integrated catchment plans developed by community-based committees (Bellamy, McDonald, Syme, et al., 1999; Curtis, Britton and Sobels, 1999). Nevertheless it is questionable whether there has been any significant lessening of the formal share of agri-environmental governance. Regardless of whether community ownership and peer pressure have arisen through such initiatives, there has been little change in farmer expectations of being compensated by governments for adopting conservation practices that yield external benefits. On current trends demands on Australian governments to resource agri-environmental conservation will therefore continue to greatly exceed their capacity (Young, 1997). Moreover translating the concept of participative catchment planning into practice is proving difficult (Pigram, Musgrave, Hooper, et al., 1994; Syme, Butterworth and Nancarrow, 1994; AACM and Centre for Water Policy Research, 1995; Margerum, 1996; Bellamy, et al., 1999).

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The failure of participative governance to live up to its rhetoric has caused considerable frustration for both civil and government participants. Reviewing international experiences with participative watershed (i.e. catchment) management, Rhoades (2000 p. 330) noted that critics were "starting to argue wistfully that the participatory rhetoric has outrun the ability to accomplish" and that a return to top-down governance "without the noise of participation" should be reconsidered. In the field he had observed projects justified using participatory rhetoric already slipping back into paternalistic patterns.

Yet the limited success may have more to do with the steep learning curve faced by designers and practitioners of participative programs than with an inherent lack of potential. After all, there are many examples around the world of successful civil self-governance of natural resources (McCay and Acheson, 1987; Ostrom, 1990; Baland and Platteau, 1996). Nevertheless participative governance has been *terra nova* for most government professionals, as well as for civilians. In addition, the move up the learning curve has been slow due to the received hegemony of the physical sciences within resource management agencies. Despite politicians recognising the potential of civil participation for addressing social and political hurdles to resolving conflicts over natural resources, many in the implementing agencies have persisted in viewing resource management as a technical problem requiring technical solutions (Woodhill, 1997). One effect of the lingering technical bias within these agencies has been resistance against giving social research a share of research budgets commensurate with the increasing reliance on participative programs seeking to facilitate social change. Until recently at least, it has largely been assumed that the required social knowledge is self-evident and does not justify the level of research devoted to technical problems (Martin, Tarr and Lockie, 1992).

Rhoades (2000 p. 337) has remarked upon the "social underdesign" of participative programs, lamenting that "the very science we need most in watershed research ... – a solid social science – is the one seen as the most dispensable". Similarly Sturgess (1997 p. 34) observed that most experiments in participative governance have failed "because of a lack of appreciation of the conditions necessary for success", and advocated research as a way of redressing this knowledge gap. Landcare, he claimed, "has not lived up to its potential" due to a lack of regard for systematically learning about what conditions need to be met for its success. At this stage the knowledge underpinning the design of participative strategies "is almost entirely anecdotal" (Rhoades, 2000 p. 333).

What appears to be urgently needed, therefore, is recognition of the importance of applying social scientific methods to designing strategies for participative governance. Otherwise the participative experiment may be convicted without a fair trial. This recognition appears to be emerging. For instance, the Land and Water Resources Research and Development Corporation, an Australian statutory body responsible for directing public funds to develop practical ways of addressing resource degradation, now recognises that:

> While much research is focused on improving biophysical understanding of ecological systems, this does not necessarily result in improved environmental management for a wide variety of reasons. Numerous opportunities exist to improve natural resources management in Australia by focusing research on the societal aspects of the relationship (Alexandra and Price, 1999 p. 3).

The purpose of this paper is to empirically contribute to knowledge about the scope for informal governance, and the voluntary cooperation it yields, to reduce the costs of resolving agri-environmental conflicts. The new-institutional tradition of economic theory that informed

the empirical modelling is reviewed in section 2. The case study setting is described in section 3, and the empirical method discussed in section 4. The models estimated are specified in section 5, with the results discussed in section 6. Finally, some concluding comments are offered.

2. Theory

Collective action and governance

Governance is fundamentally concerned with overcoming collective action, or social, dilemmas arising in the provision of public goods. The neoclassical economic explanation of such dilemmas is that benefits from providing public goods are not fully excludable or rival[1], so that provision efforts by individuals generate external benefits for others. Neoclassical economists, led by Mancur Olson (1965), thus concluded that efforts by individuals in a group will, unless the group is small, usually provide less of public goods than is collectively rational. The neoclassical 'market failure' tradition looked for a solution toward the coercive powers of the state. The state would use these powers as a 'third-party enforcer' of formal institutions designed to ensure collectively-rational provision of public goods. It could raise taxes to finance provision. It might regulate appropriation of public goods in cases where appropriation is rival (e.g. fishing). Otherwise it might directly regulate individuals' provision of a public good (e.g. conscript people into the armed forces).

The origins of the modern justification for the state as a third-party enforcer is usually attributed to Thomas Hobbes (1991 (1651)). He recognised that it is the problem of credible commitment, not external benefits, that really lies at the heart of social dilemmas. External benefits from public good provision are symmetric. Consequently they distinguish individual and collective rationality only to the extent that individuals do not expect that their provision efforts will be reciprocated. However, the difficulty lies in individuals convincing each other that they are committed to agreed shares of public good provision. Hobbes did acknowledge that commitments can be made between individuals in the "state of nature" and that informal sanctions such as "fear of the consequence of breaking their word" and "pride in appearing not to need to break it" could lend these commitments some degree of credibility. Nevertheless he argued that informal governance of this kind would not be stable.

The state as third-party enforcer

As far as Hobbes was concerned the only stable solution to the problem of credible commitment is for civilians to concede to the state the power to enforce cooperation among them. However, the apparent simplicity of this solution is deceptive for at least two reasons. Firstly, third-party enforcement, or formal governance, comes at a cost which must be counted before its efficiency relative to informal governance can be decided. Moreover the law of diminishing returns suggests that any comparative advantage of formal vis-a-vis informal governance will lessen as the load on it increases, all else held constant. Thus Gambetta (1988) commented: "Societies which rely heavily on the use of force are likely to be less efficient, more costly, and more unpleasant than those whose trust is maintained by other means". Ostrom (1998 p. 16) observed similarly that "no police force and court system on earth can monitor and enforce all the needed rules on its own. Nor would most of us want to live in a society in which police were really the thin blue line enforcing all rules".

Secondly, formal governance solves 'horizontal' social dilemmas between civilians at the additional cost of introducing 'vertical' social dilemmas between the state and the civil sphere. As Putnam (1993 p. 165) put it: "For third-party enforcement to work, the third party must itself be trustworthy, but what power could ensure that the sovereign would not 'defect'?". The difficulty of trusting the state is indicated by the following comment from North (1990 p. 59): "Put simply, if the state has coercive force, then those who run the state will use that force in their own interest at the expense of the rest of society".

Confidence in the state indeed appears to be diminishing. Randall (1999 p. 32) recently remarked that "faith in the legitimacy and efficacy of scientific government has declined precipitously ...". Support for this claim is provided by Norris' (1999b) conclusion, on the basis of data from *World Value* surveys carried out in 1981-3, 1990-3 and 1995-7, that "public support for the core institutions of representative government – including parties, parliaments, and governments – has fallen in many, but not all, established and newer democracies". Closer to home, Papadakis (1999) found that between 1983 and 1995 the share of Australian respondents claiming to have confidence (either a 'great deal' or 'quite a lot') in their federal government declined from 55 per cent to 26 per cent. Inglehart (1999) has attributed such trends to two causes: a declining emphasis on goals of economic and physical security that favour strong authority; and a long-term rise in educational levels and in political skills among the citizenry. From this he predicted that "in the long run, industrialized societies of both East and West must cope with long-term changes that are making their publics less amenable to doing as they are told ..." (p. 251). It follows that third-party enforcement by the state is becoming increasingly costly, as evidenced by the finding of Norris (1999a p. 264), based on data from all countries covered in the *World Values* survey *1995-97*, that "trust in government institutions was positively associated with willingness to obey the law voluntarily".

Evidently formal governance is no panacea for social dilemmas in the modern world. Instead of having to choose one or the other, there is growing recognition that formal and informal governance have complementary roles and the challenge is to devise strategies which best harness this complementarity. For instance, Nee (1998 p. 88) has observed that the behaviour of people frequently bears little semblance to that stipulated by formal rules. He explained this as a result of the "decoupling" of formal and informal rules: "Compliance with formal rules may be largely ceremonial, with informal norms guiding the day-to-day business of the organization". Informal norms can thus become "opposition norms". Consistent with this analysis but of more specific relevance to agri-environmental governance, Baland and Platteau (1996 p. 347) identified a basic need to reshape state interventions to:

> ... end those unproductive situations where [administration and resource users] are pitted against each other as antagonistic actors in the process of resource regulation. Enough evidence has indeed been accumulated to show that, when rural inhabitants come to view state agents with hostility and distrust, all state efforts are doomed to yield disappointing results. This is partly because villagers are bent on violating rules and resisting programs the rationale of which they do not understand, all the more so if they have the impression that those rules or programs are clumsy or do not reflect a proper understanding of the specific problems and constraints confronting them.

[1] A pure public good is one where the benefits of provision are completely non-excludable and completely non-rival.

Harnessing the contribution of informal governance

On the other hand if formal rules are perceived as congruent with informal rules then they will reinforce each other. Thus Day (1998 p. 97) reasoned that "both individuals and corporations will succeed best when they find themselves running with the grain of the social and cultural relationships which surround them; when they are sustained and propelled by the whole rather than rubbing against it".

This is not to say that it is easy to know which way the grain of the informal runs in particular settings; this knowledge often comes only with considerable perceptiveness and experience. The diverse elements of informal governance generally are not documented and not consciously designed – they emerge through an 'invisible-hand' process that relies on individuals pursuing their private concerns (Coleman, 1990). Hence they can be elusive to identify and easily taken for granted.

As a consequence, formal governance has often been imposed in ignorance of what informal governance already provides, thereby "destroy[ing] social arrangements which represent substantial past investments with enormous potential" (Day, 1998 p. 103). Mutually reinforcing relationships between formal and informal elements of governance can only be built if greater efforts are made "to understand what it is that binds populations together, and gives them energy, so that development can build on the positive strengths they have rather than appearing as a challenge and a threat" (p. 97). According to Pretty (1998 p. 217), the way to harness this understanding is to shift to "endogenous" from "exogenous" strategies for designing rural governance. The endogenous strategy actively encourages the emergence of institutional capacity from within the population suffering conflict. A variety of participative methods are available for applying this strategy. However, the exogenous strategy has dominated in the modern era. This presumes that governance is best imposed from outside the conflicted population. This model tends to foster a "dependency deadlock. Local people become entirely dependent on external agencies and actors to provide solutions to their local problems" (Pretty, 1998 p. 226). Participative methods must recognise and build escapes from this deadlock if endogenous approaches are to establish momentum.

Aside from this 'negative' case for the importance of designing formal governance so that it complements endogenous informal governance, there is a 'positive' case. The positive case emphasises that this strategy has the potential to yield substantial benefits by reducing the costs of overall governance. Recall that this is what, according to its rhetoric, participative agri-environmental governance seems to be striving for.

