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Rural Water Use and the Environment

ABARE submission to the Productivity Commission Study into Rural Water Use and the Environment

summary

Market mechanisms can be used to more closely align the private and social costs of rural water use to achieve more economically efficient outcomes. Market mechanisms may resolve many of the third party effects associated with rural water use but will not be appropriate in all situations.

- Market mechanisms can be used to increase the efficiency of rural water use through, for example, water trade or the use of water options to source additional water for environmental flows. Market mechanisms can also be used to reduce the environmental and socioeconomic costs of rural water use.
- Water trade can enhance the economical efficiency of rural water use because it enables water to move to the highest value use; however, incompletely specified water property rights mean that third party effects may result from trade. The regionally specific nature of third party effects means that, in some instances, the costs of creating, implementing and enforcing these property rights will be greater than the benefits that they generate.
- An environmental manager may use market mechanisms to cost effectively secure water for the environment. Market mechanisms, such as call options, could be included in a portfolio of water products to meet environmental demands.
  - Using an option contract to secure environmental water can be considerably less expensive than purchasing a permanent entitlement.
  - Option contracts are well suited to acquiring water to augment natural high flow events.
  - Using options, irrigators are able to retain their permanent water entitlements as a natural hedge against reduced water availability in the future due, for example, to longer term climate change.
  - Environmental managers and irrigators are able to plan with greater certainty.
- To maximise the benefits associated with sourcing environmental water, including the

use of option contracts, a planning framework with clearly stated objectives, technical efficiency in implementation and a clearly specified set of operational rules is required.

- Market mechanisms, such as levies and relocation subsidies, can be used to alter the setting under which irrigators make decisions on future investments; for example, improvements to make on-farm physical water use more efficient, or the relocation of production to lower impact areas.
- Well defined property rights structures can provide the incentive for investment in on-farm physical water use efficiency improvements; however, hydrological and agronomic factors — which may vary widely between locations and land use—will be the main determinants of the magnitude and distribution of the resulting water quality benefits.
- Factors that will have an impact on the choice of mechanism to manage environmental degradation include the completeness and type of available and potentially available information, the characteristics of the environmental degradation, and the level of uncertainty about the effects of environmental degradation.
- It is important to note that a single market mechanism is unlikely to be appropriate in all situations. In some cases, a mix of mechanisms or a regulatory approach may be more appropriate.

background

Market mechanisms can be used to make rural water use more efficient, and can also reduce the environmental and socioeconomic costs of rural water use by managing some of the resulting third party effects. Market mechanisms can also be used to more closely align the private and social costs of water use, taking account of both public and private benefits and costs, and tackling the nonexclusivity, or free rider, problem. If the free rider problem is not dealt with, there will be a suboptimal level of investment in projects that generate benefits that cannot be captured privately, such as on-farm physical water use efficiency improvement projects.

ABARE has researched a number of rural water use issues, including the use of options and water trading, and the environmental and socioeconomic impacts of increasing environmental flows. This research will form the basis of ABARE's submission to the Productivity Commission's study.

water trading

Water trade enables irrigators to respond to changing agronomic and economic conditions to maximise their returns from water use. While trade in permanent water entitlements remains a small percentage of total water trade, the temporary trade or lease of water allocations is now a key aspect of many irrigators' farming enterprise as a tool for managing intraseasonal climatic and financial risks.

While it may be argued that a well functioning market in water allocations reduces the need for trade in permanent entitlements, trade in longer term access rights to water resources can serve an important function. Longer term trade can take place through permanent entitlements or derivative contracts based on those entitlements.

Investments in new irrigation enterprises are largely fixed with little or no salvage value and subject to a considerable degree of climatic, market and sovereign risk. Without some means to mitigate these risks, the level of investment will tend to be smaller, and the rate of investment slower. Purchase of longer term access rights is one means of mitigating climatic risk. Purchase of longer term access rights can also mitigate sovereign risk if, for example, the expected volume of water conferred by an access right is reduced. A longer term entitlement acts as a standard hedge on the cost of an input into production. While not a perfect hedge against a loss of entitlement, water users will still be in a position to, at least partially, offset the effect of an increase in the market price of water resources through an increase in the unit value of their water entitlement.

