Alternative policy approaches to natural resource management

Background report to the Natural Resource Management Taskforce

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Australian Bureau of Agricultural and Resource Economics
GPO Box 1563 Canberra 2601

Telephone +61 2 6272 2000 Facsimile +61 2 6272 2001
Internet www.abareconomics.com

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Glossary

Covenant
Legal instrument attached to a deed of ownership that limits an owner's right to use or trade his or her property.

Diffuse pollution
Pollution for which it is difficult to identify and monitor the precise source.

Economic efficiency
Efficiency exists when resources are allocated such no individual can be made better off without making someone else worse off.

Externality
An externality occurs when an individual's actions affect another agent's well-being, and these effects are not reflected in market prices.

Marginal cost
The increase in total costs resulting from an increase in output of one unit.

Market failure
A situation where the market does not result in an allocation of resources that gives economic efficiency. Markets fail for four basic reasons: the presence of monopoly power; incomplete information; the presence of externalities; and the presence of public goods.

Nonexclusive good
A good is nonexclusive if it is impossible, or very costly, to exclude individuals from benefiting from the good.

Nonrival good
Nonrivalry implies that the marginal social cost of supplying the good to another individual is zero.

Point source pollution
Pollution that can be traced to an easily identifiable, single source.

Polluter pays
Approach to pricing where those directly responsible for pollution bear the cost of the resulting environmental damage.

Private externality
A private externality arises when the benefits of eliminating the external effects are excludable. With a private externality it is possible for an individual taking action to change these effects to prevent others from also benefiting from that action.

Private good
A good is a private good if, once produced, individuals can be excluded from benefiting from its availability. Private goods will also usually be rival goods, but that will not always be the case.

Property rights
Legal specification of ownership and the rights of owners.

Public externality
A public externality arises when the benefits of eliminating the external effects are not excludable.

Public good
A good is a public good if, once produced no one can be excluded from benefiting from its availability. Public goods will also usually be nonrival, but that will not always be the case.

Regulation
Institutional measures aimed at directly influencing the activities of economic agents.

Social cost (benefit)
Costs (benefits) of a production or consumption decision borne by (accruing to) society as a whole. This may differ from the costs (benefits) for the individuals directly involved in such decisions.

Tradable permit
A system where a ceiling (cap) is placed on the total permitted use of the resource or level of pollution, based on some target. Permits to use the resource or pollute up to the level of the ceiling are initially allocated in some way to users of the resource or sources of pollution. Permits may then be freely traded.

Transaction costs
Costs associated with the transfer of ownership of a good or service. Examples of transaction costs are costs associated with finding a buyer or seller, or the regulation of market transactions.

User pays
An approach to pricing based on charging for the full supply cost of a product or resource to the user of the product or resource.

Summary

In many cases the operation of free markets leads to the most efficient allocation of resources. Markets fail to allocate resources efficiently, however, when the private costs and benefits of an individual's actions diverge from those that accrue to the rest of the community. This is not uncommon when dealing with natural resources.

While there are many reasons why markets fail, at the heart of many problems is either inappropriate institutional arrangements or poorly defined property rights. Hence, the main role for governments in natural resource management is to improve resource use through a better system of institutional arrangements and property rights. The range of instruments available to governments to achieve this objective include property right solutions, the provision of information, suasive measures, economic instruments (both price and quantity based instruments) and regulation.

When inefficient resource use is the result of inappropriate institutional arrangements or the way in which ownership is defined within an existing market, governments have the opportunity to improve efficiency by removing these institutional impediments or improving the definition of property rights. There may be problems with the efficient application of property right solutions, however, where there is information failure, noncommercial benefits from the resource (for example, nonuse values from conservation) or externalities as a result of the use of the resource. Each of these problems involves public goods or externalities and free markets are likely to lead to less than optimal levels of research and development, conservation or abatement in polluting activities, respectively.

While public goods provide a rationale for government intervention (that is, nonexcludability and/or nonrivalry), the mere existence of an externality does not, on its own, warrant such action. An externality problem may be amenable to private resolution (a property right solution), though this will depend on the nature of the externality. For example, if an externality only affects a few parties in a localised area, it may be possible to resolve the problem through private negotiation, possibly including an element of financial incentives or compensation. This may not be possible for public externalities that arise when the external effects of the use of the resource by one individual are imposed on or shared by many others (for example, carbon emissions from land clearing). Under these circumstances it is extremely difficult, if not impossible, for an individual seeking a reduction in these external effects to either arrange for

payments from all potential beneficiaries or exclude those not contributing financially from the benefits of mitigation. This free rider problem means that resolution of a public externality through private collective action is typically more costly and complex than for a private externality. Hence, government intervention on behalf of all affected parties may be more cost effective.

The three primary criteria for government intervention include the rationale for intervention, efficiency and effectiveness. While market failure provides the rationale for government intervention, such intervention should only proceed if the benefits from intervening exceed the costs, resulting in an increase in public welfare.

The effectiveness of intervention refers to the degree of certainty with which an instrument achieves a stated goal. The best measure of effectiveness of an instrument is its impact on the quality of the natural resource base.

On efficiency grounds, the most appropriate form of intervention is the one that offers the largest net benefit to society. If two policy instruments have the same objective and level of effectiveness, then the preferred instrument will be the one with the lowest implementation costs.

Sometimes there are significant conflicts and complementarities between different resource decisions, and policy makers need to factor these in when calculating the net benefits of intervention. For example, replacing broadacre agriculture with forest plantations to reduce dryland salinity is likely to lead to reduced surface runoff and, hence, reduced water for irrigation. Where there are significant benefits derived from irrigation water, the net benefits from revegetation may be significantly reduced.

A potentially major constraint when designing policies for natural resource management is the availability of information. Complex information can be required in order to develop interventions that will deliver efficient and effective outcomes. This information requirement becomes particularly complex when dealing with nonmarket values such as those associated with environmental conservation. If policies are designed and introduced without the information needed to underpin the policy settings there is the potential for government failure, with intervention leading to a net loss in social welfare.

Instruments commonly used to deal with two common forms of market failure associated with natural resource management are discussed below.

If the market has under provided a good due to the public nature of the good the government can choose to stimulate its provision through a subsidy, regulate to ensure its provision or provide the good itself. For example, in the supply

of information, the Australian tax system offers incentives to industry to undertake research and development, while governments regularly undertake research and development and extension activities on behalf of industry and the wider community. On conservation, some governments have offered financial incentives to landholders to maintain biodiversity (for example, conservation covenants), regulated landholder activity to protect biodiversity (for example, restrictions on tree clearing) and directly provided biodiversity through the proclamation of national parks and the acquisition of land.

If there are external costs associated with resource use, governments may choose to intervene to limit these costs. In the event that private resolution of an externality is not possible, governments may initially resort to suasive measures to educate or pressure resource users to account for any external costs associated with their actions. Given that compliance with suasive measures by resource users is voluntary, such measures are likely to be ineffective where either the benefits of noncompliance or the costs of compliance are large.

The suitability of other instruments in dealing with externalities will depend to a large extent on whether there is reliable information on the causes and effects of environmental damage. The more reliable the information on the sources and impacts of damage, the wider the range of viable instruments. Policy makers will therefore usually have a wider selection of instruments to choose from when dealing with point source pollution than diffuse source pollution. It is often difficult to trace the sources and impacts of diffuse source pollution. The implications of this information constraint is illustrated in the search for an effective instrument to deal with dryland salinity.

A first best policy to address dryland salinity would be one that directly linked salinity damage to current land use at specific locations. To link saline discharge to land use, however, information would be needed on the relationship between land cover in a particular location and groundwater recharge, as well as on the relationship between recharge rates and discharges from the aquifer over time, and the salt content of the groundwater aquifer (Bell, Mues and Beare 2000).

Given the limitations of current understanding of the relationship between the biophysical system and salinity, there is considerable risk in linking actions to outcomes (Bell, Mues and Beare 2000). As a result, options such as taxes or charges that impose significant costs on landholders suspected of causing dryland salinity are likely to lack legal standing or credibility within the community. Moreover, it is highly questionable whether tradable permit schemes (quantity based economic instruments) designed to reduce saline discharge or recharge would be effective as the linking of actions to reduce salinity to outcomes would represent a significant risk for those engaged in

trade. For instance, trade in recharge permits between upstream and downstream users is unlikely to occur as downstream resource users affected by salinity face the risk that land use changes upstream may not significantly reduce salinity. Finally, while regulation may well lead to a change in resource use behavior, it is unlikely to be the most suitable form of intervention where the links between actions and outcomes are unclear. Where these links are not clear it may not be possible to judge the effectiveness of regulation, increasing the likelihood of government failure. Under these circumstances, the costs of regulation may be clear (for example, income forgone due to the requirement to revegetate a portion of land as well as any costs associated with policy implementation) while the benefits are unidentifiable and impossible to measure.

Where the benefits of mitigation are diffuse, incentive schemes such as subsidies for reduced recharge are likely to be more effective than taxes, charges, tradable permits and regulation. With subsidies it is the responsibility of the individual to prove eligibility for assistance, thus avoiding the legal problems associated with imposing a cost on landholders. Moreover, the risk that there will be little or no trade under a permit scheme is negated, with the government assuming the risk that reduced recharge from land use or management changes will not significantly reduce dryland salinity.

To conclude, policy makers often face significant problems when trying to resolve failures in natural resource management. For instance, there are often difficulties in identifying a level of intervention that will unambiguously improve public welfare, let alone the level of intervention that will maximise public welfare. Moreover, there can be difficulties in applying policy instruments to some natural resource problems. The ability of policy makers to implement more efficient and effective policy instruments in the future may depend on advances in our understanding of the sources and impacts of degradation and the development of more reliable valuation techniques to value non-commercial benefits associated with resource use. Such advances may even reduce the need for government intervention. For example, some parties adversely affected by the actions of resource users, and armed with evidence on the sources and impacts of damage, may be able to privately negotiate an outcome. The underlying threat of legal action would increase the likelihood of success in these negotiations.

1. Introduction

The development and use of Australia's natural resource base since European settlement has been a major contributor to national income and community well being. However, in realising these benefits some undesirable legacies, in the form of natural resource degradation, have been left for current and future generations.

It is difficult to be judgmental of past resource use decisions that have contributed to the problems which confront us today. Many of these decisions were based on the best information available at the time. Only as our understanding of the underlying biophysical processes has improved have we begun to appreciate the mistakes that were made. Furthermore, historical resource use decisions were based on the views and preferences of society at that time. But societal values change and the outcomes of past decisions may now be viewed as undesirable. Ironically, the change in societies' attitudes to the environment may have stemmed, at least in part, from the wealth generated by the resource use decisions that led to the problems in the first instance.

Policy makers do not have the opportunity to start again. Furthermore, our understanding of biophysical processes has improved to the stage where we can anticipate problems emerging in the future as a legacy of past actions. And there are undoubtedly currently unknown problems that will concern society in the future.

Considerable effort and financial resources have already been committed to dealing with these problems. Notwithstanding this, the challenge for policy makers in the first instance is to identify the weaknesses of current natural resource management policies and programs. Ranking these weaknesses according to the expected net benefits of remedying them then provides a list of priorities for government response. There will, however, be some cases where it will be uneconomic to restore the resource base to its pristine state, implying that society will have to accept that some level of environmental degradation is likely to remain.

To progress development of national policy on natural resource management, a taskforce was established in 1998 in the Department of Agriculture, Fisheries and Forestry. The taskforce commissioned ABARE to prepare a paper on the range of policy instruments that governments may use to provide incentives to resource managers to change resource use or adopt different management practices that are consistent with sustainable resource management. In partic-

ular, ABARE was asked to describe the circumstances when particular policy approaches are preferred over others to guide policy makers at all levels of government.

This work informed the development of the discussion paper, *Managing Natural Resources in Rural Australia for a Sustainable Future*, released for public consultation in December 1999. Subsequently, on 3 November 2000, the Council of Australian Governments agreed to the Prime Minister's *National Action Plan for Salinity and Water Quality*. The action plan follows the policy directions outlined in the discussion paper.

This report presents the work undertaken by ABARE for the taskforce in developing the discussion paper.

2. Overview

Increasing the social and economic benefit from natural resource management

The implementation of institutional arrangements that lead to the efficient allocation and use of resources, in an economic sense, is the ultimate goal of natural resource management. However, an inefficient use of resources can occur if the outcome arising from individuals acting in their private interests diverges from that which could occur if individuals acted collectively to maximise benefits to society.

There are numerous reasons — termed market failures — why these two outcomes can diverge, but at the heart of each problem is the nature of institutional arrangements or poorly defined property rights. Improved resource use from a better system of institutional arrangements and property rights is the main objective of governments in natural resource management.

Once the nature of the problem with natural resource management has been identified and the best possible policy response has been designed and implemented, the efficient use of resources is still unlikely. The main reason for this is that it is extremely difficult to design policy instruments that will provide incentives for individuals to use resources in a socially optimal manner.

Nevertheless, when the efficient use of resources cannot be achieved it may still be possible to change resource use such that the economic welfare of society is improved. In the design and evaluation of policy options, it is important to determine the economic welfare that is likely to be associated with resource use under alternative policies, taking into account the full range of costs of achieving any transition. These costs may include costs associated with obtaining information, and monitoring, enforcing and administering property rights, and transaction and compliance costs. It is also important that policy makers are aware of any income and wealth distribution effects expected to arise from the change.

