

Conserving biodiversity: the importance of institutional structure

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Abstract

A 'mechanism' is an instrument or policy used to achieve environmental change. An 'institutional structure' involves two features: the identification of key players, and a set of contracts that govern the relations between the key players. This paper considers several mechanisms, and how they would operate under two hypothetical institutional structures: a centralised structure and a group-based structure.

The focus is on the way that structures affect mechanism implementation. Specifically, the cost-effectiveness of the two different institutional structures is compared in terms of implementing a set of mechanisms for conserving biodiversity on public and private land. This provides information to policy makers about how to design, or redesign, institutions for biodiversity conservation. To examine cost-effectiveness, two economic concepts are considered: economies of scale and transaction costs.

In the comparison of the two hypothetical structures — centralised versus group-based — the former is shown to be often a lower-cost alternative. A centralised structure allows actions in the state-wide interest and achieves the same outcomes as the group-based structure but without large transaction costs. This result, however, depends on the circumstances: a group-based structure may be better if it allows the board or CEO to better understand local concerns, and if the goods being provided are for local residents.

Keywords

institutional economics, market failure, environment, transaction costs

Introduction

For purposes of this paper, we define mechanisms as the instruments, or policies used, to achieve environmental change. For example, regulation, and tradable permits are mechanisms.

We keep the notion of a 'mechanism' separate to that of 'structure'. An institutional structure involves two features: the identification of key players (e.g. landholders and government, or policy designers and operational staff) and a set of contracts that govern the relationships between the key players.

Institutional economics is about the way that firms, governments, etc. are structured. Structure often helps firms or governments overcome problems, and hence achieve their aims. Institutional economics tries to explain what these problems are, and how structure can help; see for example, Williamson (1985) and Dixit (1996).

We assume that structure matters for two prime reasons: it affects incentives and the flow of information. For example, the 'separation' of a government department into a commercially oriented entity may improve its incentives to cut cost, but this may be at the expense of output quality. In other words, the new entity's incentives to chase profit may be improved, but its incentives to keep output quality high may be diminished, especially if a government cannot easily observe output quality. Further, the separation and commercialisation of an entity may give it reasons to hide or misrepresent information back to government, because this may improve the entity's profits. Hence information flows will be affected.

There have been several reports about the characteristics of environmental problems and how these affect mechanism design (see for example Bardsley et al. 2002). However, there has been relatively less written in Australia about institutional structure and the way it affects environmental policy design and implementation. In this paper we take a modest step to rectify this situation, largely because we think that structures (institutions) matter.

Throughout the paper we focus on aquatic and terrestrial biodiversity management on public and private land. We view the problem from a State perspective. Our operating assumption is that a government would use a mechanism to achieve some environmental outcome at minimum cost. Hence, institutional structures that lower the cost of achieving a particular aim are preferred.

Two of the key institutional structures that have been used to tackle environmental problems in Australia (and Victoria is no exception) include a centralised structure, and a group-based structure.

A centralised structure involves a powerful Centre (akin to a head office) that delivers projects or programs through its own regional personnel. The regional personnel are a delivery system, and can be guided by fiat (directives), so they are relatively passive.

In a group-based structure, the Centre communicates and negotiates with group-based delivery components. In other words, the Groups are perceived to be ‘partners’ with the Centre rather than passive delivery agents. Often these Groups have separate governance systems (for example a board and a CEO). A group-based structure is perceived to be more ‘community-oriented’; that is, the stakeholders in each Group have a strong voice, and they have an impact on the Group’s aims or directions. In a group-based structure, a key approach of group-leaders is to coordinate and motivate through discussion. That is, flows of information between local members are thought to be critical at motivating, and coordinating, individuals.¹

Local versus aggregate public goods

Biodiversity as a public good

In economic theory, biodiversity is largely acknowledged to be a ‘public good’ (see Appendix 1). Hence, theory suggests that that private markets will under-supply biodiversity, relative to what is in the best interests of society as a whole. Since the private market will ‘fail’ to deliver enough biodiversity conservation, governments could have a role in remedying this problem by implementing policies that raise the level of biodiversity production and conservation.

Two levels of public goods

In this paper, we view the maintenance of biodiversity as having two levels of ‘public good’: aggregate and local. Imagine that (say) a state is split into two regions: *Region 1* and *Region 2*. Maintenance of a particular species or ecosystem can be at the state or the regional level. For example, consider the conservation of *Species A*. This species exists in both regions. The state’s aim is to conserve *Species A* at least cost. However, it could do this while losing the species from one region (it is concerned with the aggregate result). Assume the state decides to maintain the species in *Region 1*, and forsake the species in *Region 2* because conservation is relatively expensive in the latter. This may satisfy the state, but the people of *Region 2* may want to conserve *Species A* in their own region. Hence, the state’s biodiversity aim could be viewed as the management of an ‘aggregate public good’, whereas the people in *Region 2* may be concerned with the ‘local public good’.

