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Understanding private landholders decisions about pest management

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1. Introduction

Plant and animal pests are a threat to economic productivity and sustainable natural resource management. In Victoria the principle legislation relating to declared pest plants and animal control in Victoria is the Catchment and Land Protection Act 1994 (Department of Natural Resources and Environment 2002). This legislation requires landholders to meet land management obligations and take steps to prevent harm arising from farm activities. Landholders are required to take actions to control pests on their own land and prevent their spread to other land. While the legislation outlines the goals of land management and does impose certain specific requirements, how these goals are to be achieved is left largely to the discretion of the land manager (Roberts 2004). Communities, and landholders in particular, are supported in their efforts to manage pest plants and animals through a variety of government programs such as Weedbusters[1]. However failure to meet legislation obligations can lead to notices and penalties (Roberts 2004).

Governments have invested resources to understand the attitudes and behaviour of private landholders in regard to pest plant and animal management to inform the design of government policy and programs to support the management of pest plants and animals by landholders. However, government agencies continue to be concerned about the lack of compliance with government regulations in regard to pest plants and animals. The Victorian Government is committed to improving pest plant and animal management and has considered expanding the use of enforcement to encourage greater compliance with relevant legislation (Department of Natural Resources and Environment 2002). Expectations that more intensive enforcement of legislation will bring about the desired changes in the behaviour of landholders fail to recognise the complexities involved in achieving behaviour change.

In this report literature on land manager attitudes to pest plant and animal issues is reviewed with a view to identifying opportunities for new approaches to increasing compliance with government regulations in regard to pest plants and animals. In the first section of this report previous social and marketing studies on pest plant and animal management, focusing on individual landholders, are reviewed. In the next section a new conceptual framework for understanding landholders'

[1] Weedbusters is an integrated approach jointly funded by landholders and government focusing on weed management, education and awareness.

management behaviour in regulatory situations is reviewed. The potential of this model to predict the behavioural responses of landholders to pest plant and animal obligations is then considered.

2. Attitudes and behaviour in pest management

In this section studies on land manager attitudes and behaviour in relation to pest plant and animal issues are reviewed[2].

Australian Total Quality Research (2001) conducted a study to quantify landholders' attitudes concerning behaviours and actions in relation to the long term control of rabbits. They argued that the behaviour and actions of landholders in pest control are a function of landholder's perception of their responsibilities, their attitudes to pests and pest management practices, and the management support available (Australian Total Quality Research 2001). Hence, they classified landholders' attitudes into three themes. These were:

- attitudes relating to landholder's responsibility to neighbours and the wider community for rabbit control;
- attitudes, behaviour and knowledge relating to practices for controlling pests;
- attitudes towards the role of government and its policies

We have followed this classification in this review.

Responsibility for pest plant and animal management

A large proportion of landholders in surveys indicated that they are aware of their responsibilities to control pest plants and animals on private land (Watson 2001; Watson 2002; Watson 2003). The very small percentage that were unaware or believed the Department of Natural Resources and Environment was responsible still recognised their own role in pest management (Watson 2001; Watson 2002; Watson 2003). Also, Roberts Research and Evaluation Pty Ltd (2004) and McGeary (2004) found there was some lack of awareness of responsibility for the management of pest plants among a range of stakeholders including private landholders, local government and managers of linear reserves.

[2] Note that many of the studies reviewed concerned rabbit control.

It was evident from a number of studies that not all landholders are equally concerned or equally committed to the broader responsibility of managing pest issues (Australian Total Quality Research 2001; Watson 2001; Watson 2002; Watson 2003). For example, while recognising rabbits occur in the north east study area many landholders had not undertaken pest control measures because they believed they did not have a problem with rabbits on their property (Watson 2002). While landholders may acknowledge the general need for management control, they may perceive that this need does not apply to them specifically.

Land managers were generally aware of their pest plant and animal responsibilities however this awareness did not always translate into control action being taken. For example, most landholders in the Australian Total Quality Research (2001) survey recognised that ultimately the problem of rabbit control rests with landholders and did not dismiss it as a government problem. However, they did admit they were not controlling rabbits on roadsides adjoining their property and suggested that government should spend more money on controlling rabbits on public land. Watson (2002) found landholders would like to see changes in the control of pests on public land. The University of Ballarat (2001) found there was very strong support among landowners (95%) for government to be responsible for weed control on all public land.

In relation to the source of pest infestation, it appears private landholders recognise the need for a coordinated approach between neighbours and the wider community for pest management. For example, comments made by interviewees in the Interact Market Research (1999) study suggest pest plant and animal infestation on public land or the condition of neighbouring properties can cause frustration and can act to undermine their own control efforts. Similar results emerged in the survey undertaken by the University of Ballarat (2001) where landholders indicated that the source of their pest infestations was either other private landholders (46.5%), publicly owned land (36.6%) or roadsides (43%).

