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Multi-level Governance and On-farm Adoption of Conservation Practices in Three Australian Regions

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Abstract:

Significant steps have occurred in Australia towards devolving responsibilities for natural resource management (NRM) to community-based regional bodies, especially in motivating farmers to adopt priority conservation practices. A challenge remains in effectively engaging the large populations covered by these bodies. Following previous research indicating the value of nested multi-level (i.e., polycentric) governance in addressing such challenges, this paper examines whether nested systems can confer advantages by strengthening farmers' cooperation with the 'regional delivery model'. This examination involved double-censored regression analyses of data from mail-out farmer surveys in three regions. The findings suggest that community-based approaches are capable under the regional delivery model of motivating greater cooperation from farmers than otherwise possible. They highlight the importance of farmers coming to adopt reciprocity strategies in their key relationships under this model. It seems subregional bodies have an advantage over regional bodies in eliciting such behaviour from farmers because the former are better positioned to engage them effectively. This indicates the value of a polycentric approach to community-based NRM within regions, at least where capacities below the regional level justify devolution of significant responsibilities to lower levels in accordance with the principle of subsidiarity.

Keywords: community-based natural resource management, adoption, agriculture, Australia, regional delivery model, multi-level governance, polycentric governance, nesting.

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1. INTRODUCTION

Since the mid 1980s in rural Australia, a government-sponsored experiment in community-based governance of natural resources has evolved in ways few would have anticipated. This experiment has centred on the delivery of federal and state/territory government funds to motivate landholders to adopt the kinds of conservation practices needed to address the nation's mounting problems with degradation of natural resources. During this time, the 'community' focused on has grown from small local groups to populations of up to hundreds of thousands of people residing within government-delineated regions (Marshall 2008b). The most recent phase of this experiment is referred to as the 'regional delivery model'. The federal government recently continued funding of this model through its recently-announced 'Caring for Our Country' program.

Aside from the challenge presented by this quantum up-scaling of the community-based approach, another challenge derives from the pressures on regional bodies to assume responsibilities (e.g., demonstration of upward accountability to the governments funding them) that risk them becoming perceived by their constituents as extensions of government. A further challenge follows from governmental expectations that regional bodies will invest their funds strategically, rather than spread available funds across their constituency, and the consequent risk that community ownership of regional decisions may be weakened by perceptions of inequity or favouritism (Marshall 2008a).

Despite these major shifts in the context of community-based programs of natural resource management (NRM) in Australia, policy makers continue to expect them to achieve the same outcomes, primarily by motivating farmers to adopt conservation practices promoted under these programs. Little evidence or logic has been presented in support of these expectations. The aim of the research discussed here was to help policy-makers understand and face the foregoing challenges more systematically. It was motivated particularly by the eighth of Ostrom's (1990) design principles for sustainable community ('common property') governance of natural resources. This principle states that for long-enduring regimes of common-property management of larger, more complex, natural resource systems, 'appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises' (ibid. p.90).

This principle has served as a point of departure for researchers concerned with how community-based approaches to environmental management might succeed in settings larger and more complex than small groups and localised communities. The relevance of the 'nesting principle' to the vision behind the community-based approach to regional NRM delivery in Australia is clear from McKean's (2002 p.8) finding that 'nesting small groups inside of larger ones encourages a lot of the work to occur in smaller groups than otherwise, promotes the solidarity of subunits and this elicits more cooperation and higher contributions of effort, and reduces transaction and enforcement costs'. Nevertheless, efforts to establish nested multi-level (i.e., polycentric) systems of environmental governance remain handicapped by weak development of the relevant

theory (Berkes 2002; Marshall 2008b). Meanwhile, the value of such systems for enhancing the robustness of institutional responses to complex environmental problems, particularly where problems involve multiple spatial and temporal scales, is becoming increasingly recognised (Armitage 2008; Berkes 2008; Marshall 2005; Marshall 2008b).

The present study sought to contribute to development of a theory of nested environmental governance by examining empirically the relationship between nested systems of community-based NRM and farmers' willingness to cooperate voluntarily in adopting conservation practices promoted under the regional delivery model. The case-study method involved complementary application of qualitative and quantitative techniques. This paper reports the quantitative research. The three cases studied are described in section 2. Data collection is discussed in section 3, and the regression models estimated are specified in section 4. The findings from this research are considered in section 5, and conclusions are presented in section 6.

2. THE CASES

The three regions used as case studies were the South West Catchments Region in Western Australia, the Fitzroy Basin Region in Queensland, and the Mallee Region in Victoria. While regional bodies in Western Australia and Queensland are constituted on a non-statutory basis, in Victoria they are statutory authorities. Given the research interest in nested community-based governance, the focus in two of the case-study regions was on parts of those regions where key elements of the regional delivery model had been devolved closer to a subregional level where farmers might be expected to feel a more tangible sense of community.

The first of these regions was the South West Catchments Region, where the subregional focus was on the Blackwood Basin for which the South West Catchments Council had devolved substantial responsibilities to the Blackwood Basin Group. The second of these regions was the Fitzroy Basin Region, where the subregional focus was on the Central Highlands for which the Fitzroy Basin Association has devolved substantial responsibilities to the Central Highlands Regional Resources Use Planning Cooperative. The third case-study region, Victoria's Mallee NRM Region, offered an additional contrast to the other two (i.e., aside from the status of its regional body, the Mallee Catchment Management Authority, as a statutory authority) since it had decided against establishing subregional arrangements with similar stature as in the other two cases. Instead, it had subsumed the preceding community-based organisations as advisory committees. To maintain reasonable comparability across the three cases, our focus in the Mallee Region was on dryland farming districts of that region, since agricultural activity in the other two subregions is predominantly dryland-based.

2.1 The Blackwood Basin case

The South West Catchments Region is one of the six regions in Western Australia designated for the regional delivery model. The region encompasses 51,657 km^2,

193,000 people, around 5,000 farm businesses, and 33 local government areas. The Blackwood River flows 280 kilometres through mostly agricultural land before reaching the coast at Augusta. The Blackwood Basin encompasses about 23,500 km^2 and around 37,000 people. Currently, 78 per cent of the area of the Basin is used for agriculture. Of the Basin's land resources, 10-12 per cent are estimated to be in poor to very poor condition due to clearing, salinity and other factors.

The South-West Catchments Council (SWCC) was formed in 1999, as a federation of NRM groups that had already formed at the scale of catchments: Blackwood Basin Group (BBG); Cape to Cape Catchments Group; Geographe Catchment Council; Leschenault Catchment Council; Peel-Harvey Catchment Council; and Warren Catchments NRM Group. It is the designated body in this region for the regional delivery model.

The origins of the Blackwood Basin Group (BBG) can be traced to 1989 when environmental groups and the Bridgetown-Greenbushes Shire recognised a coordinated effort was needed to reverse degradation of the Blackwood River. The Blackwood Catchment Coordinating Group (BCCG) was established in 1992, with its name changed in 1998 to the Blackwood Basin Group. The BBG adopted a 'zone action planning (ZAP) strategy' in that year to facilitate efficient distribution of Landcare funding for conservation efforts by local groups. This strategy was the basis for a regional initiative funded over 1999-2003 with $5.3 million from the first phase of the NHT. The advantages of the ZAP concept were outlined by Ecker et al. (2000) as follows:

> Zone Action Planning is a community initiative, and a community group [i.e., the Blackwood Basin Group] provides the framework, funding requirements and support for another funding group [i.e. the zone committee]. Unlike other examples where the initiative is part of a government program, this comes from inside the neighbourhood. … This example of a local community group working closely with a regional community group, provides opportunities for greater trust building and the resultant, innovative thinking and commitment to carry through.