The above problem is of concern when there are trade-offs between the state’s objectives and those of the region. In other words, when resources are scarce, so that the state has to prioritise, then some regions may feel that their priorities are being (unnecessarily) forsaken.

Regions can, of course, self-fund additional biodiversity conservation, for example via a local levy. This levy could then be put towards funding local public goods (goods that the state views as having less priority).

¹ Generally, there are several alternatives to using group discussion to motivate and co-ordinate behaviour. In fact, markets are one alternative. However, in this paper we are considering institutional structures that can design and implement policy. In this case, market-based structures are relatively less applicable.

The case for the local provision (and funding) of local public goods is compelling, because it would allow a region's environmental managers to focus on the goods that benefit their community. However, we do not consider local public goods any further in this paper. The reason for this is that we are focusing on state-wide priorities that are delivered through different regions; we are not focusing on local priorities being delivered through local Groups.

In a practical sense, a regional community with different priorities to the state could 'free ride' on state funding where it concurs with regional priorities, and pick up any other goods via its own initiatives. However, even when delivering the state's objectives, regional bodies may still have a 'culture' of local good provision.

Mechanisms

We will examine institutional arrangements as they relate to several mechanisms:

- research
- regulation
- public estate (parks and reserves)
- auctions for conservation contracts²
- tradeable emission permits (TEPs)
- landholder education

In Appendix 2, we explain what these mechanisms are, and how they are relevant to biodiversity conservation. We use an information economics approach to examine the situations under which they are appropriate.

Regulation and landholder education are commonly used by the state and federal governments in Australia. Other mechanisms such as auctions and TEPs are less common. However, we perceive these latter mechanisms to be emerging mechanisms, and we expect them to play a more important role in Australian environmental policy in the future.

We do not claim that the list of mechanisms given above is comprehensive, or that the mechanisms are the best available for biodiversity maintenance. However, they are useful for our analysis of institutional structure because they vary in terms of their aims and approach.

Applying the mechanisms under different institutional arrangements

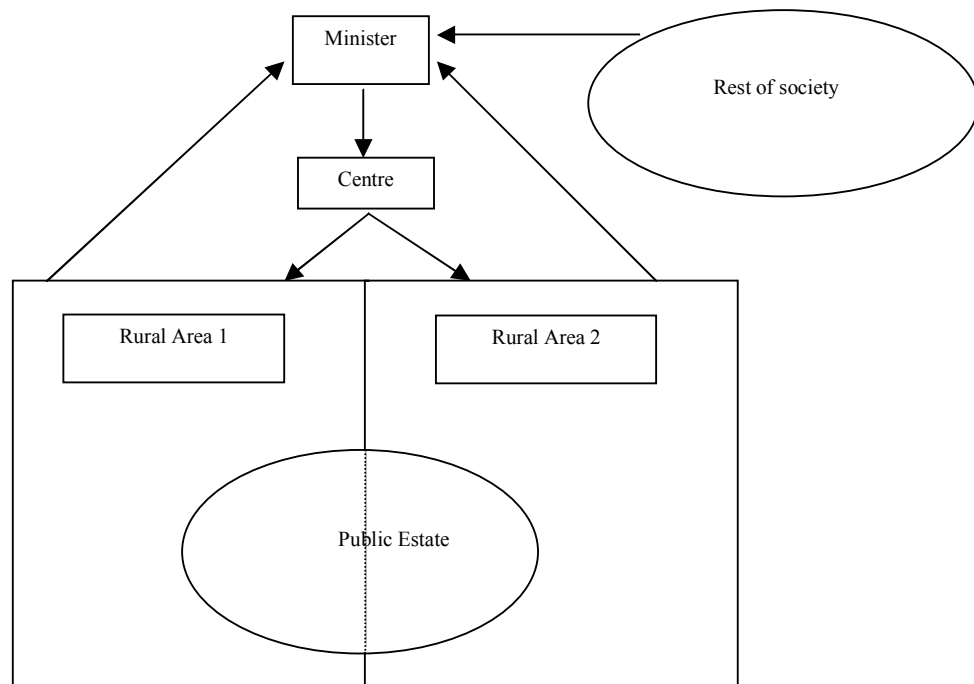
The framework

A hypothetical setting

We assume that there is a body that governs a group of people (a society), and we call this governing body the 'State'. There are three groups of people in society that could be thought of as living in different geographic areas: people in *Region 1*, people in *Region 2*, and the rest of society. People in the society take part in a political process, and elect a Minister. The Minister delegates the job of obtaining an *aggregate public good*, biodiversity, to a 'Centre'. The Centre must manage biodiversity at least cost. Funding for the Centre comes from taxes paid by the whole of society. To manage biodiversity, the Centre must achieve on-ground outcomes in two regions: *Region 1* and *Region 2*. The majority of land is privately owned, but there is a public estate that crosses the two regions. Figure 1 gives an overview of this setting.