While there was a relatively high level of frustration among landholders with pest infestation from public land, fewer landholders than expected attributed their own pest problems to infestation from public land (University of Ballarat 2001). Landholders were generally only concerned with pest management activities occurring outside their property if they perceived them to be a source of infestation on their land or if they believed other landholders were being treated differently by government.

In considering the issue of responsibility for pest control the distinctions between management of private land, roadsides for which landholders are responsible and public land are very important. These distinctions were not always clear in the studies we reviewed, especially in relation to the distinction between private land and roadsides. Roadsides are public property for which private landholders are responsible. It is important to distinguish between these when questioning landholders as landholders have quite different perceptions about their responsibilities in the management of pest on private land compared to roadsides. Many landowners consider roadsides should not be their responsibility and that the legislation is unreasonable in this respect (Australian Total Quality Research 2001). There is the perception among some landholders that enforcement of responsibilities between public and private landholders are inconsistent. This perception undermines landholders' acceptance of their responsibilities under the legislation (University of Ballarat 2001).

Pest plant and animal control practices

Generally landholders' approach to pest management was not driven by the 'threat' of prosecution but economic factors and personal and social norms such as they 'would be embarrassed and / or concerned' if they did not manage their pests (University of Ballarat 2001). Most believed they were good land managers. Meeting pest obligations was more about good management rather than the threat of prosecution. In Watson's (2002) study landholders who had undertaken pest plant and animal control measures suggested their motivation was "keeping pest numbers down, maintaining the property in good condition and to protect their animals". To a lesser extent motives such as the protection of productivity, economic reasons or wanting to be a good neighbour were given. A few landholders were motivated because they considered undertaking control measures their "responsibility, duty or legal obligation" (Watson 2002).

The University of Ballarat (2001) found the causes for offences related to a number of issues. These were the structure of the existing law, personal circumstances, external economic influences and personal values and attitudes (University of Ballarat 2001).

A common finding in the various studies was that most landowners believe they have the skills and capabilities to perform the activities required for pest plant and animal management. They perceive themselves to be knowledgeable and organised for good land management, and they were capable of making the decision on when and how to control pest plants and animals

(University of Ballarat 2001). In the Watson (2003) study of the Gippsland region, activities for controlling pest plants, primarily spraying and physical removal, had been undertaken by 91 per cent of respondents. Approximately 70 per cent of respondents indicated that rabbits were a problem in their area and of these respondents 61 per cent had undertaken control activities in the last few years (Watson 2003).

While most landowners had implemented some management measures, there was considerable variation in the measures they implemented and whether these met requirements (Australian Total Quality Research 2001; Watson 2001; Watson 2002; Watson 2003). For example, government agencies have promoted the use of warren ripping and harbour destruction in conjunction with one other control methods such as baiting to obtain effective rabbit control. However, landholders have indicated they were not necessarily using all the recommended methods. Landholders were likely to repeatedly use the same measures, such as baiting, to reduce rabbit numbers to lower levels without other activities such as the warren ripping and harbour destruction that are considered by government to be more successful control practices in the longer term. Watson (2002) found that only 22 per cent of those undertaking control activities for rabbits activities in the North East had adopted an integrated control program. A Primary Industries Research Victoria (2005) report suggests that the failure of landholders to implement an integrated control program is not due to a lack of understanding of techniques but a lack of motivation to undertake a variety of measures. By using baiting as an immediate solution to the problem, landholders were able to see direct results with an immediate decline in pest numbers (Primary Industries Research Victoria 2005).

In the experience of landholders integrated programs were not necessarily successful. Nine per cent of those using warren ripping and one other control method in the North East to control rabbits did not consider that their activities had been successful (Watson 2002). This lack of success was attributed in the report to the lack of control activities undertaken by neighbouring properties. However, many respondents believe their control efforts have been successful regardless of the types of activities undertaken (Watson 2002). This belief by landholders in the success of their current control practices is a factor to consider in future efforts by government to encourage landholders to use more than one control measure.

Community or landholders' attitudes to particular control measures can also be influenced by the acceptability of the measures. Community expectations in relation to animal welfare and control

measures is an issue recognised in the Victorian Pest Management Framework (Department of Natural Resources and Environment 2002). Also, landholders' attitudes towards the need to control rabbits and the acceptability of control measures may influence their choice of measures to control pests (Australian Total Quality Research 2001). For example, in Johnston and Marks (1997) study of the wider Victorian community and land manager attitudes to pest animal management, almost half of the respondents found it unacceptable for a small number of non-target native wildlife species to die from control measures. In addition, depending on the target species, different forms of control were favoured for controlling different species. For example, biological control was the preferred control for rabbits (Johnston and Marks 1997).