2.2 The Central Highlands case

The Fitzroy Basin NRM region includes not only the catchment of the Fitzroy River system (the Fitzroy Basin) but also the catchments of the Boyne and Calliope Rivers and of smaller streams draining the region's coast. The Fitzroy Basin comprises the catchments of the Nogoa, Comet, Mackenzie, Isaac, Dawson, and Fitzroy Rivers. The region encompasses 156,000 km^2,19 local government areas wholly or in part, and around 200,000 people. Rockhampton is the regional capital.

The Fitzroy Catchment Coordinating Group was established in 1994. This Group was renamed the Fitzroy Basin Association (FBA) in 1997, and became a not-for-profit organisation incorporated under the (Queensland) Associations Incorporation Act 1981.

The Fitzroy Basin NRM region was identified as a priority region for the NAP. This was due to levels of sediment and nutrients in its waterways, which discharge into the Great Barrier Reef lagoon and affect the condition of inshore reefs. The FBA was designated

as the appropriate community-based organisation to coordinate the involvement of the region in the NAP, including by developing a NRM strategy for the region. The FBA recognises five subregions within its region: Boyne-Calliope; Three Rivers (Isaac/Connors and Mackenzie); Fitzroy River and Coastal Catchments; Dawson Catchment; and Central Highlands.

The Central Highlands subregion is approximately 270 km inland from Rockhampton. It includes five shires, 4.5 million hectares, and about 20,000 people including the major population centre of Emerald. The majority of this subregion comprises the catchments of the Comet and Nogoa Rivers which lie within the Fitzroy Basin NRM Region. The largest land use in these catchments is agriculture, primarily grazing. The threats to land use and management include hillslope erosion, low amounts of soil surface cover, inappropriate land clearing, high inputs to agricultural systems, drought followed by high-intensity storms, and pest plants and animals. Threats to biodiversity include broadscale tree clearing, inappropriate grazing management, habitat fragmentation, environmental weeds and pest animals.

The Central Highland Regional Resources Use Planning Cooperative (CHRRUP) was established in 1997 as a three-year project supporting stakeholder sectors in planning their response to the pressures they were facing in sustainably managing the region's natural resources. CHRRUP survived beyond the duration of the project and became an Incorporated Co-operative in September 2001.

2.3 The Mallee Region dryland case

The Mallee NRM region covers approximately 3.9 million hectares, which is almost one-fifth of Victoria. Dryland agriculture, on which the case study in this region focuses, accounts for 98.6 per cent of the agricultural land in the region.

The first Mallee Regional Catchment Strategy (RCS) was released by the then Mallee Catchment and Land Protection (CaLP) Board in June 1997. The Mallee CMA assumed the responsibilities of the CaLP Board when it was established in 1997. In developing the second RCS, nine major processes were identified as threatening natural resources and productive activities in the region: loss of ecological processes; pest plants and animals; altered flooding regimes; land and water salinisation; water pollution; wind erosion; changing land use; recreational pressures; and altered fire regimes.

The CMA is a statutory body, with a Board of 10 members appointed by the Minister for Environment. Selection of these members is based on their collective skills and experience in land protection, water resource management, primary production, environmental conservation, local government and industry. The Board is supported by two Implementation Committees (ICs) that are 'the vehicles by which the Authority can ensure community awareness and ownership of the strategies and projects'. The Board appoints community members to the ICs. The Mallee Lands Committee takes a leadership role in dryland issues. The CMA leads a regional landcare network. There is no formal relationship between the ICs and the system of landcare groups in the region,

other than the fact that they are each administered and supported by the CMA. Unlike the BBG or CHRRUP, the ICs are limited to advisory roles in respect of decisions regarding funding and implementation of on-ground projects. Other key differences are that the ICs are not autonomous in selecting their members, they do not employ or supervise their own field officers, and they share the offices of the regional body. Hence, they are not autonomous subregional bodies like the BBG or CHRRUP.

3. DATA

Data for estimating the multiple regression models were obtained from surveying farmers in each case-study sub-region. Questionnaires were posted to farmers in September 2006. Farm businesses not responding within six weeks were sent a reminder letter together with a replacement copy of the full questionnaire. Survey responses were received until February 2007.

The sampling frame of 1,950 farm businesses used for the Blackwood Basin was provided by the BBG. It was calculated that a sample size of 321 would provide an estimate of proportions for that population with a confidence level of ± 5 per cent at the 95 per cent confidence level. After allowing for the anticipated response rate, it was estimated that the desired final sample of 321 farm businesses would be achieved by posting the questionnaire to 1,340 of the farm businesses in the sampling frame. Completed questionnaires were received from 333 farm businesses, a response rate of 29.3 per cent.

It was not possible for the Central Highlands subregion to develop a satisfactory sampling frame of farm businesses. The best strategy under the circumstances was to post questionnaires to all farmers within the subregion through Australia Post's 'unaddressed delivery service'. Australia Post advised that 890 farm businesses were covered by that service within the subregion. Given the impersonal nature of unaddressed delivery, the label affixed to each envelope included the CHRRUP logo and the following words: 'To the farmer or grazier. This survey collects important information which may help government $ to be invested in the Central Highlands. Your time filling it out is appreciated'. Completed questionnaires were received from 170 farm businesses, a response rate of 19.6 per cent.

The sampling frame used for this survey of farm businesses in dryland zone of the Mallee NRM Region was drawn from a database held by the Victorian Farmers Federation of its 862 farm-business members within that region. It was calculated that a sample size of 266 would provide an estimate of proportions for that population with a confidence level of ± 5 per cent at the 95 per cent confidence level. After allowing for the anticipated response rate, it was estimated that a sample of 266 farm businesses would be achieved by posting the questionnaire to all 862 farm businesses in the sampling frame. Completed questionnaires were received from 318 farm businesses, a response rate of 40.2 per cent.

4. MODEL SPECIFICATION

The research reported in this paper estimated multiple regression models to test whether, and how, farmers' trust in the regional delivery model is associated with their adoption of conservation practices promoted to them under this model. In seeking to examine this relationship, it was necessary to control for the effects of other relevant explanatory variables. The variables included in the models, and corresponding hypotheses, are specified below.

4.1 Dependent variables

A dependent variable was specified for each regression model, which measured survey respondents' expected changes in adoption of a particular conservation practice over the subsequent ten years. Each of the models differed only in terms of the particular conservation practice focused upon. Models were estimated for 22 of the on-farm conservation practices for which data were collected through the mail-out surveys. The practices for which adoption data were collected in a case were identified by the relevant NRM body (i.e., BBG, CHRRUP or Mallee CMA) as the main practices they were promoting to dryland farmers under their jurisdiction.

The model for any given practice was estimated with data for 'applicable respondents' (i.e., excluding respondents who indicated the practice did not apply to their property). Tables 4.1 to 4.3 present relative frequency distributions for the expected adoption changes of applicable Blackwood Basin, Central Highlands and Mallee dryland respondents, respectively, for each conservation practice relevant to that case.

Data for the dependent variables for each of the 22 models estimated was 'double-censored' since the value of the dependent variable for significant numbers of respondents was located at the minimum and maximum ends of the possible range. A respondent could not dis-adopt a practice any more than the practice had already been adopted. The maximum possible increase in future adoption of a practice for a particular respondent was equal to the difference between their property size and their current adoption of that practice. The option of censored normal regression available in Stata software (StataCorp. 2007) was appropriate for estimating these models. This option adapts the standard tobit procedure in order to account for double-censoring at varying limits across observations (Greene 2000). The numbers of left- and right-censored observations on the dependent variable for each practice are detailed in Marshall (2008a).

