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Market Based Policy for River Murray Salinity

Jeff Connor

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CSIRO Land and Water Policy and Economics Research Unit, PMB 2 Glen Osmond, SA 5064. Jeff.Connor@csiro.au

Introduction

In 2001 the Murray Darling Basin Commission States of New South Wales, South Australia, and Victoria reached a new agreement on salinity. Under the agreement participating states are required to offset any salinity impact increases above agreed target levels. Targets have been specified for demarcated river reaches and tributaries. While the target levels vary across locations, they generally approximate a zero increase over 2001 baseline levels of salinity contribution (MDBC, 2001).

The level of salt interception investment that will be required to meet MDBC salinity targets will depend on rates of irrigation expansion and policy influencing irrigation location and efficiency (Connor, 2003; Australian Water Environments, 2003). Until very recently the main focus of MDBC States policy has been almost solely on supplying investment in mitigating impacts with salt interception engineering works. Alternatively States could develop policy that reduces the demand for such engineering works by reducing volume and salinity of drainage under irrigation.

Moving from a supply side emphasis on providing engineering works to a demand side policy emphasis on reducing drainage would require a fundamental shift in MDBC States policies. In particular there would be a need for States to develop policy approaches that would influence location and efficiency of irrigation as these are this is the most effective way of reducing irrigation drainage (Connor, 2003).

This article reflects on opportunities for MDBC states to develop policies to influence irrigation efficiency and location with market-based instruments that use incentives rather than more prescriptive regulatory means. Several opportunities to increase the cost effectiveness of achieving salinity policy objective with MBI in the Lower Murray are illustrated.

In addition, the challenges to actually getting such approaches on the ground are discussed. One challenge is to find ways to balance equity and cost effectiveness consideration in MBI policy design. There are also challenges related to finding ways to focus incentives on reducing drainage when drainage is not easy to measure directly. In conclusion, several ways of overcoming implementation challenges are discussed that involve mixing elements of more than one MBI approach or mixing MBI approaches with more traditional regulatory approaches.

MDBC salinity policy in the Lower Murray

The first major policy initiative to address salinity in the River Murray at the Basin scale was the *Salinity and Drainage Strategy* (SDS), agreed to by the Murray-Darling Basin Ministerial Council in 1989. The SDS was a once off agreement between MDBC States and the Commonwealth to finance a program of investments to ameliorate rising River salinity. Major investments included salt interception schemes such as those at Woolpunda and Waikerie along the River Murray in South Australia (SA). Together, these schemes have reversed the salinity trend in the River Murray over the period 1990-2000. However, as shown in Figure 1, it soon became evident that new threats to the River Murray could be anticipated if no further actions were taken.

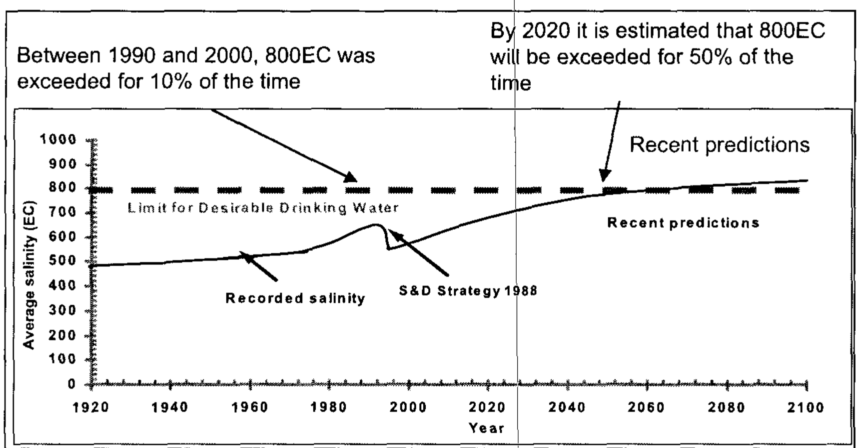


Figure 1: River Murray Salinity Impact Trends (Source: MDBC, 1999)

To address the need for further action, in 2001, the Murray-Darling Basin Ministerial Council adopted the *Basin Salinity Management Strategy* (BSMS). The BSMS is an agreement between all the basin states that each will do its part to maintain River Murray salinity below 800 EC at the reference measurement point (at Morgan, South Australia near the River mouth) for 95 % of the time, as well as manage salinity in the Basin's sub-catchments. In essence the BSMS requires States to ensure salinity loading along their stretch of the River and its tributaries does not exceed agreed "baseline" levels.