One factor that adds to the costs of establishing and administering policy responses to resource management problems, possibly to the extent that it is impractical to do so, is that the boundaries of the natural resource management issue, typically a catchment or bioregion, does not necessarily align with the jurisdiction of a single government. This is particularly so at the local govern-

ment level. Spatial differences in the magnitude of the problem and the appropriate policy response also complicate the development and implementation of effective policy responses.

It should also be noted that no single instrument is likely to be successful in addressing several objectives simultaneously (ABARE 1993). For example, it has been postulated that carbon credits may be the trigger for widespread revegetation, with the subsequent beneficial effect of reduced groundwater recharge and less dryland salinity. However, revegetation could lead to an adverse social outcome if the groundwater recharge fed an aquifer system that supported irrigated agriculture. In addition, the dryland salinity benefits of revegetation are likely to be considerably greater in some areas compared with others. Hence, to maximise the complementary resource management benefits from revegetation, it will probably be necessary to accompany the introduction of carbon credits with another policy response designed to focus revegetation activities in areas that will yield benefits through reduced dryland salinity. In general, as many instruments will be needed as objectives.

Alternative policy approaches available to government

Governments have a wide array of alternative policy approaches available to them when confronted with resource management problems. Some approaches are designed to facilitate the efficient operation of existing markets in resource use rights. However, certain resource management problems have characteristics which suggest that these approaches, in isolation, are unlikely to effect a change in resource use and an improvement in social welfare. In these situations, the government response may focus on the establishment of new markets or the use of more prescriptive policy approaches. In this section, the alternative policy approaches available to government are discussed, beginning with the less interventionist options.

Property right solutions

Properly defined property rights can provide incentives to the owner of natural resources to manage or use the resource in ways that provide greatest benefits to society. Property rights are well defined if the entitlements to the use of a resource are known and enforced, all benefits and costs of the use of the resource accrue to the holder of the property right, and the property right is secure and transferable.

Where property rights are well defined, the primary role of government may simply be to facilitate the exercise of these rights. However, property right solutions are not universally applicable. In particular, problems with their effi-

cient application occur when there are noncommercial benefits from the resource, there is information failure or the use of the resource generates public externalities.

Provision of information

One source of market failure in natural resource management is information failure, which reflects the public good nature of many types of information, particularly research results. This generally leads to a less than optimal level of investment in information generating activities and is the primary rationale for government intervention in the provision of information.

Addressing this type of market failure through the public provision of information is one way that governments can facilitate the operation of existing markets. For example, to address an on-farm resource management problem the government could commission some research and/or an awareness and information program to make individuals fully aware of the costs and benefits of their own actions.

Alternatively, the provision of publicly funded information may facilitate private collective action by providing the data on the source and magnitude of costs necessary for parties involved to privately negotiate an improved outcome. In a similar way the provision of information may mean that individuals or firms adversely affected by the actions of others could take legal action to protect their common law rights. That is, legal action may be more widely used if the nature and source of the damage is better understood. This may even apply to situations where the source of the damage is diffuse or where many individuals are affected, the latter through class action suits.

Suasive measures

The aim of suasive measures is to change perceptions and priorities within an individual's or firm's decision framework by heightening their level of environmental awareness and responsibility (Industry Commission 1997a). Suasive measures can be delivered in the form of training or knowledge and information sharing, as well as forms of 'moral suasion' such as social pressure, negotiation, the threat of regulatory action or retaliation by others whether customers or society in general. Hence, suasive measures may encourage industries to develop and abide by voluntary codes of conduct. However, these are unlikely to be effective unless the benefits of noncompliance and the costs of compliance are small (ABARE 1993).

Suasive measures may have some potential to support the successful introduction and operation of economic or regulatory instruments. By altering attitudes using suasive measures, it is more likely that the need for regulations or economic instruments aimed at altering behavior will be recognised and accepted by stakeholder groups (Industry Commission 1997a).

Economic instruments

Economic instruments affect the relative prices (costs and benefits) of alternative actions open to firms (Industry Commission 1997a). They provide the opportunity to incorporate into market signals some or all of the costs that the actions of producers or consumers impose on others in the community through environmental damage and the use of natural resources.

Economic instruments are designed to influence the behavior of resource users to ensure that the resources are used more efficiently — that is, to ensure that the welfare associated with resource use is increased. An important first step in using economic instruments in the context of natural resource management is identifying the preferred allocation of resources to competing uses and the associated environmental outcome. This difficult task is even more complicated when there is uncertainty over the costs of different environmental outcomes or the environmental target is a threshold level beyond which the costs can increase sharply. The latter case in particular may be a reason to set the environmental target on the low side.

Economic instruments to achieve a particular environmental outcome or target can take the form of either a price or quantity based instrument. Price based instruments are those that assign a price to environmental impacts within existing markets through the imposition of charges, taxes or subsidies. Firms then respond to the modified market signals and adopt the resource use or management practice that offers them the greatest benefit and, if the policy is effective, leads to a better resource management outcome.

By contrast, quantity based instruments create a market in the rights to engage in an activity (that may be associated with environmental damage) by restricting the total level of activity and allocating rights to participate in that activity. An efficient allocation of rights is then determined through a market mechanism.

Where the marginal benefits and costs of using the resource are well understood, similar levels of resource use control and, hence, economic efficiency of resource use can be achieved using either a price or a quantity instrument (Rose 1997). In these circumstances the administration, monitoring and

enforcement costs of each alternative will be important factors to consider when choosing between price and quantity instruments.

However, price and quantity instruments have other distinguishing characteristics that make them particularly suited to certain situations. For example, taxes and subsidies have different strengths in the presence of uncertainty about abatement costs. If a tax is used then all users will respond so that their marginal cost of abatement is no higher than the tax. Although the final environmental outcome will be difficult to predict, it will be achieved in the least cost manner. In contrast, tradable quotas can be used to ensure the environmental target is achieved, assuming full compliance, irrespective of the cost of doing so.

Another distinguishing characteristic is the potential level of rent seeking behavior when different instruments are being considered. Lobbying by self interested groups to ensure the wealth effects are to their advantage can add to the costs of developing and implementing policies. And alternative instruments can have very different wealth effects. For example, levying a tax on their resource use imposes a cost, whereas granting quota shares to existing resource users gives these individuals marketable assets. Alternatively, auctioning quota shares has a similar effect to taxing resource users (Rose 1997). Therefore, the expected level of rent seeking behavior will be a factor affecting the efficiency of different policy approaches. This also has implications for choosing between the polluter pays or the beneficiary pays approach.

Before an economic instrument can be introduced, there generally needs to be complementary action on the clarification of property rights and/or institutional or legislative change. These actions are required to address the source of the market failure that existed initially. Resources such as river systems, fisheries and air, which are commonly available, cannot be allocated efficiently by a market, without some form of government regulation and/or the creation of property rights. Alternatively, before a market in tradable pollution quotas will operate efficiently, governments will need to clearly specify property rights, in terms of the rights and obligations of quota holders, and establish the rules of the secondary market in which the trade in entitlements will occur.

Compared with regulatory instruments where each individual user is constrained in its use of resources (see below), the use of economic instruments has the advantage that resource users can determine the response to the situation that best suits each of them in the light of the new price signals or quantity constraints (Holland and Brown 1999). By doing so, environmental objectives are achieved in the most cost effective manner.

As well as providing incentives for economic efficiency, economic instruments tend to offer greater incentives for ongoing innovation and improved environmental performance than do regulations.

Different economic instruments are designed to be consistent with the concepts of 'polluter pays' and 'beneficiary pays'. Under the polluter pays approach, the individuals or firms directly responsible for the environmental damage bear the costs of their actions or meet the costs of abatement. However, the costs borne by the polluter need to be based on their level of use or the level of damage, otherwise there will be an equity effect but not necessarily an improvement in efficiency.

The polluter pays approach contrasts with the beneficiary pays approach where those who benefit from an action pay for a portion of the benefits they receive. With instruments such as direct government grants for the adoption of improved natural resource management practices, the definition of the beneficiary can extend to the whole community since the grants are financed from general tax revenue.

In general, neither the polluter pays nor the beneficiary pays approach has any particular advantage in terms of economic efficiency. The choice between the two will generally be influenced by the characteristics of the problem at hand, with the transaction, administration, monitoring and compliance costs being particularly relevant to the efficiency of each approach.

Regulatory instruments

Typically, prescriptive regulations refer to approaches where controls are implemented, compliance is monitored, and noncompliance is penalised (ABARE 1993). They include direct controls on the level or type of resource use, such as restrictions on land use activities, or the management practices that must be used such as closed drainage and effluent management systems on feedlots. Hence, command and control regulations allow an individual to use a resource within a stipulated set of constraints.

The potential advantage of regulatory approaches over economic instruments is that they can provide the government with a high level of control over the behavior of those using the resources. However, the information demands for the design of efficient regulations can be substantial since the regulator must know the marginal external damage costs and the marginal cost of abatement (ABARE 1997).

Because each individual user is often restricted in its response to changes in market conditions the use of prescriptive regulations has generally resulted in inefficient resource use (ABARE 1993). For example, land use regulations such as maximum (or minimum) stocking rates may be inflexible or ineffective, allowing for little or no variation in conditions from one farm to the next, or over time. Hence, it may be necessary to monitor and review the regulations as conditions change but this would add to the cost of this approach.

Other shortcomings of regulations are that they may not provide incentives for ongoing innovation to reduce environmental degradation and they are often associated with high costs of administration and compliance. For these reasons, the use of regulatory instruments in isolation from other measures is unlikely to be the least cost method of achieving environmental objectives in many cases.

Factors influencing the choice of policy instrument

Decision makers use a variety of criteria in determining which of the range of policy instruments available is best suited to the natural resource management problem with which they are confronted. The three primary criteria are the rationale for intervention, effectiveness and efficiency. However, other factors will also need to be taken into account by decision makers as part of the policy development process.

Rationale for government intervention

In many instances, private decisions about resource use may lead to the socially optimal outcome. However, in other circumstances individual decisions will result in an inefficient allocation of resources from the perspective of society as a whole. The types of market failure that commonly affect natural resource management are discussed in detail in the following section but they include information failure, externalities, poorly defined property rights and the common access nature of many natural resources.

Market failure provides a rationale for government intervention in natural resource use. However, even when this rationale for government intervention has been identified, the economic case for government intervention necessarily depends on the intervention increasing public welfare (ABARE 1997). This requires that the net benefits of the intervention be greater than the costs of the intervention so that the action leads to a net benefit to society as a whole. Put another way, the optimal policy adopted by a decision maker is to do nothing until it can be shown that government intervention will lead to a better outcome.

Effectiveness

Effectiveness refers to how well an instrument achieves its objectives. Hence, the degree of certainty with which an instrument will achieve a stated goal or standard, or its dependability, will be an important consideration (Industry Commission 1997a). This criteria will be most important when it is necessary to reduce the environmental damage to below a threshold level in order to avoid an irreversible outcome. It would also be relatively more important when there is an element of uncertainty about the environmental consequences of continued damage. Against this criteria, direct regulation and quantity based economic instruments would be expected to be favored.

Once introduced, natural resource management policies also need to be subjected to ongoing monitoring and evaluation. For the majority of natural resource management problems the most direct measure of effectiveness would be the impact on the quality of the natural resource base. For some localised projects, such as reducing salinity levels in a watercourse draining a small catchment, it may be technically feasible and cost effective to collect and monitor. However, as noted by ABARE (1997) the data necessary to assess policy responses against this indicator at a broad scale are often unavailable. In these situations, proxy indicators of the effectiveness of the policy may be investigated. For example, the recent review of the land care taxation provisions assessed their effectiveness by considering the number and value of claims made under the provisions, the effective level of financial benefit provided, and the extent to which the provisions influenced landholder decisions to invest in selected land care works (ABARE 1997).

Efficiency

As mentioned earlier, government intervention in natural resource management will only be justified if the benefits of intervention outweigh the costs, so that the policy change offers a net benefit to society as a whole. However, the most appropriate form of intervention will be the one that offers the largest net benefit.

If two policy options have the same stated objective and are expected to be equally effective, then this would simply be a matter of comparing their respective costs of implementation. However, it is possible that two policies have different objectives or differ in their likely effectiveness. For example, one might be designed to ensure the dryland salinity problem in a catchment gets no worse. Another may be designed to achieve a reduction in the extent of the problem. Comparing these two options will necessarily involve consideration of both the costs and benefits of each.

There are several factors that need to be considered when assessing the efficiency of alternative policy approaches.

Administration, monitoring and enforcement costs

Perhaps the most important component of the direct costs of alternative policy approaches in the area of natural resource management policy is the size of the expected costs of administration, monitoring and enforcement. All aspects of these costs need to be considered when weighing up the relative efficiency of different policy approaches. These costs extend to:

- transaction costs associated with trading rights;
- administration costs;
- the marginal cost of raising general tax revenue to provide government subsidies or grants;
- compliance costs for all affected individuals; and
- monitoring and enforcement costs for the effective implementation of the policy change.