Over the longer term, freer interregional trade will encourage trade in permanent water entitlements, and will be an important means of ameliorating the economic and social effects of entitlement reductions due, for example, to longer term climate change or clawbacks to source additional water for environmental flows (Heaney, Beare and Goesch 2002).

Although water trading can deliver significant benefits, without fully defined property rights, water markets will be incomplete and third party effects may arise. Four key potential third party effects can arise from trade: reliability of supply, reliability of delivery, storage and delivery charges, and changes in water quality. Aside from the effects of trade on water quality, these effects can be ameliorated by ensuring that traders account for the full stream of benefits and costs arising from the action. This can be achieved with property rights solutions. It is also important to note that creating fully specified property rights to complete the market is not free, and the costs of dealing with third party effects may outweigh the benefits. The effect of trade on water quality is intrinsically nonexclusive, and high transaction costs may prevent downstream users from collaborating to encourage investment to improve upstream improvements in water quality. Both of these factors limit the usefulness of property rights solutions that can capture the benefits of trade between parties.

Supply reliability is determined by the variability inherent to the resource pool and the institutional arrangements that govern physical water trade in allocations, such as conveyance losses and access to return flows (Heaney et al. 2005). Water entitlements are not fully exclusive because they are not currently defined according to the location from which they are sourced. The third party effects of supply reliability could be addressed by developing source based property rights whereby conveyance losses become exclusive to the entitlement holder. Alternatively, a system of administered exchange rates could be used to account for differences in the yield of an entitlement or conveyance losses associated with physical water trade (Heaney et al. 2005).

Reliability of delivery refers to the timeliness of delivery of a water allocation to the farm gate. Third party effects can result if, for example, water is traded into a scheme in which congestion in supply often occurs. All water users bear congestion costs, but they may be reduced by allocating and allowing trade in access rights to delivery infrastructure, or by using congestion charging when delivery services are rival. Those irrigators able to generate a relatively higher return from water will be more willing to pay higher delivery charges for the timely delivery of water.

Trade in entitlements may result in a permanent net trade of water out of an irrigation district, increasing the delivery charges for those remaining in the system, and, if this leads to more water being traded out of the system, irrigation infrastructure may be *stranded*. Where a utility adopts an inappropriate charging model, trade can have efficiency implications if artificial increases and decreases in average costs distort trade patterns, resulting in the movement of water to lower returning activities. The system can be made more efficient by establishing options markets for access to delivery and storage infrastructure, essentially creating a *club good*. Long term contracts can then provide protection for other members of the club in the event that water leaves the system. Alternatively, charging regimes can account for the fixed and variable components of storage and delivery services. The appropriate charging regime depends on whether the policy decision is made before or after an infrastructure investment decision.

Trade changes water quality by altering the volume and quality of return flows. Return flows may either increase or decrease water quality, depending on the agronomic and hydrological characteristics of the location to which the water is traded. In this sense, the third party (downstream) effects of trade are location specific. Also, the effect of trade on water quality is intrinsically nonexclusive and, in the presence of high transaction costs, it is unlikely that downstream users will collaborate to encourage investment upstream to improve water quality (Heaney et al. 2005).

These two factors mean that a property rights solution is unlikely to capture the benefits (and costs) of trade between parties. Market mechanisms can, however, be appropriate for tackling water quality issues. A market for pollution credits, for example, could be established by setting a target level of pollution and allocating tradeable rights to pollute. In instances where a cap and trade scheme is not appropriate, a regulatory approach, such as water use rights that impose specific conditions on irrigator use may be more appropriate. Flexible mechanisms, including levies, subsidies and exchange rates, may also be used to deal with the third party effects of trade.

In summary, most of the third party effects of trade can be dealt with by introducing more completely specified water rights; however, because of the regionally specific nature of third party effects, in some instances the costs of creating, implementing and enforcing these rights will be greater than the benefits they generate. Many of the third party effects discussed are unlikely to warrant intervention at the national or state level but may be significant at the local level (Heaney et al. 2005).

designing and meeting environmental outcomes

In highly regulated river systems, the high flow events required to reconnect rivers with wetland and flood plain areas occur much less frequently than they would naturally. A cost effective method of restoring these connections is to augment or *piggyback* natural high flow events with synchronised releases from storages.