The BSMS represents a significant policy principle shift from the SDS. While the SDS was a once-off agreement to make a set investment, the BSMS is an agreement to meet a set salinity standard, regardless of the level of investment required. Under the BSMS, MDBC partners have agreed to offset not only salinity from new development but also the "legacy of history" salinity increases that are in train from past mallee land clearing and irrigation developments (but have not yet impacted on the salinity concentration in the river).

The first step has been an agreement by partners to invest in a program of works through 2007 to provide an agreed amount of new salt interception schemes and disposal capacity. It is likely that additional investment will be required to meet targets (Connor, 2003; Australian Water Environments, 2003; MDBC, 1999). Exactly how the BSMS will operate beyond the currently scheduled investment round has yet to be decided.

In principle, under the MDBC salinity agreement, States can choose any approach they like to meeting MDBC targets, though they are required to follow MDBC protocols to account for salinity impacts from actions in their State.

The *South Australian River Murray Salinity Strategy 2002-2015* outlines broad principles of irrigation salinity obligations in South Australia (Government of South Australia, 2001a). More detailed definitions of irrigator salinity responsibilities in SA are contained the *Water Allocation Plan for the River Murray Prescribed Watercourse* - the WAP (Government of South Australia, 2001b). This Plan describes rules for allocation, transfer and use of water in the River Murray. There is a clear distinction made in the WAP between water that was first applied prior to 1988 (pre '88 water) and water brought into the area under the WAP after 1988 (post '88 water). Key salinity provision of WAP include:

- From 2003, post '88 water can only be applied if any river and floodplain salinity impact is offset by "an agreement, undertaking or works, actions or practices" to prevent any salinity impact
- From 2010, Pre '88 water can only be applied if any floodplain salinity impact or river salinity increase above 2002 level is offset by "an agreement, undertaking or works, actions or practices" to prevent any salinity impact above 2002 levels.

- From 2005, Water shall only be taken for irrigation if 85% irrigation efficiency is achieved (65% in Lower Murray Swamps).

Victoria expresses a general set of principles for dealing with River Murray salinity in its Salinity Management Framework (Government of Victoria, 2000). One key commitment described in the Framework is that by 2015 Victoria will invest in MDBC salt interception at a level sufficient to offset the impact of current & future irrigation, and protect ecologically significant assets.
More detailed policy provisions related to salinity impacts of irrigation in much of the Victorian main stem of the River Murray are contained in the Nyah to South Australian Border Salinity Management Strategy. The Strategy includes provisions that:

- Prohibit new irrigation in designated high salinity impact zones,
- Divide the area where new irrigation development is allowed into four zones based on differences in average salinity impact of equal amounts of drainage,
- Charges for new (post '93) irrigation development (per ML of water transferred into the area where the policy applies),
- Differentiated rates charged per ML by zone (rates are proportional to average salinity impact in four zones).

Salinity policy challenges

While States face "hard" salinity targets under the MDBC agreement on salinity, there is considerable States discretion regarding details of policies that they choose to reach the targets. This section outlines three of the most important challenges that the States face in efforts to develop salinity policy measures to ensure that they can meet salinity targets cost effectively and equitably.

Focussing on the cause

In principle, salinity policy can reduce salinity in the River Murray by:

- focussing on the symptom by pumping discharge away from the River's edge using salt interception, or dilution flow, or
- focus on the cause by reducing drainage below irrigation and cleared mallee in the river corridor by increasing irrigation efficiency, locating irrigation on lower impact sites or revegetating cleared dryland areas.