Information requirements

The goal of government intervention in natural resource management is to achieve the use of resources that maximises the net benefits to society. However, the information requirement for the design of policies to achieve this goal can be prohibitive. For example, in order to design an efficient regulation the policy maker needs information about the marginal external damage cost of the activity to be regulated as well as the marginal costs of abatement. Equally complex information is also required when identifying target levels of environmental conservation, particularly information on the economic returns from alternative land uses.

If policies are designed without this type of information, the probability of government failure, where policy intervention leads to a net loss in social welfare, increases. This can especially arise when there are tradeoffs between alternative land uses — the benefits of achieving a conservation objective may be less that the forgone benefits of alternative land uses. Hence, the cost of information needed for the design and implementation of policies is also a factor which affects the efficiency of an instrument.

Flexibility

There are two main aspects of flexibility that need to be considered. The first is the ability of the policy approach to deliver socially optimal outcomes in the

face of changing prices, conditions and environmental objectives. The second is the extent to which individual firms have the flexibility to determine the response to the situation that best suits them (Holland and Brown 1999). Economic instruments generally rate better than alternative approaches against this criterion because firms are free to choose how to achieve environmental objectives in the most cost effective manner.

Other factors

Aside from the three criteria listed above that focus on aspects of the economic efficiency of alternative instruments, there are two additional factors that policy makers need to take into account when designing policy.

The first is the acceptability of the policy change to affected stakeholders, which is related to both the effectiveness of a policy and its efficiency through the effect on costs of enforcement. In these circumstances, it may be worthwhile to incorporate suasive measures, such as knowledge and information sharing or awareness raising activities, designed to highlight the need for the policy change into the policy package.

The second is the direction and magnitude of any wealth effects arising from the change in policy. Although this is most often regarded as an equity issue that is related to acceptability, the method chosen for the initial distribution or sale of rights may have efficiency implications (Rose 1997).

The initial distribution of use rights among individuals does not have economic efficiency implications if all market participants have equal information, none has market power, and there are no transaction costs. But in reality, there are always transaction costs and there may be asymmetries in information and potential for the use of market power. Hence, the initial allocation of rights usually has at least some potential to affect the efficiency of government intervention.

3. Market failures in natural resource management and possible policy responses

Poorly defined property rights

The failure or absence of existing markets for using natural resources can in many cases be linked to the failure or inability of institutions to establish well defined property rights. As a consequence, many resources with poorly defined property rights are vulnerable to overuse.

Property rights are well defined if:

- entitlements to the use of a resource are known and enforced;
- all benefits and costs associated with the use of a resource accrue to the holder of the property right; and
- the property right is transferable and secure.

Properly defined property rights provide the owner with an incentive to improve or preserve the resource beyond the time he/she expects to make use of it. Under these circumstances potential buyers of the resource would be willing to pay up to an amount equivalent to the benefits they receive for the right to use the resource. Hence, when property rights are restricted to commercial outcomes that are valued in a market then defining and enforcing property rights may be an effective policy approach to the resource use problem.

If property rights were well defined, then any further government intervention could be relegated to simply facilitating the exercise of these rights. For example, for agricultural land with freehold title the procurement of such a property right carries with it a legislative prescription of who can use the land and how it can be used. In these circumstances, a market in land may be all that is required to make the efficient use of land possible.

When there are environmental benefits for which payment cannot be extracted from individuals, property rights solutions in isolation are unlikely to lead to the optimal provision of these services. For example, where an environmental asset has an existence value for numerous individuals in society it is difficult, if not impossible, for the owner of the property right to extract payment from all beneficiaries for maintaining those values. However, this could be overcome by defining and enforcing property rights and the government providing a payment on behalf of society to the holder of the property right to maintain the environmental benefits.

Designing property rights solutions to resource use problems is also difficult, if not impossible, in cases where there are public externalities or information failure, both of which are discussed below. In these circumstances, alternative or complementary government measures may be necessary to obtain a more efficient resource use.

If a property rights solution is not possible then the choice of an alternative policy instrument will be largely guided by the characteristics of the resource or environmental problem. Specifically, the success of a particular instrument in facilitating improved resource use will be determined by:

- the nature of any externalities inherent in the use of the resource;
- uncertainty and the availability of information on the implications of resource access;
- whether use of the resource is public or private in nature; and
- the existing condition of the resource and the institutional framework under which it is accessed.

Externalities

The failure of markets to reflect the true benefits and costs of resource use can often be attributed to an externality created by the use of a shared resource. Externalities exist when use of a resource by one individual results in costs or benefits for other individuals (external effects) that are not reflected in the price of resource access. Where there are positive external benefits, individual decision making is likely to lead to an underinvestment in that activity from society's perspective and vice versa. An economic objective of resource policy is to construct institutional arrangements in which market participants face the full benefits and costs of their resource use decisions where it is cost effective to do so.

Externalities are generally associated with poorly defined property rights. The extent to which property rights can be clarified or a policy instrument can be used to enable the incorporation of externalities in resource use decisions depends on the type of externality involved.

A ***public*** externality arises when the external effects of the use of a resource by one individual are imposed on or shared by others. Importantly, a public externality shares a characteristic of a public good, namely nonexcludability. That is, it is not possible for any individual who takes action to change these costs or benefits to prevent other affected resource users from also benefiting (without payment) from that action.

This characteristic of a public externality means it will often be difficult, if not impossible, to address the problem by facilitating collective private action. For example, a market may fail in a situation where the aggregate benefits of reduced dryland salinity are greater than the costs but it is not economic for an individual acting alone to offer incentives to those contributing to the groundwater recharge to change their enterprise mix or their land management practices. Although all individuals affected by the groundwater recharge, and the consequent dryland salinity problem, could contribute to the costs of abatement and improve their overall welfare, each has a financial incentive to make no contribution since an individual cannot be excluded from sharing in the benefits of reduced dryland salinity once those in the upper catchment make the necessary changes in land use and management practices. Coordinating collective action becomes more costly and complex and, hence, less feasible as the number of individuals needed to make contributions increase.

Just like a public good, investment in the abatement of a public externality will tend to be underprovided in a market economy.

In contrast, a ***private*** externality arises when the benefits of eliminating the external effects are excludable. Generally there are more methods of internalising a private externality than a public one if there are few individuals involved. For example, achieving improved resource use through negotiation between the individuals involved is more likely when there are fewer individuals and negotiation costs are small. Negotiation between affected parties would be facilitated if information on the nature of the problem were available. For example, if a land manager knows the source of the resource management problem and the costs it imposes on his business, he/she would be armed with sufficient information to negotiate a mutually beneficial outcome with the land managers causing the problem. Government involvement in the provision of that type of information would only be justified if the information possessed some characteristics of a public good.

The number of agents involved in the externality and the direction of the external effect can provide guidance to policy makers on the most appropriate policy solution. For example, if two farmers are jointly contributing to a dryland salinity problem for a farmer lower in the catchment then the farmer bearing the costs could negotiate directly with one, or both, of the upper catchment farmers with minimum transaction costs. This is an example of a private externality. However, if the actions of one farmer in the upper catchment are imposing costs on two farms in the lower catchment then this has the characteristic of a public externality. Each of the affected farmers is faced with the possibility of the other sharing in the benefits of reduced recharge without being compelled to make a financial contribution. Intervention by government

may be needed in these circumstances if a privately negotiated outcome cannot be achieved.

But resource management problems are often difficult to understand and the information to facilitate private action is not always available. A lack of information on environmental problems may mean that some policy instruments or abatement technologies introduced to correct for externalities simply result in a transfer of the externality to another location or across time to another generation. For example, intensive use of pesticides may accelerate the development of immune insect strains with which future generations of agricultural producers must contend.

A further difficulty can arise in defining an effective policy instrument if several pollutants combine to contribute to an environmental externality. For example, the production processes on two farms may emit different chemicals which when combined in a river system constitute a degradation of water quality in the river. If the two pollutants mix such that the impact of the combination is greater than the impact of the two separately, then designing an effective policy instrument may be difficult. Zylicz (1993) has shown that in such a situation, site specific charges or taxes and tradable permits are, in general, unlikely to be the most efficient alternative available.

The policies most suited to dealing with the presence of externalities associated with resource use are taxes and charges, subsidies and grants, tradable quotas and financial enforcement incentives.

Information failures and uncertainty

When resource users do not have full information on the impact of resource use on other individuals or on the resource stock, a private market in the resource is likely to fail. In some cases, poor information reflects fundamental scientific uncertainty. For example, detailed technical information on emission concentration levels at given monitoring points may be required and this will be dependent not just on the total amount of emissions, but also on the spatial location of emissions. In other cases, poor information may reflect the fact that many resource users are uninformed about all the complexities of the physical or market environment. Where the costs of ignorance are large, and where there is a public good aspect to the information being provided, government intervention may offer substantial efficiency gains.

Lack of technical information may reduce the range of policy instruments that are feasible to introduce. In some cases the level of resource use that gives the greatest economic welfare to society may be associated with a policy that

requires such substantial changes in the economic and institutional framework, that it is not even considered as a feasible option. Even when there is perfect information on the impact of resource use decisions and property rights are well defined, the existence of local optimums for resource use may mean that the market can fail to achieve efficient resource use (the global optimum). In that case, resource use may be at a point where price information provided by the market would indicate net losses in efficiency from small changes in resource use in any direction, while large changes may be required to achieve efficient resource use. The market may thus be stuck at an inefficient resource use combination.

A lack of information can also constrain policy making. For example, without an understanding of the costs of pollution abatement it is difficult to assess the opportunity cost of setting different pollution targets.

However, some useful information on abatement costs may be generated through trade in property rights. For example, a regulator may be able to obtain information on the marginal cost of undertaking pollution abatement by observing the market price of emission permits under different conditions. This may assist the regulator in assessing the likely opportunity cost or potential benefit of an adjustment of the aggregate quantity of emission permits.

Public nature of resource use

Another case where the market may fail to achieve an efficient resource use is when it is impossible or very costly to exclude others from using a resource and also when consumption of the resource by one individual does not reduce the amount of the resource available to be consumed by others. If the use of a resource by one individual affects the use by other individuals, while each individual has a legal right to use the resource, each has an incentive to capture as much of the benefits that its use provides before others are able to capture these. In such a case, the resource will be economically overexploited. When overuse occurs as a result of an inability to exclude resource users, the market has failed to price the use of the resource at a level that is indicative of its scarcity. This problem of nonexcludability is most evident in access to fisheries.

Existing resource state and access arrangements

The existing system of property rights governing access to a resource or environmental asset may restrict the range of instruments that can be considered for managing resource use. For example, the imposition of conditions on the use of land held by freehold title may be more difficult than with land held

under a short term lease arrangement. There may also be jurisdictional restrictions on the imposition of some economic instruments. Local, state and federal governments in Australia are largely confined to exercising regulatory power according to constitutional and legislative specifications.

The current state of the resource may further restrict the appropriate form of management that can be undertaken. Many of the consequences of resource use decisions are irreversible. In such situations the efficient level of resource use may be zero and the most appropriate policy instrument that can be adopted is complete prohibition on use of the resource. For example, natural wilderness areas can generally not be returned to a natural state once developed, at least not in a reasonable time frame. Similarly, an overexploited fishery may be best managed by a complete ban on harvesting until stocks recover.

4. Description of instruments

If a property rights solution to the resource use problem is not feasible, then government intervention in the use and management of natural resources falls into three main categories — direct regulation in the cases when it is not possible to create a market, improving the operation of existing markets, or addressing an incentive or property right problem to enable the creation of new markets. Examples of policy instruments falling into each of these three categories are presented below. Criteria that should be used for selecting the most appropriate option for any resource management problem were presented in chapter 1.

Tradable permit schemes

Tradable permits are aimed at addressing a lack of clearly defined property rights for a resource. In many cases in which there are poorly defined property rights, there are public externalities associated with the use of the resource. That is, the external costs and benefits are imposed on or realised jointly by users of a resource. By assigning property rights, a market in the environmental damage may be created whereby users of the environmental asset or resource pay for the right to contribute to the overall damage of the resource.

Marketable permits need a legal structure to define the property rights to trade permits and to ensure the rights are enforceable. Penalties for violating permits must be set by the regulator above the expected benefits to individuals or firms of violating permits in order to give incentives for polluters to purchase permits.

The basic idea with permit schemes is to estimate a desired level of resource quality or level of social damage. Permits that allow a specified amount of social damage to the common resource are then distributed to resource users and this right to generate social damage becomes tradable between resource users. Buyers of permits will be the firms for which it is relatively costly to reduce the social damage associated with their production. Sellers of permits will be the firms for which the cost of reducing social damage associated with their production is relatively low.

If property rights are well defined and there is information on the contribution of each resource user to environmental degradation, then the total level of resource damage may be determined by the market. However, usually it is necessary for the policy maker to determine an optimal or welfare improving

level of resource damage, facilitate an initial distribution of permits, and establish the rules and mechanism for trading. If trade in permits results in the marginal costs for all market participants of avoiding further damage being equal, the environmental outcome can be achieved at least cost. The cost minimising feature of tradable permits is a key argument favoring the use of these policy approaches over regulatory alternatives.