An environmental manager, as a representative of the states, could purchase an appropriate portfolio of permanent and temporary entitlements and call options from irrigators to source water for the environment. Under the specifications of the call option, the environmental manager pays the irrigator an option premium for the right, but not the obligation, to buy a quantity of water at a predetermined price when allocations are above a certain threshold (for example, 70 per cent of allocation), at specified periods during the year (Hafi et al. 2005). The main benefits of using water options are:

- An environmental manager can gain access to environmental water relatively cheaply compared with the purchase of a permanent entitlement.
- Irrigators retain their permanent water entitlements, which are a natural hedge against the risk that the pool of water resources available will decline in the future.
- Water options can be exercised by an environmental manager to coincide with natural high flow events, reconnecting the floodplains with the river, hence providing a greater level of environmental benefit from this event.
- Environmental managers and irrigators are able to plan with greater certainty.
- Irrigators are compensated for losing some of their planning flexibility.

Hafi et al. (2005) estimated that the costs and benefits of using options would increase the environmental flows of the Murrumbidgee River. The findings suggest that, under most conditions, using an option contract to secure environmental water is less expensive than purchasing a permanent entitlement. The savings could be up to $35 a ML each year over a 10 year contract period. This is 70 per cent lower than the annualised cost of a permanent entitlement.

Initially, the preferred method for establishing the option contracts would be for the environmental manager to request or advertise them. This allows for information economies of scale in the writing of contracts. Transaction costs can be lowered by creating standardised terms for option contracts.

Beare et al. (2005) identified the following necessary characteristics for an environmental framework that is intended to generate both well specified demand for environmental water and an optimal set of high flow release rules:

- clearly stated environmental objectives that give rise to measurable outcomes
- technical efficiency, meeting environmental goals at the lowest possible resource

costs, where these costs reflect both productive and environmental values

- a clearly specified set of operational — or decision — rules to provide planning certainty for environmental managers and consumptive water users.

An environmental release strategy for a given location that reconnects river and flood plain environments should have the following elements:

- timing or release window of the high flow event; for example, to coincide with breeding seasons
- duration of the high flow event
- minimum and maximum flow requirements
- frequency of occurrence — distribution of return times between high flow events.

A formal planning strategy or decision framework that defines the *triggers* for environmental watering events allow an environmental manager to exploit unexpected opportunities, such as natural high flow events, to meet environmental objectives. Water options could be used to source additional water to achieve these objectives.

the use of market mechanisms to improve physical water use efficiency

Water use efficiency can be increased through both off-farm and on-farm investments and improvements in managerial practices (McDonald and Heaney 2002). Investment in on-farm physical water use efficiency improvements benefits irrigators by reducing the amount of irrigation water needed to achieve the same level of production, resulting in water savings. These savings can be retained by the irrigator and used to expand irrigated production, sold (if an operational water market exists), or left in the river. Water quality can be enhanced by improving water use efficiency because any water savings that remain in the river will have a dilutive effect.

Appropriate property rights structures can provide the incentive for on-farm physical water use efficiency improvements. McDonald and Heaney (2002) examined the impact of an improvement in on-farm physical water use efficiency in five locations along the Murray River, including its tributaries, under different property rights structures. The internal benefits of water savings were greatest when all of the savings were retained, providing the incentive to use water more efficiently.

With improvements in on-farm physical water use efficiency generating downstream water quality benefits that are not captured by the investor, there may be a role for the government, which may include public investment. A competitive tender process could deliver cost effective water quality outcomes by taking action in areas where the greatest benefits can be generated. This is more likely than blunt policy instruments (such as regulation or levies) to be cost effective because it sources efficiency gains from the lowest cost suppliers.

It should be noted that the effects of improved on-farm physical water use efficiency vary widely, based on the locations of irrigation efficiency investments. The magnitude and distribution of the resulting total benefits, as well as salt concentrations and flow levels, depend heavily on the locations of investments.

the role of fixed assets in water policy reform

Market mechanisms, such as levies and relocation subsidies, can be used to alter the setting under which irrigators make decisions on future investments (for example, irrigation efficiency improvements and the relocation of production to lower impact areas); however, irrigators typically have large, sunk investments in on-farm infrastructure and assets (for example, a dam or irrigation piping). These assets have long life cycles — sometimes more than 20 years. If this infrastructure has not reached the end of its economic life, the irrigator will have little economic incentive to respond to policy initiatives designed to meet environmental objectives. If policies are implemented to support improvements in water quality, for example, such as the relocation of activities to lower impact areas, irrigators may be *locked in* to the existing location (and technology choice) until they have recouped a return on their fixed investment. The larger the net present value of the remaining cash flows of the asset, the stronger the economic incentive would have to be to induce irrigators to reinvest in a lower impact area or in improved water application technologies (Gordon, Heaney and Hafi 2005).