Several modelling studies suggest that failure to focus on the causes could result in MDBC targets being unattainable or increasing cost of investment to meet MDBC targets. For example, it has been estimated that a 72 GL expansion in irrigation in the South Australian Murray would require fourfold less salt interception investment if new irrigation were zoned to lower impact areas and efficiency improved by 2.5% on average (Connor, 2003).

Existing irrigation salinity responsibility:

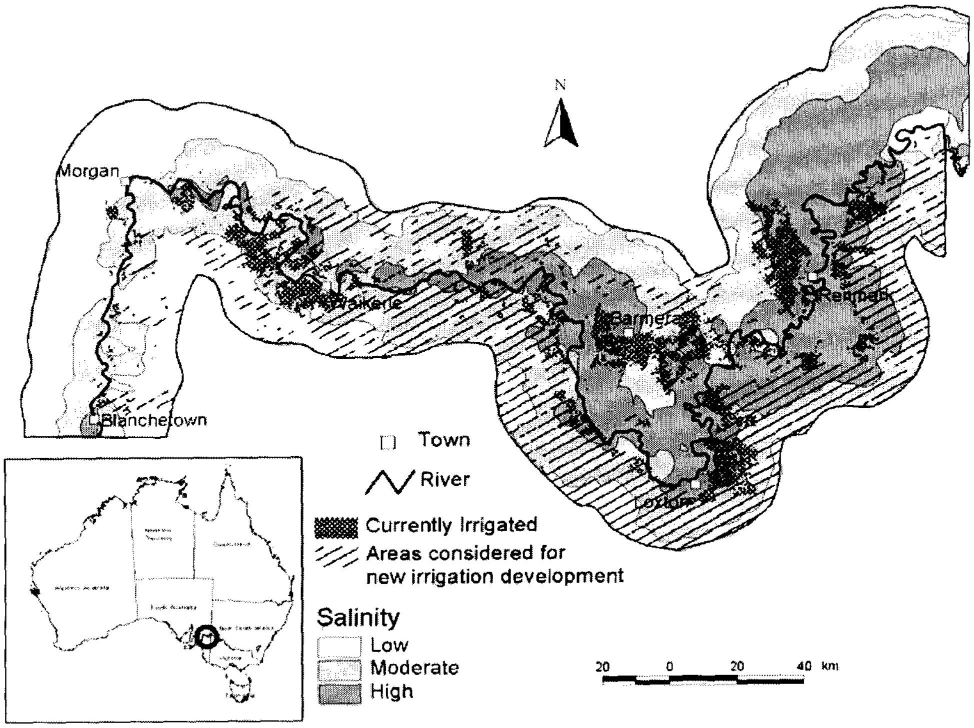
Both South Australia and Victoria define salinity mitigation responsibility for irrigation. However, in both cases, responsibility only applies to irrigation development that occurred after a certain date (1988 in South Australia, and 1993 in Victoria). Analysis of available statistics reveals that 86% of South Australian irrigation is pre-1988, and 88% of Victorian irrigation in the Lower Murray is pre-1993.

This is particularly problematic because much of existing irrigation in the lower Murray is located where irrigation drainage mobilises large salt loads in groundwater that migrate to the river with short time delays. This can be clearly seen for the South Australian part of the River in Figure 2 where the cross hatching representing existing irrigation lies predominantly in dark shaded high salinity impact areas.

Furthermore, the current Victorian new irrigation development salinity charge policy creates a disincentive for existing irrigation in highest impact areas to move to lower impact sites. Irrigators currently pay no charges on water brought in before 1993, even if it is applied where it has large salinity impacts. In fact there is a disincentive effect because if holders of pre-1993 water relocated some of their water to lower salinity impact sites, they would face salinity charges.

Protecting floodplains in some areas will require recharge below current levels ("clawing back"). This is a key finding from preliminary assessments of the risk of floodplain health degradation as the result of rising saline groundwater tables for part of the River Murray floodplain in South Australia (Overton, *et al*, 2003). Overton *et al* (2003) show that reducing risk to floodplain ecological health will require reducing inflows in at least some areas.