It is important to note that if permits are poorly defined it is possible to end up with an environmental outcome that is actually worse than with no intervention at all. As an example, see the discussion on the differences between a tradable emissions scheme and an ambient pollution scheme below.

The examples of a tradable fisheries quota and emissions permits for air pollution provide interesting comparisons and contrasts. In the case of the fishery, the potential benefits or costs of changing the level of fishing effort may be fully captured in the overall value of the quota. For example, in an overexploited fishery, reducing resource access may increase the resource rent derived from the fishery and this will be reflected in the value of the quota. In contrast, the benefits of reducing air pollution are not confined to holders of the emissions entitlement. If, however, property rights over emissions are enforceable, trade should lead to a least cost outcome. If the government wishes to reduce the level of the quota, it can do so by entering the market to buy quota, or simply regulate to reduce the level of quota. In either case the price of remaining quotas will increase.

There are a number of advantages associated with a tradable permits scheme relative to other economic instruments for controlling environmental damage:

- Provided that the market for permits is competitive (perfect information, single good, sufficient number of traders so that each is unable to individually influence the market outcome), tradable permits minimise the costs of restricting use of the resource.
- Firm specific information required by the regulator may be lower with a tradable permits scheme than for the introduction of charges or taxes, as the policy maker does not need to know firm specific production information or details of the damage by each permit holder at every point in time.
- Depending on the nature of the resource problem and information available, permits may be defined in terms of either emissions or damage.
- Permit schemes may be useful in cases in which there is either diffuse or point source pollution, although the costs of ensuring pollution levels

adhere to permit levels may be more difficult in the case of diffuse source pollution.

- Resource users can enter the industry without increasing the overall level of pollution. In contrast, under a tax system a new entrant will result in an increase in pollution.
- Nonconsumptive resource users, such as government, environmental or community groups, can purchase permits in the market if it is reassessed at a later date that pollution is unacceptably high.
- A tradable permits scheme is flexible enough to allow production processes of resource users to adapt over time in response to changes in economic conditions or pollution abatement and production technology.
- Trade may take place on a large scale, such as at an international or national level, or within a localised region.

However, there are a number of well known potential problems with tradable permit schemes, only some of which can be dealt with in the design phase. These include:

- A lack of information or high transaction costs may erode the benefits, or prevent market prices from reflecting marginal social costs and returns.
- The usefulness of tradable permits may be affected by the spatial distribution of resource users. For example, if the permit is defined in terms of emissions rather than pollution, the spatial location of firms may mean that the social costs of one firm's emissions may be substantially different from the social costs of another firm's emissions. In such a situation, the permit can no longer be considered a single good to be traded. Alternatively, it may be necessary to introduce regional exchange rates for permits.
- It is likely to be just as difficult for a regulator to determine a total allowable pollution level and the associated initial allocation of permits as it would be to determine an optimal charge or tax rate. If the total level of permits is set too high, the resource will be overexploited. If set too low, the market may fail to find a price at which resource users agree to trade permits. An appropriate timeframe under which the permitted pollution activity can occur must also be determined.
- The permit market may not be competitive. If, for example, the number of resource users is relatively small, the opportunity may exist for the exercise of market power over the trading price of permits. Under some circumstances, however, the existence of market power may actually facilitate permit trade by increasing the information that market participants

have on the potential impacts of trade on the environment or their production processes.

- The inability to define enforceable access rights — under these circumstances a competitive market in quotas is unlikely to form.

There is a range of tradable permit schemes available, and the choice of an appropriate scheme often comes down to the scope of the resource use problem and the amount of information available.

Tradable emissions scheme

Tradable permits can be based on emissions of a pollutant, and are potentially useful when dealing with point source pollution where it is feasible to measure discharges from individual sources and the marginal damage is the same from each emission source. Trade in permits takes place on a one for one rate basis — one permit conveys an identical discharge right to any holder of the permit. That is, if source A sells one permit it must reduce its emissions by the amount of emissions covered by the permit. If source B buys this permit, it can increase its emissions by the same amount. Total emissions therefore remain unchanged. A tradable emissions scheme is a relatively simple system and may be successful if the level of environmental damage is the same regardless of where the emission occurs.

Ambient pollution scheme

If the location of emissions matters, then an ambient permit scheme may be a more effective instrument for controlling environmental damage. Under this scheme, permits are defined in terms of damage at particular receptor locations. Rules for trading take into account that some permit buyers may be located in environmentally more sensitive areas and therefore one permit may convey to these firms the right to a lower discharge than it conveys to other firms in less sensitive areas.

A disadvantage of an ambient pollution scheme is that the market may be extremely complicated. To be effective, there must be a separate market in permits at each receptor location and firms must trade in as many markets as their emissions affect receptors. Transaction costs may therefore be relatively high and the number of traders in each market may be low.

In contrast to an emissions based scheme, total emissions may actually rise under an ambient pollution scheme if a polluter in an environmentally less sensitive area purchases additional permits.

Pollution offset arrangements

To avoid the above problems associated with tradable emissions and ambient pollution schemes, trading rules systems known as pollution offsets are sometimes proposed. These systems typically work on the basis that permits are defined in terms of emissions, but there are rules governing trade in permits that prohibit violation of ambient quality targets.

There are three basic forms of pollution offset systems. The first proposes that trade may not violate the ambient quality target at any receptor point (Krupnick, Oates and Van der Verg 1983). However, this is consistent with a deterioration in ambient quality up to the target level and an increase in overall emissions. The second form imposes an additional constraint that total emissions may not increase as a result of trade (Atkinson and Tietenberg 1982). The third form allows trade as long as neither the pretrade quality level nor the target level (whichever is consistent with lower environmental damage) is not violated (McGartland and Oates 1985).

Trading zones

Another variant to a tradable emissions permit system is a system based on zonal permits. Under this system, a series of zones is created within the polluted area and emission trades are permitted within each zone. No trades across zonal boundaries are allowed. This system is part way between the basic emission permits system and an ambient pollution scheme and may prove particularly useful when the location of emissions matters but reliable information on the environment and pollution is only available on a broad scale. However, because this strategy restricts trading opportunities, it may not achieve an allocation of permits at the lowest possible cost (Atkinson and Tietenberg 1987).

Subsidies and taxes

One way for governments to intervene to correct a market failure arising from the presence of externalities is to use taxes or subsidies. A Pigouvian tax (subsidy) is a tax levied on (subsidy given to) the producer of a negative (positive) externality so that their private costs are equal to the social costs of their actions (Peterson 1995). The basis for a Pigouvian tax is the external damage caused by the use of natural resources for agricultural production while a Pigouvian subsidy is based on the extent of any external benefits of an activity. If it is possible to introduce an appropriately designed tax on, or subsidy to, those causing the externality, then a socially optimal distribution of resource use could be attained at the least cost to society (Peterson 1995).

A Pigouvian subsidy could be offered for activities that are known to address environmental or resource use problems. The range of possible ways to provide a subsidy include direct grants, concessional loans and through the taxation system. In order to avoid paying subsidies to individuals who have already undertaken the activities to address the environmental effects of their actions, subsidies are usually only offered for the costs associated with implementing the change in resource use or management practices. Where a Pigouvian subsidy is introduced, society as a whole bears a portion of the costs of changing to damage mitigating resource uses or management practices through an increase in taxation expenditures.

Under a policy of subsidies, there is less of a need to identify the individuals eligible for the subsidy since it becomes the responsibility of the individual to apply, though clearly this relies on individuals being aware of the offer of the subsidy. Consequently, the monitoring and enforcement costs are likely to be lower than a system of taxes (ABARE 1997).

However, ABARE (1997) discusses some economic literature that is critical of a policy encouraging investment in land care works using subsidies. The basis for this argument is that subsidies for structural forms of soil conservation induces more investment in soil conservation but at the same time increase the need for such works. It is argued that by lowering the private opportunity cost of degradation through a reduction in the cost of repair, farmers will have the incentive to adopt more intensive, and potentially more degrading, uses of land. However, it is not clear whether the more intensive land uses would also be more degrading nor whether there would actually be a net increase in the level of degradation. Furthermore, if this model were accepted then the implied policy recommendation would be to tax all forms of soil conservation to reduce the extent of degradation.

Rather than accepting these arguments, ABARE (1997) supported a more intuitive and broadly applicable model where subsidies for inputs that are complementary to reduced degradation will lead to greater use of these inputs and, hence, less degradation. This is consistent with marginal analysis that suggests that a reduction in the marginal cost of treatment or prevention of degradation would lead to an increase in land care works up to the point where the marginal private return equals the now lower marginal cost.

A Pigouvian tax is suited to situations where the individuals responsible for the problem or the polluting activity can be readily identified. However, the costs of monitoring and enforcement may still be high because of the need to ensure that all individuals responsible for the problem are subjected to the tax (ABARE 1997). Where a Pigouvian tax is used the individual or firm respon-

sible for the environmental damage bears all of the costs of changing resource use or management practices.

There are a number of ways to design a tax on activities that are associated with environmentally damaging activities. Three of these are discussed below.

Site specific charges and taxes

Site specific charges and taxes are Pigouvian taxes levied on individuals known to be contributing to environmental damage through their resource use or management practices. By setting the charge or tax to reflect the cost to society of the environmental damage arising from the actions of a firm, an efficient use of resources can be achieved.

This type of instrument changes the behavior of firms directly by affecting the firm's production costs and, hence, their input use or pollution abatement decisions. Those able to reduce their pollution at a lower cost than the rate of the charge or tax will do so. Those who cannot will elect to pay the charge or tax instead. However, if the charge or tax is based on output of emissions rather than on environmental damage, it is unlikely to be consistent with an efficient use of the resource.

When charges or taxes are levied on the volume of either emissions or pollution, thereby making the marginal cost of the polluting activity greater than zero, the polluter has an ongoing incentive to introduce new technologies associated with cleaner production processes or to find ways to reduce emissions and thus avoid payment of the charge or tax.

This policy might be made more acceptable to those paying the tax if the revenue derived from the charge or tax is used to correct the associated environmental damage either through direct treatment of the environmental asset, research on new abatement technologies or to subsidise new investment in such technologies by polluters.

To ensure that polluters bear the costs associated only with their own activities and any reductions in emissions as a result of the charge or tax can be attributed to individual firms, each polluter should be levied with a different charge or tax according to their own individual contribution to the overall damage of the resource. As such, these instruments are not likely to be appropriate when there is little information on site specific emissions.

Setting site specific taxes to the estimated level of marginal damage is difficult for two reasons. First, it is often difficult and, hence, costly to estimate the

environmental damage caused by resource use at any specific location. Where the affected environmental assets include those that are not traded in a market the task of valuation becomes problematic. Second, in order to continue to reflect the level of social damage, the individual tax rates may need to be adjusted regularly. Measurement of emissions and the consequent environmental damage at each production site can be a costly and imprecise process that may need to be undertaken on a regular basis.

Uniform charge or tax

One alternative to a site specific tax is a single uniform charge or tax determined for a group of polluters on the basis of pollution measured at a particular site to which all the firms contribute. The liability of each producer depends on the aggregate emissions from the entire group of polluters, as emissions of individual producers cannot be easily monitored.

The uniform charge or tax may have both a fixed and variable component — a per unit charge or subsidy based on the deviation from some ambient standard and a lump sum penalty for not achieving the standard. If the total ambient concentration of a pollutant is found to exceed the standard, each polluter is required to pay a proportion of the full incremental social costs of the excessive ambient concentrations. The policy maker can set the charge and penalty in different combinations to achieve the desired reduction in pollutants. However, relative to a site specific tax scheme, under a single uniform tax scheme those firms with a relatively high contribution to the total resource damage may be undertaxed while firms with a relatively low contribution to resource damage may be overtaxed, with implications for economic efficiency.

The information requirements and ongoing administrative costs of a single uniform charge or tax are likely to be much lower than those of a site specific charge or tax since continual monitoring of emissions is only required at the monitoring site rather than at every source of pollution. However, given that all producers pay the same charge if the ambient standard is breached in total, an individual producer will be unable to fully capture the benefits (in terms of reduced tax burden) associated with a reduction in his own contribution to pollution. Moreover, the incentive exists for relatively poor performers (in terms of pollution) to free ride on the abatement activities of other producers, since they cannot be excluded from sharing in the benefits (reduced tax burden) of reduced pollution. Hence, a uniform charge or tax is unlikely to be associated with an efficient distribution of resource use.

Product charges

Product charges are fees or taxes levied on products identified as having a potentially adverse impact on the environment, either in the manufacturing or consumption phase. They may be based on the final product, such as the use of petroleum, or on some component of the product, such as the carbon content in petroleum. Product charges promote a life-cycle approach to pollutant control by focusing attention on potential environmental costs at each stage of the product cycle — production, use and disposal.

The effectiveness of product charges in achieving an environmental objective is based on the idea that an increase in the price of the product will lead to a reduction in its use through substitution to alternative products. Hence, for product charges to be effective the introduction of the charge needs to make alternative products that are less harmful to the environment price competitive.