Individuals in each region face different costs of achieving a unit improvement in biodiversity. Individuals in each region have a preference for local biodiversity management. The majority of land is privately owned, but there is a public estate that crosses the two regions.

² Auctions are a form of subsidy.

Figure 1 Hypothetical setting.

Alternative institutional forms

In this section, we explain two alternative institutional structures. However, before doing so, we need to point out what is common to both structures:

The Centre is assumed to know society's preferences in relation to biodiversity assets, and understand how this differs from the preferences of people in each region.

The Centre is assumed to have good information about when a particular mechanism is warranted (but we relax this assumption in a later section).

We will examine two institutional structures: centralisation, and a group-based structure.

In centralisation, the Centre would be akin to a head office, and it would have 'regional personnel'. Regional personnel would be involved in undertaking (or commissioning) any on-ground works for the Centre. However, the Centre operates by fiat; regional personnel are passive.

In the group-based structure, there would be a central office (again we call it the 'Centre') that deals with two regional groups: Community Group 1 and Community Group 2 (or 'Group 1', and 'Group 2'). These groups are in charge of environmental policy implementation in their respective areas; the Centre tries to obtain aggregate public goods by allocating funds to each Group to carry out works, organise land use change, etc. We assume that both Groups have their own board and CEO. The aim of the board is to understand local preferences; that is, to be 'in tune' with the community. Local preferences may conflict with the preferences of society in general. We assume that the Centre cannot get on-ground work undertaken unless it negotiates this with the relevant Group. For example, the Centre cannot get work done in *Region 2* unless Group 2 (either the CEO or his delegate) has certified the proposed actions. This is actually a complex bargaining process, the result of which will be uncertain. Appendix 3 provides an explanation of how we assume bargaining takes place.

It is worth noting that there is a third, more radical alternative: complete decentralisation. In this case there would be no 'Centre'. Instead, each Group would act autonomously. This would give each Group far-reaching powers (and empowerment). However, it would require different funding arrangements. There are two possible funding arrangements for a decentralised

structure. First, each Group would draw funds from within its own region (using ‘tax-like’ powers). Alternatively, complete decentralisation could work if a ‘Centre’ undertook other functions (like macro policy) and gave completely ‘untied’ grants to each Group, so that it had complete freedom to allocate those grant monies as it pleased (to get local public goods). We do not consider the decentralisation option any further in this paper, because we have ruled it out by assumption: we are assuming that we are dealing with ‘aggregate public goods’, not local public goods.

Assessing the forms

Economists propose that there are three basic economic conditions, or properties, that will affect the optimal institutional structure: economies of scale, economies of scope, and transaction costs:

- Economies of scale occur when it is relatively efficient to have one entity to produce a certain quantity of an output, rather than have two (or more) entities produce some share of the total quantity. For example, in the case of tackling a problem across two regions, it *may* be more efficient to tackle it with one set of infrastructure, since this could spread fixed costs.³
- Economies of scope occur when it is more efficient for one entity to produce two goods jointly rather than have two firms specialise in the production of each good.
- Transaction costs are the costs of affirming a transaction. This includes all costs, both before the transaction occurs (contract design, bargaining) and after (monitoring, evaluating, renegotiating). Transaction costs are particularly important in dynamic situations (that is, when there is repeated interaction between the parties of the contract), and when there is asymmetric information (since one party can use hidden information to get favourable outcomes).

Although each of these three properties is *generally* important in terms of determining the most cost-effective institutional structure (the boundary of the entity), economies of scope are relatively less important in our context for two key reasons. First, we focus on biodiversity policy (the production of biodiversity public goods), and not the interaction between biodiversity and other environmental goods. Hence, the question about ‘scope’ (i.e. about producing several different goods) is less relevant. Second, an economies of scope criterion would not help us differentiate much between the two structures above a centralised or group-based model, since if economies of scope were obtained in one they would most likely be obtained in the other. For example, if it were in fact efficient to produce biodiversity and salinity outcomes jointly, this would be true for a centralised *and* a group-based structure; the economies of scope criterion does not help us discriminate between the two institutional structures. Therefore, we will consider only economies of scale and transaction costs.

The nature of the comparison

Our aim in the next section is to compare the two institutional forms given above — centralisation and group-based — in relation to achieving a given outcome. At the start of each example we define the outcome (or need) as clearly as possible. We assume that the Minister receives the same type of information under either structure, and hence delivers the same instructions to the Centre. That is, the *aggregate* preference revelation under the two structures is equivalent.⁴

³ Economists generally think of economies of scale as a ‘long run’ concept; that is, all inputs—including plant and equipment—are assumed to be variable. This is not strictly the same as spreading fixed costs for a *given* infrastructure (which is called economies of *size*). However, we use a ‘loose’ interpretation in this document, i.e. we consider both economies of scale, and size.