Figure 2: Salinity impact and existing irrigation location in South Australian River Murray



source: Connor, 2004

The Measurement Problem

NRM issues, such as salinity, involving complex environmental processes present challenges in designing and implementing MBI approaches because environmental performance is inherently difficult to measure. It is common practice in such settings to specify a "proxy" for measured environmental performance. A proxy is an input or practice correlated with the outcome of interest but more easily measurable and thus a more programmatic focus for standards, permits or charges for diffuse source emissions[1].

A challenge in choice of proxy is how to balance benefits of more accurate differentiation against the cost of more administrative and implementation complexity. A focus of recent MBI development efforts has been on developing proxies through modelling to more closely relate incentives to actual environmental performance (Bardsely, 2003; Collins, 2003).

Currently, Victorian salinity charges are based on water applied as an input proxy for the outcome of interest, salinity impact. The approach increases the accuracy of the proxy (water applied) with a relatively simple charge

[1] The same challenge in measurement leads to the need for proxy measures of performance in MBI which are focussed on other complex environmental processes such as biodiversity. The Victorian BushTender MBI, for example, uses a complex evaluation algorithm to score biodiversity values of actions rather than any actually biodiversity outcome measurement.

differentiation by zones. Basically irrigable land along the river is separated into four zones, each representing an area where similar volumes of water applications have similar salinity impacts. This zone based charge differentiation is a positive feature of the current approach in that it creates the right incentives for new development to located in zones where salinity impact is minimal.

There are potentially very large benefits from further improvements in the proxy measure currently used in Victoria for irrigation salinity charges. In particular there are potentially significant benefits to developing a proxy that creates stronger incentives to encourage the relatively small water use reductions, "at the margin" that can be gained through increased irrigation efficiency. Incentive to reduce marginal water use through irrigation efficiency improvements is important because such water use reduction can lead to proportionally much greater reductions in irrigation drainage volume. For example, a grape crop irrigated to full water requirement of 680 mm at 85% efficiency would involve drainage of 120 mm, and a total water application of 800 mm. Increasing irrigation efficiency to 90% reduces drainage by 33% from 120 mm to 80 mm, but total water use would only be reduced by 5% from 800 mm to 760 mm.

The ultimate purpose of developing a better proxy for drainage is to be able to relate charges or incentive payments more closely to the outcome of interest. A charge or incentive payment related to drainage applied to existing irrigation could be a particularly cost effective way to reduce salinity impacts. One reason is that such charges would provide incentives to reduce water use at the margin through improved efficiency.

Another reason that such charges might be particularly effective is that, as noted in above, a significant amount of existing irrigation is located in high salinity impact areas. Currently existing irrigation has little incentive to reduce impact because salinity charges don't apply to existing pre-1993 irrigation. If an adequate standardised approach to measuring irrigation efficiency could be developed charges or incentive payments based on irrigation efficiency could be applied to both new and existing irrigation.

MBI opportunities

As outlined in Table 1, there are a wide range of both market-based and more traditional, prescriptive policy instruments that could be used to address the challenges outlined above.

Table 1: Types of Market-based instruments

Price based instruments - are instruments that attempt to influence environmental performance by pricing negative externalities or subsidising mitigation actions. There are several variants including:

> **Environmental charges** - charges with the rate related to the level of an environmental externality (e.g. emissions charges for effluent). Alternative implementations can involve charges on inputs related an externality (a charge for vehicle registration with rate based on engine displacement as a proxy for an emissions charge).
>
> **Incentive payments** - involve subsidising the cost of actions to mitigate an externality. Often, incentive payment levels are set at fixed rates.
>
> **Tendering** - is an alternative approach to distributing incentive payments that involve distributing funds by tender or auction. This involves those seeking incentive payments making offers describing mitigation action and cost sharing payment terms. The Government selects among offers based on value of mitigation per cost sharing dollar expenditure.