There are a number of elements that influence wider community support for, or opposition to, the use of particular control measures. Fraser (2006) in a New Zealand study of community acceptance of control methods identified elements such as moral and ethical concerns and perceptions of risk and benefits as strongly influencing community acceptance of measures. Other mediating effects, such as perception of the target animal and perceptions of genetic engineering, can also influence community acceptance of control methods (Fraser 2006).

Most landowners believed they are already doing as much as they reasonably could to implement pest plant and animal eradication measures. Further, they suggested that they were operating at or near the limits of their physical and financial resources. The focus of the University of Ballarat (2001) survey was to identify landholder's ability to practice 'good' land management and to explore some of the main practical issues or barriers to 'good' land management. They found that land manager age, cost and time involved were practical constraints on the landholder's ability to undertake pest plant and animal control (University of Ballarat 2001). The survey did not provide the opportunity to explore other possible factors that may influence the landholders conducting control behaviour.

Landholder's view of management activities themselves in the Australian Total Quality Research (2001) survey identified quite strong support for rabbit control as being cost effective. Most landholders indicated they saw rabbit control as a priority even in times of financial constraints and that by not implementing control measures infestations could ruin their property into the future. It should be noted that the focus of this questioning was around intentions when setting budgets, and the findings do not necessarily reflect other contextual barriers to undertaking control measures.

In conclusion, landholders considered that they were doing the best they could within their current resource constraints. They were confident in their personal knowledge of pest plant and animal control and 'good' management. There were clear differences in what landholders and government agencies considered as being 'effective' measures for managing pests.

Government support and assistance

The majority of respondents implemented pest plant and animal control measures without financial assistance (Watson 2002). There appeared to be little awareness of sources of financial assistance and of some of the government funded 'control' programs currently occurring in the community (Watson 2001; Watson 2002; Watson 2003). Only a small percentage (11%) of landholders in the Australian Total Quality Research (2001) indicated that they had received financial assistance with rabbit control by way of a subsidy.

While landholders feel they have the knowledge and are able to manage pest plants and animals control they do, however, favour further public investment in the provision of education and information. There was a perceived need among landholders for more extension in the wider community and practical assistance to deal with weed and pest animal control obligations (University of Ballarat 2001).

Landholders varied with regard to their attitudes to government support for pest plant and animal management. Respondents in the Australian Total Quality Research (2001) survey were generally only moderately satisfied with the level of support provided by government and its agencies and the effectiveness of this approach in controlling rabbits. The University of Ballarat (2001) study identified a lack of confidence in the abilities of government agency officers to provide advice and help in a useful manner. Some interviewees indicated that they are aware of resource issues that may affect the ability of agency staff to do their job (University of Ballarat 2001).

Landowner perceptions of government policy

There was little awareness among landholders of fines for non-compliance and many landholders believed they are unlikely to inspected. Less than half of respondents to the Watson (2002) survey were aware of enforcement and fines. This suggests that contact with field officers and the subsequent visibility of inspections and enforcement could be improved (Watson 2002). Of the respondents in the University of Ballarat (2001) survey, just over 73 per cent believed it was unlikely that they would be prosecuted for offences (University of Ballarat 2001). This suggests that the existence of regulation penalties is not perceived to be a strong deterrent. There was also limited knowledge of the particular legislation that relates to pest plants and animals (University of Ballarat 2001). However, it should be remembered that land managers said they were aware of their responsibilities for management of pest plants and animals.

The policy approach preferred by landholders to pest plant and animal management was education in conjunction with enforcement (University of Ballarat 2001). The preference was for a flexible, cooperative approach, where ultimately government provides a 'helping hand' (University of Ballarat 2001). There was only moderate support in the Australian Total Quality Research (2001) survey for fining and prosecuting landholders that did not make a sufficient effort to control rabbits on their property. However there was support for the idea that persistent repeat offenders should incur heavier penalties. There did not appear to be a clear indication in the studies that the number of prosecutions was the community's measure of effective compliance.

There was a perception among landholders that the legislation is not applied equally and penalties for non-compliance for pest infestations on public land were not being enforced. Those landowners adjoining public land were dissatisfied with pest plant and animal control on public land and held the relevant government agencies responsible (Watson 2002). There was the feeling that public landholders that were not meeting their obligations should be prosecuted, and that it is an issue of fair play (University of Ballarat 2001). This study also found that it was difficult to persuade landholders to clean-up public land because of the associated cost and obvious breach of the law by public landholders. Those private landholders who had been prosecuted or received land management notices were 'particularly annoyed about government land being infested' with pest plants and animals and considered it inconsistent that other landholders with infestations 'get

away' with non-compliance (University of Ballarat 2001). Broadly speaking, enforcement was considered by landholders to be ineffectual and inconsistent.