Kaufman (1995 p. 21) coined the phrase "order for free" to describe the self-organising propensity of certain complex systems. Sturgess (1997) borrowed this phrase to refer to the unplanned, or spontaneous, social order provided by informal institutions. This is not to argue that the actions of individuals from which informal institutions evolve and by which they are monitored and enforced are costless. The point is that these actions often occur for reasons unrelated to the need to create or maintain institutions. Thus Nee (1998 p. 87) observed that:

> ... informal norms ... are reinforced by means of ongoing social relationships ... Unlike formal rules, the monitoring of informal norms is intrinsic to the social relationship, and enforcement occurs informally as a by-product of social interaction ... The cost of social rewards to achieve conformity to norms is low because it is produced spontaneously in the course of social interaction in networks of personal interactions.

Jacobs (1961 p. 36) drew similar insight from studying how an inner city New York neighbourhood contributed to its own security: "The safety of the street works best, most casually, and with least frequent taint of hostility or suspicion precisely where people are using and most enjoying the city streets voluntarily and are least conscious, normally, that they are policing". Furthermore she found that this informal policing largely occurs without significant personal cost due to "small, sensitively managed details, practised and accepted so casually that they are normally taken for granted" (p. 59). Likewise, Ellickson (1991 p. 53) found that the initial response from graziers in Shasta County, California, to discovery of a stray animal was usually a phone call "usually couched not as a complaint but rather as a service to the animal owner, who, after all, has a valuable animal on the loose". Where breaches continued, the culprits were disciplined through an escalating scale of sanctions almost exclusively self-administered rather than by officials. An example of this disciplinary strategy closer to home has been documented by Sturgess (1997 p. 17):

> There is a widespread convention amongst fishers not to inform on other fishers [to government inspectors] ... However, fishers do enforce their own local rules and conventions, a process which was described to the author as 'educating' offenders. Typically this involves escalating penalties. At the lowest level, a fisher breaching local rules would be 'spoken to', whether informally on the water or more formally following a meeting between the fishers from the affected area. In some cases, especially where the offender is a relatively new entrant who lacks a sophisticated understanding of the local conventions, or where they can only afford one or two different kinds of nets, this really will be a process of education.
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> At the second level of enforcement, where the offending behaviour persists, the fisher will be ostracised, perhaps finding access to a lake blocked by the cars of other commercial fishers, or being denied access to a private coolroom ... While there is a general reluctance on the part of commercial fishers to complain to fisheries inspectors, this remedy will also be pursued from time to time, particularly where the offenders come from outside the local region and normal methods of 'education' or shaming are likely to be ineffective.
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> In the most serious cases, the offending fisher might find their boat or gear damaged, or the tyres on their car let down ...

To the extent that relevant informal norms do exist and significantly affect behaviour, then efficiency urges that full advantage be taken of the order they already provide. Accordingly Nee (1998 p. 88) has argued that formal rules should be made consonant with relevant informal rules so that "informal processes of social control largely subsume the cost of monitoring and enforcement". Indeed when this is achieved then "it is often difficult to demarcate the boundaries between informal and formal social control" (p. 87).

Social norms

So far this discussion has abstracted from what informal institutions are and what gives them force. Informal institutions are often also known as social norms. Posner (1997 p. 365) defined a social norm as "a rule that is neither promulgated by an official source, such as a court or legislature, nor enforced by the threat of legal sanctions, yet is regularly complied with ...". Thus social norms are diverse and include etiquette, customs, rules of grammar, moral codes of

conduct, and so on. Strong norms lessen the challenge of credible commitment by enabling individuals to predict more confidently how even strangers will behave (Sturgess, 1997).

Posner (1997) suggested that social norms are given force by four types of incentives for individuals to obey them. Firstly, some norms are self-enforcing because they are prerequisites to advantageous transactions (e.g. rules of grammar). Secondly, they can be enforced by social disapproval, the efficacy of which lies in its implicit threat of exclusion from ongoing advantageous transactions. Thirdly, compliance with norms might sometimes be due to emotional reasons like fear that non-compliance might provoke revenge. Finally, norms might be internalised and therefore obeyed to avoid feelings of guilt or shame. He recognised that in any given case compliance is likely to be affected by a mix of these incentives. In addition, Boyd and Richerson (1990) identified conformism ('When in Rome, do as the Romans do') as giving further force to compliance with norms. They argued that when there are high costs of individuals self-learning the optimal behaviour in a given situation, they reason that the norm followed most frequently must be the most advantageous.

Fairness

Social norms concerning fairness have particularly strong implications for the cost of obtaining compliance with formal governance of agri-environmental conflicts. It has been noted earlier that, for most environmental goods used by agriculture, appropriation rates have reached full capacity only over the last few decades. As a result, the realisation that one landholder's freedom comes at the expense of other landholders or the public generally has started to dawn only quite recently. Due to the slow evolution of norms generally, fairness norms concerning agricultural use of environmental goods therefore lag some way behind the reality of agriculture's biophysical relationship with the natural environment having matured. This explains in part why the absolutist view of property rights in agricultural land, whereby ownership of land also confers de facto rights to exploit whatever open-access environmental goods happen to be appropriable from that land, still remains so pervasive in countries like Australia and the USA (Reeve, in press)).

External intervention is indeed often justified because fairness norms are no longer congruent with contemporary social needs. Hardaker (1993 p. 206) has remarked how institutions "often survive long after they have ceased to be effective". Designing formal rules without sensitivity to long-held fairness norms nevertheless runs a high risk of entrenching the latter as opposition norms, thereby appreciably increasing the enforcement effort required for successful intervention. Moreover, there is evidence that government agency staff also prefer policy alternatives that farmers perceive as fair (McCann, 1999; McCann and Easter, 1999). As McCann and Easter (1999 p. 206) found, "policy makers do not want to implement unpopular policies". Agency staff reluctance to recommend or enforce policies that farmers consider to be unfair can be particularly problematical in Australia where agri-environmental legislation and regulations have often been framed in ways that leave agencies considerable discretion over how they are to be enforced (Bradsen and Fowler, 1987). As Bradsen (1994 p. 442) remarked, "programs with a heavy reliance on discretion and appropriate administrative attitudes have minimal chances of ensuring efficacy".

It is possible to distinguish norms of procedural fairness from norms of distributive fairness. Distributive fairness is closely aligned with the mainstream economic concept of equity. According to Syme et al. (1999 p. 53), the major hypothesis of procedural justice research is that "if procedural justice is demonstrated in a decision-making process the outcome is more likely to be accepted". On the basis of a review of evidence in water-policy contexts, their judgement on the hypothesis was: "Fair decision-making processes are of paramount importance to community acceptance of water allocation decisions" (p. 67). Similarly, Syme et al. (1991 p. 1793) concluded "it may be just as important from the point of view of the public to feel that the decision was arrived at 'fairly' as for them to approve all aspects of the final plan". Likewise, McClaran and King (1999) found that improvements in both procedural and distributive fairness would increase participants' support for a forestry agency more than would increased agency emphasis on presenting an image of expertise.

It follows that potential exists to reduce opposition to redistributing de facto environmental rights away from farmers by tailoring the associated decision-making processes as closely as possible to farmers' norms of procedural fairness. Participative decision-making processes which give farmers a chance to speak their mind and an opportunity to influence the process can be important in this regard (Syme, et al., 1999). Importantly they also provide opportunities to identify the norms of procedural fairness that apply in a given situation. Moreover, a procedurally-fair participation program can give farmers confidence to engage with each other, agency staff and others in a discourse that enables a more rounded understanding of the conflict at hand. Reeve (in press) has reasoned accordingly that:

> As far as long term changes in land management practices are concerned, the unimplementable catchment plan is an irrelevance. What is important and likely ultimately to have gradual impacts on land degradation and externalities is the learning and reflection that occurred in the preparation of the plans and the normalising power of integrated catchment management discourse to bring about self-imposed restrictions by landholders on the property rights associated with land ownership.

Social norms in modern society

In societies with developed economies, Posner (1997) suggested that it may be quixotic to expect that the need for formal governance can be reduced by relying more on normative regulation. As society becomes more complex in the course of economic development, social dilemmas are less and less shared by people who are familiar with one another; increasingly these dilemmas are shared by strangers. Normal social interaction becomes less able to provide incentives spontaneously to comply with social norms. So the cost of informal governance increases, all else held constant.

In addition, Posner argued that incentives to follow norms are likely to be reduced as incomes rise with economic development. To the extent that education levels increase with income (because education is a superior good[2]), norm internalisation may be weakened by increasing individuals' abilities to think for themselves and circumvent norms by such devices as rationalisation and pluralism. By exposing people to more of the diversity of norms held across a society, education may also encourage "'norm shopping', whereby an individual can opt into

[2] The amount demanded of a superior (or normal) good has a positive relationship with the level of income. In contrast, the amount demanded of an inferior good has a negative relationship with income level (Kamerschen and Valentine, 1977).

the system of norms that constrains his own behavior the least" (Posner, 1997 p. 367). He suggested that the reduced scope for norm shopping in rural areas compared with cities partly explains the well-documented moral differences between the two (although he acknowledged that the greater degree to which social dilemmas in cities are shared between strangers, and thus the lower efficacy of social disapproval, also plays a part here). Relatedly, heterogeneity of norms, and awareness of this heterogeneity, reduces the contribution that norms can make to predicting how others will behave. As Sturgess (1997 p. 29) has pointed out:

> If one is not sure whether the other party has the same deep background in a particular social convention, or if they are using unfamiliar cues to signal compliance or temporary departures from the rules, then it will be much more difficult to read or to anticipate the extent of the other's compliance.

Additionally Posner observed that privacy, because it is also a superior good, becomes increasingly protected by law as incomes rise. Protected privacy makes it harder for civilians, potential norm-enforcers, to observe others' behaviour and thereby reduces the costs expected by those violating norms. Finally, as incomes rise the cost of being subjected to social disapproval can be expected to fall, all else held constant:

> ... because in a wealthy society the individual is less dependent on the good will of his particular community (either because he is wealthy himself or he has a social safety net under him) ... [Thus] normative regulation is an inferior good.

On the other hand, North (1990 p. 35) has observed that depersonalisation of social dilemmas means that "the returns of opportunism, cheating, and shirking rise in complex societies". From this Putnam (1993) concluded that economic development makes informal governance increasingly essential. Does this not contradict the earlier conclusion that the cost of informal governance is tending to increase? Although Putnam does not address this question, an answer may be adduced. Posner (1997) failed to acknowledge that formal governance introduces new, vertical, social dilemmas between the state and civil society. These vertical social dilemmas are also susceptible to the incentives for opportunism, cheating and shirking that strengthen with economic development. The cost of effective formal governance (i.e. including the cost of resolving associated vertical dilemmas) therefore can also be expected to increase as economic development proceeds. To the extent that formal institutions are expected to continue coping alone with the increasing load of governance associated with economic development, their share of overall governance vis-a-vis informal institutions will increase. Following from the law of diminishing returns, the comparative advantage of formal institutions will tend to decline compared with informal institutions, all else held constant. Informal institutions thereby become increasingly essential for efficient governance.

The increasingly impersonal nature of the social dilemmas faced in modern societies nevertheless presents a formidable challenge to informal governance. Yet there is considerable evidence of strategies based on informal governance successfully providing durable solutions to impersonal social dilemmas (e.g. Ostrom (1990)). Evidence of this kind motivated a wide-ranging research effort seeking to explain these successes in order to draw lessons for maximising the spontaneity, hence minimising the cost, of informal governance. This effort started by recognising that "all else" aside from economic development, and indeed the nature of this development, is not constant nor preordained.