Quantity based instruments - involve setting standards for mitigation effort (e.g. emissions standards) and allowing trade among those providing mitigation (allowing individual underperformance if it is compensated by over performance elsewhere). There are two major variants:

> **Tradeable credits** - involve setting individual rights to input levels, output levels or performance standards (e.g. individuals are granted an allowable level of emissions as a number of emissions credits). Individuals are then only allowed to exceed the standard if they purchase additional credits from someone who is under their allowable emissions and therefore has excess credits.
>
> **Environmental Offsets** - environmental offsets are actions taken to meet a standard (reducing pollution or environmental impacts) at a site away from where the action causing an environmental externality occurs. The party causing the externality can either take the action themselves or pay for others to do it on their behalf.

Market barrier elimination instruments - focus on removing barriers to market activities that create positive environmental outcomes. Product labeling schemes are perhaps the most widely applied market creation MBI approach. They involve providing information about the environmental outcomes of production so that those who value associated improved environmental outcomes can express their preferences through markets (that did not exist before labeling). In addition, market barrier elimination can involve removing government regulation that are impediments to markets that create positive environmental outcomes. For example, some western U.S. States have recently allowed water to be sold out irrigation for use to improve river systems ecologically health where previously water could only be sold for direct consumption purposes.

Three MBI approaches that could be good bets to address River Murray salinity are outlined in the remainder of this section. The MBI approaches outlined were chosen because they hold promise to address at least one of the key salinity policy challenges outlined in the last section and have potential to be politically feasible, environmentally effective and cost effective.

MBI 1: Irrigation drainage performance incentives**MBI approach**: This MBI approach would build on other projects underway to develop standardised methods for estimating irrigation drainage which is hard to measure directly. These related projects involve developing indicators of drainage estimates using more easily measured (or modelled) water applied, soil moisture, and plant water use measures.

Once developed a standardised drainage measure could be used as the basis for charges or incentive rates related to drainage performance. Given the lack of a generally accepted single approach to inferring drainage, a limited duration and geographic area pilot approach may be desirable. This could involve qualified parties competing to demonstrate the accuracy and cost-effectiveness of their drainage measurement approaches. Policy that relates charges to drainage could then be implemented more broadly once a satisfactory system had been worked out through pilot trial.

Why this MBI?

Existing salinity charges rely on a water application metric as the basis for charges. Water application is, however, only imperfectly correlated with salinity outcomes. Drainage volume in contrast is highly correlated with salinity impact. If there were a good standardised estimator for drainage it could be used to set charge rates. This would give irrigators incentive to focus on the marginal water use that can be achieved through irrigation efficiency. Charges, or even incentive payments focussed on existing irrigation could be particularly effective. This is because a significant amount of existing irrigation is located in high salinity impact areas. At the present there is little policy providing incentive to these irrigators to reduce the salinity impact of their irrigation. Charges, or incentive payments related to drainage volume or even tradeable drainage credits could redress this current policy deficiency.

Challenges to implementing this MBI

A key challenge to relating charges more closely to drainage is technical in nature. It involves development of a standardised method for relating metered flow, measured soil moisture and modelled crop water use to drainage so that effective input proxies could be developed that reflect salinity or drainage output goals.

MBI 2: Tendering for salinity mitigation effort

MBI approach - Tendering is a market-based instrument for distributing incentive payments. Applicants for incentive payments prepare bids that describe actions they are willing to take and the payment level that they would require to take the action. The agency distributing the incentive payments ranks bids based on a measure of environmental value per payment dollar, and funds bids in order of value ranking.

The Colorado River Basin Salinity Control Program run in seven states in the USA is a good example of how tendering could be applied to irrigation salinity. The program involved calls for proposals for projects to reduce salinity. Bids were assessed based on cost per tonne of salt removed and the level of uncertainty associated with estimated salt removal. Risks of cost overruns or sub-optimal performance are borne by project proponents through contractual limits on the Government's payment obligations (US Bureau of Reclamation, 2001).