Those landholders that have been penalised for non-compliance through the issuing of infringement notices or prosecution do not regard themselves as breaking the law or considered themselves as recalcitrant in character (University of Ballarat 2001). They considered pest management to be important and strongly believed they were using good management practices to the best of their ability. Because they felt they were doing the best they could, the enforcement action taken against them had not altered their behaviour (University of Ballarat 2001). These landholders agreed that landholders who make no attempt to clean up their land should be given notice and fined if they failed to take control action when directed (University of Ballarat 2001). These landholders consider they were doing the best they could and probably did not consider themselves as having behaved in a way that required action to be taken against them. These landholders suggested that a cooperative approach that involved consideration of circumstance and ability to undertake control measures would be preferred and more effective than "threats and ultimatums" (University of Ballarat 2001).

Some of the studies reviewed (Australian Total Quality Research 2001; University of Ballarat 2001) investigated landholders' attitudes toward landholders joining together to address pest issues, the current process of setting priorities for weeds, and working in priority areas. There was some indication in these studies of a preference for support officers being allocated priority areas to manage rather than priority weeds that were spread across different areas (University of Ballarat 2001). There was also some suggestion from those who had received infringement notices or been prosecuted that by focusing only on priority weeds, other weeds may get out of control (University of Ballarat 2001). This indicates that there may often be a difference between landholders and government in the importance they attach to particular pests and particular courses of action.

Findings

There were a number of themes in the literature we reviewed. These were that the majority of:

- Landowners acknowledged they were responsible for pest plant and animal management
- Landowners believed they were doing the best they could within their resource constraints
- They were confident in their personal knowledge of pest control and land management

- There was a preference for agencies to approach pest control through education and public support in conjunction with enforcement
- The risk of non-compliance being detected was perceived to be low therefore current prosecution for non-compliance was not a credible deterrent
- Acceptance of the legislation requirements by landowners was affected by:
  - perceived inconsistencies in enforcement between public and private landholders
  - perceptions that the legislation is not reasonable, for example in treating roadsides as the responsibility of private landholders
- There were differences in what landholders and government agencies considered to be effective management of pests
- Landholders management of pests on their land is not necessarily aligned with government priorities

The studies we have reviewed have provided considerable information in terms of descriptions of landholders' attitudes and behaviour in relation to the control of pest plants and animals. The Australian Total Quality Research (2001) study went so far as to identify differences in these descriptions by geographic zone, size of property, age of land manager and their length of time on the property. While the descriptions generated in these studies are useful, they provide only limited guidance to the policy maker on the selection of policy instruments to improve compliance.

For example, prosecution for non-compliance was not a credible deterrent for landholders because they believed the risk of detection was low. This does not mean however that increasing the rate of likelihood of detection will necessarily increase the rate of compliance among landholders.

On the one hand, Nagin (2001) suggests that the deterrent effect of enforcement activities depends on the perceived risk of being caught rather than factors such as the severity of the penalty. Individuals weigh up the expected benefits and costs of compliance and act accordingly (Winter and May 2001). This suggests that increasing the likelihood of detection would increase the rate of compliance among landholders.

On the other hand, landholders reactions also depend on the perceived legitimacy of the law and law enforcement authorities, and perceptions as to whether penalties for transgressions are considered fair (May and Burby 1998). Not surprisingly, people prefer to support legislation that they feel is just and of benefit to society (Winter and May 2001). Consequently, if landholders believe they are acting faithfully given their pest management priorities and their resource constraints, increasing the rate of prosecutions may not alter compliance rates at all. Increasing the

rate of prosecutions may even be counter-productive if landholders begin to believe they are being treated unfairly relative to the rest of the community.

One recommendation from the Australian Total Quality Research (2001) study was that collective action among neighbouring landholders should be encouraged. While encouraging collective action is a desirable, the studies we reviewed provided little guidance as to how such action can be encouraged. Survey results indicate that most landholders are aware of their responsibilities in relation to pest management and they recognise the need for a coordinated approach between neighbours and the wider community. This suggests that promotional programs encouraging collective action are unlikely to change the behaviour of landholders. In the absence of a more fundamental understanding of the contexts and motivations of landholders, deciding on a course of action other than promotion is problematic for policy makers.

In the studies reviewed recommendations tended to be general in nature and not give specific advice that policy makers require for successful implementation.