4.2 Explanatory variables and corresponding hypotheses

As far as possible given the constraints on collecting data through mail-out surveys (particularly farmers' time and patience), the regression models estimated in this study included explanatory variables identified in previous research as key predictors of farmers' adoption of conservation practices. The models estimated for the Blackwood Basin and Central Highlands cases each comprised 18 explanatory variables plus an

Table 4.1: Relative frequency distributions for expected adoption changes for relevant practices by applicable Blackwood Basin respondents

Practice	Proportion (%) of applicable respondents expecting to change their use of practice by:							n
	≤ -500 ha	-500 to -100 ha	-99 to -1 ha	0 ha	1 to 99 ha	100 to 499 ha	≥ 500 ha	
Surface water management	2.7	2.3	3.1	53.1	15.4	16.9	6.5	260
Groundwater management	0.0	0.5	2.6	63.3	17.3	11.7	4.6	196
Establish perennial vegetation	0.0	1.2	2.7	57.3	29.4	7.5	2.0	255
Establish perennial pastures	0.7	0.0	2.2	51.5	25.0	17.5	3.0	268
Revegetation & protective fencing	0.0	1.5	3.8	56.4	28.6	8.3	1.5	266
Soil remediation	0.4	1.1	1.1	79.6	5.7	5.7	6.4	265
Zero or minimum tillage cropping	1.4	2.7	0.9	70.0	10.0	11.4	3.6	220
Pest and weed control	1.4	1.7	1.7	83.6	4.2	4.5	2.8	287

Table 4.2: Relative frequency distributions for expected adoption changes for relevant practices by Central Highlands respondents

Practice	Proportion (%) of applicable respondents expecting to change their use of practice by:							n
	≤ -500 ha	-500 to -100 ha	-99 to -1 ha	0 ha	1 to 99 ha	100 to 499 ha	≥ 500 ha	
Maintain groundcover on grazing land	0.5	0.0	0.0	76.8	2.9	5.3	14.6	134
Fencing to land type for grazing	0.5	0.0	0.0	66.1	0.0	4.0	29.4	125
Minimum or zero tillage cropping	2.7	1.8	2.4	79.6	0.0	7.8	5.6	97
Soil conservation measures	1.7	1.5	1.0	70.1	3.9	9.7	12.2	120
Property management planning	0.0	0.0	1.1	81.1	0.0	2.6	15.3	106
Fencing riparian areas and installing watering points	1.5	1.0	0.5	64.9	5.2	5.9	20.9	118
Environmental weeds control	1.8	0.9	1.6	75.7	1.9	4.3	13.8	142

intercept term. These explanatory variables are listed in Table 4.4. The models estimated for the Mallee Region case comprised a corresponding set of explanatory variables, with the exception that the variable *trust in subregional body* was not included since no relevant subregional body exists in that region. The hypothesised direction, or directions, of relationship between each explanatory variable and the relevant dependent variable is also noted in the table. Also included are the questionnaire items from which data for each explanatory variable were derived and, where relevant,

Table 4.3: Frequency distributions for expected adoption changes for relevant practices by Mallee dryland respondents

Practice	Proportion of respondents identifying practices as applicable (%)							n
	≤ -500 ha	-500 to -100 ha	-99 to -1 ha	0 ha	1 to 99 ha	100 to 499 ha	≥ 500 ha	
Reduced or minimum tillage	1.4	1.8	0.4	76.1	1.8	7.1	11.4	280
Continuous cropping	1.2	2.0	0.4	72.8	1.2	9.1	13.4	254
Establish high water-use plants	0.5	0.5	0.5	72.6	11.7	11.7	2.5	197
Control pest animals	1.1	0.4	0.4	95.8	0.4	0.0	1.9	265
Control environmental weeds	2.2	0.4	1.1	92.5	0.7	1.1	1.9	268
Remove grazing pressure from native vegetation	0.0	0.0	0.0	81.9	13.2	4.2	0.7	144
Link patches of native vegetation	0.0	0.0	1.1	79.4	17.7	1.7	0.0	175

explanations of how values for each variable were derived from corresponding item scores.

Property characteristics

The first two explanatory variables in each model were included to explore how the structural characteristics of respondents' properties relate to their adoption of conservation practices. *Property size* (hectares) was included following the lead of a number of previous studies of farmer adoption of conservation practices. Feder et al. (1985) remarked that a frequent reason given for expecting greater adoption of innovations on larger farms follows from the logic that the fixed costs of adoption are a lesser obstacle to uptake on larger farms where they can be defrayed over a greater area of adoption. Nevertheless, they observed that some studies have found tendencies for adoption of innovations to be greater on smaller farms. The possible reasons they identified for such findings included smaller farmers seeking to farm their land more intensively, and the opportunity costs of family labour on small farms being lower. Due to this ambiguity, it was hypothesised only that the coefficient of *property size* in each model differs from zero. Mean values for *property size* in the Blackwood Basin, Central Highlands and Mallee dryland cases were 1,117 hectares, 8,782 hectares, and 2,296 hectares, respectively.

The other variable included in models to account for property structural characteristics was *% net income from grazing*. This variable provides a measure of respondents' current financial dependence on grazing enterprises relative to broadacre cropping enterprises. A number of the conservation practices covered in this study are clearly more relevant to grazing enterprises than cropping enterprises. However, a clear one-way relationship should not be expected between greater dependence on one of these enterprise classes and the adoption of a conservation practice particularly relevant to

Table 4.4: Explanatory variables, associated hypotheses and questionnaire items

Explanatory variable	Expect-ed sign	Questionnaire items	Measurement
Property area	+ / -	What is the total area of land owned or managed by you or your immediate family in the (relevant subregion)?	Hectares
% net income from grazing	+ / -	In approximate terms, please indicate the percentage of your property's total net income from farming over the last few years that came from grazing?	%
Years experience farming	+ / -	As an adult, how many years practical experience do you have in owning, managing or working on a agricultural or grazing property?	Years
Local group involvement	+	We are interested in local groups concerned with sustainable farming/grazing/irrigation issues, or natural resource or environmental issues, on or near your property. (For the one such group) that your property has been most involved with over the last few years, please indicate your property's level of involvement with this local group over the last few years.	0 = no involvement 1 = occasional 2 = fairly active 3 = active involvement
Formal education	+ / -	What is the highest level of formal education you completed?	1 = primary school 2 = part secondary 3 = all secondary 4 = trade/technical certificate 5 = diploma/associate diploma 6 = degree
Place attachment	+ / -	How strongly do you agree or disagree with each of the following statements? I feel a bond with our property I feel a bond with our district	1 = strongly disagree 2= disagree 3 = agree 4 = strongly agree Scale scores calculated as means of the 2 item scores. Cronbach's Alpha values: Blackwood Basin = 0.69 Central Highlands = 0.72 Mallee = 0.81
Profitability	+ / -	How profitable has your property been over the last few years?	1 = very unprofitable 2 = unprofitable 3 = breaking even 4 = profitable 5 = very profitable
Equity ratio	+ / -	Approximately, what is the current level of equity in your property?	1 = less than 50% 2 = 50-69% 3 = 70-89% 4 = 90% and over
% income from farm business	+ / -	In the last few years, about what proportion of your household's total net income came from farming activities on your property?	1 = less than 20% 2 = 20-49% 3 = 50-69% 4 = 70-89% 5 = 90% and over

Table 4.4 (continued)