Product charges differ from ambient charges in that they are not directly related to environmental damage in specific locations. This means that they may be a more appropriate instrument in situations in which ambient charges are not feasible (for example, because it is difficult or costly to identify sources of pollutants), when there is nonexcludability in the impact of the environmental damage, or when environmental damage occurs as a result of the product consumption rather than the product manufacture.

Product charges share some of the problems associated with uniform taxes. In particular, they do not distinguish between the environmental impacts associated with different uses of the polluting product. This is important since some uses may have less adverse environmental impacts than others.

There are many variations to product charges and they have been used extensively in a number of countries. However, a common feature of almost all reported product charges is an apparent lack of impact on the behavior of producers (OECD 1994). This suggests that product charges have been set at relatively low levels, so that it is more cost effective for producers and consumers to pay these charges than to seek substitute inputs or finished products or to vary their practices for waste disposal.

Noncompliance fees

Noncompliance fees are a fine levied on a resource user if their actions lead to environmental degradation in excess of some set standard. If the fine is levied directly on the polluter then the need to monitor individual polluters may become very costly.

One alternative that avoids these information requirements is an environmental rank-order fee system (Govindasamy, Herriges and Shogren 1994). Under this scheme, polluters are ranked according to either their resource use or their pollution control efforts. If a pollution standard is found to be violated, then one or more of the lowest ranked producers is penalised. If the environmental damage is found to be less than the pollution standard then the highest ranked producers may be rewarded. Rewards and penalties depend on the relative rank of the producers, not on the absolute level of pollution. An advantage of this approach is that information requirements are less than for emissions taxes and charges. Further, producers will have a financial incentive to reduce their pollution in order to move higher in the relative ranking system. However, when designing a system to rank producers based on their pollution control efforts, it will be important to ensure that the system acts to minimise pollution rather than maximise ranking.

Deposit–refund systems

Under a deposit–refund system, buyers of products that are potentially damaging to the environment pay a surcharge that is refunded to them when they return the product or container to an approved centre for recycling or disposal. Deposit–refund systems have been widely used to encourage recycling and minimise environmental damage through inappropriate disposal of products. Examples may include the disposal of petroleum based products and tyres on tractors, trucks and other farm machinery.

Performance bonds

A performance bond is a direct mechanism aimed at inducing the maintenance of, or improvement in, the state of the environment in which a producer is operating. Typically, a producer posts a bond before resource use begins and forfeits the bond if the firm's activities cause environmental degradation. Performance bonds are applied primarily in cases in which there is obvious environmental damage by a known resource user, for example with opencut mining. Well defined property rights are essential in order for performance bonds to be effective and enforceable.

The value of the bond should reflect the value of damages, in addition to any costs incurred in detecting and assessing the state of the resource or environment. One of the main advantages of performance bonds is that they shift the burden of proof for environmental damage from society to the producer. The producer must prove that no environmental degradation occurred in order to avoid forfeiting the bond.

In environmental policy, performance bonds have not received wide acceptance for several reasons. First, the regulator may have a financial incentive to retain the bond money, regardless of the extent of environmental damage. Second, some producers may face liquidity constraints at the start of their operations and be unable to post the necessary bond.

Leasehold conditions

The range of instruments that can be considered for managing resource use may be far wider under leasehold arrangements than under freehold or other property rights systems. For example, on renewal of agricultural leases, management conditions to achieve environmental objectives can be included in the new lease. These can be of a prescriptive nature with penalties for noncompliance or in the form of a performance contract.

Changes in leasehold conditions prior to expiry can also be attempted but may require compensation of leaseholders.

The imposition of conditions on leaseholds requires that property rights be well defined, both in terms of who has access to the property and the time frame over which this access is granted. In addition, performance against the leasehold conditions needs to be amenable to objective measurement.

Industry production accreditation systems

Standards are documented agreements containing technical specifications or criteria to be used consistently as rules, guidelines or definitions of characteristics to improve environmental protection, reduce waste and enhance product quality.

A standardised approach to setting environmental objectives and targets is provided by environmental management standards known as the ISO 14000 family of standards. The ISO 14000 standards are designed by the International Organisation for Standardisation (ISO), a federation of national standards bodies from about 130 countries. The ISO 14000 standards is a management tool that enables an organisation of any size or type to control the impact of its activities, products or services on the environment. The standards operate by acting as an encouragement for firms to examine areas in which they are having an environmental impact, to set environmental objectives, achieve these and to demonstrate that they have been achieved (Industry Commission 1997b).

The adoption of ISO 14000 standards is voluntary. As such, the main reasons that businesses tend to adopt these standards is to increase or maintain prof-

its, or to avoid more prescriptive regulation by governments on certain production processes. The standards can be used by firms to assure government, consumers and community groups that the firm is operating within predefined environmental standards. Adherence to standards can be confirmed through independent audits of the firm's activities.

Management agreements

The environmental amenity of nature conservation is often not reflected in a market. The inability to exclude nonpayers from the benefits (particularly off-site benefits) of conservation mean that a market in such services is unlikely to form. Under these circumstances, government intervention may be warranted.

The federal government has called for the creation of a National Reserve System (Commonwealth of Australia 1996), which will require that the environmental values of significant areas of freehold and leasehold land will need to be preserved. There are two basic approaches to nature conservation on private lands: acquisition and management agreements.

Acquisition is a costly method of achieving nature conservation. Depending on what level of representation of biodiversity is desired, the present value of costs associated with the acquisition and management of a National Reserve System would be $1.4–2.5 billion for New South Wales alone (Howard and Young 1996). This clearly makes management agreements an attractive option to achieve nature conservation.

A management agreement, also known as a conservation covenant, is a contract between a landholder and a third party on the use of their land. Management agreements are usually entered into voluntarily, and are potentially very flexible as they can be tailored to individual sites and landholders (Binning and Young 1997). Management agreements play two important roles:

- changing property rights — a management agreement limits or changes landholders' ability to exercise one or more of their existing property rights of the area in question; and
- defining plans of management — a management agreement contains a plan outlining detailed management strategies, actions and performance indicators for the area covered by the agreement.

(Binning and Young 1997)

An example of the rights and obligations that may be included in a management agreement is given in table 1.

The advantages of management agreements are that they are voluntary, acceptable to the community, and do not discriminate on the basis of farmers' incomes. They also offer a high degree of protection for the natural resource as landholders entering into management agreements are bound by the terms of the contract on the use of the land. Management agreements can be assessed on a case by case basis, and provide for targeting of priority conservation areas or degradation problems (ABARE 1997).

However, management agreements have their drawbacks. They require the landholder to trade off unrestricted use of the parcel of land for agricultural or grazing purposes with using it within the conditions of the agreement which may involve forgoing income. While the initial response to a covenant scheme has been positive in Victoria, the incentives to persuade additional landholders to establish management agreements may be significant (ABARE 1997). Management agreements also require additional administration such as monitoring and compliance enforcement, which can be costly (ABARE 1997). Compared with the costs of acquisition, however, it is likely that management agreements offer a more cost effective route to nature conservation.

Incentives for the donation of management agreements

While some management agreements may be freely donated, some incentive for philanthropic donation could further the preservation of areas of high envi-

1 Examples of obligations and rights in a management agreement

Commitment by implementation body	**Commitment by landowner**	**Joint commitment**
Approval and provision of payments	Manage for conservation, which may preclude certain land use	Development of the covenant
Undertaking flora/fauna surveys	Undertake active management	Development of the management plan
Provision of management advice and support (may include materials)	May initiate review of a management plan	Review of management performance and revision of the management plan as required
Provision of regular extension services	May carry out permitted land uses that are consistent with the maintenance of environmental values	
Monitoring and compliance		

Source: Tasmanian Public Land Use Commission (1994).

ronmental value. In assessing the role that each type of incentive instrument can play, it is assumed that a similar level of inducement must be provided to landholders by each instrument. In general, there is a tradeoff between program cost, and the level of flexibility and targeting offered.

Income tax arrangements

One possible instrument is the administration of a system of incentives through the tax system. Specifically, making the costs associated with entering management agreements and managing the protected area deductible from income tax may provide an incentive.

Under the present taxation system, only the costs associated with income earning activities are tax deductible. In principle, therefore, expenditure on philanthropic activities, such as nature conservation, must be financed from post-tax income. In practice, however, many of the costs of nature conservation by individuals with primary producer status are probably deducted as normal operating expenses because the separation of the costs of income earning and nonincome earning activities can be difficult and costly, especially where landholders use their own equipment and labor. Hence, this is only likely to be a practical concern for landholders who do not have primary producer status.

The major advantage of using the tax system to deliver incentives for entering into management agreements is that it is low cost. The infrastructure needed to deliver tax based incentives already exists, and by using this infrastructure the incentives can be delivered relatively cheaply. This suggests that the public benefit from nature conservation need only be moderate for the incentive scheme to contribute to an increase in social welfare.

However, using the tax system to deliver incentives for nature conservation will not target those areas of high environmental value. It is likely that land of marginal economic value will first be offered, and this would not necessarily coincide with areas of high conservation value.

It can also be argued that a system of tax deductions is of greater benefit to landholders with high incomes. This may result in income, rather than environmental value, playing an important role in conservation decisions.

It may also be possible to treat the opportunity cost of the donation of a conservation covenant as a tax deduction or for some form of capital loss. However, the value of the covenant must first be determined. Binning and Young (1999) outline two possible ways in which this may be valued:

- The reduction in land value resulting from entering the covenant could be assessed. If this approach was chosen, consideration would need to be given to:
  - whether existing land use restrictions, particularly native vegetation clearing controls, are to be taken into account,
  - whether the market, unimproved or other value of the land should be used as the basis for calculating loss of value.
- The value of the deduction could be based on the value of the covenant to the community, consistent with the beneficiaries pays approach. In this case, the value of the covenant to the Australian community would be valued and used as the basis for the deduction.

However, it would be very difficult to determine the value of the donation by either approach. Also, the extension of this approach to capital losses fails to address the problems associated with targeting areas of greatest environmental value.

Local government based incentives

At the local government level, there are a number of potential policy instruments available to encourage the entry into management agreements. As outlined in Binning and Young (1998), they include rate rebates for those entering management agreements, exempting land covered by a management agreement from rates, and the rezoning of land of high environment value so that it faces lower rates.

The potential advantage of local government level incentives is that they are very flexible. By managing environmental resources at the shire level, specific areas can be targeted for conservation. Also, perverse incentives that exist at the local government level can be removed. For example, setting rates according to the unimproved value of the land means that rates do not increase when an area is cleared, creating an incentive to clear native vegetation (Binning and Young 1998).

A possible barrier to the wider use of local government based incentives is the inconsistency between local government boundaries and the boundaries of the catchments or ecological communities. Hence, the development of broad scale strategic plans will generally require the involvement of several local governments, thereby increasing the costs.

Direct grants

As an alternative to tax based incentives, direct grants could be used to provide incentives to enter into management agreements. The main advantage of a grant based scheme is the ability to target specific sites of high environmental value. Also, once these sites have been targeted, the level of the grant can be adjusted to reflect the public benefits generated by their preservation. Direct grants also have the advantage that the level of incentive offered is not dependent on the recipient's income level, as it is with a system of tax deductions.

However, grant schemes require individual application, assessment and auditing, and are thus likely to be expensive to administer. Another drawback is that there is a considerable burden of uncertainty and administration placed on an applicant for a grants scheme, which may limit claims. Binning and Young (1999) also point out that there are often information failures in landholders becoming aware of government programs.

Regulation

There also exists the option of direct regulation of landholder rights over particular parcels of land. While this option is highly flexible and can be used to target individual sites, the information requirements for program managers can be significant. Information on the environmental value of the land being conserved and the opportunity costs of changing land use is required to ensure that the public benefit from the land use regulations outweighs income forgone by the landholder.

Land use regulations are introduced to alter the existing set of property rights and, hence, involve a wealth transfer from landholders to the community. However, this may be overcome using a complementary package of compensation payments.

5. Case studies

Information case studies

One of the conditions of an efficient market is that all participants make decisions based on perfect information. If this is not the case, inefficiencies may occur. For instance, if the condition of a resource such as land is not fully reflected in its market value, the incentive for resource owners to maintain the resource in its optimal state will be inadequate.

Governments may be able to facilitate existing markets through the provision of information where deficiencies are known to exist. The mere existence of an information deficiency, however, does not mean that government action is warranted. For example, some potential buyers of an asset such as land may be prepared to bear the risk of buying the land without paying for an objective assessment of its quality. This is a private decision that is unlikely to warrant government intervention. Intervention may still be warranted under these circumstances, however, if the benefits of redressing the information deficiency exceed the costs.

The two case studies discussed below illustrate how information may be able to facilitate existing markets. While the ACT energy efficiency ratings (EER) case study is not directly related to natural resource management, the basic tenets of the policy are transferable to the land market, as seen in the second case study.

Energy efficiency ratings and the residential property market

The ACT government recently adopted EERs (energy efficiency ratings) that provide greater information to the residential property market. Under the *Energy Efficiency Rating (Sale of Premises) Act 1997* a 'star energy rating' is required before selling a residential property in the ACT. This act is part of the ACT Greenhouse Response Strategy, aimed at reducing the use of nonrenewable resources, such as gas, coal and oil. The EER scheme aims to reduce the consumption of nonrenewable resources by enabling the energy efficiency of a home to be reflected in the home's capital value. Planning and Land Management (PALM) (1998) states that an energy efficient home can use 40 per cent less energy than an average home. Energy efficient homes can be up to 10 degrees cooler in summer and 5 degrees warmer in winter.