In the following section a conceptual framework developed by Murdoch *et al.* (2006) is presented which provides a systematic basis for the selection of policy instruments to improve compliance. The framework predicts landholders responses to interventions to improve pest management using an understanding of the importance and concern a particular pest issue has for landholders, and the consequences the relevant control measures have for landholders. The framework draws on behavioural models of landholders developed by Payne *et al.* (2005) and Kaine (2004).

3. Predicting the behaviour of landholders

The control of weeds and pest animals is governed by legislation that imposes obligations, requirements and conditions on landholders. Murdoch *et al.* (2006) has developed a compliance response framework for predicting the behaviour of landholders in response to a policy intervention that imposes an obligation to act, such as a regulation. The behaviour of landholders is predicted on the basis of their *involvement* with the policy *issue* and the policy *intervention*.

In the compliance response framework *involvement* is defined as is a motivational state that results from the decision-makers' perception that an activity can contribute to satisfying their goals, which may be utilitarian, social, or hedonic (Mittal and Lee 1989). Involvement has a number of

dimensions such as perceived importance, perceived risk and perceived value that influence decision making behaviour (Laurent and Kapferer 1985). Thus decision-makers can vary both in the level of their involvement and the basis for that involvement (Kaine 2004).

Involvement is intended to predict behaviours such as extensiveness of decision-making, interest in communications about the activity, commitment to the activity, and social observations about the activity (Mittal and Lee 1989). Involvement has been shown in consumer decision making to influence the number and types of sources of information consulted about an activity, the number of activity attributes evaluated, the number of alternatives considered and trialed, and the time spent on making a decision. In short, involvement is a motivational state that is proposed to predict the level of effort the decision-maker will invest in controlled behavioural processes in relation to a decision.

In the compliance response framework a policy *issue* is defined as a particular problem or situation that government has a responsibility to address. An *intervention* is defined as the obligation imposed by government that requires individuals to act in a particular way to address a particular issue (Murdoch *et al.* 2006).

In the context of this study the policy *issue* is the management of plant and animal pests. The policy *intervention* will be actions taken by government to deal with the issue such as the imposition and enforcement of regulations, implementation of incentive programs or the mounting of education programs. In this framework the behaviour responses of landholders with regard to pest management is predicted to depend on the manager's level of involvement with the pest issue and their involvement with government interventions aimed at promoting compliance.

The framework for predicting compliance behaviour responses is shown in Figure 1. For a particular issue and intervention landholders' responses are mapped within four quadrants. The quadrants formed by the horizontal and vertical axis are based on a continuum of low to high involvement with the intervention and issues respectively. The two types of involvement can be combined to predict four types of likely behavioural responses (Murdoch *et al.* 2006). The behavioural models of landholders developed by Payne *et al.* (2005) and Kaine (2004) can be used to place landholders in each quadrant.