⁴ It is unclear whether preference revelation would be different, or more accurate under either structure. For example, one could argue that the group-based structure gives the Minister much more information about local preferences. However, this is *local* information. Hence, the reverse could be argued: that the centralised structure allows the Minister to receive relatively more ‘even’, or ‘aggregate’ information. Due to our uncertainty about this, we assume there is not bias either way. Besides, this lets us focus on the bureaucratic, rather than political, structures.

Examples

In this section we consider the State trying to implement the mechanisms listed earlier while operating under each of the two institutional structures. We comment on the likely advantages and disadvantages in terms of our two criteria: economies of scale; and transaction costs. Our comments about the likely advantages and disadvantages are, to a large degree, speculation. Whether these advantages and disadvantages would prevail in reality is an empirical question; our observations are only at the level of ‘casual empiricism’.⁵

Research

We assume here that there is a need to monitor and examine a variety of species or ecosystems (i.e. there is a research need), and that these species exist across both regions.

Economies of scale: If this problem were relevant to both regions (the aggregate public good question), then it could be efficient to use one connected set of infrastructure, rather than establish two sets of infrastructure. This would better spread the fixed costs. Further, once information is produced it can be delivered to either region.

Transaction costs: We would expect a centralised structure to build one facility, and to distribute the results or allow access to them as required. With a group-based structure, however, the Centre must come to an agreement with the regions. This does not rule out a joint research facility in the group-based structure, for two reasons. First, the Centre could allocate research money to both Groups, and ask them to undertake the research needed. The two Groups could then negotiate a common research facility (and hence reap economies of scale, if they exist). Second, the Centre could negotiate to build the facility on the Groups’ behalf. However, under centralisation the Centre would build the infrastructure and direct the research program. In a group-based structure there is relatively more bargaining involved to build a joint facility; transaction costs would increase. Further, when regional views on the relevant ecosystem differ (perhaps with regard to importance) to the Centre’s viewpoint, then each Group would have an incentive to push for research on issues favoured by their own community. Hence, negotiations could be prolonged.

Regulation

We assume here that there is a need to regulate, for example, to prevent clearing of native vegetation. This regulation needs to be drafted, communicated, and enforced in both regions (aggregate public goods). Since the ability to write legislation is a State function, we assume that the Centre would, under either structure, take care of the drafting and central communication of the policy (policy statements, etc.), and get the agents (whether they be regional personnel or Groups) to undertake further region communication, and the policy’s enforcement. Hence, we only examine regional communication, and policy enforcement, below.

Economies of scale: In terms of regional communication, there would not seem to be large economies of scale. The cost would be that of training personnel to communicate the policy (perhaps through discussion groups), which would be made up mostly of labour costs. This would be mostly a variable cost that could be delivered in a very similar manner within either structure. The same goes for enforcement.

Transaction costs: If the Groups accepted the regulatory policy as readily as regional personnel there would not seem to be any difference in transaction costs. Further, if the Groups could better target their communication and enforcement, because they were relatively more ‘in touch’ with the local community, this could actually lower the cost (increase the effectiveness) of enforcement in the group-based structure. However, if the Groups did not accept the regulations because they perceived that people in their region would be unfairly hurt, then they may resist the policy and thus raise the transaction costs.

⁵ We attribute this nomenclature to Vivek Chaudhri.

Public estate

We assume here that there are well-defined goals in terms of public estate management, and that the costs do not involve research (since this is covered above) but mostly involve operations (weed and pest control, road management, fencing, etc.).

Economies of scale: There are economies of scale in terms of coordination across a contiguous public estate (actions in one part of the estate should be synchronised with actions in other parts). For example, main roads through the estate should be centrally organised. However, many of the other on-ground costs would not involve economies of scale; they would involve labour costs that are mostly variable.

Transaction costs: In the cases where there are economies of scale, a group-based structure could incur relatively higher transaction costs: the two Groups would need to coordinate via discussion, rather than have works coordinated from the Centre. Apart from those cases, there is little reason to expect either institutional form to perform better under this criterion, unless Groups in the group-based structure haggle over the provision of local versus aggregate public goods in the estate.

Auctions

We assume here that the Centre hopes to raise the level of biodiversity management on private land, and it will achieve this by using an auction-based subsidy, akin to BushTender, which has been trialled by the Department of Natural Resources and Environment (see Stoneham et al. 2002). The auction process needs to be designed, the policy communicated, and the auction process run, and the successful bidders need to be monitored or engaged through time.

Economies of scale: The design of an auction system would be more efficiently carried out once. Further, if the design of an auction were undertaken, this would provide very useful information for auction-type systems (for example, expanding the mechanism into other States, or for other environmental problems). The process of running an auction is labour-based, so there is no reason to expect economies of scale, *a priori*. The same may be said of monitoring works: the design of an optimal monitoring system would be best done centrally since when done once, it can be applied to any region. However, implementation (on ground) would not be subject to economies of scale, at least *prima facie*.