The EER scheme provides information on the energy efficiency of a home that buyers can then use in their decision making. If buyers have a preference for homes with a higher EER, the capital value of the more energy efficient homes will increase. If this increase in capital value is greater than the costs of improving the energy efficiency of a home, property owners are likely to invest in such improvements, thereby lowering the energy consumption of their homes.

Additionally, the EER scheme may increase community awareness of energy efficiency, the benefits of improving energy efficiency and the improvements that can be made to a property to increase energy efficiency.

The EER ranges between 0 and 5. However, homes built after 1 July 1995 need to achieve a minimum of a four star rating. Any advertisements for the sale of a home must include the EER.

To undertake the energy rating a full set of building plans, including plans of subsequent alterations, must be provided to an accredited assessor. Other relevant information required in the 'Sale of Residence Checklist' includes information on a home's construction, insulation and fittings. The basic charge for an energy rating by an accredited assessor in 1999 was $80 for residences with a floor area of up to 200 square metres, and $120 for residences with a floor area greater than 200 square metres (Jem Consultants 1999).

As the EER scheme is an addition to existing legislation the scheme's implementation costs are minimal. The additional costs only include initial expenditure of around $20 000 plus the cost of staff time to implement the legislation (David Power, Project Manager, PALM, personal communication, July 1999).

No study has been conducted at this stage to determine whether EERs have encouraged people to improve the energy efficiency of their home, or whether the measure has had any impact on the capital value of homes. However, David Power (Project Manager, PALM, personal communication, July 1999) stated that property owners have indicated an increasing interest in improving the EER of their homes.

Considering just that aspect of the EER scheme that requires a star energy rating for residential properties being sold, it is unclear how this form and level of government involvement is likely to improve the efficiency of the residential housing market. Many home buyers currently pay for building and pest inspections before purchasing a property with no government requirement for them to do so. There are few, if any, reasons why this aspect of house quality should be treated any differently. Potential buyers will seek out that information if their expected benefits are greater than the costs. Alternatively, vendors

would provide this information to prospective buyers if they thought the costs were outweighed by the prospects of a higher sale price.

The only role for government may be to establish an accreditation scheme for assessors where an industry body or association stipulating basic standards of technical competency for inspectors does not already exist.

The land market in Australia

Where land markets fail to accurately reflect the costs of resource degradation or benefits of remedial works, farmers will be encouraged to ignore the long run impacts of their practices on the land resource (Rausser 1980). Although buyers of rural properties consider current productivity to be a measure of the property value, this may be an inappropriate indicator of future productivity. For example, a number of forms of land degradation, such as dryland salinity, soil acidity and even soil loss, do not have a significant impact on productivity until a critical level has been reached. Alternatively, there may be a significant delay between the completion of remedial works or a change in practices and an improvement in farm productivity. Hence, current productivity may not be the only factor that needs to be considered when determining the value of the land.

Mues and Collins (1993) have suggested a 'Property Appraisal Scheme' may be one way to facilitate the incorporation of the long run benefits of conservation works or best farm management practices into land values. The scheme is analogous to the preparation of building and pest inspection reports for residential properties and car inspections offered by various motoring associations. The property report could include information on the productive potential of the property and details of existing and potential resource degradation problems.

The role for government in facilitating the operation of a Property Appraisal Scheme may only be small. The private sector may provide the necessary information on land resource condition in response to demand from potential buyers of rural properties, just as they have for building reports in the residential housing market. However, there may be a role for government support for research and development into the development of criteria for the reports and cost effective methods for collecting the required information if it was not possible for an individual or firm investing in that research and development to capture all the benefits.

Production standards: ISO 14000

ISO 14000 is a set of standards providing businesses with a structured process for continual improvements in environmental performance. It is a voluntary measure. As such, the main reason that businesses tend to implement the measure is to increase or maintain profits. Company sales may be improved by becoming ISO 14000 compliant if consumers demonstrate a clear preference for companies that comply with the standards in the market place. If consumer preferences were evident, there would be pressure on noncompliant companies to adopt the standards so that they do not lose market share.

Businesses may also adopt ISO 14000 standards if they wish to avoid more prescriptive regulation by governments on certain production processes.

ISO 14000 was published in 1996. By the end of 1997, around 5017 certificates had been awarded in 55 countries, more than three times the number awarded in 1996 (ISO 1999).

A disadvantage of ISO 14000 is that it is unlikely to achieve the optimal level of pollution in an area. This is because companies that comply with the standards can choose their own environmental goals and an insufficient number of companies may become ISO 14000 compliant. Companies would be expected to invest in ISO 14000 standards up to the point where the private marginal costs of doing so equal the private marginal benefits. However, there are additional benefits to society from companies investing in standards. These additional benefits will not be considered by the company in its decision making process.

Another disadvantage is the high cost of certification. The certification process involves commitment of time and resources and there are potential costs incurred if a company addresses the environmental issues identified during the certification processes (Flanagan 1997). The costs of the certification process for large multinationals are reported to range from $100 000 to $1 million per plant and from $10 000 to $100 000 for the smaller to medium sized facilities with no ISO 9000 (a quality management system standard) experience and no programs in place (Flanagan 1997).

An advantage of complying with the scheme for some firms is that, after meeting initial certification costs, business costs may actually fall. Cost savings for some companies have included lower distribution and waste management costs, as well as savings in materials and energy consumption (Transformation Strategies 1999; ISO 1998). For example in 1995 the Xerox Corporation saved more than $12 million from their site recycling programs and IBM saved $15.1

million from their energy conservation activities (Transformation Strategies 1999).

The relevance of ISO 14000 to natural resource management will depend on the extent to which consumers show a preference for goods produced in an environmentally friendly manner.

Management agreements: Trust for Nature

The Trust for Nature is a statutory authority set up under the *Victorian Conservation Trust Act 1972* to provide permanent protection of remnant vegetation on private land in Victoria through voluntary conservation covenants. The trust approaches landholders whose land includes areas of high conservation value, and, where possible, a conservation covenant for perpetuity is attached to the title of the following agreement between the trust and the owners. By mid-1999 the trust administered around 300 covenants covering approximately 11 000 hectares (P. Foreman, Conservation Manager, Trust for Nature, personal communication, July 1999). It collaborates with other organisations to compile an inventory of high priority sites, and contacts landholders either directly or through field days to donate covenants over these priority sites.

The Trust for Nature relies heavily on the altruism of landholders to donate covenants over sites of high conservation value. There are, however, some financial incentives employed by the trust. In some shires, it can guarantee rate rebates on land under a conservation covenant, and water rate rebates are available in some catchments. Tax rebates are available for donations of title over high priority land, and the trust assists with fencing costs on land under covenant.

In 1996 a revolving fund, under the administration of the trust, was established. Money from the fund is used to purchase important sites on the open market, place a covenant on the land, and resell it. The person who subsequently buys the land does so fully aware of the conservation value of the land, and their obligations to protect the site. Over time, the result will be a matching of people interested in conservation, with sites of high conservation value (Environment Australia 1997).

The rights and obligations under a covenant are tiered according to the conservation value of the land covered. Activities restricted on land under a conservation covenant include grazing, timber cutting, subdivision, housing developments and, in some cases, mining (P. Foreman, Conservation Manager, Trust for Nature, personal communication, July 1999). The covenants are

managed under stewardship agreements, whereby contact is maintained with the landholder to monitor compliance with the conditions of each covenant.

The focus of the Trust for Nature makes its operations very targeted — regional managers approach individual landholders directly. However, the small size of the trust, and the limited financial incentives it can offer, makes the program heavily reliant on altruistic actions of landholders interested in nature conservation. As a result, the trust is limited to protecting sites of high conservation value that are owned by landholders interested in nature conservation or who are willing to sell the sites. The scheme could be made more effective by offering greater incentives to enter into conservation covenants, as outlined in chapter 4. Recognising this, the trust is pushing to have more shire councils guarantee rate rebates on land under covenant (P. Foreman, Conservation Manager, Trust for Nature, personal communication, July 1999).

Subsidies and taxes: land care taxation provisions

The guiding principles for selecting between a subsidy and a tax were discussed in the previous chapter. However, a subsidy can be delivered using any of a number of vehicles. Direct grants or concessional loans may be provided on the basis of applications or subsidies may be offered using the taxation system. The case study of the land care tax provisions is used to illustrate two things. First, it is presented as an example of an effective and efficient subsidy. Second, the case study is used to highlight the range of factors that need to be considered in selecting between vehicles for providing a subsidy.

The rationale for the land care provisions is that some of the potential benefits from treating or preventing degradation would accrue to individuals other than those undertaking the land care expenditures. In the absence of any subsidies for these activities, some land care works of potential economic benefit to society would not be undertaken. That is, these activities would be undersupplied in the absence of some form of government intervention (ABARE 1997).

Sections 75B and 75D of the *Income Tax Assessment Acts of 1936 and 1997* provide for the accelerated deduction of the cost of investment in water reticulation and storage and a range of capital expenditures aimed at controlling or preventing land degradation respectively. This is provided through the choice of a deduction or, for individuals with taxable incomes below $20 700, a rebate for expenditures on each activity for up to $5000. The rebate or deduction under sections 75B and 75D are provided over three years and one year respectively.

The rebate component of the provisions was introduced in the 1997-98 financial year following a review of the tax based land care incentives. Prior to this the land care incentives were based solely on a system of deductions. The discussion in the remainder of this case study draws on the review of the pre-1997 system of incentives completed by ABARE in 1997.

Effectiveness

The ABARE review concluded that the system of land care incentives based on deductions was effective in providing a modest incentive to invest in land care works (ABARE 1997). Key findings of the review that related to the effectiveness of the provisions were:

- compared with the tax treatment of land care expenditures in the absence of these provisions, the pre-1997 provisions offered very modest incentives to invest in land care works:
  - around 86 per cent of individuals received the equivalent of a taxable subsidy of less than 22 per cent of the cost of the investment;
- generally more than half of farmers with expenditures rated the pre-1997 provisions as having a positive effect on their expenditure decision; and
- the provisions provided incentives for land care works that require capital expenditures, but offer no incentives for costless changes in management practices or changes that only involve recurrent expenditures.

Efficiency

Having concluded that the provisions were effective in providing incentives to invest in land care works, the issue becomes one of efficiency. That is, do the benefits of the incentives outweigh their cost and are they the form of intervention that offers the largest net benefit?

The modest incentives for land care works were provided at a low cost in terms of tax revenue forgone, estimated to be between $5 million and $12 million, depending on the tax treatment of the claims in the absence of the provisions. However, compliance costs borne by taxpayers generally add around 10 per cent to the cost measured as revenue forgone. The costs of administering the system of deductions were concluded to be low because the existing tax infrastructure could be used to deliver the subsidies.

No broadly applicable information on the value of the benefits from the treatment or prevention of land degradation that accrue to individuals other than those bearing the costs of the works — that is, the external benefits — was available for the ABARE review. However, if the value of external benefits

are, on average, more than 12 per cent of the total value of claims, then the benefits would warrant the cost of the pre-1997 land care provisions.

The 1997 review of the land care provisions concluded by considering the relative efficiency of alternative policy instruments. A summary of this aspect of the review is:

- taxes were not suited to this problem because of the difficulty in cost effectively identifying individuals contributing to the problem and monitoring their actions;
- subsidies in general were favored over taxes because people come forward to accept a subsidy, resulting in relatively lower monitoring and enforcement costs than taxes;
- the tax system is suited to providing broad based subsidies for a range of activities though it cannot be used to target priority regions or problems; and
- in contrast, direct grants and concessional loans can be used to effectively target specific priorities but have higher transaction costs associated with application, assessment and monitoring.

None of the other nontax instruments had the general characteristics to suggest that they would be more efficient than the tax based subsidy in providing broad based incentives to treat and prevent land degradation. However, there may be specific circumstances where they could be more efficient than subsidies. This suggests that the best approach may be to complement the broad tax based incentives with other instruments in specific circumstances where the prospective benefits are large enough to warrant the higher costs that are associated with these alternatives (ABARE 1997).

User charges: Hunter Water Corporation

Increased demand for water resources has resulted in more emphasis being placed on how the resource is allocated. In the past, water was allocated to end users by a pricing scheme that had little connection with the costs of supplying water. Usually, in the case of urban water use, charges are based on property vales, with an allowance of water that can be consumed without any charge. Effectively, for many consumers, the marginal cost of water was zero (ABARE 1993).

Underpricing of a scarce resource such as water will encourage overuse. Recognising this problem, there has been a move by water management authorities to price water according to the costs of supply. In 1982, the Hunter

Water Corporation (HWC) introduced a water charging system designed to recover the full costs of supplying water to consumers. A similar scheme was also introduced for providing wastewater services. The scheme had the following objectives:

- to better reflect the cost of providing the service;
- to impose a charge that reflected consumers' use so that those who use the resource pay the costs of providing the service to them;
- to eliminate unjustified cross-subsidies;
- to act as a demand management tool.