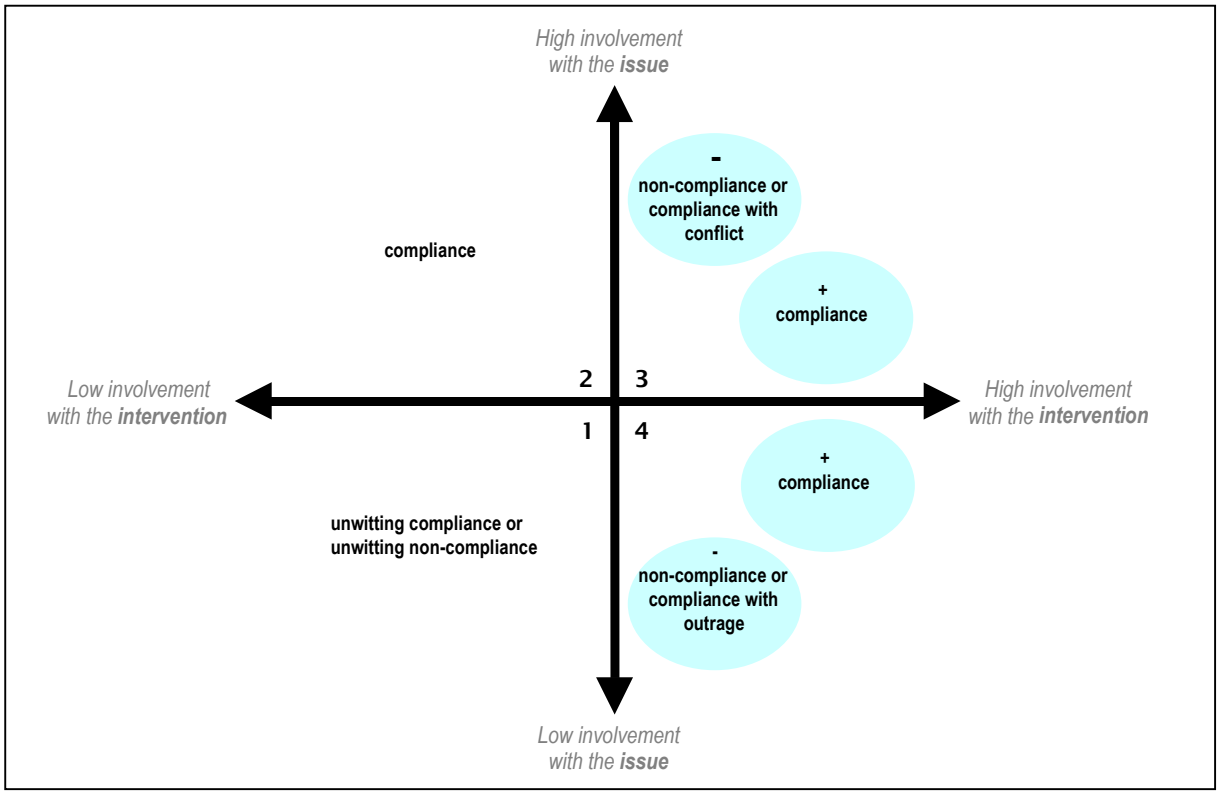

Figure 1. **I_3 Response framework with behavioural predictions (Murdoch *et al.* 2006)**

Quadrant 1 of the framework represents landholders that have low involvement with both the issue and the intervention. We would expect that landholders in this quadrant would be largely unaware of the details of the issue and any related intervention requirements. Consequently, they would not have considered or evaluated their behaviour with respect to the issue and potential best practices (Murdoch *et al.* 2006). Landholders in this quadrant are unwittingly compliant or non-compliant.

Quadrant 2 represents landholders that have high involvement with the issue but low involvement with the intervention. Consequently these landholders would invest time and energy in processing information, decision-making and responding to the issue (Murdoch *et al.* 2006). However, as the intervention is not involving for these landholders this suggests the intervention requires little or no change in their behaviour. Presumably, this is because the intervention aligns with their existing response to the issue. We predict that landholders in this quadrant will comply with the intervention (Murdoch *et al.* 2006).

Quadrant 3 represents landholders that have high involvement with both the issue and the intervention. High involvement with the issue means these landholders invest time and effort in making decisions about their most appropriate and relevant actions and practices. There is now a further division of the type of responses within this quadrant. This division describes individuals' perceptions of how the requirements of the intervention would impact upon or affect them. Landholders would be positively involved with the intervention where they perceive the benefits of complying with the intervention outweigh the costs. We predict that these landholders will comply with the intervention (Murdoch *et al.* 2006).

Landholders would be negatively involved with the intervention where they perceive the benefits of complying with the intervention are exceeded by the costs. We predict that these landholders will intentionally choose not to comply with the intervention or comply reluctantly. Either behaviour is likely to result in a high level of dissatisfaction. As a consequence, landholders may express their dissatisfaction by lobbying for regulatory change, or forming groups opposed to the regulation (Murdoch *et al.* 2006).

Quadrant 4 represents landholders that have low involvement with the issue and high involvement with the intervention. We expect these landholders would be unlikely to have invested time or effort in considering the issue but have invested time and effort in evaluating the

requirements of the intervention because of its relevance to them and their business. We expect landholders that perceive the intervention to have positive consequences for them or their business will comply with the intervention. On the other hand, we expect individuals who perceive the intervention to have negative consequences for them will deliberately choose not to comply with the intervention or comply reluctantly (Murdoch *et al.* 2006). These landholders may publicly voice their disapproval of the intervention and devalue its role in managing an issue, and they may attract the support of the broader community in doing so.

The results of applying this framework provide a basis for choosing a policy instrument that may improve compliance as shown in Figure 2. Landholders in Quadrant 1 have low involvement with both the issue and the intervention. As a result, they may behave in a way that does not comply with intervention requirements, albeit unintentionally. If agencies wish to increase compliance in this quadrant it would be necessary to either change the level of land manager involvement with the issue or the intervention, or provide a means of assisting them to comply with little effort (Murdoch *et al.* 2006).

For example, assume the policy issue is to reduce weed populations on private property and that some landholders are characterised by the lower left quadrant. They may believe certain weeds are not serious pests on their property. Consequently, they have low involvement with the issue to manage weeds. These landholders are also likely to have low involvement with the intervention and would be expected to have limited knowledge of the details of the legislation and, based on their experience, have seen little enforcement of the legislation. The framework suggests that one policy instrument to promote compliance among these landholders would be to change their involvement in the intervention (Murdoch *et al.* 2006).