Generalised reciprocity

Perhaps the most significant discovery in this research has been that high rates of spontaneous compliance with norms of generalised reciprocity are possible even in quite impersonal situations. According to Putnam (1993 p. 172), "generalized reciprocity[3] refers to a continuing relationship of exchange that is at any time unrequited or unbalanced, but that involves mutual expectations that a benefit granted now should be repaid in the future". Essentially it involves cooperating with others unless others defect first, and in that case defecting in proportion to the level of defection by others (Axelrod, 1984).

Compliance with reciprocity, like with other norms, requires cooperation in providing a collective good. Compared with other norms, however, in addition it has a retaliatory aspect requiring individuals to cooperate in enforcing the compliance of others. As Elster (1989 pp. 40-41) realised, informal enforcement of norms is itself subject to a social dilemma: "Punishment almost invariably is costly to the punisher, while the benefits of punishment are diffusely distributed over the members". The cost of punishment, and thus the difficulty of this dilemma, increases as the share of punishment that occurs during normal social interaction declines. As social dilemmas become more depersonalised, consequently, adequate enforcement of most types of norms becomes less likely.

By punishing failure to punish, reciprocity norms suggest a solution to this problem. Yet it is a solution only to the extent that people comply with such norms. The key aspect of compliance with reciprocity is that it requires trust that one's cooperation or non-cooperation now (either in providing the collective good sought or in punishing non-providers) will later be reciprocated. Hardin (1993 p. 516) described the trust of one person for another as "just the expected probability of the dependency working out well" and argued that this trust is revised through an instinctive form of Bayesian learning as new information is gained through time.

Trust and reciprocity are positively reinforcing (Ostrom, 1998). As observed by Betts (1997 p. 2), "a group can become engaged in a virtuous circle of reciprocal exchanges where trust and collaboration beget more trust and collaboration, or a vicious circle where defection and betrayal lead to more of the same". More technically, Bayesian learning increases trust in others following reciprocity once greater compliance with this norm is observed. Increased trust raises the expected returns from cooperating (and the opportunity cost of risking ostracism by not cooperating) which, in turn, strengthens the incentive to follow reciprocity. Conversely, reduced reciprocity weakens trust and thereby further lessens reciprocity.

Whether this helix of positive feedback causes escalating or diminishing compliance with reciprocity norms can be influenced by modifying the structure of a social dilemma to affect the "shadow of the future" (Axelrod, 1984 p. 126). This shadow refers to the opportunity cost of missing out on future rewards from cooperation as a consequence of non-compliance in the present. This cost for an individual depends on a range of factors including the expected stream of rewards from continued cooperation, perceived risk of non-compliance being detected, expected punishment associated with detection, rate of risk aversion, and rate of time preference.

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[3] This is distinct from balanced reciprocity which refers to a simultaneous exchange of items of equivalent value (Putnam, 1993). Hereafter reciprocity will refer exclusively to generalised reciprocity.

As an example, any depersonalisation of social dilemmas associated with economic development tends to reduce the risk of non-compliance being detected, thereby weakening the shadow of the future and reducing incentives to follow reciprocity. Nevertheless people have managed to sustain feedback regarding compliance and trustworthiness in many impersonal settings. Evolutionary psychologists have explained this by speculating from experimental evidence that humans inherit a "faculty of social cognition" that helps them to adapt reciprocity norms to the various social dilemmas they face (Cosmides and Tooby, 1992 p. 163). Hence feedback in impersonal settings often occurs through "the endless 'chatter' that goes on in a successful community, the continuous shuttling back and forth of small bits of information about expectations and performance" (Sturgess, 1997 p. 29). According to Jacobs (1961 p. 119), the secret of this impersonal feedback is to "grow networks of small-scale, everyday public life and thus of trust and social control ...". Networks of this kind enable trust to become transitive. Putnam (1993 p. 169) illustrated this process as follows: "I trust you, because I trust her and she assures me that she trusts you". Indeed, Newton (1999 p. 185) concluded from *Eurobarometer* and *World Values* survey data that 'social' trust in Western Europe has generally been rising[4], and that this is partly due to a shift to "a greater variety of looser social relations".

A classic portrayal of how loose social networks provide the feedback required for trust in an inner city neighbourhood has been provided by Jacobs (1961 p. 56), and is worth quoting at length:

> The trust of a city street is formed over time from many, many little sidewalk contacts. It grows out of people stopping by at the bar for a beer, getting advice from the grocer and giving advice to the newsstand man, comparing opinions with other customers at the bakery and nodding hello to the two boys drinking pop on the stoop, eyeing the girls while being called for dinner, admonishing the children, hearing about a job from the hardware man and borrowing a dollar from the druggist, admiring the new babies and sympathizing over the way a coat faded. Customs vary: in some neighbourhoods people compare notes on their dogs; in others they compare notes on their landlords.
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> Most of it is ostensibly utterly trivial but the sum is not trivial at all. The sum of such casual, public contact at a local level – most of it fortuitous, most of it associated with errands, all of it metered by the person concerned and not thrust upon him by anyone – is a feeling for the public identity of people, a web of public respect and trust, and a resource in time of personal or neighbourhood need. The absence of trust is disaster in a city street. Its cultivation cannot be institutionalized.

Feedback for distinct social dilemmas often happens to be provided by networks which overlap each other. In such cases the incentive to follow reciprocity is greater than it would otherwise be since non-compliance in one social dilemma risks punishment in others as well. For instance, Ellickson (1991) noted that farmers typically deal with one another on a large number of fronts, including staffing the volunteer bushfire brigade, controlled burns, fence repairs, and social events. These farmers are said to have multiplex relationships with each other. Moreover, overlap of social dilemmas affords greater flexibility in complying with reciprocity norms. As Ellickson (1991 pp. 55-56) observed:

> A person in a multiplex relationship can keep a rough mental account of the outstanding credits and debits in each aspect of that relationship. Should the aggregate account fall out of balance, tension may mount ... But as long as the aggregate account is in balance, neither party need be concerned that particular subaccounts are not.

Coleman (1988) argued that multiplex relationships are a particularly important ingredient of social capital[5]. The extended trust yielded by multiplex relationships allows behaviour of the kind described below to be understood as a product of reciprocity:

> Where social capital is high people contribute to the school library, even though it will not be finished before their child leaves. Where it is low a parent would be a soft-headed fool to do such a thing. Where it is high people join a working-bee to care for a local park. Where it is low they dump their household rubbish in it (Betts, 1997 p. 1).

Rehabilitating social capital

Despite human ingenuity in using whatever social capital exists to apply reciprocity, the social capital of farming communities seems to have suffered from the depersonalising effects of economic development. Pretty (1998) has described how modernisation of agriculture has reduced the number of people involved in farming. It has also meant that horizontal links within rural communities have been replaced by vertical links to organisations located elsewhere. For instance, local information networks have been replaced by external sources; banks have substituted for local credit arrangements; the place of cooperatives and marketing boards has been taken by input and product markets; and supermarkets have replaced local shops. Consequently, farmers have fewer direct contacts with local people.

This suggests the capacity of local social networks to provide the feedback necessary for trust formation in rural communities has declined. As a result rural people, like people elsewhere, have had to rely more on the mass media for feedback of this kind. However, the efficacy of this remedy is diminishing as trust in mass media weakens. Papadakis (1999) has reported that between 1983 and 1995 the share of Australian respondents expressing confidence in the press fell from 29 per cent to 16 per cent. It seems reasonable to suppose that increasing globalisation of mass media, so that services offered are less tailored to local needs, norms and values, has contributed to this trend. As overall capacity to obtain the required feedback has dissipated, therefore, capacity for local self-organisation has also eroded.

If informal governance of agri-environmental conflicts is indeed to be strengthened, then identification and implementation of ways out of this 'vicious circle' of diminishing social capital, trust and reciprocity is required. Participative governance strategies, to the extent that they strengthen social networks and devolve tasks commensurate with local capacities, may be a useful step in this direction (Marshall, 1999). Nevertheless empirical evidence of what these strategies can realistically deliver remains sorely lacking (Bellamy, et al., 1999).

[4] The question asked in the *Eurobarometer* survey was: "Now I would like to ask you how much trust you have in people from [your own country]. Please tell me whether you have a lot of trust in them (4), some trust (3), not very much trust (2), or no trust at all (1)". The question asked in the *World Values* survey was: "Generally speaking would you say most people can be trusted or that you can't be too careful dealing with people?"

[5] Social networks were first recognised as building blocks of social capital by Jacobs (1961).

3. The Case Study

Rationale

As Dovers (1999 p. 100) has remarked, "... the very rapid growth in community-based [natural resource management] programs follows no apparent coherent design or intent ...". Likewise, Mobbs and Dovers (1999 p. 4) commented that many of these participative programs "are in place before any sound proposition of how they might work has been formulated". Accordingly these authors identified an important role for the social sciences in drawing lessons from past and present experiences. The aim would be to "isolate elements, strategies or mechanisms within particular experiences with potential for more generic application" (Mobbs and Dovers, 1999 p. 131).

At the same time it is important to appreciate that case study processes and institutions, and their success or failure, are influenced by their unique context. It follows that drawing lessons from case studies to help with the design of processes and institutions elsewhere is inherently risky. Dovers (1999 p. 101) suggested that the way to reduce this risk "is to build up a stock of [case study lessons] from across our collective experience, and apply these in various combinations to answer future needs". This accords with Cocks' (1999) conclusion that "[Australian] society is a complex adaptive system which we cannot hope to manage directly but which we may be able to manage adaptively ... we can attempt to steer or lever society in a preferred direction by thoughtful trial and error - a process of social learning ...".

The research reported in this paper was motivated by thinking of this kind. It sought to use a participative process of developing and implementing four 'land and water management plans' (LWMPs) as a case study to add to the stock of knowledge available to those pursuing participative agri-environmental programs elsewhere.

Case study setting

The four land and water management planning processes largely correspond with the four sets of government-built irrigation schemes located around Deniliquin. This town currently has a population of about 8,500, and it is a drive of 300 kilometres (three and a half hours) north from Melbourne and 750 kilometres (nine hours) south-west from Sydney. Its industries are mainly associated with the surrounding agricultural and pastoral industries, and it also serves as a regional administrative and work headquarters for various government and semi-government organisations (McCotter, 1994). A Deniliquin community worker was quoted by Bullen and Onyx (1998 p. 29) as follows:

> Deniliquin is a strong community ... The isolation gives it a bonding sense ... Local Government doesn't have much to do with community services in Deniliquin. It is not that they don't see it as a need. It is just that we as a community have been doing it for 20 years.

Around a further 4,000 people live in the surrounding shires. These contain various smaller settlements, including Finley, Berrigan and Wakool, largely providing services to surrounding rural areas.

The four irrigation schemes are Berriquin, Wakool/Tullakool, Deniboota and Denimein. The farm area in the four districts is 749,202 hectares. Berriquin accounts for 45 per cent of this, followed by Wakool/Tullakool (29 per cent), Deniboota (19 per cent) and Denimein (7 per cent). The number of farm businesses within the schemes has recently been estimated at 1,610, of which 209 operate farms with less than 20 megalitres of water entitlement. After excluding these small businesses, the average business area is 518 hectares and the average business water entitlement is 1,026 megalitres (Murray Irrigation Limited (MIL), 1998b).