In principle the tendering approach could be applied to salinity in the Mallee zone. For example:

- Individual irrigators or irrigator groups could prepare bids describing salinity impact reducing investments they would make and the incentive payment that they would require.

- The Government would then rank proposed bids based on the level of expenditure required per estimated unit of salinity impact reduction; and
- Bids offering greatest salinity reduction per dollar of cost-sharing required would be funded.

Why this MBI?
As discussed above, neither Victoria, nor South Australia currently impose significant salinity obligations on existing irrigators. At least a partial explanation is likely the political resistance to establishing responsibilities that are expensive to meet for irrigators who made decisions about where to located irrigation before any salinity obligations were in place. Even if the political consensus is that existing irrigators should be charged, it is likely to be less expensive for at least some existing irrigators to treat the cause (reduce recharge) than it would be for the State to treat the symptom by building and operating salt interception. Where this is the case, it is cheaper for the State to subsidise actions to treat the cause, than it is to pay the costs of treating the symptom.

Basically, incentive payments would be a way to address the source of significant salinity impact from existing irrigation located in high impact areas at less cost than would be required to treat the impact once it occurred. Distributing the incentive payments by tender has the advantage that it would reduce cost of achieving salinity targets compared to standard "fixed rate" incentive payments. Competition among irrigators for limited tender funds should encourage irrigators to seek out low cost salinity reduction strategies.

Challenges to implementing this MBI
A key challenge to developing a tendering approach is developing a good science based approach to prioritising bids. An approach is needed that allows estimation of salinity impact reduction effectiveness across locations and actions. There are additional challenges associated with designing the detail of the tendering process in ways that ensure best value for Government expenditure dollar (Stoneham and Chaudhri, *et al*, 2002).

MBI 3:Tradeable salinity entitlements

MBI approach: A tradeable entitlement policy, also known as a cap and trade policy involves setting individual limits on allowable levels for some outcome or input (a quota). Those subject to the policy are then only allowed to exceed their quota if they purchased additional quota from someone who is under quota. Those who can achieve large input or output reductions at low cost are motivated to sell part of their quota at a profit to those who would only be able to achieve similar levels of reduction at higher cost, and thus would rather buy credits than incur the high cost of reducing input use levels or output.

In principle, a cap and trade could be applied to limiting salinity in parts of the River corridor where this is important. Presumably, high salinity impact areas would be highest priority for such policy. Implementing a tradeable salinity entitlement system would involve:

- Establishing caps on allowable salinity, recharge or water application levels for existing irrigation in areas chosen for cap and trade implementation,
- If caps are on recharge or water application (proxies for salinity), the number of entitlements required might be differentiated based on location specific salinity impact differences,
- Issuing individual salinity, recharge or water application entitlements,
- Making the entitlements transferable within a defined area,
- Possession of a number of entitlements commensurate with impact would be a condition on application of irrigation within defined areas.

The general approach has proven successful at reducing the cost to industry of achieving reductions in sulphur dioxide emissions from coal fired power plants in the US and has been applied to salinity emissions from mines in the Hunter Valley of NSW (NSW EPA, 2003).

A form of salinity credit trading is already in place for the States that are party to the MDBC agreement on salinity. Under this arrangement, States have the option of meeting their salinity obligations through in-state action, or paying for mitigation investments in other States. NSW and Victoria have taken advantage of the credit trading option by co-investing in cost effective salt interception in South Australia at the Woolpunda and Waikerie sites to meet their MDBC salinity obligations.

There is also one local cap and trade scheme for salinity operating at the individual irrigator level along the South Australian River Murray, the *Qualco Sunlands Groundwater Control Act*, 2000 (South Australian Parliament, 2000). Irrigators who are party to the agreement are required to buy shares (on a 30 year lease basis) of capacity in the salt interception scheme that protects the River from salinity impacts in the area. The number of shares required is determined by the level of irrigation water allocation applied by the irrigator in the scheme area. Irrigators can buy excess shares in anticipation of expanding their irrigation up to the limit of the salt interception scheme capacity. Expansion of irrigation in the scheme area will be allowed if those who wish to expand are willing to finance additional capacity sufficient to offset their impacts by buying additional shares.