This might involve changing landholders perceived risk of being prosecuted for non-compliance and changing the severity of penalties for non-compliance. This effectively changes their segment membership such that their involvement with the intervention is higher. An alternative policy option is to reduce compliance effort and remove the risk of non-compliance by public funding and management of weed control activity.

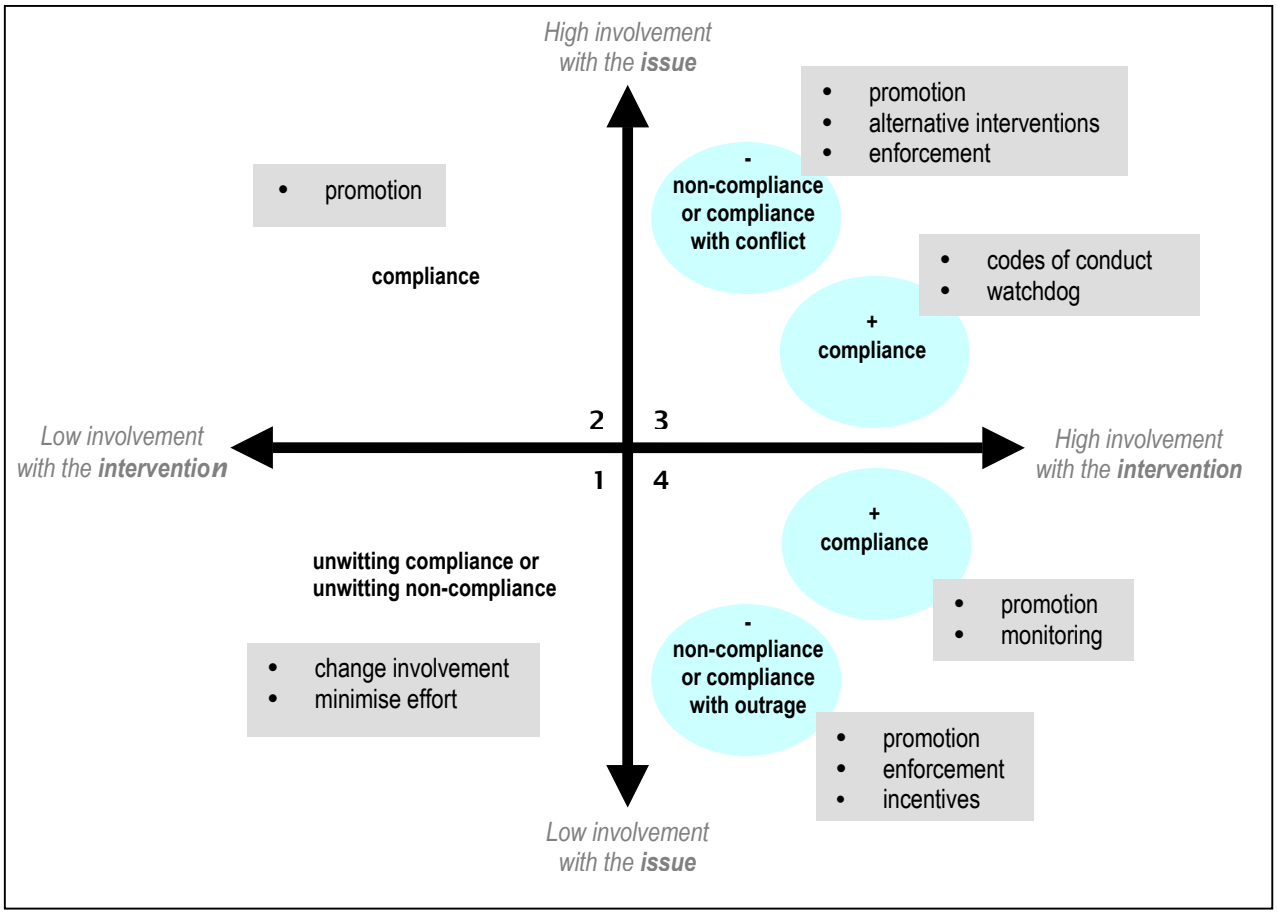

Figure 2. **I_3 Response framework with policy interventions (Murdoch *et al.* 2006)**

Quadrant 2 represented landholders with high involvement with the issue but low involvement with the intervention. In this situation a focus on enforcement is unlikely to be necessary, as the behaviour of these landholders is likely to align closely with the requirements of the legislation. There may be the need for promotion and education activities that ensure managers are, and continue to, meet the requirements of the legislation (Murdoch *et al.* 2006).