The introduction of an economic *wedge* via a policy initiative, such as a levy, will change the setting under which irrigators make investment decisions. Gordon, Heaney and Hafi (2005), in a case study of vineyard production, found that targeting policies towards enterprises nearing the end of their productive lives will generate faster and more cost effective environmental outcomes. Using the example of water quality improvements, they showed that, because of the lag from policy implementation to the realisation of environmental benefit, it may be more effective to promote the adoption of more efficient on-farm physical water use technologies than to introduce policies that encourage relocation to lower impact areas. If the effects of environmental degradation are incremental, then the best policy solution may be to wait until the assets reach the end of their economic lives. Conversely, if environmental degradation is reaching a critical threshold, a greater incentive for action may be warranted. This highlights the need to implement policies that are appropriate, given the nature of the environmental problem to be addressed.

issues to consider when choosing appropriate policy instruments for environmental management

If markets do not accurately reflect the value of natural resources, private decisions based on lower private values will not allocate resources in a way that efficiently meets the demands of the community. Most market failures in natural resource management can be linked, in one way or another, to incomplete markets. A market is incomplete in the sense that the full interests of all members of society are not represented. Incomplete markets can result from a number of issues, including property rights that are too broadly or narrowly defined, and asymmetric or missing information. In an incomplete market, participants are not required to face the full costs or benefits of their actions. When these actions affect other users or the environment, they can generate costs or benefits that are outside the market — an externality (also referred to as a third party effect).

Externalities in the water economy arise primarily because access rights to water resources and infrastructure do not convey the full costs and benefits of water use to the holder of those rights. If, in the process of exercising their right to extract and use water from a river or irrigation system, a producer imposes third party effects on downstream users, the right to impose these effects has not been paid for, the downstream users have not been compensated, and there is no market through which either can occur.

When markets are incomplete, efficiency gains may be achieved through government intervention, but the cost effectiveness of any policy response would need to be assessed. There are a number of instruments that may be used to achieve a more efficient level of environmental protection. The efficacy and viability of each instrument depends heavily on factors such as the completeness and type of available and potentially available information (for example, information on marginal costs of abatement or input use), the number and location of parties involved, the characteristics of these parties (for example, the age of existing plant and machinery will affect the decision to change technology), and the level of uncertainty of the effects of environmental degradation.

Types of instruments available

The instruments that are available to attempt to correct inefficient allocations of resources come under three general headings:

- regulation
- primary market intervention
- secondary market development.

Each of these instruments can be introduced either as site specific mechanisms with different rates or regulations applied to different parties, or as general mechanisms with across the board common rates or regulations for all parties.

Regulation

A regulatory approach can take the form of either voluntary or non voluntary regulation. Voluntary regulation is a situation in which stakeholders voluntarily initiate and enter into an agreement—or covenant—with the government or other authorities to identify target outcomes and the means to achieve these outcomes. Industry developed codes of practice are a common example of voluntary regulation.

Voluntary regulation may also take the form of government issued management or production guidelines. These guidelines are designed to change perceptions and priorities within an individual's or company's decision framework to either assist or prevent future intervention.

Non voluntary regulation is a more heavy handed approach to environmental management and is commonly referred to as a *command and control* approach. Governing authorities lay down the target outcomes or methods of production that are to be adhered to by polluting parties. Non voluntary regulations allow an individual to use a resource within a stipulated set of constraints (Newby et al. 2004).

Primary market intervention

Common examples of primary market intervention include levies and subsidies. Governments introduce these instruments to alter the setting under which production or consumption decisions are made. Environmental externalities are addressed through competing markets and accounting for any external costs and benefits that were previously overlooked. Levies and subsidies take the form of either site specific or general mechanisms and can be implemented as input, output or trade based mechanisms, depending on the information that is readily available and the characteristics of environmental damage. Examples include levies on polluted water discharge and subsidies for water recycling or cleaning before discharge.