Explanatory variable	Expect-ed sign	Questionnaire items	Measurement
Contribution to goals	+	How strongly does (relevant practice) help or hurt your property's chances of achieving its main goals?	1 = hurt greatly 2 = hurt moderately 3 = hurt slightly 4 = help slightly 5 = help moderately 6 = help greatly
Perceived commons problem	+ / -	Sometimes, if a practice is going to work properly on one place, it needs also to be used by other landholders in the same district. In your view, how much does the effectiveness on your property of (relevant practice) depend on what others in your district are doing? (If you marked 'possibly/certainly depends on others'), how likely is it that other landholders in your district will use the practice sufficiently for it to work properly on your place?	0 = doesn't depend on others 1 = possibly depends 2 = certainly depends on others 1 = highly likely 2 = likely 3 = neither likely or unlikely 4 = unlikely 5 = highly unlikely Variable score for a respondent was zero if answer to first item was 'doesn't depend on others'. Otherwise it was calculated as the product of the two item scores.
Expected future district adoption	+ / -	How widely do you expect (the relevant practice) will eventually be used in your district?	1 = zero or minimal use 2 = limited use 3 = moderate use 4 = wide use
Trust in subregional body *Since no relevant subregional body exists in the Mallee Region, this variable was excluded from models estimated for this Region's farmers.*	+ / -	The (relevant subregional body) understands the issues faced in our district. The (relevant subregional body) is serious about helping our community to solve our own NRM problems. Community members on the (relevant subregional body) can be trusted to argue forcefully for the interests of the (relevant subregion). Staff of the (relevant subregional body) care about our community. The (relevant subregional body) is less bureaucratic than government generally.	1 = strongly disagree 2 = disagree 3 = agree 4 = strongly agree Scale scores calculated as means of the 5 item scores. Cronbach's Alpha values: Blackwood Basin = 0.90 Central Highlands = 0.91
Trust in regional body	+ / -	The (relevant regional body) understands the issues faced in our district. The (relevant regional body) is serious about helping our community to solve our own NRM problems. Community members on the (relevant regional body) can be trusted to argue forcefully for the interests of the (relevant region). Staff of the (relevant regional body) care about our community. The (relevant regional body) is less bureaucratic than government generally.	1 = strongly disagree 2 = disagree 3 = agree 4 = strongly agree Scale scores calculated as means of the 5 item scores. Cronbach's Alpha values: Blackwood Basin = 0.87 Central Highlands = 0.90 Mallee = 0.87

Table 4.4 (continued)

Explanatory variable	Expect-ed sign	Questionnaire items	Measurement
Trust in gov't commitment to community empowerment	+ / -	The Federal Government is serious about empowering our community to solve our own NRM problems. The (relevant state government) is serious about empowering our community to solve our own NRM problems.	1 = strongly disagree 2 = disagree 3 = agree 4 = strongly agree Scale scores calculated as means of the 2 item scores. Cronbach's Alpha values: Blackwood Basin = 0.74 Central Highlands = 0.73 Mallee = 0.76
Trust in government integrity	+ / -	The regional approach is a way for governments to 'pass the buck' on difficult issues. The regional approach is part of a strategy to increase government regulation of rural land-use. The regional approach is a way to transfer NRM costs onto volunteers.	1 = strongly agree 2 = agree 3 = disagree 4 = strongly disagree Scale scores calculated as means of the 3 item scores. Cronbach's Alpha values: Blackwood Basin = 0.65 Central Highlands = 0.58 Mallee = 0.63
Trust in regional/subregional autonomy	+ / -	The (relevant regional body) is just a 'rubber stamp' for decisions made by the Federal Government. The (relevant regional body) is just a 'rubber stamp' for decisions made by the (relevant state government). The (relevant subregional body) is just a 'rubber stamp' for decisions made by the Federal Government. The (relevant subregional body) is just a 'rubber stamp' for decisions made by the (relevant state government). The (relevant subregional body) is just a 'rubber stamp' for decisions made by the (relevant regional body). *Note: Since no relevant subregional body exists in the Mallee Region, data on the last 3 of these items were not collected from this Region's respondents.*	1 = strongly agree 2 = agree 3 = disagree 4 = strongly disagree Scale scores for Blackwood Basin and Central Highlands respondents were calculated as means of all 5 item scores. Scale scores for Mallee Region respondents were calculated as the mean of the first 2 items only. Cronbach's Alpha values: Blackwood Basin = 0.86 Central Highlands = 0.91 Mallee = 0.86

that enterprise class. The direction of such a relationship can be expected to be positive if farmers tend to perceive the practice as benefiting that class of enterprises, and negative if they perceive it as handicapping those enterprises. Consequently, it was hypothesised only that the coefficient of *% net income from grazing* in each model differs from zero.

Farmers' human capital

The next three explanatory variables in each model examined how farmers' human capital relates to their adoption of conservation practices. *Years experience farming* was included following the observation of Abadi Ghadim et al. (1999) that greater experience of this kind can influence adoption. The direction of influence may depend on whether experiences with related innovations were positive or negative. It may depend also on the degree to which the skills accumulated through this experience are useful for successful adoption of a conservation practice. The more skills a farmer has accumulated in respect of existing practices, and therefore the greater his or her efficiency with those practices, the higher will be his or her opportunity costs of switching to alternative practices less reliant on those skills. Given this ambiguity, coefficients of *years experience farming* were hypothesised only to differ from zero.

Another variable included to account for human capital considerations was *local group involvement*. Since the 1990s in Australia, extension services to farmers have increasingly been delivered through local groups, and this has included extension regarding conservation practices. Various studies have found adoption of some conservation practices to be related positively with membership of catchment and landcare groups (e.g., Kington et al. 2003; Mues et al. 1998), although the direction of the cause-effect relationship remains unclear. *Local group involvement* was therefore hypothesised to relate positively with adoption of each conservation practice.

The last of the three variables accounting for farmers' human capital was *formal education*. Various studies have found a tendency for beneficial innovations to be adopted more quickly with higher levels of formal education (Feder et al. 1985). Not all innovations benefit all farmers, however, and Pannell et al. (2006) observed how farmers with greater formal education may be better at identifying innovations detrimental to their interests and may thus be less likely to adopt these innovations. Accordingly, coefficients for *formal education* were hypothesised only to differ from zero.

Attachment to place

Terms like 'place attachment' and 'sense of place' have found increasing use to refer to the phenomenon of places becoming imbued with meanings that enhance people's emotional ties to a natural resource. It seems part of the implicit rationale for the regional delivery model was that devolution of NRM governance to more local scales of place would more effectively mobilise individuals' feelings of place attachment as a way of motivating their adoption of conservation practices. The variable *place attachment* was included in models to explore whether farmers' emotional ties to their own locality (their property and district) are indeed associated with their adoption of conservation practices.

The two questionnaire items used in this study to measure *place attachment* were adapted from items demonstrated by Williams et al. (2003) to provide a measure of attachment to place that is generalisable across multiple places. For farmers whose

place attachment derives largely from features of the local landscape maintained through existing farming practices, we might expect their place attachment to relate negatively with their adoption of conservation practices which threaten these features (eg, replacement of pastures with perennial vegetation). For other farmers whose place attachment derives largely from natural features of the local landscape, in contrast, we might expect their place attachment to relate positively with their adoption of conservation practices that return agricultural landscapes closer to their natural state (eg, linking patches of native vegetation). Accordingly, coefficients for *place attachment* were hypothesised only to differ from zero.