The corresponding 'land and water management planning districts' are known as Berriquin, Wakool, Cadell and Denimein. The Cadell district includes the Deniboota scheme as well as an adjoining area to the east (East Cadell) which includes considerable private irrigation development. East Cadell includes a farm area of 156,137 hectares. By area, the greatest land use across the four districts is dryland pasture (34 per cent of farm area in 1997-98), followed by winter crops (21 per cent), winter irrigated pasture (20 per cent), and rice (6 per cent). However, the greatest water use is by rice (54 per cent of 1997-98 total water use), compared with annual pasture (20 per cent) and perennial pasture (14 per cent) (MIL, 1998b).

The four LWMP districts are located in the Murray Basin which covers 300,000 square kilometres. This is a saucer-shaped depression underlain by bedrock, so it is essentially a closed groundwater system (Denimein Community Working Group (CWG), 1995). The districts are situated within the riverine plain zone of the Basin, which formed during the Pliocene era as a broad floodplain of the Murray River (Cadell CWG, 1995). Since European settlement most of the deep-rooted vegetation in this zone has been cleared and replaced by shallow-rooted crops and pastures.

The Murray Basin is part of the Murray-Darling Basin (MDB), a catchment of some 1.1 million square kilometres or about one-seventh of the area of Australia. Across the four LWMP districts, around 46 per cent of the farm area has been developed for irrigation, although the rate varies from a low of 30-40 per cent in the Cadell district to a high of 70 per cent in the Berriquin district. The area irrigated in any year depends on annual water availability, and is commonly less than 30-50 per cent of the area developed for irrigation (MIL, 1998b). While this intensity of irrigation is low, the large area irrigated means that Murray Irrigation Limited (MIL), which now runs the schemes, has the largest single diversion license in the MDB (Marsden, 1996). The four schemes covered by the case study use about 15 per cent of all the irrigation water available in the MDB (NSW Government, 1996).

Origins of the LWMP processes

The hydrological consequences of clearing deep-rooted vegetation for irrigation development, and of irrigation itself, became apparent 'on the ground' when shallow watertable problems were first recorded in the Wakool scheme area in the early 1950s (Wakool CWG, 1995). The vast majority of the shallow groundwater within the four schemes is saline, but salinity levels are generally highest in the Wakool scheme (MIL, 1998b). Once a watertable rises to within a critical depth from the soil surface, which in the Murray-Darling Basin is generally considered to be two metres, upward movement of salt to the root zone can occur due to capillary rise of saline moisture from the watertable (Pope and Marston, 1988). The primary effect of soil salinity on plant growth is to decrease the availability of soil water to plant roots by increasing the osmotic potential of the soil solution (Rhoades and Ingvalson, 1971).

By 1981, 30,900 hectares within the Wakool scheme had watertables less than two metres from the soil surface (Wakool CWG, 1995). By 1988 the shallow watertable area in the Berriquin and Denimein schemes had reached 58,000 hectares (Marsden Jacob Associates, 1994). By 1990, the shallow watertable area in the Cadell LWMP district had reached 6,000 hectares (Cadell CWG,

1995). Early responses to the problem of rising watertables typically concentrated on large-scale engineering schemes, as exemplified by the Wakool Tullakool Sub Surface Drainage Scheme which was built between 1979 and 1988 (Wakool CWG, 1995).

Intensification of irrigation also contributed to increasing problems of surface drainage. The schemes were intended originally for stock and domestic water and low-intensity irrigation of pasture and fodder crops, and consequently were constructed without surface drains (Marsden Jacob Associates, 1994). These problems were worst in Berriquin which mostly has very little topographical relief and lacks effective natural drainage. Again the focus was on a single-fix engineering solution, so government construction of a surface drainage scheme commenced in 1979. By the end of the 1980s, however, NSW Government policy for funding further drainage works (about one-third of Berriquin had surface drains by then) had changed under the influence of the *Natural Resources Management Strategy* developed by the Murray-Darling Basin Ministerial Council[6]. This Strategy "identifie[d] the need for communities and Government to co-operate and coordinate their efforts" (Murray-Darling Basin Ministerial Council, 1989 p. iii). The shift in NSW was eventually formalised in the *NSW Integrated Drainage Policy for Irrigated Areas* (Department of Water Resources, 1992).

This change in public policy coincided with growing concern that rising watertables would threaten local agricultural viability by exacerbating the existing waterlogging problems as well as by causing soil salinisation. As a result members of the Berriquin farming community organised a public meeting in August 1991 to instigate development of the Berriquin Land and Water Management Plan. Over 250 farmers and community representatives attended the meeting and voted to support the proposal. A Community Working Group (CWG) was elected at the meeting to oversee the development of the Plan. Representatives from local government and relevant government agencies were subsequently invited to become members of the Working Group (Stewart, 1992). The objective ultimately adopted by the Working Group was "to halt or reduce accessions to the watertable, thus stopping or retarding the spread of high watertable areas and the attendant salinisation and to decrease the extent and duration of waterlogging across the District" (Berriquin CWG, 1995).

Government and community leaders now recognised that solutions involving engineering schemes are subject to social dilemmas of their own. These dilemmas arise because the aquifers behind the shallow watertables responsible for soil salinisation normally overlap boundaries between farms and also between farm areas and other areas. Due to transmissivity of groundwater within an aquifer, one party's effort to lower its own watertable helps to lower others' watertables. 'Freeboard' between the soil surface and an underlying watertable consequently has characteristics of a common-pool resource (CPR). Such a resource is a public good because it is non-excludable, although 'impurely' so since its appropriation is rivalrous (Sandler, 1992). As with any public good, provision of this freeboard will be less than collectively rational unless credible commitment to share this provision is established.

A government's incentive to invest in engineering schemes is therefore reduced to the extent that it lacks confidence that cooperation between all parties in providing complementary measures will be forthcoming. For instance, a large share of the potential benefits from surface drainage schemes in Berriquin depends on farmers cooperating by constructing networks of drains within their properties (Marsden Jacob Associates, 1994). This cooperation is affected in turn by government cooperating with farmers to ensure the scheme meets the latter group's needs. It also depends on government cooperating in other activities, like educating farmers about the need for improved on-farm drains and reducing groundwater accessions from irrigation supply channels. The booklet entitled "What's happening in Berriquin?", circulated by the Berriquin CWG prior to its first round of local consultation meetings, highlighted this dilemma as follows:

> No single technique will solve our problems ... However, there is a range of options which, if they are adopted in the right combination, will go a long way towards minimising further rises in watertables ... You may already be doing your best, either individually or as part of a small group, but unless everyone's efforts are directed towards a common goal, they will not succeed in the long term ... This is the purpose of the Land and Water Management Plan. It helps all the people in your district (including landholders, local shires and state government departments) to direct their efforts toward a single goal.

Lack of mutual confidence historically between farmers and the NSW Government agency responsible for running the irrigation schemes[7] had been a particularly serious obstacle to coordinating efficient solutions to issues arising in running the schemes. A former senior executive in this agency gave this account of the problem when interviewed recently:

> I think that the irrigation areas and districts were seen a bit within Government as being Government-owned exercises. There was a bit of an attitude that we know best. That was there, there's no question about that. There was also paternalism ... I probably got involved in irrigation in the Murray in the early 80s ... There was a fair degree of antagonism between the SRIDC [the Southern Riverina Irrigation District Council which represents local irrigators] and the WRC [Water Resources Commission] at that stage. You'd go to meetings and there was shouting across the floor and all sorts of things. The Commission and the SRIDC at that stage were at loggerheads to a large degree ... The SRIDC viewed the Commission, and the executive of the Commission ... as a very antagonistic group. The SRIDC played the politics pretty hard.

Developing the LWMPs

By June 1992, CWGs had formed to develop draft LWMPs to address problems of rising watertables in all four districts. The conditions under which the Groups could gain financial and logistical support from Government for plan development and implementation were outlined in the *Guidelines for Land and Water Management Plans* prepared by the (community-based) Murray and Murrumbidgee Catchment Management Committees in consultation with the NSW Government. These *Guidelines* defined the community to be represented by the CWGs as "everyone who lives or runs a business in a particular town. It includes people who lives in farms or town, and also businesses, local government and state government agencies" (Murray and Murrumbidgee Catchment Management Committees, 1992 p. 4).

[6] At the time this Council consisted of Ministers representing the water, land and environmental portfolios of the Commonwealth, New South Wales, Victorian and South Australian Governments.

[7] When the LWMP process commenced this was the Department of Water Resources. It was preceded by the Water Resources Commission and superseded by the Department of Land and Water Conservation.

The importance of CWGs actively consulting with their constituents was stressed strongly in the *Guidelines*. Presumably seeking to overcome historical antipathy of the local community towards paternalistic governance, it was stressed that "consultation with the wider community is critical in the early stage of identifying the problems, evaluating the impact of different solutions and developing a plan ... It is essential to keep the community informed of progress and give everyone the opportunity to comment on the draft plan" (p. 4). At the same time the CWGs were encouraged to "gain the support of government if you want funding" (p. 7) and to "be realistic about possible government funding" (p. 13). They were expected to evaluate options in terms of their technical feasibility, economic effects, environmental effects, community effects, and compatibility with government regulations and policy. Moreover, they were expected to ensure that "access to and use of natural resources as well as costs are shared fairly among all and that no one group is unfairly burdened" (p. 15). Costs would be shared according to the principle of "'those who benefit pay' ... Put simply, this means that the cost of the options should be divided proportionally among those who benefit: farmers, people living in the area and the state" (p. 15).

The Department of Water Resources appointed an independent consultant in late 1991 as a Project Coordinator for the Berriquin LWMP process, but soon after this role was extended to the other three processes. This appointment provided valuable project management expertise, but also had the important benefit of handing the project coordination role to someone clearly seen to be independent of government or any other stakeholder (Stewart, 1992). The Project Coordinator and his staff were in fact soon relocated to their own premises.

Each CWG met at least monthly until the draft plans were submitted to the NSW Government towards the end of 1995. As the process proceeded, members spent increasing time in additional meetings held by specialised subgroups. The average Denimein CWG member was estimated to have attended a meeting every ten days during 1993-94 (Denimein CWG, 1995).

After the large public meetings held initially in each district to gain community support for the LWMP processes and select CWGs, each group moved independently to more focussed consultation strategies. The project coordinator and CWG members made themselves available to discuss the progress of the LWMP with non-farmer stakeholder groups like local business associations.

Farmers were consulted in rounds of locality meetings held in places convenient and comfortable for farmers like wool sheds, paddocks, community halls, clubs, and pubs. In general, four or five rounds of these meetings were held during plan development. In Berriquin, the initial round comprised 23 locality meetings, followed by 17 for the other four rounds. The typical attendance at each of these rounds was around 300, or about 40 per cent of Berriquin farm businesses. For all these rounds, "information was relayed to farmers about the LWMP and their views sought. Feedback from the meetings was collated, analysed and then disseminated via newsletters, brochures, media releases and radio interviews" (Berriquin CWG, 1995 p. 5). A final round of four larger locality meetings was held in March 1994 at which the LWMP proposals, their costs and cost-sharing arrangements were discussed. Negotiations with the NSW Government over cost-sharing arrangements eventually took place during September 1995 and the resulting Berriquin LWMP was formally endorsed at a community meeting held a month later and attended by over 300 farmers (Berriquin CWG, 1995). Similar consultation processes were followed, and levels of community approval obtained, in the other three districts. The high levels of approval at the final meetings were taken as evidence that community consultation had created a sense of local ownership of, and commitment to, the plans.