Secondary market development

Secondary market development is used to resolve issues associated with incomplete markets by creating those missing markets. Cap and trade mechanisms are commonly referred to secondary market developments that create, for example, a market for emissions that have an impact on environmental degradation. The total number of allowed emissions is set or capped. Transferable permits to emit are then traded between polluters ensuring that the costs of environmental degradation are included in the production decision, either via the cost of purchasing the emissions permits (net buyer of emissions) or the value of the emissions permits (net seller of emissions). Trading also allows the emissions to be transferred to the highest valued users.

Another form of secondary market development is the creation of a minimum standard; for example, to maintain or improve environmental outcomes from a given or current level. Minimum standard instruments usually include a clause associated with offset options in which any actions that may negatively impact environmental outcomes can be undertaken only if sufficient offsetting activities are also undertaken.

Costs associated with policy intervention

In an ideal world with perfect information and low to nil transactions costs, the instruments described above can all be used efficiently and equity can be maintained. In a situation of incomplete or asymmetric information and transactions costs, however, each of the instruments has different information requirements and costs associated with its implementation. The policy issue is to determine which type of instrument has the lowest costs under the given circumstances.

The costs associated with instrument implementation can be divided into three general categories: information costs, costs of institutional reform, and monitoring and enforcement costs.

- Information costs: asymmetric information and missing information are common characteristics of environmental issues. The amount of private or missing information and the cost of sourcing this information is an important factor in determining the type of instrument to implement. This private or missing information can include the marginal costs and benefits of pollution and abatement, but may also be the identity of polluting and affected parties.

- Costs of institutional reform: implementing new regulations, levies or subsidies that alter market outcomes and develop new markets will require some level of institutional change. The direct costs involved with institutional change are a large component of the cost of implementing certain instruments. There are also indirect costs associated with institutional change, including increased uncertainty over possible future changes, which are likely to have an impact on other areas of the economy such as investment.

  Education costs are another possible institutional reform cost. For an instrument to be able to work efficiently, all parties must have a clear understanding of the instrument, how it works, how the outcomes are to be achieved and their role in achieving these outcomes. The more complicated the instrument, or the more complicated the environmental problem, the greater the education costs will be.

- Monitoring and enforcement costs: an important component of implementing any instrument is to ensure that the conditions of the implementation are upheld. This includes ensuring regulations are abided by and that taxes are paid. The harder instruments are to monitor and enforce, the more costly the exercise; for example, the regulation of non point source pollution.

As well as identifying the instrument that will minimise implementation costs under a given set of circumstances, the total expected costs of intervention must be weighed up against the total expected benefits of intervention. There may be some situations in which the costs of intervention are expected to outweigh the benefits, in which case, instrument implementation will pose a net expected cost to society.

Policy intervention in environmental markets in any form generally poses immediate and certain costs, but generates benefits of an uncertain size that will not be realised until a future date. Uncertainty of environmental costs and degradation can be a major challenge for government intervention. If there is a possibility of catastrophic damage to the environment that could, for example, result in an irreversible outcome, such as species extinction, strong and costly immediate action may be warranted even if the true impact of the degradation or the efficacy of the policy was uncertain. Alternative instruments that are more flexible and less costly may be a better option, however, when the expected costs of degradation are lower and there is no risk of catastrophic damage.

Issues and application of each instrument type

Regulation

The information costs governments face when implementing regulations are minimised under industry initiated voluntary regulation, compared with government initiated voluntary or non voluntary regulation. Under a voluntary agreement, polluters have disclosed, at least to some extent, their private cost information, and governments may not be required to go out and estimate these costs. It should be noted that governments may still need to assess whether further policy action is required in addition to the proposed voluntary agreement.

Voluntary regulation schemes also avoid the strict need to *get it right the first time*, as is required under a non voluntary regulation scheme. Education programs and suggested management practices can be adjusted as new information becomes available. Non voluntary regulations that detail production processes and restrictions on input use, for example, not only require a large amount of government collected information on the costs of production and abatement, but also on the relationships between production and environmental damage.