Transaction costs: The process of scoring bids would be more efficiently managed via the centralised structure. The Centre could then simply rank bids, using all information (both region's bids) in the process. It could then allocate its budget to the best bids (regardless of the region they belong to). However if the Groups wanted to run their own auction process (i.e., run a separate ranking system), then an efficient outcome (comparing all bids on a consistent basis) would require that the Centre pre-empted the ranking of bids, and allocated the right amount of money to each region. This is highly unlikely, since the Centre would have to allocate that amount of money to each region, such that the marginal bid provided exactly the same amount of biodiversity per dollar.

Tradeable emissions permits (TEPs)

We assume here that there is a need to use a 'cap and trade' system to improve river health. This mechanism may cap the amount of nitrogen, or salinity, or some other nutrient, in the environment. One of the key reasons for the cap could be to improve aquatic biodiversity. We assume that the river flows through both regions (aggregate public good). Such a cap would require design, communication and enforcement.

Economies of scale: Like an auction, the design of the cap and trade mechanism would be more efficiently carried out once. Further, the design of one type of trading system would provide very useful information for others (in other regions, for example). The issues of communication and enforcement have been discussed above.

Transaction costs: In a centralised structure the best *design* for the mechanism would take account of the river as a whole. However, in a group-based structure the Centre would need to convince the two Groups via negotiation about the best overall design. (This is important so that there are as many traders as possible, and environmental thresholds are viewed from a whole-of-

river perspective.) Efficiency would require that low-impact and high-profit producers would expand under a TEP scheme. However, either Group 1 or Group 2 could rally against this if they were carrying a disproportionate number of inefficient producers. In contrast, difficult-to-sell policy change may be facilitated by the group-based structure if the Groups have a closer affinity with their community and can more easily sell a tough policy choice.

Landholder education

We assume here that the Centre decides to tell landholders some key messages about biodiversity. This might contain, for example, information about the way some farming practices affect biodiversity, and the types of things that a landholder can do to ameliorate the problem. The Centre decides to do this via group discussions.

Economies of scale: There could be economies of scale in designing the information package (see above), but it is unlikely that there are economies of scale in delivery.

Transaction costs: If a group-based structure has a better relationship with landholders, then for a given expenditure on communication, the Groups may have better penetration: locals will be more willing to participate in the discussions. Hence, transaction costs could be lower in a group-based structure. However, the Groups would have to accept the design of the information package, rather than haggle over its content.

Information about the choice of mechanisms

We assumed above that the Centre decides on the mechanism to be used, and that its choice of mechanism, and mechanism design, is efficient. However, there is an alternative option in the group-based structure: the Centre could defer to the Groups regarding the appropriate mechanism.

Whether this would be efficient depends on the ability of the Groups, in comparison to the Centre, to choose the best mechanism. There are three possible scenarios.

When the Centre has better information about the right mechanism, it is best placed to choose, and hence negotiations occur over implementation. (In effect this is our assumption above, and hence the case we have examined.)

When the Centre and the Groups have the same information about mechanism choice, the scenario is also very similar to above, because the Centre would generally choose the same mechanism as the Groups. However, since preferences over biodiversity assets are different (the State has a preference for aggregate rather than local public goods) then the Groups would bias their choice of mechanism in favour of local public good outcomes. If the Centre detects this, then bargaining between the Centre and the Groups would ensue, raising transaction costs.

When Groups' information about mechanism design is better than the Centre's information, the Centre would want the Groups to reveal their information, and then bargain over the attainment of local versus aggregate public goods. In other words, the structure would have to work differently to the way described above, since we have assumed that the Centre chooses the mechanism to be used.

Summary and musings

Summary

In this paper we have considered the generation of two types of public goods: aggregate and local. We argued that local public goods could be efficiently provided by local Groups, but that funding for these goods would have to be either locally derived (via a local tax) or provided in an untied fashion from the State.

The focus of our paper has been on the provision of aggregate public goods. That is, goods that are prioritised as beneficial by the State. When the State has limited funding its preferences may or may not coincide with those of regions. Hence, the State will hope to allocate funds to aggregate public goods, but regions may feel that their priorities are being ignored.

A government must not only choose the best mechanisms (or combination of mechanisms) to tackle an environmental problem such as creating aggregate public goods: it must also decide on the institutional structure that will implement the mechanism. The focus of our paper has

been on the way that structures affect mechanism implementation. We considered two hypothetical structures: a centralised structure, and a group-based structure. We examined these two structures using two criteria: economies of scale, and transaction costs.

There are probably economies of scale in coordination functions, and in those that require infrastructure development. The definition of infrastructure here is relevant not only to the physical type, but also the human type. For example human capital that specialises in mechanism design. This is because a core of mechanism design expertise (infrastructure) can apply, and re-apply, its skills to different problems. By contrast, many on-ground activities would not be subject to economies of scale. For example, getting one individual to visit ten sites is unlikely to be more efficient (lower cost) than having two individuals visit five sites each⁶.