Government-community cost shares were largely based on precedents set elsewhere (e.g. the Victorian salinity planning process which had commenced earlier) rather than on detailed calculation of the respective benefit shares (Jerrems, 1996). The NSW Government agreed to contribute $116 million over the first 15 years of plan implementation, subject to the Federal Government meeting half this cost and the community delivering annually on its agreed contributions. Farmers agreed to contribute $382 million over 30 years (Percival, 1996). Most of this contribution is 'in kind', in the form of costs incurred in adopting the on-farm measures included in the various LWMPs[8]. A diversity of such measures appeared in the four plans; examples are establishment of irrigated woodlots, introduction of lucerne into dryland pastures, installation of drainage recirculation systems, and cessation of pasture irrigation before May 1 each year. In addition, farmers were levied between $0.50 to $3.15 per megalitre of irrigation entitlement, depending on the district, to help fund communal LWMP works and measures. Local government in the region agreed to contribute a further $2 million toward implementing the plans (Marsden, 1996).

Implementing the LWMPs

Deliberations over how authority and responsibility for implementing the LWMPs were to be structured involved a lengthy and intense debate within the local community and between the community and the NSW Government. As part of the wider COAG[9]-led process of water policy reform, the four irrigation schemes were privatised in March 1995. The schemes became the property of Murray Irrigation Limited. Shares in this company are fully apportioned among its water supply customers, in proportion to their volumetric delivery entitlements. Eight of the ten elected company director positions are reserved for irrigators, with two reserved for persons with skills in engineering and finance. One vote is allowed for each landholding owned within MIL's area of operation (MIL, 1997a). The company is autonomous within the constraints set by Government-imposed conditions attached to the licenses it needs to operate under the Irrigation Corporations Act, 1994 (Schroo, 1998). The local community eventually agreed with the NSW Government's proposal that MIL become the 'implementation entity' for the plans.

The details of how devolution of LWMP implementation authority to MIL was to occur were specified in a Heads of Agreement signed in April 1996 by community leaders and relevant NSW Government Ministers (Percival, 1996). Such a document signifies agreement in principle, is given informal force by political convention, and can be a precursor to a legally-binding contract. The Agreement included compliance with the LWMPs as a condition in MIL's licenses. It required the Government to appoint an independent party to audit progressive compliance of all parties with the plans (McGlynn, 1998). Legal powers provided to the company under its Operating License and the Irrigation Corporations Act were expected to be

[8] The full cost of these measures was counted in the landholder contribution irrespective of any private benefits expected from the measures.

[9] Council of Australian Governments.

sufficient for it to ensure that farmers within its area of operation complied with the LWMPs. It was anticipated MIL would enforce farmer compliance with LWMPs through attaching conditions to water supply agreements with its customers. LWMP levies could be raised through the company's normal water charging system (Schroo, 1998). Subject to its satisfaction with MIL's progress in implementing the plans, the Government's agreed contribution is released to MIL annually. It is noteworthy that this contribution is not tied to purchasing public works or services from the Government.

The MIL Board established an Environment Committee to, among other roles, advise it on matters relating to LWMP implementation (MIL, 1998a). The four CWGs (renamed Community Implementation Groups) now provide feedback and advice to MIL regarding LWMP implementation in their respective districts (MIL, 1998b). They have continued to keep their communities involved in implementation decisions through locality meetings, newsletters and the like. The Implementation Groups have a particularly important role in suggesting how their LWMPs can be improved as better knowledge becomes available. The Heads of Agreement anticipated this need for adaptive management and allowed for what is now known as a 'substitutions' process (Diacono and Musgrave, 1998). A substitution is an agreed variation to a LWMP without changing the total Government and total community contributions (Rudd, 1999). Minor substitutions can be adjudicated by the Regional LWMP Committee comprising representatives of the independent auditor, MIL and the Department of Land and Water Conservation. However, more substantial substitutions must be referred to the more senior Land and Water Planning Assessment Team (based in Sydney) (Diacono and Musgrave, 1998).

Musgrave (1996a p. 56) has expressed concern that "despite the substance and discipline imparted to them by their legal underpinning" the successful implementation of LWMPs ultimately depends on "moral agreement" between governments and communities and the trust on which it rests. He concluded "that such an important process of reform should have to rely on such a fragile instrument is cause for concern. Despite this, understanding of the problems leads to the conclusion that such reliance is probably unavoidable". The trust problem of course cuts both ways, but a particular challenge for governments is to establish confidence that the community leadership with whom they reach agreement has the capacity to deliver on its side of the bargain. In the case of the Murray LWMPs, the community's side of the agreement includes adoption of a diverse range of conservation measures by a large population of farmers spread across an extensive area. Given the past lack of progress by governments in gaining widespread farmer adoption of conservation measures (Barr and Cary, 1992; Martin, et al., 1992; McDonald and Hundloe, 1993), the NSW Government's signing of the Heads of Agreement for the Murray LWMPs represents a remarkable vote of confidence in the Murray community's leadership.

Community leadership of the Murray LWMPs now rests with MIL. So far this organisation has relied on farmers complying voluntarily with the LWMPs. In doing so it has, given the underlying 'freeboard commons' dilemma, placed considerable faith in the community commitment to the plans that was fostered by developing them participatively. Nevertheless it has attempted to augment this commitment by using some of the funds obtained from farmer levies and Government to educate farmers about how and why they should comply, and to subsidise compliance. Education is valuable for correcting misapprehension about the benefits and costs of compliance. However, it is unlikely alone to significantly lessen the externality problems posed by the commons dilemma. Moreover, subsidies are available for relatively few of the required on-farm measures.

It is difficult at this stage to judge whether MIL needs to become more coercive to ensure that on-farm targets of the LWMPs are met. However, it has already introduced a policy – also for watertable management purposes – under which paddocks exceeding a rice irrigation (megalitres per hectare) limit must be withdrawn from further rice growing (MIL, 1997b). Although the policy was supported by most irrigators, it attracted vociferous opposition from a minority. It is arguable that this balance would have been less favourable if the Government water supply agency had tried to carry such a policy – so much so that the policy may have been substantially watered down, revoked or not enforced. Aside from the symbolic value of MIL's irrigator ownership, it has a more substantive value insofar as it enhances the likelihood of formulating policies in ways consonant with local norms of procedural fairness and delivering policies that account for local practicalities.

The potential of participative planning to make greater progress in Australia with agri-environmental commons dilemmas than has occurred under top-down governance has been recognised previously (e.g. Musgrave and Sinden, 1988; Pigram, et al., 1994; Musgrave, 1996a). The scope for community-based organisations that lead the preparation of participative plans to evolve into common property regimes capable of effectively implementing the plans has also been discussed (Read, 1989; Industry Commission, 1992). The devolution to MIL of responsibility for implementing the Murray region's LWMPs is an early instance of this scope being tested. Although MIL is a private company, it is also a common property regime insofar as it has been granted property rights to assets with CPR characteristics such as irrigation supply channels and drains, and (implicitly) to the 'watertable-freeboard' within its area of operation. In this case the conversion of the community-based planning organisations (i.e. the CWGs) into a common property regime with respect to watertable management was assisted by the establishment of MIL. Although MIL's area of operation was primarily determined by its infrastructure management role, this jurisdiction fortuitously coincides in large degree with that needed for regional watertable governance. Significant 'economies of scope'[10] were therefore available by spreading MIL's fixed costs over both functions. Moreover, the fact that MIL evolved from an arm of the Government's water supply agency that had been previously commercialised meant that it inherited expertise and organisational cohesion of considerable value in discharging its new LWMP implementation role.

A number of commentators have suggested that the institutional arrangements for developing and implementing the Murray LWMPs be used as a blueprint for LWMPs and similar planning exercises undertaken elsewhere (Marsden Jacob Associates, 1995; Diacono and Musgrave, 1998; Schroo, 1998). Marsden (1996 p. 54) remarked that "in several key respects we believe the four Murray Land and Water Management Plans are the forerunners of the new contractual approach to regional resource management". Nevertheless irrigation communities may have advantages over other communities in making such a model work (Musgrave, 1996b; Schroo, 1998). Irrigation serves as a focus for social cohesion even where irrigators are distant from each other and running different enterprise types. Opportunities for co-opting existing organisations for the purpose of implementing a LWMP are also likely to be fewer in many

[10] This term is borrowed from Sandler (1992).

other communities. Nevertheless the Draft Report of the *Independent Inquiry into the Clarence River System* recently recommended that a 'partnership agreement' approach to coastal floodplain management, based on the Murray LWMP model, should be developed and tested (Healthy Rivers Commission of New South Wales, 1999).

4. Method

Rationale

At least in Australia, participative agri-environmental programs continue to rely heavily upon voluntary, or informal, cooperation by farmers with the plans that emerge from the programs. This is despite the limited success with this strategy, as observed earlier. There is considerable optimism that the contractual approach pioneered with the Murray LWMPs will enable greater success by imposing increased discipline on the parties responsible for implementation, including governments and farmer communities. Certainly there is considerable interest in adapting the Murray LWMP model to a diverse range of agri-environmental issues elsewhere. As we have seen, however, implementation of these LWMPs still depends to a large extent on voluntary farmer compliance. The optimism is based on two beliefs: farmers are more likely to comply with a plan that they helped to create; and, they are more likely to cooperate with an implementation authority they co-own than they are with government. As yet, however, these beliefs remain untested. Closing this knowledge gap appears to be a vital step in gauging whether the Murray LWMP model has merit for other settings. The aim of the empirical research to be reported here was to help close this gap.

Research over the last few decades into how rural communities have dealt with CPR dilemmas has made considerable progress (see Baland and Platteau, 1996 for an excellent survey). The early phase of this effort mainly involved qualitative comparison of successful and unsuccessful cases, the aim being to identify 'design principles' generally explaining success. This research is exemplified by the works of McCay and Acheson (1987), Ostrom (1990) and Bromley (1992). Progress with this line of research slowed during the 1990s because many of the variables thought to be critical functioned interactively and it was difficult finding field studies which allowed the interactions to be isolated for qualitative investigation (Ostrom, 1998). As Wirt, Morey and Brakeman (1971 p. 4) have observed, "The slippery nature of causation makes the move from description to explanation extremely difficult".

The research program consequently moved into a second phase which emphasised experiments with people subjected to social dilemmas simulated in 'laboratory' settings. This method is amenable for isolating and testing inter-variable relationships using statistical methods and has added considerably to knowledge of how voluntary cooperation emerges even in challenging social dilemmas. This research is surveyed in Ostrom (1994) and Ostrom (1998).