Industry initiated voluntary regulation also limits the direct and indirect institutional reform costs arising from the regulations. Non voluntary regulation is inherently inflexible in the face of new or improved information and continual revisions will generate an increased level of uncertainty in associated markets which may in turn have an affect on investment markets. Under voluntary regulation, polluters are seen to be more in control of the regulation, which may alleviate uncertainty and limit the indirect costs on investment.

Monitoring and enforcement costs are also likely to be lower under an industry initiated voluntary agreement if there is a credible threat for governments to implement a stricter non voluntary regulatory system on polluters if they are seen to be not adhering to the agreement. Additionally, industry initiated voluntary regulation is likely to occur when participants are able to reap some benefits from their participation; for example, improved reputation among environmentally conscious consumers. It is likely, therefore, that participants will have a vested interest in ensuring that the agreement is upheld, reducing the possible costs of government monitoring and enforcement. Monitoring and enforcement costs of non voluntary regulation, on the other hand, may be large if regulated actions are not easily observed or easily hidden, or if regulation parties are not located in a local area.

The advantage of non voluntary regulatory instruments over voluntary agreements is the high level of control the government has over the behaviour of those using the resources. This can be especially important when dealing with the potential thresholds that can lead to irreversible resource management problems (Newby et al. 2004).

Primary market intervention

Using readily available information will reduce the information costs of instrument implementation. If information on the level and type of inputs used by each polluter is available but the level of pollution contributed is not easily measured, an input based levy or subsidy can be implemented. Alternatively, if the identity of all parties is observable and a large number of inputs is used in the production process, that would complicate an input based mechanism; an output based levy or subsidy may be used. Finally, if the environmental degradation is highly localised and affected by changing regional water levels, then a trade based mechanism may be more efficient. A trade based mechanism can be tailored to affect only inter regional water trade in certain areas.

To be able to achieve a desired or optimal level of abatement, levies and subsidy schemes do require some information on the marginal costs and benefits of abatement as well as the relationship of input use, pollution output and interregional water trade with environmental damage. Recognising that this information is likely to be very costly to acquire, a suboptimal, estimated levy or subsidy rate may be able to more closely align the private and social costs and benefits of pollution than no taxes or subsidies (Newby et al. 2004).

For a levy or subsidy system to work effectively, participants need to understand the links between their actions, environmental degradation and the levy or subsidy scheme. Clearly establishing these links is an important and possibly substantial education cost. If polluters do not recognise that their actions are contributing to environmental degradation, however, the ability of the instrument to impact environmental degradation may be limited, at least in the short term.

The indirect institutional costs of implementing environmental levies and subsidies are related to the incentives, and ability polluters have to undertake abatement or research into abatement. Under a levy scheme, polluters have an increased incentive to invest in abatement technologies or environmentally friendly inputs as they become cheaper than the levied options. The increased levy liability that a polluter faces, however, reduces their ability to invest in these alternate options. This may not be a net loss to society if tax revenues are used to support government funded research into abatement technologies.

The indirect institutional costs associated with a trade based levy or subsidy are likely to be lower than under an input or output based system. This is because a trade levy or subsidy is only initiated when trade in a particular area occurs. The uncertainty over future changes in the system is confined to a particular location. Affected parties are also provided with the incentive to invest in abatement research and development. With a trade based levy, for example, the increased costs of sourcing water in regions with high degradation levels increase the attractiveness of abatement research investment.

Under a program subsidising pollution abatement technologies or inputs, polluters are again faced with an incentive to invest in abatement technologies and are also given an increased ability to invest through the subsidy payments. Monitoring and enforcement costs of a levy policy will be used to reduce the level of shirking in the system and ensure all polluters are paying their required levies. Under a subsidy system that encourages participation and volunteering, monitoring and enforcement costs will be used to ensure that subsidies are not being overpaid. Primary market intervention in the forms of levies and subsidies will have limited applications when affected parties are not easily identified and the actions of parties cannot be observed or verified. In these cases, the information costs associated with identifying polluters and observing their actions are likely to outweigh the benefits of intervention.

If neither the identity nor the actions of individual polluters can be identified, but they can be collectively identified, there may be an opportunity to introduce a group levy or subsidy arrangement in which the group of polluters is treated as an individual. This, of course, relies on the observability of the actions, total emissions or environmental degradation generated by the group.