Farmers' financial situation

The subsequent three explanatory variables were concerned with how various aspects of farmers' current financial situation relate to their adoption of conservation practices. The first of these is *profitability*, which relates to farmers' profitability over the previous few years. Pannell et al. (2006) suggested that low profitability may inhibit farmers' adoption of innovations by reducing their financial capacity to adopt. Financial capacity may be augmented through off-farm income or credit, however, and low current profitability may sometimes be the spur needed for farmers to overcome inertia holding them back from adopting innovations, including conservation practices, with reasonable prospects of enhancing their longer-term profitability. Consequently, coefficients for *profitability* were hypothesised only to differ from zero.

The second variable included to account for farmers' current financial state was *equity ratio*. Abadi Ghadim (1999) suggested that farmers with higher equity are more likely to trial innovations since this makes them more able to bear the risks of the trials ending unsuccessfully. Another possible reason for expecting a positive relationship between *equity ratio* and adoption of conservation practices follows from observing that pay-offs from adoption of conservation practices are often relatively long-term, making such practices less attractive to farmers in financial difficulty who tend to have higher discount rates. Hence, a positive relationship between *equity ratio* and farmer conservation of conservation practices was hypothesised.

The last of the three variables accounting for farmers' current financial situation was *% income from farm business*. Pannell et al. (2006) reasoned that greater reliance on off-farm income (i.e., lower *% income from farm business*) might increase adoption of beneficial practices by strengthening financial security. They also offered a counter argument that increased reliance on off-farm income might reduce a farmers' likelihood of adopting practices that are otherwise beneficial but involve greater demands on their time. Hence, coefficients for *% income from farm business* were hypothesised only to differ from zero.

Contribution of adoption to farmers' goals

Contribution to goals measures respondents' perceptions of the degree to which adoption of a given conservation practice helps achieve their main goals in running their

property. Inclusion of this variable was motivated by Vanclay's (2004 p.217) conclusion that 'farmers are more likely to adopt innovations that are compatible with other farm and personal objectives', and Pannell et al. (2006 p.1408) finding similarly that 'the core common theme from several decades of research on technology adoption is that landholder adoption of a conservation practice depends on their expectations that it will allow them to better achieve their goals'. A positive relationship between *contribution to goals* and farmers' adoption of conservation practices adoption was thus hypothesised.

Farmers' perceptions of adoption as a commons problem

Perceived commons problem was included in each model following previous studies observing that farmers' adoption of a conservation practices may depend on the degree to which they believe the benefits they receive from their own adoption will increase with increased adoption by other farmers in their locality. Pannell et al. (2001) observed how many Australian farmers came to perceive that successful mitigation of dryland salinity on their own properties would depend on neighbours cooperating by undertaking similar mitigation efforts on their properties. Pannell et al. (2006) reasoned that although this commonly-held perception was incorrect for many properties (particularly in Western Australia), it may still have weakened farmers' incentives to adopt mitigation practices given the transaction costs of farmers developing trust that other farmers will reciprocate their efforts.

Individuals with such a perception (whether correct or incorrect) can be said to face a 'commons problem' of the kind popularised by Hardin (1968). Hardin represented the problem in terms now referred to as a 'free-rider problem', since he assumed implicitly that individuals perceiving that others' conservation efforts would benefit themselves, and also trusting others to undertake those efforts, would (in terminology since made popular) 'free ride' on those efforts rather than engage in those efforts themselves. This representation leads us to expect that individuals perceiving themselves in a commons problem will invariably contribute less to solving the problem the more they trust others to solve the problem.

Subsequent empirical research on behaviour in commons problems, however, has established it is mistaken to assume that individuals perceiving themselves as facing commons problems will invariably respond by following free-rider strategies. This research has demonstrated it is not uncommon for individuals perceiving themselves in a commons problem to respond by following reciprocity strategies rather than free-rider strategies – and consequently to contribute more to solving a commons problem the more that they trust others to help solve it (Baland et al. 1996; Marshall 2005).

Although free-rider and reciprocity strategies differ, they each are examples of contingent strategies. If others are trusted to cooperate more, an individual will also cooperate more if she follows a reciprocity strategy, but will cooperate less if she follows a free-rider strategy. Individuals can also follow non-contingent strategies, including unconditional cooperation or unconditional non-cooperation. The behaviour of such individuals in commons problems may be dominated by various factors, including

ideological convictions or judgements from experience that unconditional cooperation/non-cooperation tends to best serve their interests.

Respondents' perceptions of a commons problem in adopting a particular conservation practice were measured as explained in Table 4.4. An applicable respondent's score for this variable was calculated from two questionnaire items. The first of these was: 'Sometimes, if a practice is going to work properly on one place, it needs also to be used by other landholders in the same district. In your view, how much does the effectiveness on your property of (relevant practice) depend on what others in your district are doing?'. The second of the two questionnaire items was asked only of respondents who had answered 'possibly depends' or 'certainly depends on others'. The item was 'How likely is it that other landholders in your district will use the practice sufficiently for it to work properly on your place?'. *Perceived commons problem* was scored as zero if a respondent answered 'doesn't depend on others' to the first of these items. Hence, a score of zero identifies respondents without a perceived commons problem in adopting a particular conservation practice. Otherwise, this variable was scored as the product of the scores of the two items.

Higher scores for *perceived commons problem* would be expected to be associated with greater adoption of a practice if farmers were predominantly following free-rider strategies for that practice – the less they perceive an opportunity to free-ride on others' adoption of a practice, the more likely they are to adopt it themselves. In contrast, higher scores for this variable would be expected to be associated with lesser adoption of a practice if farmers instead were predominantly following reciprocity strategies for that practice. Finally, we would expect higher scores for *perceived commons problem* to be unrelated with adoption of a practice under two possible scenarios: (i) where farmers were predominantly following non-contingent strategies for that practice, or (ii) where most farmers were following contingent strategies (i.e., either reciprocity or free-riding) but the proportions following reciprocity and free-riding were sufficiently similar that their influences on adoption of a practice 'cancelled each other out'. To the extent that farmers were following non-contingent strategies in this context, we would expect unconditional non-cooperation to be more common than unconditional cooperation. Empirical research (e.g., Axelrod 1984) has demonstrated that unconditional cooperation is easily exploited by free riders or unconditional non-cooperators and is therefore rarely sustainable. Given these multiple possibilities, coefficients for *perceived commons problem* were hypothesised only to differ from zero.

Farmers' expectations of future adoption across their district

Perceived future district adoption was included in the model for each practice to account for variability across respondents in how widely they perceived this practice would eventually be adopted by other farmers in their respective districts. Inclusion of this variable in these models was motivated by Vanclay (2004) and Pannell et al. (2006) highlighting adoption of conservation practices as a social process. Pannell et al. observed how farmers' adoption of innovative practices can be affected by their perceptions of how adoption may affect their social standing. Sometimes the effect on

social standing, and thus on adoption, may be negative, such as when local norms of good farming practice exist which reward conservatism and sanction innovation. Where social dynamics of this kind are dominant for a particular practice, we might expect to find that farmers expecting to increase their adoption of this practice the most tend to be those whose *perceived future district adoption* of that practice is lower (i.e., who perceive their adoption would challenge local conservatism least).

In other settings the effect of adopting an innovation on social standing, and thus on the likelihood of adoption, may be positive. Abadi Ghadim (1999) observed how some proportion of farmers is driven by the status generally afforded in sections of their communities to those seen as innovative. In some farming communities for some areas of farming practice, moreover, local norms of good farming practice may predominantly focus on rewarding innovation rather than discouraging it. Where this social dynamic is dominant for a particular practice, we might expect to find that the farmers with higher expectations of increasing their adoption of this practice tend to be those that regard their adoption as having been more innovative (i.e., whose *perceived future district adoption* of that practice is lower). Given these opposing considerations, coefficients for *perceived future district adoption* were hypothesised only to differ from zero.