Difficulties nevertheless remain in extrapolating laboratory findings to complex real social dilemmas (Ostrom, 1998). In particular, relationships demonstrated in laboratory research may not be substantively significant in real settings given the effects of myriad other variables. As this study was concerned with a real setting, a method for isolating and testing relationships of interest under such circumstances was required. The method chosen was multiple regression using data from a survey of the farmers facing the real social dilemma of implementing the on-farm aspects of their respective LWMPs. This approach allows quantitative testing of theories by passively observing phenomena as they occur naturally. Cohen and Cohen (1983 p. 14) encapsulated the approach as follows:

> The basic strategy ... is first to state a theory in terms of the variables that are involved and, quite explicitly, of what causes what and what does not ... The observational data are then employed to determine whether the causal model is consistent with them, and estimate the strength of the causal parameters. Failure of the model to fit the data results in its falsification, while a good fit allows the model to survive, but not be proven, since other models might provide equal or better fits.

The hypotheses tested in this study were based on the theory reviewed in section 2. Details of the hypotheses, and the method of testing them, are provided below.

The sample

In order to demonstrate compliance with the on-farm components of the LWMPs, each year MIL undertakes a survey of land holdings within the four planning districts. The interviews are performed face-to-face and are concerned with enumerating adoption of the on-farm measures included in the plans. Permission was given by MIL for the data collection for this study to be carried out concurrently with its annual survey for 1998-99. This limited the duration of questioning dedicated to this study, but this disadvantage was outweighed by MIL's sample being considerably larger than otherwise could have been afforded. Interviewers recruited and trained by MIL performed all the interviewers, although the author was involved in the interviewer briefing.

The sample of land holdings was selected according to a stratified-random procedure designed by Lin Crase and Julie Jackson at the Wodonga campus of Latrobe University. Stratification was by LWMP district, holding area and enterprise mix[11]. The target sample size was 318 holdings[12]. For this study, however, the relevant entity for interview was the farm business which may comprise more than one holding. A business was therefore interviewed only once if more than one of its holdings were selected in MIL's sample. There were 235 farm businesses in the sample[13], which represents 14.6 per cent of the 1998 population of 1,610 farm businesses. The interviews were conducted during September 1999.

The interview schedule

The interview schedule for this study was mainly comprised of bi-polar (e.g. strongly agree/strongly disagree) rating scales. Scales of this kind are frequently used in social surveys (de Vaus, 1995). Unless otherwise specified, a nine-point rating scale (with the negative and positive poles scored for analysis as one and nine respectively), was used for such items. A 'don't know' response was also allowed. Scales with seven to nine categories have been found to be more reliable than scales with fewer points (Pannell and Pannell, 1999) and also provide a

[11] The holding-area (in hectares) strata were 0-100, 101-200, 201-400, 401-600 and 600+. The enterprise-mix strata were dairying, horticulture/viticulture, mixed farming/rice, and mixed farming/non-rice.

[12] The target number of holdings for Berriquin was 156; for Wakool 44; for Cadell 98; and for Denimein 20. In cases of refusal to participate in the survey, replacement holdings were drawn from a randomly selected 'reserve list' for the relevant stratum.

[13] The number of farm businesses interviewed for Berriquin was 129; for Wakool 37; for Cadell 55; and for Denimein 14.

richer data set for statistical analysis. The schedule was normally completed within 30-45 minutes. Respondents were assured of the confidentiality of their responses.

Method of statistical analysis

Standard methods of multiple regression like the Ordinary Least Squares (OLS) technique assume that all variables are measured on an interval scale. Rating scales differ from an interval scale since in the former there is no guarantee of equality of interval[14]. Although it is not uncommon for behavioural and social scientists to use OLS with rating-scale-measured variables, the departure from interval measurement introduces measurement errors of uncertain magnitude into the analysis (Cohen and Cohen, 1983).

In this study, multiple regression using the ordered probit method was used to avoid this measurement problem, at least in respect of the dependent variable. In this technique the dependent variable is assumed to be ordinal. An ordered probit model is developed around a latent regression as is the case with a binomial probit model[15]. The general specification of each single-equation model is

$$y^* = \beta' x + \varepsilon$$

where y^* is a latent (unobserved) variable, x is a ($K \times 1$) vector of observed explanatory variables, β is a (K x 1) vector of unknown parameters, and ε is a random error term. Although y^* is not observed, what can be observed is

$$\begin{aligned} y &= 1 && \text{if } y^* \le 0, \\ &= 2 && \text{if } 1 < y^* < \mu_1, \\ &= 3 && \text{if } \mu_1 < y^* < \mu_2, \\ &\;\;\vdots \\ &= J && \text{if } \mu_{J-1} \le y^*. \end{aligned}$$

The μ's are unknown parameters to be estimated with β. It is assumed that all error terms have zero mean and that the error terms for different observations are uncorrelated. The ordered probit model also assumes that ε is normally distributed across observations[16].

The parameters of the ordered probit model are obtained by the method of maximum-likelihood estimation. In this study the ordered probit models were estimated using the STATA software (StataCorp., 1997) which maximises the log-likelihood function using the Newton-Raphson procedure. The software also provides standard errors and asymptotic Z statistics for the estimated β parameters. In addition, a pseudo-R^2 was calculated as a measure of the goodness-of-fit of the estimated models. The measure chosen was one recommended by Veall and Zimmerman (1992) because, when it takes a value less than about 0.6, it seems to mimic the OLS-R^2 that would be calculated if y^* were in fact observed.

Measurement errors associated with ordinal explanatory variables remain with the ordered probit method. Hence models estimated with such variables must still be interpreted with some caution (albeit with less caution than if the OLS method were used).

Missing data

A pervasive problem with social survey analysis is missing data due to 'don't know' responses, inadvertent skipping of items, illegible responses, refusals to respond, and so on. As this study was no exception, a solution was sought. With missing data scattered across cases and variables, deletion of cases with data missing for one or more variables would have meant substantial loss of the valid data obtained for the remaining variables. Furthermore, unless cases with missing data can safely be assumed to be a random subset of the full sample, then deleting these cases biases the sample (Tabachnick and Fidell, 1989).

Given these limitations of deleting 'incomplete' cases, a common strategy is to estimate each missing datum by capitalising on the information provided by the remainder of the data set. One of the more sophisticated versions of this strategy is to regress a variable with missing data against the other variables, using only cases with complete data in the estimation. The estimated model then is used to predict the data missing for the dependent variable. The process is repeated for each variable with missing data (Tabachnick and Fidell, 1989). This strategy was followed for this study using the Missing Value Analysis facility provided in recent versions of the SPSS software (SPSS Inc., 1998)[17].

5. Model specification

Dependent variables

The aim of the case study was to explore how informal governance influences farmer compliance with the Murray LWMPs. In doing so it was recognised that farmer compliance targets were generally set globally (e.g. a total number of drainage recirculation systems to be installed) rather than for individual farm businesses. Moreover, many of the targets are long term (e.g. irrigated woodlots established within 15 or 30 years), while implementation of the plans formally commenced less than five years ago. Given these factors, as well as the multiplicity of applicable targets, it was decided to model precursors to compliance instead of

[14] Where there is equality of interval then a given distance along a scale (e.g. between 2 and 3) signifies the same change in the value of the variable being measured as does any other equal distance along that scale (e.g. between 8 and 9). Equality of interval also requires that a given distance along a scale (e.g. between 2 and 3) signifies the same change in the value of the variable for all respondents.

[15] The following exposition of the ordered probit model is based on that presented in Greene (1993).

[16] Alternatively, an ordered logit model results if ε is assumed to be logistically distributed. However, O'Donnell and Connor (1996 p. 741) noted that there is an appealing theoretical rationale for the ordered probit model: if ε represents the combined influence of many independent factors not formally expressed in the model, then central limit theorems can be used to justify the assumption it is normally distributed. In any case, Greene (1993 p. 673) has observed that the ordered logistic model "is a trivial modification of the [ordered probit] formulation and appears to make virtually no difference in practice".

[17] In order to avoid artificially enhancing the goodness of fit in the analysis proper between dependent and explanatory variables, advantage was taken of the option offered in the SPSS software to adjust the prediction for each datum by a random normal variate. For the same reason, missing data were predicted only for a model's explanatory variables.

compliance per se. Moreover, compliance was to be considered on an 'average' basis rather than separately for each on-farm measure included in the LWMPs.

Two such dependent variables were used as proxies for actual compliance. The first, known as Commitment, was measured by scores recorded against the following rating item:

> On our farm we are committed to following the plan[18].

The rating item used to measure the other dependent variable, called Intention, was:

> How likely is it that your farm business will carry out all the applicable on-farm aspects of the plan within the next ten years?[19]

The Intention variable is clearly a more direct precursor to actual compliance than is the Commitment variable. The measurement of Intention is more likely to have accounted for farmers' capacity to comply within a defined, yet reasonable, period. It might be expected that responses to the rating item used for the Commitment variable would be less constrained by this capacity, which includes access to financial and other resources.

Explanatory variables concerned with informal aspects of LWMP governance

Both these dependent variables were modelled using the same set of explanatory variables. Two variables were included to explore the relationship between farmers' perceptions of LWMP compliance as a social dilemma and their intentions to comply. The neoclassical view of self-interested rationality typified by Olson (1965) suggests that compliance should be negatively related with perceived degree of exposure to a social dilemma.

There are considerable differences between farmers in terms of the degree of social dilemma associated with their compliance decisions. Farmers vary in their risk of exposure to shallow watertables due to inter-farm differences in topography, soil type, enterprise mix, and so on. Depending on local transmissivity of shallow groundwaters, moreover, farms differ in the extent to which LWMP compliance confers private benefits as against benefits to neighbouring farms. Other farm circumstances can also have a strong influence on the private costs and benefits associated with particular LWMP measures. For instance, the marginal private value of water savings obtained as a result of installing a drainage recirculation system tends to be greater for farmers with lower irrigation entitlements (Marshall, Jones and Wall, 1997).

The first explanatory variable included to explore effects of this kind was a summated scale, derived as the mean of the scores of three rating items. The three items are:

> The benefits on our farm of following the plan depend at least partly on what other farmers do;
>
> The benefits on our farm of following the plan depend at least partly on what is done with the plan off-farm; and
>
> The long-term viability of our farm would really be improved if everyone successfully carried out their parts of the plan[20].

[18] The poles were "very far from my view" and "very close to my view".

[19] The poles were "extremely unlikely" and "extremely likely".

[20] See footnote 18.

The composition of this scale was suggested by exploratory factor analysis. Cronbach's Alpha for the scale is 0.64, indicating that it has a satisfactory level of internal consistency reliability[21]. This variable, known as Dependence, was hypothesised to be related positively with compliance.

The second of these two explanatory variables measured the degree to which farmers perceived that their own compliance would be worthwhile independently of whether others also complied. This variable, called Independence, was based on the rating item following:

> There would be worthwhile benefits to us from following the plan even if no one else followed it[22].

As this variable measured freedom from subjection to a social dilemma, it was hypothesised to have a positive relationship with both the compliance proxies. Rejection of this and the previous hypothesis would suggest that the neoclassical assumption of narrow rationality does not hold in this case. It would lend support to the proposition that self interest has been broadened as a result of the participative plan development and implementation process and collective farmer endorsement of the LWMPs. This proposition is consistent with the experimental research suggesting that group identity (or 'community ownership' in terms of the rhetoric of agri-environmental policy) can emerge from social interaction which makes self interest more congruent with the group's agreed collective interest.

Trust that others would comply with the LWMPs was measured by an explanatory variable, called Plan Trust, based on this rating item:

> The overall plan will be successfully carried out inside the scheduled time[23].