  (Michel 1986 in Read, Formby and Day1987)

The corporation sought to set a price for water based on the costs of supplying it, including a return to the state government as the owner of the corporation. According to the corporation, the main avenue of conservation for water resources occurs through individuals adapting use to the point where the value they place on additional consumption is equal to the price that they face (ABARE 1993)

The Corporation designed a two part tariff, with an access charge and a charge for actual water consumption. The access charge was fixed, and covered the costs of plant, equipment and overheads. The second charge was directly related to consumption per kilolitre of water, and covered management, maintenance and operation costs. The fixed charge varied between users, based on the size of the pipe carrying water to the user. Those with wider pipes paid higher prices to reflect larger infrastructure costs.

The scheme appears to have been effective in meeting its objectives. Among the outcomes, it was noted that:

- household water consumption fell by approximately 30 per cent;
- loss of water through leaks fell;
- savings from the scheme led to the deferment of construction of the next major reservoir, saving $10 million a year; the HWC's works expenditure has also fallen by approximately 10–15 per cent; and
- an increase in the use of water conservation measures was noted.

The most efficient pricing regime is to charge users the cost of supplying additional water (marginal cost pricing). Because of the existence of large fixed costs, the marginal cost of provision will often be below the average cost of

provision, creating a revenue shortfall. Hence, a two part tariff is often used. If consumers are charged a fixed price to cover overheads, and a variable charge equal to marginal cost to cover variable costs, allocative efficiency is not diminished. The HWC system operates along these lines; however, the difficulties in quantifying marginal cost make it difficult to judge whether the scheme is operating efficiently.

ABARE (1993) identified a number of potential changes to the pricing regime that may improve efficiency. One option was peak load pricing where consumers who wish to consume water during periods of peak demand would pay the higher cost of providing water at that time. However, the additional costs associated with continuous monitoring of water use throughout the day may outweigh the benefits of this approach. Variations in charges by region, to reflect cost differences in service provision, and price variations to ration demand during times of drought are other options that may have advantages in efficiency compared with the current arrangements.

Emission charges: New South Wales Environment Protection Authority load based licensing scheme

In July 1999, the New South Wales Environment Protection Authority (EPA) introduced a new load based licensing system for the control of pollutants released into the environment. In conjunction with the licensing scheme, a load based pollution charge was introduced. A load based pollution charge is levied on the pollutant load discharged by a firm. Preconditions for the effective use of pollution or emissions charges include the ability to: (a) identify the sources of pollution; (b) monitor discharge; and (c) determine an appropriate level of charge that reflects the marginal environmental damage of emissions.

Prior to July 1999, the EPA controlled the impact from discharges by setting absolute concentration limits on discharges, which the licensees were never allowed to exceed. However, this approach provided firms with no incentives to reduce discharges below the allowable limit. Under the new load-based licensing system, discharges are controlled by absolute maximum load (volume) limits accompanied by a new license fee structure. Pollution charges are now levied on the annual pollutant load discharged by a firm to provide an ongoing incentive to reduce loads. The general objectives of the load-based licensing scheme are:

- to provide incentives to reduce discharges of pollutants based on the polluter pays principle and to apply them within an equitable framework;

- to give industry incentives for ongoing improvements in environmental performance and the adoption of cleaner technologies;
- to provide incentives that are complementary to existing regulation and reduction programs for environment protection.

  (New South Wales Environment Protection Agency 1998)

In the first year of the new licensing structure (1999-2000), measurement of pollution loads at the firm level will provide a basis for negotiation of annual maximum pollutant loads. In subsequent years, the pollution load fee system will be in place. Initially, the incentive fees will apply to approximately 1000 of the current 3400 licence holders, with more entering the system as procedures are finalised.

For each industry category, assessable pollutants have been identified. These are the substances to which licence load limits and load based fees will apply. The selection criteria for the industry/pollutant combinations were:

- the potential of the pollutant to cause serious environmental harm is known and understood;
- robust pollutant measurement techniques are available; and
- the industry is known to have significant discharges of the pollutant.

  (New South Wales Environment Protection Agency 1998)

In calculating the pollution fees faced by each licensee, the load of assessable pollutants discharged by each firm over the course of the year is determined. The licensee can choose one of three methods of measuring its annual pollutant load:

- ***source monitoring:*** the actual loads of air and water pollutants that are discharged are measured.
- ***emission factors:*** the pollution loads are determined via an estimated emission rate relative to the rate of industrial activity; the emission can be a general industrywide rate, or a site specific one.
- ***mass balance:*** the materials going into and out of a production process are quantified, with the difference assumed to be released as pollutants.

Recognising that each type of pollutant has different impacts on the environment, the EPA has assigned each pollutant a different weight, depending on its environmental impact, and the EPA's policy objectives. The pollutants are weighted according to their toxicity to humans; toxicity to aquatic ecosystems; photochemical ozone creation potential; impact on atmospheric acidification;

impact on eutrophication of waterways; their contribution to malodorous air; and their nuisance value. The load of each pollutant that each licensee discharges is multiplied by that pollutant's impact weight, and summed across the assessable pollutants for that industry. The result is that licensee's weighted pollution load, and it is this that attracts a per-unit load fee.

In assessing the levels at which to set the fees, the EPA recognised the difficulties in determining the optimal rate of fees to be charged under the scheme. In particular, they had problems obtaining reliable information on abatement costs of New South Wales firms and the external costs of environmental damage. Hence, they opted to set the fees so that the scheme was largely revenue neutral in the first instance, with fees increasing over two years followed by a review of scheme performance. The review would then provide the opportunity to reassess tradeoffs between the benefits derived from activities that harm the environment and the costs of the environmental damage.

Because the load based licensing scheme has only been operating for a short period, it is difficult to judge its success. However, it can be acknowledged that the scheme has many desirable properties, including the potential to encourage more effective and economic management of discharges, allowance for environmental impacts, and the recovery of administration costs (James 1997). It is also an evolutionary policy in that it was built on existing licensing arrangements, lowering the costs of transition to the scheme.

As to whether a pollution charge is the most efficient economic instrument in this case, the lack of data on the costs to society of pollution makes this difficult to ascertain. This is exacerbated by difficulties associated with modeling licensees' abatement response. However, based on the load based measurements used to establish licence compliance and fees, the EPA intends to investigate a range of trading based schemes. The objective of these schemes will be to increase the efficiency of pollution control expenditures over time (New South Wales Environment Protection Agency 1998).

Tradable permits: Regional Clean Air Incentives Market

Tradable permit schemes are most applicable to situations where the polluters can be readily identified and the emissions from each source reliably measured and reported. The effective operation of a tradable permit scheme requires that the standard on which the scheme is based be set at an appropriate level. This requires knowledge of the marginal damage costs of the externality and marginal abatement costs. Permits will need to be allocated and a regulatory system put in place so permits can be traded.

The Regional Clean Air Incentives Market (RECLAIM) consists of tradable permit markets for two pollutants, nitrogen oxides (NOx) and sulfur oxides (SOx). The program was introduced in the Los Angeles (LA) Basin in 1994 to meet the severe environmental problems of the region by improving air quality.

Under RECLAIM a finite number of emissions credits are assigned to facilities based on historical emissions patterns. Allocations based on historical use ensure there are minimal income redistribution impacts from the introduction of the instrument. Fewer credits are assigned each year until the emissions are capped in 2003 at a level that meets national air quality standards for SOx and NOx. The control authority sets air quality standards by selecting a pollution control technology and calculating the amount of discharge reduction achievable by that technology.

RECLAIM provides plant facilities with increased flexibility to achieve emissions reductions at least cost through the trading of credits. Facilities that reduce emissions more than required can sell their excess credits to other facilities. These credits can only be used in the year they are issued. To reflect the pollution patterns of the LA Basin, two different geographic zones were established for trading.

Additionally, RECLAIM provides flexibility to the facility to achieve emissions reductions at least cost internally. This is because each facility is allocated credits to cover all its emission sources. These credits can then be allocated among the sources according to how the emissions reductions will be achieved within a facility.

Stationary facilities emitting four tonnes of NOx or more a year were included in the market. These 390 facilities represented around 65 per cent of the permitted stationary NOx emissions in the LA Basin. The smaller SOx market began with 65 facilities (Klier, Mattoon and Prager 1997). On average the original facilities were required to reduce their NOx and SOx emissions by 75 per cent of starting emissions levels.

Klier, Mattoon and Prager (1997) conclude that RECLAIM is a well designed environmental market in general. Trades are easy to carry out as information is readily available and brokers have entered the market. Information is available on an electronic bulletin board and the regulator also provides market activity data (Klier, Mattoon and Prager 1997).

The South Coast Air Quality Management Districts (AQMD 1998) three year audit of the performance of RECLAIM determined that aggregate reported

emissions from RECLAIM facilities were below required levels and were achieved at a lower cost than projected for the continuation of the previous 'command and control' regulations. The majority of facilities complied with their allocations during 1994 to 1996 and most instances of noncompliance were caused by miscalculations, problems with data or a lack of understanding of the credit scheme (AQMD 1998).

The success of RECLAIM can also be analysed from the level of trades and the price level of credits. There was a 50 per cent market participation rate in trading of credits that expired in 1995 in the first two years of the NOx program (Klier, Mattoon and Prager 1997). Klier, Mattoon and Prager (1997) believe this volume of trade seemed low given that banking of credits is not permitted under RECLAIM. However, by the end of the third year an active market had developed. Around 1200 trades of NOx and SOx had taken place by the end of 1997, involving 244 000 tons of NOx and SOx at a value of over $21 million (AQMD 1998; Klier 1998).

Prices reported for NOx credits during the first two years of the program were also lower than expected. This is possibly because the increased flexibility to meet standards provided by the trading scheme has lowered the cost of controlling NOx (Klier, Mattoon and Prager 1997). However, a low demand for credits during that period may also have led to low prices. Firms may have had sufficient credits to meet the first two years of reductions because during that period firms were operating below normal capacity in response to the 1990-91 recession (Klier, Mattoon and Prager 1997).

One issue of concern with this scheme (and one that it shares with other instruments) is that national air quality standards are unlikely to be set at the socially optimal level of pollution because of the formidable information requirements necessary to do so.

Another concern with the scheme is that in the beginning (between 1994 and March 1995) the majority of credits that were traded came from facilities reducing production rather than resulting from investment in pollution reduction technologies (Klier, Mattoon and Prager 1997). Only around 15 per cent of credits arose from a process change to lower emissions and only 10 per cent from new or additional control equipment to reduce emissions (Klier, Mattoon and Prager 1997). Klier (1998) concludes that the low prices for emissions credits have encouraged facilities to maintain equipment or manage equipment operations more efficiently to reduce emissions as this is less costly than investing in new or modified equipment.

Tradable permits: Hunter River Salinity Trading Scheme

The Hunter River Salinity Trading Scheme is another example of a tradable permit scheme. In 1995 the New South Wales Environment Protection Agency (EPA) established the Hunter River Salinity Trading Scheme to manage salinity in the Hunter River. Prior to the start of the scheme, salinity levels were particularly high during periods of low river flow and average conductivity in the river (a measure of the saltiness of the water) was increasing.

The Hunter River is naturally saline as salt occurs in the rocks and soils of the Hunter Valley. However, human activities, including mining, power generation, irrigation and other catchment industries, have increased the salinity in the Hunter River. The increasing salinity of river water can bring about a number of negative externalities such as causing the river water to become unsuitable for drinking and irrigation, and damaging the aquatic system of the river.

The Hunter River Salinity Trading Scheme is a system of tradable discharge permits. Permits were allocated to point source polluters, including coal mines and Pacific Powers, by a hybrid grandfathering process that principally rewarded good environmental performance (Collins and Smith 1998). The EPA retained 20 per cent of the credits for an environmental buffer and new entrants can enter the market by receiving credits from the EPA. The volume of permits allocated to a polluter represents the percentage of total allowable salt load each polluter is allowed to discharge. The total allowable salt load is the level that will ensure conductivity remains below a level predetermined by stakeholders. High charges apply if a firm discharges without credits.

During low flow periods of the river the environmental impact of saline water is the greatest and there is the greatest demand for water by irrigators. Therefore, participants are only allowed to discharge saline water during periods of high flow or floods. During floods unlimited discharges are permitted except when a particular tributary is protected.

Mine operators have needed to invest in storage dams to avoid releasing salty water during the low flow periods. The size of storages depends on whether it is intended that discharge will occur during high flow periods (smaller storages) or only during the flood period (larger storages) (J. Pattison, New South Wales EPA, Economics and Environmental Reporting Branch, personal communication, July 1999).

The New South Wales EPA states that the scheme has been successful in achieving its environmental objectives. In the scheme's first year, general conductivity levels remained within the targeted limits. In 1997 salinity in the

Hunter River was 20 per cent below 1991 levels, and average conductivity levels continued to fall in 1998 (New South Wales EPA and DLWC 1998).

However these environmental objectives are unlikely to have been achieved through the trade of permits. There have been few trades, though several dischargers have offered to sell their entitlements. Gilligan, Hannan and Smith (1996) state that the low level of trades may be the result of uncertainty about long term needs, the value of entitlements and concerns about longer term allocations. Collins and Smith (1998) identified that dischargers were concerned that the sale of entitlement may prejudice any future allocations.