Farmers' trust in the regional delivery model

The final five explanatory variables included in all models each relate to a different aspect of farmers' trust concerning the regional delivery model. As such, they constitute the vehicles by which the hypotheses of central interest in this study – concerned with relationships between farmers' trust in the regional delivery model and their preparedness to adopt the on-farm practices promoted under that model – were tested. Whereas the trust of farmers for other farmers perceived as sharing a commons dilemma with them is a kind of 'horizontal' trust, the trust of farmers in the multi-level governance system constituting the regional delivery model is a kind of 'vertical' trust. The relevance of vertical trust for farmers' adoption of conservation practices has been highlighted by various authors (Lubell et al. in press; Marshall 2004a; Marshall 2004b; Pannell et al. 2006).

Construction of explanatory variables to account for farmers' trust in the regional delivery model began with qualitative analysis of transcripts of workshops and key-informant interviews to identify the issues associated with farmers' trust in the regional delivery model. These issues formed the basis for specifying questionnaire items designed to obtain data on farmers' trust in this model. For each of the three cases, farmers' responses to each of these questionnaire items were subjected to principal components analysis (PCA). The striking feature of the PCA solutions after varimax rotation was the similarity across cases in the items loading at least moderately onto different components. This consistent pattern of loadings provided an unambiguous basis for the assignment shown in Table 4.4 of items for measuring each of the explanatory variables accounting for farmers' trust in the regional delivery model.

Four variables were constructed corresponding to the same four components identified across the three cases with eigenvalues exceeding one. The names chosen for these variables, and also for the fifth variable discussed below, reflect the common thread of the issues covered by the items allocated to those variables. The names assigned to these four variables were: (i) trust in regional body; (ii) trust in government commitment to community empowerment; (iii) trust in government integrity; and (iv) trust in regional/subregional autonomy. A fifth variable was constructed corresponding to a fifth component identified in both the Blackwood Basin and Central Highlands cases that in each case had an eigenvalue exceeding one. This variable was named *trust in subregional body*.

The earlier reasoning in relation to a hypothesis for *perceived commons problem* is relevant to our hypotheses regarding the relationship between farmers' trust in the regional delivery model and their adoption of conservation practices promoted to them under that model. If farmers' trust that higher-level bodies will cooperate with them in solving the NRM problems important to them is increased, they will tend to cooperate more themselves (e.g., by adopting conservation practices) if they are following a reciprocity strategy, but less if following a free-rider strategy (Marshall 2004a).

Aside from the possibilities that farmers have been following contingent strategies (either reciprocity or free-riding) in their interactions with the regional delivery model, the possibility also exists that significant numbers of farmers have been following strategies of unconditional non-cooperation or, more simply, opposition. Continuing anger felt by many Australian farmers as a result of state governments imposing regulations restricting their rights to clear native vegetation and utilise water may be transferred to regional NRM bodies to the extent they are perceived as extensions of government or under its control. Anger of this kind can heighten appreciably the risk of farmers adopting strategies of opposition in their dealings with governments and other organisations perceived as allied with them.

Given lack of prior knowledge regarding whether farmers in each of the cases studied were following strategies of reciprocity, free-riding or opposition in their dealings with the regional delivery model, coefficients for the five variables accounting for farmers' trust in the regional delivery model were hypothesised only to differ from zero. A positive coefficient sign for a variable would indicate the predominant strategy was reciprocity. A negative coefficient sign would indicate free-riding was dominant. Rejection of the hypothesis would indicate either that (a) landholders were predominantly following strategies of opposition (unconditional non-cooperation) in their dealings with higher-level organisations, or (b) there was no clear majority following reciprocity or free-riding strategies in these dealings.

With the Australian history of paternalistic natural resources governance in respect of farmers, and the considerable antagonism this has sometimes caused, it seems reasonable to assume that few farmers were following reciprocity strategies in their dealings with government before the mid-1980s. This pattern may have begun to shift around this time as a consequence of the introduction of Landcare, integrated

catchment management, and other community-based NRM programs. With such programs, Australian governments turned towards supporting the self-reliance of farmers and their communities in addressing natural resource issues, while expecting farmers and their communities to reciprocate this support by voluntarily contributing some resources towards resolving these issues (e.g., investing in adoption of recommended on-farm conservation practices).

Nevertheless, the focus of such programs until introduction of the regional delivery model was on community levels no higher, relative to the scale of regions delineated under this model, than what is now called 'subregional'. To the extent that such programs have effected a transition in farmers' dealings with higher-level NRM bodies towards strategies of reciprocity, therefore, we would expect this transition to be more evident in their dealings with subregional groups than in their dealings with regional groups. Accordingly, it was hypothesised that farmers remain more likely to follow reciprocity strategies in their dealings with subregional bodies than with regional bodies.

We might also expect to find in those subregions where subregional groups have continued as 'frontline' agents for NRM delivery, that the transition towards farmers dealing with regional groups on the basis of reciprocity has been particularly slow. The reasoning here is that reliance on such intermediaries makes it harder for regional groups to demonstrate through their deeds, not just their words (e.g., brochures and public statements), that they are trustworthy for a relationship of mutual reciprocity. Accordingly, it was hypothesised that farmers would be more likely to follow reciprocity strategies in their dealings with regional bodies in those subregions where a subregional body was not acting as a frontline agency for NRM delivery.

5. RESULTS

5.1 Statistical findings

The focus here is on identifying patterns of statistical support for the hypotheses across the models and cases. This task is assisted by Table 5.1 which summarises findings across the three cases concerning each explanatory variable[1]. For each case, and also for the three in aggregate, the table presents the total frequency with which the hypothesis concerning a specific variable was supported at the 90 per cent level of significance, as well as the frequency with which the variable's relationship with expected adoption change was found to be in a positive or negative direction.

The '% of possible' column reveals the one-tailed hypothesis (of a positive relationship) for *perceived contribution to goals* to be the hypothesis supported by the highest proportion (68 per cent) of models across the three cases. Of particular interest to the present study, we find that the hypothesis for *trust in subregional body* was supported by the second highest proportion of models (nine out of fifteen, or 60 per cent) across the two relevant cases. It is also of particular interest that all of these nine models identified a positive relationship between this variable and farmers' adoption plans for

[1] See Marshall (2008a) for detailed regression results.

Table 5.1: Summary of hypothesis-test findings and associated coefficient signs

Explanatory variable	Frequency of models supporting each hypothesis (*total*), and of associated coefficient sign (+ or -)												
	Blackwood Basin (possible 8 models)			Central Highlands (possible 7 models)			Mallee Region dryland (possible 7 models)			Total (possible 22 models*)			
	+	-	Total	+	-	Total	+	-	Total	+	-	Total	% of possible
Property area (ha)	2	1	**3**	3	0	**3**	3	0	**3**	8	1	**9**	**41**
% net income from grazing	0	0	**0**	1	0	**1**	1	0	**1**	2	0	**2**	**9**
Years experience farming	0	2	**2**	2	0	**2**	0	1	**1**	2	3	**5**	**23**
Local group involvement	5	na	**5**	3	na	**3**	2	0	**2**	10	na	**10**	**45**
Formal education	1	1	**2**	2	0	**2**	1	0	**1**	4	1	**5**	**23**
Place attachment	0	2	**2**	1	0	**1**	0	0	**0**	1	2	**3**	**14**
Profitability	0	1	**1**	1	1	**2**	1	0	**1**	2	2	**4**	**18**
Equity ratio	1	na	**1**	1	na	**1**	0	na	**0**	2	na	**2**	**9**
% income from farm business	0	0	**0**	0	0	**0**	1	0	**1**	1	0	**1**	**5**
Perceived contribution to goals	6	na	**6**	4	na	**4**	5	na	**5**	15	na	**15**	**68**
Perceived commons problem	0	0	**0**	1	1	**2**	2	0	**2**	3	1	**4**	**18**
Expected future district adoption	5	0	**5**	0	0	**0**	5	0	**5**	10	0	**10**	**45**
Trust in subregional body	4	0	**4**	5	0	**5**	Na	na	**na**	9	0	**9***	**60**
Trust in regional body	0	1	**1**	0	4	**4**	1	0	**1**	1	5	**6**	**27**
Trust in gov't commitment to community empowerment	0	1	**1**	0	0	**0**	1	1	**2**	1	2	**3**	**14**
Trust in government integrity	1	0	**1**	0	2	**2**	1	0	**1**	2	2	**4**	**18**
Trust in regional/subregional autonomy	0	0	**0**	1	1	**2**	0	1	**1**	1	2	**3**	**14**

na ~ not applicable.
* Total number of practices for *trust in subregional body* was 15 rather than 22, since this variable was not relevant to the seven models for Mallee Region dryland.