A positive relationship with the dependent variables was hypothesised in this case.

A variable measuring the social, or impersonal, trust that the literature suggests is important for enabling generalised reciprocity in modern society was also included. Factor analysis indicated that this variable, called Social Trust, be constructed as a summated scale comprised of these rating items:

> When you work with others to solve a common problem, you generally get less out of it than you put in;
>
> Over the long haul you will be more successful if you avoid accepting help from other people; and
>
> Over the long haul you will be more successful if you avoid giving help to other people[24].

These items were reverse-scored so the scale corresponded positively with social trust[25]. The scale's Cronbach's Alpha of 0.72 evidences reasonable reliability. This variable was hypothesised to relate positively with the dependent variables.

[21] A researcher-designed scale is considered to have an acceptable level of reliability if Cronbach's Alpha is 0.6 or greater (Cooksey, 1997).

[22] See footnote 18.

[23] See footnote 18.

[24] See footnote 18.

[25] For instance, raw scores of 1, 2, 3 were rescored as 9, 8, 7 respectively.

The possibility that farmers' compliance with the LWMP is partly motivated by the benefits they expect to result for their wider community was investigated by including a variable measured by the rating item:

> The long-term viability of our district's community would really be improved if everyone successfully carried out their parts of the plan.

This variable, known as Community Benefit, was hypothesised to be positively related with the compliance proxies. This hypothesis need not contravene rational choice theory's assumption that all motives derive from self interest maximisation. Contributing to community viability often confers private benefits as well. The chairperson of the Wakool CWG revealed how he emphasised community-minded self interest to local farmers by saying things like "Do you want to end up drinking in the pub on your own?" and "When you go to sell your farm, do you want prospective buyers driving through wasteland to get to your place?". Moreover, experimental evidence supports the notion that group identity can emerge from interactions among its members, and that this phenomenon can cause group members to behave with some degree of self-interested altruism towards each other (Dawes, van de Kragt and Orbell, 1990). To the extent that a degree of group identity exists within a community (or can be created through measures like participative planning), it follows that it can be self-interestedly rational for individuals to be motivated by benefits of their actions that spill over to others in their community.

The possibility that farmers' adherence to a social norm of civic duty positively influences their LWMP compliance was tested by including a variable based on the rating item:

> The rights of individuals should come before the interests of their local community[26].

Scoring for this item was reversed so this Civic Duty variable appropriately measured adherence with such a norm.

A variable representing farmers' sensitivity to peer pressure from their local farming community was also included. The rating item used to measure this variable was:

> I really don't care if other farmers respect me or not[27].

Item scores were reversed in order to enumerate the variable appropriately. The variable, called Peer Sensitivity, was hypothesised to relate positively with the compliance proxies.

It was further hypothesised that the strength of peer pressure is positively influenced by the level of peer pressure anticipated. This degree of anticipation was accounted for by including a variable based on the rating item following:

> Other farmers respect for us would be lowered if we did not follow the plan[28].

It was hypothesised that this variable, known as Peer Threat, is positively related with compliance.

Variables were also included in the models in order to explore whether farmer perceptions regarding procedural and substantive fairness influence their intentions to comply with their respective LWMPs. The rating items used to measure the two procedural fairness variables (called Procedural Fairness 1 and Procedural Fairness 2) were, respectively:

> How satisfied were you with chances to influence what went in the plan?; and
>
> How satisfied are you with chances to influence how the plan is carried out?[29]

The Distributive Fairness variable was measured by the rating item:

> How fair is your farm's share of the costs of carrying out the plan?[30]

The three fairness variables were all hypothesised to positively influence the compliance proxies.

Explanatory variables concerned with personal influences

Additional variables were included to control for personal factors possibly influencing farmer adoption of measures included in the LWMPs. Abadi Ghadim and Pannell (1999) noted that the literature has identified a wide range of personal factors affecting farmer adoption of innovations. Three of these factors were modelled in this study: farm business security, farmer conservatism, and farmer age.

Abadi Ghadim and Pannell (1999 p. 152) discussed farm business security in terms of wealth. They observed that greater wealth is likely to influence adoption of an innovation positively since it "allows the farmer to invest a relatively smaller proportion of their (sic) wealth to venture into an uncertain enterprise". They attributed the influence of this factor to its relaxation of financial constraints and its likely reduction of risk aversion. The first of these effects was emphasised as follows in the Berriquin LWMP: "Farmers in a strong financial position are ... better placed to undertake capital investments and changes to management that will lead to greater environmental sustainability" (Berriquin CWG, 1995 p. 128).

Since the limited time available for each interview precluded obtaining the data required to calculate farm wealth, and perceptions of business security are in any case inherently subjective, perceived business security was measured in this study by the following rating item:

> How secure is the long-term viability of your farm business?[31]

This variable, known as Security, was hypothesised to positively influence the dependent variables.

In relation to farmer conservatism, Abadi Ghadim and Pannell (1999 p. 152) observed that "different farmers require a greater or lesser number of observations of success by other farmers before trialing an innovation". This variability was accounted for in this study by including a variable, called Conservatism, measured by the rating item following:

> We are waiting to see how other farmers follow the plan before we go further on our farm[32].

It was hypothesised that the relationship of this variable with the compliance proxies is negative. Of course the score for the rating item might also be affected (negatively) by trust in

[26] See footnote 18.

[27] See footnote 18.

[28] See footnote 18.

[29] The poles were "not satisfied at all" and "completely satisfied".

[30] The poles were "very unfair" and "very fair".

[31] The poles were "very insecure" and "very secure".

[32] The poles were "very far from my strategy" and "very close to my strategy".

others' compliance. Since this effect was specifically tested using the Plan Trust variable, however, it seems reasonable to expect that the additional variable would account predominantly for conservatism. Nevertheless judicious interpretation of coefficients estimated for this variable is warranted.

Farmer age was obtained by asking respondents to nominate the year in which they were born. As noted by Abadi Ghadim and Pannell (1999), the traditional view is that older farmers are more risk averse, suggesting that they tend to be less likely to adopt new measures. This Age variable served also as a proxy measure of experience in farming. However, a farmer's experience has both positive and negative implications for his or her propensity to adopt new measures (Abadi Ghadim and Pannell, 1999). Given these opposing tendencies, the parameter for Age was hypothesised only to differ from zero.

Dummy variables to control for interviewer-induced bias

Finally, a set of three dummy variables was included in the models to control for possible interviewer-induced response bias. This possibility arose because the 17 interviewers used by MIL for the survey included farmers from within the LWMP districts, as well as other people involved in the development and/or implementation of the LWMPs (i.e. by serving on a Working or Implementation Group or working for MIL). Interviewee's awareness of the background of this group of interviewers might have biased some of their responses, for instance due to not wanting to appear critical or unenthusiastic.

Preliminary analysis indicated significant differences between data collected by four groups of interviewers in respect of a few of the key survey items. The four mutually-exclusive groups were: (i) non-farmers from outside all four LWMP districts (two interviewers accounting for 58 interviews); (ii) farmers from inside the LWMP districts with no further involvement in the LWMP process (ten interviewers accounting for 118 interviews); (iii) people who have served on an LWMP Working or Implementation Group or worked for MIL, excluding the person comprising the fourth group (four interviewers accounting for 45 interviews); and (iv) an ex-chairperson of one of the CWGs (one interviewer accounting for 14 interviews). Due to the indication of a possible bias, dummy variables were included in the models to test for biases associated with interviewer groups (ii), (iii) and (iv). These variables are known as Int_Dum1, Int_Dum2 and Int_Dum3, respectively. The first group was chosen as the control group, as there was no reason to suspect any bias associated with this group.

Descriptive statistics

Descriptive statistics for each of the (non-dummy) variables discussed above are presented in Table 1.

Given that the bounds of possible scores are one and nine (except for Age), the means for most variables lie above the scale midpoint of five. Conservatism, with a mean of 1.9, is a notable exception. The only variable (except for Age) with a mean exceeding seven is Community Benefit. It is noteworthy that the mean of 7.0 for Social Trust is 40 per cent greater than the 'ambivalent' 5.0 associated with Plan Trust. The mean scores for Commitment and Intention (7.0 and 6.9, respectively) are only about three-quarters of the possible maximum score of nine. This suggests that, at this stage at least, voluntary compliance by itself is unlikely to be sufficient to yield full and on-schedule compliance with the on-farm components of the LWMPs.

6. Results and discussion

Coefficient estimates and their statistical significance

The estimated models for Commitment and Intention are presented in Table 2.

Goodness-of-fit for both models is reasonable given the use of cross-sectional data, although the fit is better for the Commitment model. The only cases of unexpected coefficient signs involved the Social Trust variable in the Commitment Model, the Procedural Fairness 1 variable in the Intention Model, and the Civic Duty variable in both models. In none of these cases would the coefficient be significant with a two-tailed test. There is no evidence of interviewer-induced bias. No suggestion of collinearity between explanatory variables was found.

Table 1: Descriptive Statistics for Model Variables

Variable	Mean	Standard deviation
Commitment	7.0	1.67
Intention	6.9	2.23
Dependence	6.3	1.77
Independence	7.0	1.99
Plan Trust	5.0	2.29
Social Trust	7.0	1.75
Community Benefit	7.7	1.53
Civic Duty	6.2	2.30
Peer Sensitivity	6.1	2.77
Peer Threat	5.7	2.31
Procedural Fairness 1	6.1	2.28
Procedural Fairness 2	5.4	2.32
Distributive Fairness	5.9	2.24
Security	5.9	2.04
Conservatism	1.9	1.46
Age	48.8	11.99

The hypothesis that Dependence negatively affects farmer compliance with the LWMPs is not supported in either model. The hypothesis that Independence positively affects compliance is also not supported in the case of the Intention Model. Nevertheless the latter hypothesis is supported at the 0.05 level in the case of the Commitment Model. Given that the Intention variable is likely to more validly measure actual compliance, however, it seems that asymmetry in farmers' perceptions of LWMP compliance as a social dilemma is not responsible for variation in their compliance. Thus the neoclassical assumption of narrow rationality is not supported. It would appear that the participative process and collective farmer endorsement of its outcomes has broadened the farmers' self-interested rationality, perhaps by way of establishing a strong sense of group identity or 'community ownership'.

For both models, support at the 0.01 level for the hypothesis that Plan Trust positively affects compliance is evident. In contrast, the hypothesis that Social Trust affects compliance positively is not supported in either case. Based on the earlier identification of trust as a crucial precursor to generalised reciprocity, it seems reasonable to presume that the positive affect of Plan Trust on compliance is through enabling generalised reciprocity. It is interesting that the trust farmers need to follow this norm appears to emerge from knowledge about other parties involved in LWMP implementation rather than from social experience more generally.