An important limitation to using levies and subsidies to generate environmental outcomes occurs when individuals face short term constraints on their production or investment decisions. Specifically, current irrigation infrastructure is a large, sunken cost to many operators. Levy or subsidy rates are unlikely to generate any changes in current production levels or alter the use of current investments until the rate is large enough to overcome the costs associated with abandoning the fixed asset before the end of its economic life. Long term production decisions and new investment decisions are more likely to be affected by changes in levy and subsidy programs. Gordon, Heaney and Hafi (2005) also noted that aiming policy instruments towards infrastructure reaching the end of its life cycle will generate faster and more cost effective outcomes.

Secondary market development

Secondary market development is aimed at addressing the lack of clear property rights for a resource. Cap and trade instruments and minimum standards are two examples of secondary market development.

Cap and trade mechanisms

Once the cap of emissions is set, governments are not required to identify which emitters have the highest value because information on willingness to pay and marginal costs are revealed as a market process. The information costs faced by governments are going to be from determining the efficient level of emissions, or setting the cap, as well as identifying polluters to include in the market.

There will generally be limited direct and indirect costs of institutional change. The largest costs are likely to be in education, to ensure that traders understand the process and the benefits of trading. Some institutional costs will be for setting up a workable market for trading permits.

Under a cap and trade system, all traders have a private incentive to ensure that other traders are not abusing the system and producing more emissions than they hold permits for. This is because, as more traders do not follow the market rules, the value of permits falls. If all traders can observe the emissions of all other traders, government monitoring and enforcement costs could potentially be limited to the set up of an effective watch dog to act on reports of excess emissions. If traders are not able to observe the actions of others, then the monitoring and enforcement costs of the government will be increased.

To ensure that a market for emissions permits functions properly, it is also important to ensure that there is a certain level of heterogeneity between traders. If traders have different marginal costs of abatement, or marginal benefits from their emissions, a market is likely to be able to transfer the emissions permits to the highest valued users. Homogenous traders with similar willingness to pay for the permits, however, are likely to lead to a thinly traded market unable to provide any benefits that could not be achieved through other instruments.

Minimum standards

Information costs faced by governing authorities are likely to be large when setting up a minimum standard program and offset mechanisms. Information on the current level of environmental degradation or protection is required, as well as detailed information on the effects that any proposed production or land use changes may have on this degradation and, finally, information on the level of offsets required to mitigate the effects of any changed practices. This information is also required to be transparent, and education of polluters may be required to familiarise them with the system.

The indirect costs associated with minimum standards are for the restrictions on land use change and the ability of polluters to take advantage of future potential improvements in productivity that may affect land values or business values. Monitoring and enforcement costs will be used to ensure that there are no changes to production that reduce environmental outcomes. These costs may be significant if the actions of polluters are hard to observe, or easy to hide, or producers are not located in a single local area.

General versus site specific mechanisms

With perfect information and no transactions costs, the decision of whether to introduce a general or site specific mechanism would be based on the type of environmental degradation that is occurring. In a situation of general environmental degradation—for example, pollution of an aquifer where pollution from any source affects all parties in a similar way—then a general mechanism would be the preferred choice. Pollution of a river system or use of an irrigation waterway, however, produces more site specific degradation. The source of pollution or degradation impacts only a certain number of affected parties—for example, only downstream users. The level of impact also varies among affected parties. The further downstream the users, the more likely they will face higher aggregate damages, with distance possibly mitigating the level of degradation attributable to each upstream source. With site specific damages, a site specific mechanism would be the preferred choice, where all costs and benefits of actions can be accounted for.

Implementing a site specific mechanism requires a large amount of information on the level of environmental degradation that is attributable to each source of degradation, as well as the costs imposed on affected parties by each source of degradation. There are also instrument specific issues associated with implementing site specific regulations, levies or subsidies or secondary market development mechanisms that need to be considered.

Site specific regulation would require information on the total level of environmental degradation that is attributable to each site and, as with site specific taxes, it is likely that upstream users will be regulated more heavily than downstream users. This will depend on the characteristics of the environmental degradation; for example, whether there any mitigating effects occurring downstream, such as additional tributaries entering the waterway. A site specific levy or subsidy system would have to be specified in terms of the aggregate level of environmental degradation that is attributable to each user; for example, upstream users that may generate more degradation should face a higher levy than downstream users whose effects may be limited.