the relevant practices. Given the reasoning above, it seems that farmers in each of these instances are following reciprocity strategies when interacting with their relevant subregional body.

The hypotheses for *local group involvement* and *perceived future district adoption* were supported by the next highest proportion of models (45 per cent) across the three cases. Each of the ten models supporting the hypothesis for *perceived future district*

adoption identified a positive relationship between this variable and farmers' expected adoption change for the relevant practices. Given the reasoning above in respect of this variable, it seems that the influence of *expected future district adoption* of a practice on their own adoption plans is predominantly via social dynamics encouraging them to innovate.

The hypothesis for *property area* was supported by the next highest proportion of models (41 per cent) across the three cases. Of the nine models supporting this hypothesis, eight identified a positive relationship between this variable and farmers' expected adoption change. It seems that where *property size* is influencing farmers' expected adoption changes, this influence is mostly through larger property sizes affording them increased scope to spread fixed costs over a larger scale of adoption.

The hypothesis for *trust in regional body* was supported by the next (i.e., sixth) highest proportion of models (27 per cent) across the three cases. The proportion of models supporting the hypothesis for *trust in regional body* is less than half the proportion supporting the hypothesis for *trust in subregional body*. Aside from the one Mallee model supporting this hypothesis, all other models supporting this hypothesis found *trust in regional body* to be negatively related with farmers' expected adoption changes. In the Blackwood Basin and Central Highlands cases, therefore, it seems that this trust is influencing farmers' adoption plans predominantly through free-riding dynamics rather than reciprocity dynamics. The more in these instances they trust their regional body to cooperate with them in addressing their natural resource concerns, the less it seems they are prepared to cooperate with their regional body by adopting the on-farm practices it promotes to them.

This contrasts with the above finding across the three cases that farmers' trust in their subregional body is influencing their decisions on future adoption predominantly through reciprocity dynamics rather than free-rider dynamics. Four of the five models from the Blackwood Basin and Central Highlands cases that found *trust in regional body* to have a significant negative relationship with farmers' expected adoption change (i.e., to influence farmers' decisions via free-rider dynamics) also found *trust in subregional body* to have a significant positive relationship with farmers' expected adoption change (i.e., to influence farmers decisions via reciprocity dynamics). The implication seems to be that the subregional bodies in these cases have managed to foster relationships of mutual responsibility (reciprocity) with most farmers, whereas the regional bodies in these cases have not been as successful in leading their relationships with farmers away from a culture of dependency (i.e., free-riding).

The one model for the Mallee case supporting the hypothesis for *trust in regional body* identified a positive relationship between this variable and farmers' expected adoption change for the relevant practice. In this case, therefore, the regional body (Mallee CMA) appears to have fostered relationships of reciprocity with farmers in respect of this practice. The reasoning regarding this variable in section 4 may help to explain the Mallee CMA's greater apparent success, compared with SWCC and the FBA, in fostering adoption of reciprocity strategies by farmers in its region. The absence of a

subregional group as an intermediary in the Mallee ase may have led farmers in that case to deal more directly with the CMA than would otherwise have occurred, and thus allowed it greater opportunity to demonstrate to farmers through its behaviour that (at least in respect of this practice) it seeks to foster their self-reliance.

Overall, however, future adoption of conservation practices by Mallee dryland farmers seems less affected by trust in the community-based subsystem of the regional delivery model as it applies to them than is the case for farmers in the Blackwood Basin and Central Highlands cases. Hence, it seems that the trust of Mallee dryland farmers in their community-based subsystem of the regional delivery model has generally less 'traction' on their plans for future adoption of conservation practices than does the equivalent trust of Blackwood Basin and Central Highlands farmers. Does this suggest the lack of a subregional community-based level in the Mallee case is a handicap to farmers' future adoption of conservation practices? A reason to think so is that the regional community-based level in this case seems to have been unable to establish reciprocity dynamics with farmers to the same degree that subregional bodies in the other two cases apparently have achieved. Nevertheless, we cannot be sure from the evidence presented here that introducing a subregional level to the Mallee case would establish such dynamics to the same degree that they appear to exist in the other two cases.

The hypotheses for the remaining three variables accounting for farmers' trust in the regional delivery model – *trust in government commitment to community empowerment*, *trust in government integrity* and *trust in regional/subregional autonomy* – were supported by lower proportions of models across the three cases (14 per cent, 18 per cent and 14 per cent, respectively) than was the hypothesis for *trust in regional body*.

The last pattern to be considered here concerns the hypothesis for *perceived commons problem*, which was supported by 18 per cent of models across the three cases. Of the four models supporting this hypothesis, three found a positive relationship between this variable and farmers' expected adoption change, and one identified a negative relationship. In most of these instances of support for this hypothesis, therefore, farmers perceiving adoption as a commons problem appear to have been responding as free-riders. The more that farmers perceived themselves as benefiting from others' adoption, and the less they trusted others to actually adopt, the more they planned to increase their own adoption. This finding that *perceived commons problem* was negatively related with expected adoption change for less than five per cent of the practices indicates that any problems of farmers over-perceiving adoption of conservation practices as a commons problem, and becoming less motivated to adopt as a result, might not be discouraging adoption to the degree suspected by Pannell et al. (2006).

5.2 Substantive significance of farmers' trust in the regional delivery model

The preceding discussion highlighted how the hypothesis for *trust in subregional body* was supported statistically by a higher proportion of models for the Blackwood Basin and Central Highlands cases than any other hypothesis except the one for *perceived*

contribution to goals. However, it is possible for an explanatory variable to be *statistically* significant in predicting a dependent variable while having little *substantive* significance by way of the dependent variable's predicted value changing markedly in response to variation in the value of the explanatory variable.

In this section, therefore, we examine the substantive significance of *trust in subregional body* in predicting variation across farmers in the changes they expected to make in the subsequent 10 years to their adoption of conservation practices. This examination proceeds by comparing the elasticity value for *trust in subregional body* in each model where it was found to be statistically significant with the elasticity values for the other explanatory variables found to be statistically significant in the same model. The elasticity calculated for an explanatory variable is a measure of the predicted percentage change in the dependent variable given a one per cent change in the explanatory variable, when all explanatory variables are set at their mean values.

This examination is assisted by Table 5.2, which compiles elasticities for all statistically-significant explanatory variables in each of the models where *trust in subregional body* was itself found to be statistically significant. Note that elasticities could not be calculated where a model predicted a negative expected adoption change for the relevant practice when all explanatory variables were at their mean values. (For such models, elasticities are reported as *nc*).