Table 2: Estimated Ordered Probit Models for LWMP 'Compliance' by Farmers

Explanatory variables	Dependent variables					
	Commitment			Intention		
	Coef.	P>|z|	Sig.	Coef.	P>|z|	Sig.
Dependence	-0.01	0.782		-0.04	0.396	
Independence	0.08	0.046	*	0.02	0.710	
Plan Trust	0.10	0.007	**	0.15	0.000	**
Social Trust	-0.04	0.447		0.02	0.714	
Community Benefit	0.26	0.000	**	0.13	0.053	*
Civic Duty	-0.01	0.846		-0.04	0.330	
Peer Sensitivity	0.07	0.017	**	0.04	0.184	
Peer Threat	0.01	0.817		0.01	0.780	
Procedural Fairness 1	0.01	0.868		-0.04	0.433	
Procedural Fairness 2	0.02	0.574		0.02	0.570	
Distributive Fairness	0.09	0.018	**	0.11	0.005	**
Security	0.02	0.618		0.09	0.016	**
Conservatism	-0.11	0.041	*	-0.12	0.044	*
Age	-0.00	0.586		-0.00	0.760	
Int_Dum1	-0.01	0.957		0.04	0.863	
Int_Dum2	0.32	0.200		0.33	0.196	
Int_Dum3	0.32	0.378		-0.08	0.832	
μ_1	0.55			0.48		
μ_2	0.78			0.98		
μ_3	1.48			1.22		
μ_4	1.82			1.46		
μ_5	2.63			1.74		
μ_6	2.99			1.99		
μ_7	4.00			2.75		
μ_8	4.85			3.40		
Pseudo R^2	0.39			0.31		

Note: * and ** indicate that a coefficient differs significantly from zero in the direction hypothesised at the 0.05 and 0.01 levels of confidence, respectively.

The hypothesis that Community Benefit positively affects farmer compliance is supported at the 0.01 level for the Commitment Model and at the 0.05 level for the Intention Model. This

suggests scope for increasing compliance by farmers by fostering group identity among farmers and their community and by raising their appreciation of the benefits that flow to their local community and in turn back to themselves.

The lack of support from both models for Civic Duty positively influencing compliance suggest that farmer education programs are misguided to the extent that they seek to inculcate civic responsibility instead of a better understanding of the importance of community viability and cohesion for individual welfare. This conclusion is consistent with Sinden and King's (1990) empirical finding (for Manilla Shire, New South Wales) that civic responsibility in the form of a 'land stewardship ethic' helps to explain farmers' recognition of a land degradation problem but does not help to explain their adoption of conservation measures.

There is support at the 0.01 level for the hypothesis that Peer Sensitivity positively affects Commitment. Variation in farmers' desire for approval from other farmers thus appears to help explain variation in their commitment to their LWMP but not in their intention to comply with it.

The hypothesis that Peer Threat positively affects compliance is not supported in either case. Hence it seems that peer pressure does affect farmers' commitment to follow the LWMPs, but that this effect is driven by farmers abstractly desiring approval from other farmers and not by them having a concrete fear of other farmers disapproving a lack of compliance. This also is consistent with the prior finding that Civic Duty appears not to motivate compliance.

Neither the Commitment nor the Intention Model supports the hypothesis that procedural fairness, either in plan development or implementation, positively affects compliance. In contrast, both models support the hypothesis that Distributive Fairness affects compliance positively at the 0.01 level. This finding does not exclude the possibility that farmers' perceptions of procedural fairness indirectly influence compliance by affecting their perceptions of distributive fairness. This possibility is to be explored in an extension of the current study.

The hypothesis that Security positively affects compliance is not supported by the Commitment Model, but it is supported at the 0.01 level by the Intention Model. This makes sense given that consideration of intention to comply within ten years is likely to be substantially more constrained by current financial capacity than is consideration of commitment to comply over an undefined period.

Support at the 0.05 level is evident in both models for the hypothesis that Conservatism negatively influences compliance. As noted earlier, it is possible that the estimates for this variable capture some of the effect that Plan Trust was intended to capture. However, the significance of Plan Trust in both models suggests that the estimates for the Conservatism variable measure a distinct effect as intended.

Finally, the hypothesis that Age (and, by proxy, farming experience) influences compliance is not supported by either model.

To summarise, the estimated models are consistent with the proposition that informal aspects of governance affect farmer compliance with the LWMPs. In particular, trust in the compliance of others (including non-farmers), recognition that compliance confers benefits to the local community, and a perception of LWMPs as fair in a distributive sense, all seem to have a positive effect on the intention to comply. Peer pressure, in the abstract sense of desire for respect from other farmers, appears to positively influence commitment to the LWMPs, although it was found to not extend as far as motivating the more concrete intention to comply. The finding that asymmetric farmer perceptions of LWMP compliance as a social dilemma does not help to explain variation in intentions to comply, moreover, indicates that the narrow neoclassical conception of self-interested rationality does not apply in this setting.

Substantive significance of estimated model coefficients

The substantive significance of coefficients in ordered probit models is appropriately interpreted by calculating elasticities. These elasticities measure the effects of a one-percentage change in an explanatory variable on the probabilities of each of the possible ordinal values being observed in relation to the dependent variable. The method of calculating these elasticities is described in Greene (1993 pp. 673-675). The elasticities reported in Table 3 for the Commitment Model were calculated with all explanatory variables set to their mean levels, except for the dummy variables which were set to zero[33].

It is evident that Commitment is most elastic by far with respect to the Community Benefit variable. For instance, a one per cent increase in Community Benefit is estimated to effect a 6.5 per cent reduction in the number of cases scoring one for Commitment and a 3.5 per cent increase in the number of cases scoring nine. If the remaining variables identified as statistically significant in this model are ranked in declining order of elasticity, then Independence takes second place, followed by Distributive Fairness, Plan Trust, Peer Sensitivity and, finally, Conservatism.

The elasticities calculated for the Intention Model are reported in Table 4. Again, these were calculated with all explanatory variables set to their mean levels, except for the dummy variables which were set to zero.

As in the case of the Commitment model, Intention is most elastic with respect to the Community Benefit variable. Elasticities for Community Benefit are nevertheless lower than observed in the case of the Commitment Model. For instance, a one per cent increase in Community Benefit effects a 2.3 per cent reduction in the number of cases scoring one for Intention and a 1.4 per cent increase in the number of cases scoring nine. Moreover, the gap between the elasticities for Community Benefit and the elasticities for

[33] An elasticity is not presented here (nor in Table 4) for the Age variable since it is not measured using a rating item; in any case its coefficient is not statistically significant.

Table 3: Elasticities for the Commitment Model

	% change in probability of a Commitment score of:								
from a 1% increase in:	1	2	3	4	5	6	7	8	9
Dependence	0.3	0.2	0.2	0.2	0.1	0.1	0.0	-0.1	-0.1
Independence	-1.9	-1.7	-1.4	-1.1	-0.7	-0.4	0.0	0.5	1.0
Plan Trust	-1.6	-1.4	-1.2	-0.9	-0.6	-0.4	0.0	0.4	0.9
Social Trust	0.9	0.8	0.6	0.5	0.3	0.2	0.0	-0.2	-0.5
Community Benefit	-6.5	-5.7	-4.6	-3.7	-2.5	-1.5	-0.1	1.6	3.5
Civic Duty	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	-0.1
Peer Sensitivity	-1.3	-1.2	-1.0	-0.8	-0.5	-0.3	0.0	0.3	0.7
Peer Threat	-0.2	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.1
Procedural Fairness 1	-0.2	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.1
Procedural Fairness 2	-0.4	-0.4	-0.3	-0.2	-0.2	-0.1	0.0	0.1	0.2
Distributive Fairness	-1.8	-1.6	-1.3	-1.0	-0.7	-0.4	0.0	0.4	1.0
Security	-0.4	-0.3	-0.3	-0.2	-0.1	-0.1	0.0	0.1	0.2
Conservatism	0.8	0.7	0.5	0.4	0.3	0.2	0.0	-0.2	-0.4

Table 4: Elasticities for the Intention Model

	% change in probability of an Intention score of:								
from a 1% increase in:	1	2	3	4	5	6	7	8	9
Dependence	0.7	0.5	0.4	0.3	0.3	0.2	0.0	-0.1	-0.4
Independence	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	0.0	0.1	0.2
Plan Trust	-1.8	-1.3	-1.1	-0.9	-0.7	-0.5	-0.1	0.4	1.1
Social Trust	-0.3	-0.2	-0.2	-0.2	-0.1	-0.1	0.0	0.1	0.2
Community Benefit	-2.3	-1.7	-1.4	-1.1	-0.9	-0.6	-0.1	0.5	1.4
Civic Duty	0.5	0.4	0.3	0.3	0.2	0.1	0.0	-0.1	-0.3
Peer Sensitivity	-0.6	-0.4	-0.3	-0.3	-0.2	-0.2	0.0	0.1	0.3
Peer Threat	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.1
Procedural Fairness 1	0.6	0.4	0.3	0.3	0.2	0.2	0.0	-0.1	-0.3
Procedural Fairness 2	-0.3	-0.2	-0.2	-0.2	-0.1	-0.1	0.0	0.1	0.2
Distributive Fairness	-1.6	-1.1	-0.9	-0.8	-0.6	-0.4	-0.1	0.3	0.9
Security	-1.3	-1.0	-0.8	-0.7	-0.5	-0.4	-0.1	0.3	0.8
Conservatism	0.6	0.5	0.4	0.3	0.2	0.2	0.0	-0.1	-0.4

the other variables is not as great. The next most elastic effect relates to the Plan Trust variable; a one per cent increase in its value effects a 1.8 per cent reduction in the number of cases scoring one for Intention and a 1.1 per cent increase in the number of cases scoring nine. If the remaining variables identified as statistically significant in the Intention Model are ranked in declining order of elasticity, then Distributive Fairness takes second place, followed by Security and, finally, Conservatism.

7. Concluding comments

Earlier it was observed that farm business viability is recognised as an important constraint on farmer compliance with the LWMPs. However, the above results suggest that informal aspects of governance have at least as much substantive significance for farmers' LWMP compliance as their viability (represented in this study by the Security variable) does. Moreover, it is not at all obvious that policy can enhance farm viability at a lower cost than it can enhance informal social assets like farmers' trust or group identity. The challenge is to progressively learn from experiences with participative agri-environmental programs so that they may designed to deliver such assets ever more efficiently.

Despite the intensive participation strategy followed in the Murray LWMP process, for instance, farmers' trust that others will comply with the plans remains only moderate on average. Social scientists, including economists, have an important role to play in explaining successes, or their lack, so that design and implementation of participative programs can move forward with increased confidence.

The results of the case study reported in this paper indicate that substantial capacity for informal governance already exists within the farming communities of the Murray LWMP districts. Without the voluntary cooperation, or 'order for free', afforded by this capacity, the need for formal governance of the region's commons dilemmas would be so much greater. Yet its seems there is considerable potential for voluntary cooperation that is yet to be tapped.

Obtaining the knowledge to realise this potential, in the case study setting and elsewhere, requires social scientists to shift from the materialistic conception of rationality that has conventionally dominated agri-environmental policy discourses. Business viability, for example, accords with this worldview and is regarded seriously in such discourses as a result. Economists, for instance, have expended considerable effort evaluating the case for government-sponsored structural adjustment programs to reduce the population of non-viable farm businesses (e.g. Gow and Stayner, 1995). In contrast, informal social assets of the kind mentioned above have no place in this worldview and, in consequence, are regarded as part of a natural order that is beyond the concern of rational policy (Stretton and Orchard, 1994).

Persisting with a narrow view of rationality in policy deliberations makes it likely that increasingly valuable opportunities to lighten the mounting burden of formal agri-environmental governance will be inadvertently missed. Acceptance of a broader notion of rational policy seems crucial.

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