The existence of economies of scale does not necessarily mean that a function should be centrally undertaken. If there are zero transaction costs, and information is openly shared, then different groups can bargain to attain efficient implementation. This is true whether economies of scale are due to co-ordination, or technological (infrastructure) reasons. When co-ordination is needed and transaction costs are zero, then the different parties can co-ordinate via bargaining/discussion. When infrastructure is being built and transaction costs are zero, then parties will identify the most efficient infrastructure design, build it, and negotiate over the sharing of the infrastructure's outputs.

However, transaction costs are not zero, and information is not openly shared. Hence, different institutional structures will affect the total cost of implementing any given mechanism. It is here that our comparison between a centralised and group-based structure showed that the former often seemed a lower-cost alternative. A centralised structure allows the Centre to act in the state-wide interest, and achieve the same outcomes it could in the group-based structure, but without large transaction costs.

A group-based structure for aggregate public goods is—to a large degree—a straw man. The Groups, by definition, prefer local public goods. The State, by definition, prefers aggregate public goods. Hence, costly haggling ensues when it comes to policy implementation.

We are unsure about how effective a group-based structure would be in the case where the State hoped to change property rights that adversely affected landholders (e.g. regulation). The group-based structure could be more or less effective in this circumstance. It would be more effective if the Groups readily accepted the change in property rights, and could better negotiate with their regions' people to deliver the policy. However, if the Groups fought against the regulation, because they perceived that it unfairly hurt people in their region, then they would just raise the transaction costs of achieving government's aims.

Some Musings

Many mechanisms for biodiversity conservation may be more efficiently organised in a centralised structure. However, if a group-based structure pertains, does this mean we are strapped to inefficiency?

We have argued that in terms of the delivery of aggregate public goods, a group-based structure would raise transaction costs in many circumstances. However, in reality institutional structures are not an either/or proposition. Rather, they can be blended and adjusted.

If we assume that a State is operating according to a group-based structure, what could it do to lower transaction costs?

First, it could use a combined structure: it could use both a group-based, or centralised, structure depending on the policy. It may seem that this would create tension because Groups would perceive the centralised structure as a threat. However, this is not necessarily the case. Wilson (1989) argues that organisations (for example, our Groups) can be loathe to take on functions that require a completely different skill set or *modus operandi*. Rather, organisations are happy to expand into areas of work where their core values, skills and methods can be easily applied. Hence Groups may be happy to stick with using their core skill set, and let other structures (other agents) deliver goods that require a completely different skill set.

⁶ We are assuming the two individuals are equally skilled.

Second, Groups in a group-based delivery structure could be given two types of funding from the Centre: some untied; and some tied. The untied funding could be used by the Groups to procure local goods. The Groups would have large amounts of discretion over how the use the monies. The local community would be interested in the results achieved using untied monies. Each Group's CEO would be accountable to the board, which should represent its stakeholders: the local community. Each Group's CEO and board form an important part of the governance structure, that should deliver outcomes to the local community. There is a problem with this since the local community (who effectively operate like shareholders) are not bearing the full cost of the Group's activities. Hence the community's incentives to demand results from the board may not be as sharp as they otherwise might.

With regard to untied monies, Groups would probably need to report back to the Centre, but this would be only a nominal reporting requirement. By definition, if the state has given untied funding it should not expect to have much control over its use.

However, because some untied funding goes to Groups, the Centre could perhaps more easily direct the tied portion of funding. Groups would perhaps more easily accept that they could not haggle over the priorities that the state wanted to achieve with the tied monies. In terms of tied funding, each Group would effectively operate as a passive agent, akin to regional personnel in our centralised structure.

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Appendix 1

Public goods

Public goods (such as biodiversity) differ from private goods (such as a loaf of bread) in terms of their use or consumption properties. Stiglitz (1988) defined public goods as goods where it is *infeasible* and *undesirable* for rationing. In the following explanation of public goods, we borrow heavily from Stiglitz's approach.

A good is public in the sense that if one individual derives benefits from using that good this does not preclude consumption by any other individual. In other words, it is *infeasible* to ration public goods because these goods are available to every one in society to consume. In terms of biodiversity, many people may derive benefits from it by knowing it exists; biodiversity has an 'existence' value. If one person 'consumes' biodiversity in this way, it does not mean that there is any less for others to use, or enjoy.⁷

Further, given the nature of public goods, it is also *undesirable* (too costly) to ration them. If you produce a loaf of bread, it is easy to exclude people from using it: if you don't pay, you don't receive. However, if an ecological community is preserved, how do you exclude people from the benefits? This is too costly to be economically sensible: it is *undesirable* to ration biodiversity in the existence sense as we have described in the previous paragraph.