Table 5.2 reveals that elasticities could be calculated for all but one of the four Blackwood Basin models finding *trust in subregional body* to be statistically significant. We see that the elasticity for *trust in subregional body* in respect of the model for:

i *revegetation and protective fencing* has a higher absolute value than the elasticities of the four other statistically-significant explanatory variables;

ii *establish perennial pastures* has a higher absolute value than the elasticities of two of the other statistically-significant variables and a lower absolute value than one other statistically-significant variable; and

iii *surface water management* has a higher absolute value than the elasticities of two of the other statistically-significant variables and a lower absolute value than three other statistically-significant variables.

This table reveals also that elasticities could be calculated for all but one of the four Central Highlands models finding *trust in subregional body* to be statistically significant. We see that the elasticity for *trust in subregional body* in respect of the model for:

i *environmental weeds control* has a higher absolute value than the elasticities of two other statistically-significant explanatory variables, and a lower absolute value than one other statistically-significant explanatory variable;

Table 5.2: Elasticities of statistically-significant variables for the Blackwood Basin and Central Highlands cases in models where *trust in subregional body* was statistically significant

Explanatory variable	Elasticities for Blackwood Basin practices:				Elasticities for Central Highlands practices:				
	Revegetation & protective fencing	Fencing riparian areas and installing watering points	Environmental weeds control	Maintain groundcover on grazing land	Soil conservation measures	Fencing to land type for grazing	Establish perennial vegetation	Establish perennial pastures	Surface water management
Property area (ha)	2.0	nc			1.4			1.9	-3.5
% net income from grazing				1.9					
Years experience farming	-4.5		3.2	0.8					
Local group involvement	1.4		0.8	0.2			nc	1.0	
Formal education					4.6	6.3	nc		
Place attachment					11.3		nc		
Profitability									
Equity ratio									
% income from farm business									
Perceived contribution to goals		nc				19.1	nc	16.6	19.3
Perceived commons problem					2.0	-1.2			
Perceived current district adoption									
Expected future district adoption	6.0						nc		9.3
Trust in subregional body	9.3	nc	8.9	4.7	13.5	37.0	nc	11.4	8.5
Trust in regional body			-14.2	-6.5		-25.0			-10.3
Trust in gov't commitment to community empowerment									
Trust in government integrity				-1.5		-14.1			6.4
Trust in regional/subregional autonomy					-6.9				

* Elasticities are presented for only those explanatory variables for which corresponding hypotheses were supported with at least 90 per cent confidence.
nc ~ could not be calculated.

ii *maintain groundcover on grazing land* has a higher absolute value than the elasticities of four other statistically-significant explanatory variables, and a lower absolute value than one other statistically-significant explanatory variable;

iii *soil conservation measures* has a higher absolute value than the elasticities of all five other statistically-significant explanatory variables; and

iv *fencing to land type for grazing* has a higher absolute value than the elasticities of all five statistically-significant explanatory variables.

These comparisons reveal that the substantive significance of *trust in subregional body* is greater than that of most of the other variables found to be statistically significant in the models for the Blackwood Basin and Central Highlands cases. Of the seven models for which elasticities could be calculated, the absolute value of the elasticity for *trust in subregional body* was in three instances higher than that of all other significant variables. In three further instances, it was second highest of all the statistically-significant variables. In the remaining instance, the absolute value of the elasticity for *trust in subregional body* was fourth highest of six statistically-significant variables.

We can conclude with reasonable confidence, therefore, that *trust in subregional body* was not only one of the explanatory variables most likely to be associated with farmers' future adoption of conservation practices in the two relevant cases, but that it was also among the explanatory variables to which their future adoption was most sensitive.

6. CONCLUSIONS

Regression models were estimated to identify variables associated statistically with farmers' plans to change their adoption of conservation practices over the ensuing decade. The practices analysed were those promoted to farmers under the regional delivery model. Five variables were included in the models to test: (a) whether farmers' trust in Australia's regional delivery model was associated statistically with their adoption plans for conservation practices promoted to them under the regional model; (b) whether this trust was more, or less, likely to be associated with their adoption plans compared with other variables commonly hypothesised to be associated with such plans; and (c) whether farmers' adoption plans were more, or less, sensitive to changes in their trust in the regional delivery model relative to changes in other variables commonly hypothesised to be associated with such plans.

In respect of (a), the regression analyses indicated that farmers' trust in the regional delivery model was associated with their adoption plans for most of the conservation practices promoted to them under that model. Concerning (b), the quantitative analysis indicated, for the Blackwood Basin and Central Highlands cases where a subregional body existed, that *trust in subregional body* was the element of farmers' trust in the regional delivery model most likely to be associated with their adoption plans. *Trust in regional body* was the element of this trust second most likely to be associated with

farmers' adoption plans. Of all 18 variables included in the models, the analyses indicated that *trust in subregional body*, where relevant, was second most likely to be associated with farmers' adoption plans. *Trust in regional body* was found to be the variable sixth most likely to be associated with these plans.

An interesting pattern was that in the two cases with subregional bodies, coefficient signs for *trust in subregional body* and *trust in regional body* indicated that farmers were, when such trust was associated with their adoption plans, predominantly following reciprocity strategies in respect of their subregional body, and free-rider strategies in respect of their regional body. This pattern indicates that subregional bodies in these two cases, by virtue of working more directly with farmers than the respective regional bodies, have been more successful than regional bodies in turning around the dynamics of dependency and opposition that earlier paternalistic approaches to natural resources governance tended to cultivate. This less likely reflects deficiencies in the community engagement efforts of the regional bodies in these two cases than the fact that these bodies have substantially devolved to subregional bodies the responsibility for community engagement through which a new dynamic with farmers might be forged.

In the Mallee dryland case which lacked a subregional body, in contrast, the coefficient sign for *trust in regional body* indicated that farmers were, in the one instance when trust was found to be associated with their adoption plans, predominantly following reciprocity strategies in respect of their regional body. This suggests that the regional body in this case (the Mallee CMA) has been more successful than the regional bodies in the other two cases in turning around inherited dynamics of farmer free-riding (dependency) and opposition. This is consistent with the earlier comments, in so far as the Mallee CMA has not, as in the other two cases, substantially devolved the responsibility for community engagement to a subregional body. Accordingly, it has been in a better position to forge a reciprocity dynamic with farmers than has been true of the other two regional bodies. Overall, however, the subregional bodies in the other two cases appear to have been more successful than the Mallee CMA in forging such a dynamic with farmers, at least in terms of the proportion of conservation practices for which such a dynamic appears to have been established. This is consistent with, but only tentatively corroborates (given the limitations of establishing a pattern with three cases), our reasoning that we should expect a lower level of a multi-level governance system to be more successful than a higher level in motivating cooperation.

Concerning (c), the analysis indicated that farmers' adoption plans were more sensitive to changes in *trust in subregional body* than to most other variables found to be associated with such plans – at least in the two cases where this variable was relevant. Hence, it appears that *trust in subregional body* was not only more likely than most other variables to be associated with farmers' adoption plans in these cases but also, when association exists, to be relatively strongly linked in a substantive sense.

The findings suggest that community-based approaches are capable of succeeding under the regional delivery model in motivating greater cooperation from farmers than possible without such approaches. In particular, they highlight the importance of farmers

coming to adopt reciprocity strategies in their key relationships under this model. It seems that subregional bodies have an advantage over regional bodies in eliciting such behaviour from farmers because the former are better positioned to engage them effectively. This indicates the value of a nested multi-level approach to community-based NRM within regions, at least where capacities below the regional level justify devolving significant responsibilities to lower levels following the principle of subsidiarity.

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