For example, consider the problem of reducing rabbit populations on private property. Some landholders may have experienced serious losses from rabbit infestations and so are highly involved with the issue. Consequently, they are undertaking control measures. If these measures have been successful then these landholders may not find interventions, which are designed to promote compliance, involving because the intervention requires minimal change in their behaviour. These landholders have high involvement with the issue but low involvement with the intervention, placing them in Quadrant 2. The framework suggests that these landholders will tend to comply with the requirements of the legislation (Murdoch *et al.* 2006). The policy response would therefore focus on reinforcing their continuing compliance by using promotion to reinforce their behaviour.

Quadrant 3 represents landholders with high involvement in the issue and the intervention. These landholders need to be approached differently depending on their perception of whether the intervention has positive or negative consequences for them. There may be little need for biosecurity and landscape protection agencies to enforce compliance among those landholders who perceive the intervention to have positive consequences. These managers may be largely self-regulating as meeting the requirements of the intervention creates obvious benefits for them. Biosecurity and landscape protection agencies may assist in developing voluntary codes of conduct and work with industry to develop standards that promote best practice (Murdoch *et al.* 2006).

Promoting compliance among those land managers in this quadrant who perceive the intervention to have negative consequences for them requires a different policy approach. Ideally, the policy aim should be to move managers from negative involvement to positive involvement. Promotion of the intervention that describes its intention to manage the issue in a way that appeals to land managers may assist in doing this. Biosecurity and landscape protection agencies may also consider legitimising alternative measures to meet obligations that better suit these managers.

Alternatively, enforcement programs may be needed that increase the likelihood of prosecution and impose higher penalties for non-compliance (Murdoch *et al.* 2006).

Finally, Quadrant 4 represents landholders with high involvement in the intervention but low involvement in the issue. These individuals also require a different mix of approaches, depending on how they perceive the consequences of the intervention. For those who perceive the consequences as being positive, there should be little need for biosecurity agencies and landscape protection to promote compliance. Agencies may play a watchdog role to check that the conditions promoting compliance do not change and managers continue to comply (Murdoch *et al.* 2006).

Landholders in this quadrant who perceive the intervention to have negative consequences for them may require one or more policy interventions to be implemented to ensure compliance. Ideally the policy aim should be to move managers from negative involvement to positive involvement. This might entail promotion that highlights how the intervention may be used to the advantage of their business and provides different, more appealing motivations for compliance. The challenge for agencies is being able to promote appropriate responses to managers who consider the intervention to have negative implications by identifying factors that may match their business priorities. Biosecurity and landscape protection agencies may consider ways of making it easier for managers to comply with approaches such as introducing incentives to offset the cost of compliance. Ultimately, enforcement programs may need to be implemented that increase the risk of detection and increase the penalty for non-compliance (Murdoch *et al.* 2006).

For example, consider the policy issue as being lowering pest populations on roadsides adjoining private property. Involvement with the issue is likely to be low among private landholders even though they may be undertaking control activities on their own property. Many land managers may have strongly held, negative attitudes towards the proposition that pests on roadsides adjoining their property should be their responsibility. Consequently, the likely response is non-compliance. Biosecurity and landscape protection agencies may consider introducing incentives to offset the cost of compliance, such as rate rebates, as a means of promoting compliance among these landholders.

In conclusion, the I^3 Response framework provides a foundation for policy makers to systematically consider the appropriate mix of interventions needed to achieve the desired policy outcome.

4. Conclusion

Government has responsibility for ensuring pest plants and animals are controlled to protect natural assets and the productive capacity of land and water. Legislation places obligations on landholders to control pests for their benefit and the benefit of the broader community. In addition, government has invested substantial resources in policies and programs to influence the management of pest plants and animals by private landholders. Despite this investment the level of non-compliance with regulations is, in some cases, still unacceptable.

While studies into the behaviour and attitudes of private landholders have produced considerable information, this information has provided only limited guidance for policy makers in choosing new policy interventions to promote compliance behaviour. One reason for this is that these studies have not identified systematic relationships between landholders' attitudes towards the issue of pest management, their attitudes towards particular measures for managing pests, and their actual implementation of pest control measures.

The I^3 Response framework developed by Murdoch *et al.* (2006) provides a means of identifying such systematic relationships. The framework is used to predict the behaviour of landholders in response to a policy intervention, such as a regulation, that imposes an obligation on them to act. The behaviour of landholders is predicted on the basis of their involvement with the policy issue and the policy intervention.

In the context of this study the policy *issue* is the management of plant and animal pests. The policy *interventions* are actions taken by government to deal with the issue such as the imposition and enforcement of regulations, implementation of incentive programs or the mounting of education programs. In this framework the behaviour of landholders with regard to pest management is predicted to depend on the manager's level of involvement with the pest issue and their involvement with government interventions aimed at promoting compliance on that issue. In principle, policy makers can employ the framework to assist them in choosing new policy interventions to promote compliance among landholders on pest management issues.

5. References

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