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Appendix 2

Mechanism design — an information approach

In a recent paper, Bardsley *et al.* (2002) argue that 'information-economics' can help policy makers who want to design better mechanisms. Policy makers can benefit from information-economics for two reasons: it can help them to better characterise the problem; and design solutions. Our commentary in this section is very brief, since we wish only to highlight some key issues. Interested readers are referred to other papers (Bardsley *et al.*, 2002 and Stoneham *et al.* 2000) for a more comprehensive statement of the issues.

A2.1 Information Problems

We split the key information problems into two sorts: imperfect and asymmetric:

- *Imperfect information:* When information about a problem is unknown or it is unreliable. In other words, it is beyond the current state of knowledge/technology.
- *Asymmetric information:* When information is unevenly distributed between different parties. We consider two important examples: a landholder to State asymmetry; and an asymmetry across landholders.

Landholder to State asymmetry: This may occur, for example, when the State tries to get individual landholders to change their management of biodiversity. Each landholder knows the cost of undertaking a set of actions, but the State does not know each landholders private costs. Further, the State would know its own priorities relatively clearly. However, any given landholder may not know much about State priorities. Therefore, there exists an *information asymmetry* between government (who wants to conserve biodiversity) and private landholders (who want to maximise the value of their land). However, the government has to acquire biodiversity from private landholders. But private landholders are in a strong position to charge and receive a high price for the biodiversity present on their land—in some cases much higher than the value of current landuse. This is the core of the information asymmetry problem.

Asymmetry across Landholders: This may occur, for example, when it would be useful for different landholders to co-ordinate their management changes. In some cases market signals may provide enough co-ordination (e.g. a tradable permit system, see below), but in others, discussion may be the most efficient cross-landholder co-ordination device. For example, if

⁷ In technical terms, the good is 'non-rival'.

several different landholders needed to co-ordinate in terms of a corridor of vegetation that crossed their properties, they may need consistent signals about location of the corridor, vegetation type, and management regime.

A2.2 Some Mechanisms:

In this section we comment on some mechanisms that have been used, or promoted, with regards to biodiversity conservation. We briefly comment on their information revelation and dissemination properties.

Research

Research attempts to solve the imperfect information problem: it tries to improve the community's knowledge about a biodiversity problem, or its solution. Research can take the form of monitoring and analysis of a species, or eco-community, or it may involve biophysical modelling, or economic analysis.

Regulation

Generally, regulation attempts to prevent landholders, or others, from undertaking particular actions. For example, it may make clearing illegal, unless the landholder follows some due process to receive authority. Regulation has to be backed by some sort of penalty for non-compliance, whether that be a fine, jail, or something else. Hence, monitoring is required. Regulation can be seen as a sensible mechanism in terms of some of the characteristics mentioned above, namely thresholds and uncertainty. With thresholds and uncertainty, placing a 'cap' (a regulation) on (say) the amount of salinity that can enter a river—to protect native species—makes sense: this helps the State to restrict pollution below the threshold. However, since regulation is often a blanket measure (the same rule applies to all parties) it does not deal with differential costs of compliance across landholders, and hence is often criticised by economists for being inflexible, and costly (see the TEP section below).

Public Estate

The State may decide to own large areas of land, to protect biodiversity (for example, National Parks). This may be efficient where there are economies of scale in managing a large, contiguous, land area. Further, if thresholds require large (say) habitat areas to be joined, then it may be more efficient for joint ownership, rather than trying to co-ordinate across many individuals. Public ownership may also facilitate research because it lowers the cost of entering, and operating within the area.

Auctions

Economists have developed 'market based mechanisms' to encourage private landholders to change their landuse in line with a government's environmental goals. One such mechanism is an auction for conservation contracts (Latacz-Lohmann and Van der Hamvoort 1997).

The process of an auction for conservation contracts is as follows. After initial publicity about an auction, an interested landholder is visited by a field officer who assesses the quality and significance of the native vegetation on his site, and discusses management options with him. A landholder then identifies the actions he proposes to undertake on the site and, with the field officer, prepares a management plan. Following the site visit, a landholder receives a printed draft management plan. A landholder then submits his management plan, along with a bid for payment, to government. The government can then choose, from a pool of management agreements, those that help the government to achieve its biodiversity aims at low cost.

An auction system allows government and landholders to exchange information. Through the bidding process, a government gets landholders to reveal something about their cost of managing biodiversity. Through site visits, the government can collect information on the quality and significance of biodiversity on different sites. Further, the government can reveal to landholders some information about the value of their sites, and about the actions that would

enhance/protect those values. In summary, the auction allows government to be an ‘intelligent purchaser’ and the landholders to be ‘competitive suppliers’.

The Victorian Department of Natural Resources and Environment has recently trialed an auction system, called BushTender, to purchase biodiversity from private landholders (Stoneham *et al.* 2002). Substantial landuse change was achieved under BushTender. For example, the trial purchased landuse change on 3,160 ha for the cost of less than \$400,000 (Stoneham *et al.* 2002).