If a site specific cap and trade mechanism were to be introduced, for example, there would be a large number of bilateral agreements between parties and thinly traded markets. The site specific cap and trade mechanism would have to be specified in terms of the ability of upstream users to impact specific downstream users, effectively creating a separate market set up between each combination of upstream and downstream users.

Where there is site specific environmental degradation occurring but it is too costly to implement site specific mechanisms (if cost effective), the second best option would be to implement some form of general mechanism. Alternatively, if certain parties can be grouped in terms of their contribution to damages or the costs imposed on them by degradation, it may be possible to introduce a group specific mechanism as an intermediate step between site specific and general mechanisms.

current application of instruments to address environmental degradation

Non voluntary regulation

Environmental regulations are currently used in the rice growing regions of the Murrumbidgee and Murray valleys (Marsden Jacob Associates 2003). Under the *Water Management Act 2000*, it is a condition of licences issued to irrigation corporations that the corporations comply with the rice environmental policy. The rice environmental policy stipulates restrictions on:

- the location of rice growing enterprises, to ensure appropriate soil types are used
- the maximum area that can be devoted to rice growing on any property
- maximum water use levels.

Voluntary regulation

The Australian cotton industry has introduced a voluntary program of best management practices to address issues such as water recycling and improved water use efficiency, erosion minimisation, and safe chemical storage and handling (Cotton Australia, n.d.)

Levies

In 2002, salinity zones were established in the Sunraysia region of Victoria, based on the relationship between ground water flow and estimated salinity impacts at different locations along the Murray River. The Victorian Government has adopted a levy based approach to restricting water traded from low impact to high impact salinity zones in the Sunraysia region. The salinity levy is an indirect fee attached to the use of irrigation water use in high risk areas. To account for the spatial impacts along the river, the levy varies according to the source and destination of water trade.

Additionally, in high impact zones, a trade barrier was also established to prevent significant water trades into these regions. This regulation acknowledges the higher salinity impacts associated with water use in these zones and the higher third party costs that arise. In periods of extremely low flows, such as a drought, trades into high impact areas are closely controlled with a cap on the amount of trade (SRWA 2002).

Subsidies

The Rural Water Use Efficiency Initiative was introduced by the Queensland Department of Natural Resources and Mines. The aims of the project—to be achieved by July 2003—included observing a reduction in runoff and drainage of pesticides, salts and nutrients into rivers, aquifers and streams (Coutts and Bell 2004). Under the Rural Water Use Efficiency Initiative, operators in the sugar, cotton, horticulture and dairy industries were provided with financial incentives to achieve defined best management practices.

Cap and trade

Cap and trade mechanisms are well suited to a situation of point source pollution in which all polluting parties are easily identified and their actions are observable. A current example of a cap and trade mechanism being effectively introduced is the Hunter River salinity trading scheme (NSW EPA 2004).

Minimum standards

The Environmental Protection Agency of Western Australia is currently considering implementing an offset program to maintain a given level of environmental values (WA EPA 2006). Under the proposed no *net loss to environmental values* plan, activities such as petroleum and mineral exploration and other production operations would be undertaken on the condition that offsets be introduced to mitigate any net environmental degradation that occurs. Suggested offsets include:

- rehabilitating land historically associated with mining
- conducting studies to further scientific knowledge regarding biodiversity conservation
- conducting remedial works on adjacent agricultural lands to reduce the potential for salinisation within a reserve.

The Conservation Commission of Western Australia's recommendations on the offset program include that the choice of offsets be based on the probability of success in arresting a decline in environmental quality (Conservation Commission of Western Australia, n.d.).

concluding remarks

Market mechanisms can be used to improve the economic efficiency of rural water use by more closely aligning the associated private and social costs. This could include using these tools to address the third party effects of rural water use and trade. In some situations, however, market mechanisms may not be appropriate, and other approaches, such as regulation, could be considered. Finally, it is important to note that, because of the location specific nature of some problems, a single market mechanism is unlikely to be appropriate in all situations. In some cases, a mix of mechanisms or a regulatory approach will be more appropriate.

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