Why this MBI?
A tradable salinity entitlement approach is a way to address the issue of existing irrigator responsibility. Limiting the amount of permissible salinity at some locations makes entitlements to produce salinity impact at such sites valuable. The approach often has been used to overcome political resistance by existing industry participants who current practices produce significant environmental impacts. These existing parties are given entitlements free of charge. In the case of irrigation this would create an incentive for existing irrigators to reduce impact if there was demand for entitlements for additional irrigation development in an area.

Challenges to implementing this MBI

This MBI would work most effectively if it were underpinned with a good standardised methodology for estimating salinity impact. Thus as with the other MBI approaches discussed, there is a technical challenge involved in developing an approach to estimate salinity impact based on easily measured or modelled proxy measures. Another challenge specific to tradeable entitlements is the relatively high administrative cost associated with tradeable entitlements systems. There is need not only for monitoring and enforcement as with other policy approaches, but also for a permanent entitlements registry, and accompanying development restriction.

Mixing and matching policy approaches

Past experience suggests that with the right design in the right circumstances, MBI approaches can reduce the cost of achieving environmental goals. However, choosing the right approach is not straight forward as there is inevitably a need to balance several considerations in developing policy that is equitable and cost effective[2].

World best practice often involves mixing traditional policy approaches and MBI approaches to balance tradeoffs among policy objectives. In some instances, existence of more traditional policy approaches is a prerequisite to development of effective MBI approaches. This is certainly true for tradeable entitlement MBI approaches, where a prerequisite to an effective trade scheme is an effective limit on the level of the output or input that is the basis for the policy. Thus a prerequisite to development of an effective tradeable salinity entitlement MBI would be effective limits on salinity or an easily measurable proxy such as water applied or irrigation drainage. One way that this could be implemented is a restriction precluding further development within a specified area. The idea of the tradeable salinity entitlement would then be to relax the development restriction for developers who could acquire offsetting salinity entitlements through entitlement markets.

In other instances mixing approaches represents a particularly effective way to balance environmental effectiveness, cost efficiency, and equity goals of NRM policy. The NSW load-based licensing program for industrial air pollution is a good example of mixed MBI policy designed to balance environmental effectiveness, cost efficiency, and equity policy goals. Fee rates are tiered. They double if the load goes over an emissions threshold that is defined for each industry type and pollutant. In addition, the policy includes an upper limit emission of each pollutant for each industry type that is a traditional regulatory standard. Violations of this upper limit can result in fines of up to $250,000 for corporations and $120,000 for individuals (NSW EPA, 2001). This mixed approach addresses equity concerns by reducing compliance costs for those already producing little pollution and simultaneously provides industries using particularly antiquated "dirty technology" a strong incentive to update.

[2] The list below is a very abbreviated version of frameworks for determining how MBI potential depends on the biophysical nature of the environmental issue, institutional, and market conditions elaborated in Connor and Bright (2003); and in MacDonald, Connor, and Morrison (2004).

There are mixed policy approaches that hold significant promise for salinity policy. One good example of how mixing policies might be advantageous (but by no means the only desirable mix) involves using tradeable salinity entitlement together with tendering MBI approaches. This mix holds promise for balancing:

- Equity (or political feasibility) objectives of avoiding costly compliance burden on those who invested in irrigation before salinity regulation,
- Environmental effectiveness objectives related to floodplain health that will require not only avoiding any additional salinity impacts of new irrigation development, but also reducing drainage from existing development in some areas, and
- Cost effectiveness goals, both tendering and tradeable entitlements create incentives for irrigators to seek out low cost salinity impact mitigation strategies.

Establishing tradeable entitlements for current irrigators would limit growth in salinity impact in a way that did not impose additional compliance cost on existing irrigators. A call for tenders allowing existing irrigators to provide reductions in drainage (and turn in entitlements) would then allow those who were willing and can do so cost effectively to provide salinity impact reductions.

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