Tradable Emission Permits

TEPs (Tradable Emission Permits) are a cap and trade system. The ‘cap’ places some restriction on the aggregate amount of (say) pollutant that can be emitted, and the ‘trade’ allows parties to exchange the rights to emit certain amounts. Hence, more efficient producers—those that make a greater profit per unit of pollution—should benefit from a cap and trade system: they out-compete inefficient producers in terms of a share of the rights, and the total cost of achieving the cap is minimised. Hence, in many circumstances TEP are viewed as having very good information properties: they allow thresholds and uncertainties to be dealt with by regulation (the cap); and they allow heterogeneous individuals to engage in the system, using their private information (trade).

Landholder Education

Landholder education would need to be used in conjunction with most of the mechanisms mentioned above. However, on occasions, governments educate landholders with the aim of changing their behaviour purely through the education’s suasive element.

Landholder education tries to bring all landholders up to the same level of understanding about an issue. Hence, it tries to tackle, at least in part, both aspects of asymmetry mentioned above: the asymmetry between government and the landholder; and the asymmetry across landholders.

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Appendix 3

Bargaining between the state and a region

There are several key features to the bargain between the State and one region. Throughout this Appendix we call the latter the *relevant* region. If we are talking about a different region, we will call that *another* region. We summarise the key features of the bargain between the State and the relevant region in Figure A3.1.

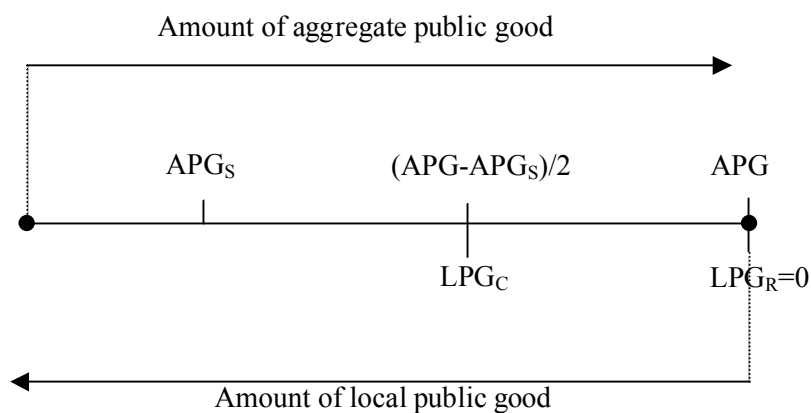


Figure A3.1

If there is a fixed budget to allocate to implementation, then there is a direct trade-off between the amount of aggregate public good and the amount of local public good; scarce resources allocated towards one cannot be used for the other. The amount of aggregate public good procured by the State is measured from left to right in the figure; the amount of local public good obtained by the relevant region is measured from right to left. We assume that a one unit increase in the amount of aggregate public good causes a one-unit decrease in the amount of local public good, and vice versa.

If the relevant region fully co-operates with (ie, yields to) the State then the amount of aggregate public good the State gets is $APG > 0$.

We denote the best the State can do without the relevant region by APG_S . We assume that $APG_S > 0$. Further, we assume that $APG_S < APG$ (see Figure A3.1). A rationale for this assumption is as follows. If the State were to approach another region to provide the same amount of biodiversity, it could not procure the same amount of aggregate public good, for a given cost. That is, another regions would be only an imperfect substitutes. Hence, the State has some incentive to bargain with the relevant region. Note that if the State gets APG_S from *another* region, then the *relevant* region would get zero local public good.

We denote the best the Region can do without the State by LPG_R . We assume that $LPG_R = 0$. A rationale for this assumption is that if the Region were to go it alone, it would receive no resources (funding) from the State. Since we have assumed that the region does not have a no local funding source (e.g. a local tax), then it would be unable to fund any local public good procurement.

Although it may seem—given that the State has all the resources—that the State would be able to force the region into supplying a level aggregate public goods equal to APG , this is incorrect. In fact, the Region knows that it adds value to the State, to the extent that with a successful bargain the State gets more than APG_S . Hence, we assume that the relevant region commences the bargaining process by guaranteeing the State at least APG_S . The two parties then bargain over the trade-off between local and public goods (the zone between APG_S and APG in the figure). Since each party is required for the two parties to improve their position within this zone, *each party has equal bargaining power*. Hence, they agree to a middle ground; they agree to the point $(APG - APG_S)/2 = LPG_C$. The result is:

- the State gets $APG_S + \{(APG - APG_S)/2\}$
- the Region gets an amount of local good equal in magnitude to LPG_C .

Note that the outcome here is that the State receives less aggregate public good than it would if it could administer by fiat, even though the funds are being provided by society as a whole. The State could obtain the full amount of aggregate public good by agreeing to bribe the relevant region with more resources. However, this additional cost could be seen as additional transaction costs due to the group-based institutional structure.

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