The low flows throughout the earlier operation of the scheme may have restricted the volume of trades as there were few high flow periods in which to release pollutants (J. Pattison, New South Wales EPA, Economics and Environmental Reporting Branch, personal communication, July 1999). The rate of trades has increased with the increase in water flows. Up to mid-1999, twenty trades had taken place (J. Pattison, New South Wales EPA, Economics and Environmental Reporting Branch, personal communication, July 1999).

The fact that there have been few trades suggests that reductions in river salinity have been achieved by a change in timing of discharges to high flow periods rather than any reductions in the levels of saline water discharged. For instance during the schemes second year some mines stored wastewater for discharge during the flood flow period rather than during the high flow period. As a result only about 35 per cent of the total amount of wastewater that could have been discharged in the high flow period was released (James 1997).

One problem experienced with the scheme is that trading cannot take place outside office hours because trading occurs through EPA and Department of Land and Water Conservation (DLWC) offices. However the EPA is looking at implementing a 24 hour electronic trading facility (J. Pattison, New South Wales EPA, Economics and Environmental Reporting Branch, personal communication, July 1999). Another difficulty experienced is problems with data collection and monitoring (James 1997).

Operation of the scheme by the DLWC costs between $150 000 and $200 000 a year. All participants contribute to the scheme through a retrospective annual fee based on credit holdings (J. Pattison, New South Wales EPA, Economics and Environmental Reporting Branch, personal communication, July 1999).

The Hunter River Salinity Trading Scheme has achieved its environmental goals but with few trades. One reason for the absence of widespread trading could be that permit holders face similar marginal costs of abatement.

Alternatively, the lack of trading could suggest that it is the regulation of the timing of discharge that has resulted in the reduction in salinity rather than the operation of the tradable permit system.

Diffuse source nutrient runoff

While economic instruments may be useful in managing externalities, situations do exist where their application is difficult and the benefits of doing so are tenuous.

The potential for economic instruments to assist in reducing nutrient levels in agricultural runoff to waterways has been analysed by ABARE, in a report to the Department of Primary Industries and Energy (DPIE 1995).

Phosphorous is a key nutrient in the development and maintenance of algal blooms. Agricultural lands, through the application of fertiliser are generally regarded as a major source of phosphorous entering streams. Unlike pollution from factories where the point source can be easily identified and monitored, nutrient runoff from agricultural fertiliser use is characterised by diffuse sources. In this case, accurate identification of the nutrient contributions attributable to individuals is virtually impossible. Added to this is the complex nature of the relationships between fertiliser use and the eventual rise of algal blooms among the many other factors contributing to such outbreaks.

Four types of economic instruments were assessed by ABARE to determine their potential to assist in reducing nutrient levels in agricultural runoff: effluent taxes, product taxes, subsidies and tradable emission permits. The problems associated with each of these for addressing diffuse point nutrient runoff are discussed below.

Effluent taxes

There are several limitations to the effectiveness of effluent taxes in controlling diffuse point nutrient runoff. As stated previously, it is difficult to identify the source and quantity of the discharge at the individual farm level. Where this has been a problem in other applications of effluent taxes, proxies have sometimes been used. In this case such a proxy might be the agricultural output of the farm, though the robustness of using proxy measurements such as this is also questionable.

From a legal and administrative point of view, the spatial distribution of farms make monitoring prohibitively expensive. Also the poorly defined nature of effluent emissions and lack of clear relationships between climate, fertiliser

application, management practices and actual runoff could lead to legal challenges from any taxes imposed.

So while effluent taxes may be an effective tool in managing readily identified and monitored point sources of pollution, they do not lend themselves to the management of diffuse point emissions.

Product taxes

In the case of controlling nutrient runoff to waterways, a tax on fertiliser would be an example of a product tax. However, issues such as the elasticity of demand, substitutes and the relationship between product use and nutrient runoff have implications for the incidence, efficiency and effectiveness of imposing a product tax on fertiliser.

Because farmers generally have few economically viable options to applying fertiliser, the relationship between fertiliser use and its price is likely to be fairly inelastic. Indeed, past studies have found this to be the case. In this case a fertiliser tax will tend to result in small changes in product use while imposing significant costs on producers. Also, the price elasticity, and hence the effectiveness of a fertiliser tax, could be expected to vary between locations, reflecting differences in soils, land use intensity and substitution possibilities. And substitution between taxed and nontaxed products should not offset the benefits derived from the tax as may be the case if the substituted products lead to other forms of environmental degradation.

As with effluent taxes, to be truly effective there must be a strong causal relationship between the use of the product to which the tax applies and environmental degradation. As discussed previously, this has not been clearly established in the case of fertiliser and algal blooms.

A further disadvantage of a product tax on fertiliser is that it cannot discriminate between a farmer using poor land management practices on nutrient rich soils (and hence, although having a low demand for fertiliser, contributing significantly to nutrient pollution), and a farmer using sustainable land management practices on nutrient poor soils (thus having a high demand for fertiliser but making little contribution to nutrient pollution because of, say, earthworks and/or drainage to reticulation systems).

Subsidies

As with the other instruments discussed there are limitations to the effectiveness of subsidies in dealing with diffuse source pollution.

Activities such as revegetation, minimum tillage and improved fertiliser application methods could lend themselves to subsidies, but to be effective there must be a strong and readily measurable relationship between the activity being subsidised and the occurrence of environmental degradation. Due to the complexity of the processes ultimately resulting — in this case, in algal blooms — such defined relationships are virtually impossible to establish.

Assuming that the scientific relationships between activities and degradation could be accurately accounted for, the price elasticity of demand for those activities must then be determined to ensure effective application of the subsidy.

As with product taxes, there are also difficulties in ensuring that the activities subsidised do make a positive contribution in all locations and circumstances. If they do not, or their contribution is marginal relative to their cost, the efficiency of the subsidy will again be compromised.

A potential advantage of subsidies over other forms of intervention in dealing with diffuse pollution is that it is up to the individual to prove eligibility for assistance. This avoids the legal problem associated with imposing a cost on landholders where there is considerable risk in linking actions to outcomes. Moreover, the risk that there will be little or no trade under an emissions permit scheme because of uncertainty is negated.

Tradable emission permits

Emission permit schemes require a total acceptable level of pollution to be defined and set. The significant gaps in information and understanding of the processes involved in algal bloom generation, including contributions from point and nonpoint sources, place severe doubt on the ability to correctly identify such a level. Unless such a level can be determined and universally agreed, there will be difficulties in gaining the acceptance and commitment of potential participants in the arrangement.

Even if these initial obstacles could be overcome, the possibility of 'hot spots' developing where tradable emission permits become concentrated in certain areas of waterways are a potential limitation to the environmental effectiveness. Restrictions in trade may be required where this occurs.

The difficulties in clearly identifying and monitoring the contributions of individual broadacre farms to total nutrient loads would affect the ability to enforce permit conditions, the costs of doing so and ultimately the overall effectiveness of the system.

Performance bonds: Great Barrier Reef

The Great Barrier Reef Marine Park Authority issues permits for tourism operations, mariculture and the commercial collection of shellfish, corals and aquarium fish undertaken in the marine park. A permit specifies the limits to entry and use of the marine park for the particular project and the conditions that need to be met before construction or operation occurs in the marine park (ABARE 1993).

A permittee (other than state governments) is required to pay a performance bond before any structure is installed in the marine park. Performance bonds ensure that the authority has funds available for the cleanup and rehabilitation of a site if an operator fails to meet the obligations of their permits. The authority, however, only uses the bond as a last resort (ABARE 1993).

The bond is calculated to cover the costs of removing structures and facilities from the site, site rehabilitation and insurance premiums. It also covers the costs of an environmental monitoring program and a code of environmental practice program in case the permittee defaults on these payments (ABARE 1993).

The authority had called on performance bonds four times between their introduction in 1987 until 1991. An example is where a tourist pontoon on Fantasy Island broke up and sank while being towed in 1988. Following several requests to remove the wreckage the authority drew on the performance bond to complete the task, which cost $210 000 (ABARE 1993).

The payment of a performance bond encourages each developer to take into account the costs associated with rehabilitation at an early stage, thus encouraging operators to choose the most efficient scale and type of operation (ABARE 1993).

Performance bonds encourage an operator to rehabilitate a site in a cost effective manner from its own funds where the costs of rehabilitation are likely to be lower than the value of the performance bond. Stipulating the level of rehabilitation required and not the method of rehabilitation encourages the most cost effective rehabilitation to be undertaken (ABARE 1993).

Performance bonds were introduced by making the provision of the bond a condition of the permit, so there was no conflict with existing legislation or need to make any special legislative requirements. As the bond is a condition of the permit the additional costs of administering the bond are likely to be small (ABARE 1993).

One difficulty experienced by the authority were the occasions when the amount of the performance bond had not met the costs of cleanup and removal. This was particularly a problem early in the use of the bonds because of the difficulty in defining rehabilitation of a marine environment and a lack of knowledge of the likely costs of rehabilitation. For example, initially the amount of the bond available for salvage work was found to be inadequate as the authority had a limited basis to assess whether the salvage estimates provided by permittees were adequate. In addition, problems arose when the acceptable level of cleanup had not been specified (ABARE 1993).

Despite these information difficulties, by using site specific costs rather than average costs across all sites the authority reduces the risk of having some performance bonds that could be lower than the cost of rehabilitation at a site. Hence, the authority is attempting to equate the price of the bond to the level of possible damage (ABARE 1993).

It would appear that performance bonds are best suited to situations where there is one source of potential damage and that the level of damage can be estimated.

While the concept may appear to have relevance for other natural resource management issues, such as management of leasehold land, it would be necessary to be able to objectively measure performance. This may be difficult in the case of land due to the possibility of third parties being responsible for environmental damage. Climatic events may also make it difficult to measure performance.

Direct regulation: New South Wales concentration based licensing scheme

The main feature of regulatory instruments, as they relate to pollution control, is that they prescribe a specific level of pollution (or abatement) and/or the means of reducing environmental damage, and the polluter is left with no choice but to comply with the regulation or face penalties (OECD 1994). As a result, regulation is often considered inflexible and may not provide incentives for ongoing innovation to reduce environmental degradation (Industry Commission 1997a). An example of this was the New South Wales Environment Protection Authority's pollution regulations that were in force until June 1999.

In 1998, there were approximately 3400 licences issued under the *Pollution Control Act 1970*, overseen by the (EPA). The licences imposed conditions that:

- specified discharge limits,
- required, controlled or prohibited listed activities,
- stipulated monitoring of discharges and/or receiving environments by licensees, and
- listed reporting requirements.

  (New South Wales Environment Protection Authority 1998)

The EPA controlled the impact from discharges by setting absolute concentration limits on discharges that the licensees were never allowed to exceed. Over time, the EPA also negotiated pollution reduction programs with licensees that were binding programs that required reduction of harmful impacts by future dates. Licences covering discharges to water also placed a daily limit on the volume of effluent that could be discharged. However, because discharge volume limits were set to accommodate the discharger's *maximum* expected discharge, the implicit load limits were generally non-binding constraints. In some cases, there was the potential for these conditions to add to environmental management costs without significant environmental benefit (New South Wales Environment Protection Authority 1998).

Licence fees were based broadly on the potential to pollute, and were designed to recover the costs of administration, monitoring and enforcement of the licensing system. There were considerable inequities across licensees, with some paying significantly more than others with comparable environmental impacts (New South Wales Environment Protection Authority 1998).

For premises scheduled under the *Clean Air Act 1961*, throughput or production was used as an indicator of the resources required to administer the licence. As a result, the licence fees were not directly related to actual discharges, and so did not provide incentives to reduce discharges (New South Wales Environment Protection Authority 1998). For premises scheduled under the *Clean Waters Act 1970*, the fee generally depended on the maximum daily volume of effluent permitted to be discharged. Because the fees were based on the maximum amount, they were only weakly linked to actual quantities of pollutants released, and so did not provide significant incentives for pollution reduction (New South Wales Environment Protection Authority 1998).

This direct regulatory approach to pollution control was not an efficient policy. There was evidence that it was ineffective and too inflexible. For example, even if all licensees complied with their concentration limits, the proliferation of sources of pollutant loads, caused by economic expansion, resulted in cumulative increases in total pollution. Also, the system was weak in stimulating ongoing improvement in environmental performance beyond mere compli-

ance with the required minimum level of performance. This was because the fees were not directly linked to pollutant loads, and were small compared with the costs of pollution abatement. As a result, good environmental performers were disadvantaged to the extent that they committed more resources to abatement than their competitors (New South Wales Environment Protection Authority 1998). In recognising these points, the EPA introduced a load based licensing system in July 1999, with fees that are related to actual pollutant loads released. This policy is reviewed in the New South Wales load based licensing case study.

There are few circumstances where direct regulation of natural resource markets is the most efficient instrument. Direct regulation is only justifiable where the costs of government regulation, including economic costs, are outweighed by the social benefit of the regulation, and are less than the costs associated with implementing a market based economic instrument. Such a situation may exist when the costs of determining an optimal pollution tax level are high, or when the transaction costs associated with a tradable rights scheme are high.

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