INTEGRATION OF SALINITY MANAGEMENT OPTIONS INTO THE MULTI-OBJECTIVE CONTEXT OF NATURAL RESOURCE MANAGEMENT

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The economic assessment of projects using benefit-cost analysis depends on the valuation of the flows of benefits and costs in commensurable units and their aggregation at present value. The interdependent relationships between water use, salinity, climate and vegetation are illustrated and the need for the resolution of the trade-off between the environment and development is discussed. Where market failure exists in terms of the provision of environmental utility, contingent valuation of all the diverse objectives of natural resource management may provide insights to assist decisions regarding the allocation of public resources.

1. Introduction

The aim of this paper is to encourage discussion on the need for more complete integration of salinity management options into the multi objective context of natural resource management. Land and water salinity are major issues for natural resource management in Victoria with current annual agricultural losses estimated around $40 million. Most of the agricultural loss is concentrated in irrigation areas where resource use intensity is high and the hydrological consequences of irrigation are locally expressed. The current annual loss in dryland farming regions is approximately $5 million. Industrial and domestic annual losses around $5 million also occur due to water salinity. Although salinity environmental impacts are high due to the topographical manifestation of damage associated with high value habitats, there has been little economic valuation of environmental damage. Most environmental assessment has been in biological terms in non-commensurable units. Agricultural salinity losses need to be kept in perspective in relation to other natural resource management issues. For example, Kearns (1993) estimated the losses due to the recent mouse plague in the Wimmera and Victorian Mallee to be in the order of $33 million or about 5% of the 1990/91 value of cropping production. If the "Target 10" extension program achieves a 5% increase in water use efficiency in the Shepparton-Kerang irrigated dairy industry, annual benefits will be in the order of $9 million. The increased crop and pasture water use to be promoted in dryland areas could lead to productivity benefits 20 to 30 times the present value of the salinity benefits which may accrue over the next couple of generations. Thus while salinity losses are important, and will increase with time if nothing is done, there is good reason to consider the opportunity cost of salinity management in terms of other management issues. It is the aim of integrated catchment management strategies such as the Murray-Darling Basin Commission Natural Resource Management Strategy to integrate all aspects of rural, urban, water and human resource management to achieve sustainable regional development.

2. Allocation of Scarce Resources

Most salinity management options have multiple outcomes. For example, increased plant water use and/or sub-surface drainage may lower groundwater levels. Agricultural, domestic, environmental and industrial benefits will accrue because of reduced land and water salinity. In terms of total catchments, these benefits are often complementary across and between the various levels in the hierarchy of natural resource management. Because there are external salinity benefits from programs initiated with a single natural resource management objective in mind, there is an opportunity to attempt to optimise the coordination of all programs to maximise net social benefit.
This is the expressed goal of integrated catchment management.

There is a number of optimisation methods available, (Cohon and Marks 1975, Thampapillai 1978) all of which suffer shortcomings because of difficulties in valuing all project outcomes in commensurable terms. The problem lies in the absence of perfect markets for utility in which all members of society can reveal their individual valuation of benefits (costs). Thus attempts at unconstrained optimisation rely on a subjective valuation by the analyst, or expert, of changes in utility of others. Similarly, constrained optimisation relies on a subjective setting of the level of constraints. And in the perspective of the aim to equalise VMP_{x1}/P_{x1}, VMP_{x2}/P_{x2}, VMP_{x3}/P_{x3}.................. VMP_{xn}/P_{xn} (where VMP is the benefit to society for a particular objective and P is the cost of obtaining the benefit), the setting of constraints is an implicit subjective estimate by the analyst or decision maker of the valuation other members of society may make. The situation becomes even more complex where distributional weights are derived subjectively by the decision maker and used explicitly by the analyst. There has been considerable criticism of the use of weights by Mishan (1982) and he outlines the minimum prevailing socio/economic conditions necessary to dismiss the use of weights as social engineering leading to selection of inferior solutions/projects.

3. Investment Appraisal and Public Funding of Salinity Control

The Victorian state salinity program addresses aspects of market failure in natural resource management.

Community plans coordinate collective action in the control of externalities due to salinity and produce public goods through increased environmental values and regional output *vis a vis* the non-intervention scenario. The economic justification for joint participation and cost sharing by landholders, and regional and state-wide interests is that the net benefits arising from investment exceed those obtainable in the absence of coordination. The economic evaluations and cost sharing proposals set out in draft salinity management plans are the basis of the proposed level of Government investment or expenditure. The distinction between investment and expenditure is that expenditure implies that the program is not economic but that there are significant social or environmental benefits not valued in money terms.

4. Valuation of Non-Market Goods

Various approaches have been taken to reduce or overcome the problem of integrating project outcomes measured in non-commensurable units. One productive area of work has been in the use of survey data to estimate willingness to pay for non-market goods. Methods such as hedonic valuation, contingent valuation and travel cost have been widely applied. For example, Sappideen (1992) used survey methods to estimate the contingent value of the Sale Wetlands to assist the preparation of, and Government response to, the Lake Wellington salinity management plan. Sinden (1987) used survey data to estimate public willingness to pay for soil conservation in NSW.

Another approach has been the presentation of a break-even scenario to the decision maker. To assist the resolution of the conflict between development and conservation over the Gordon below Franklin scheme, Saddler *et al* (1981) estimated the present value of development divided by the number of Australian citizens. It was then up to the decision makers to make the political judgement regarding willingness to pay.

5. Opportunities for application of non-market valuation to assist integration of salinity management options.

5.1 Trees

Salinity problems have worsened since the wide scale clearing of trees and there is a view that replacement of tree cover will solve the salinity problem in the long term. The question for the economist is to determine what level of tree planting activity will equalise VMP_{trees}/P_{trees} with that for other programs. In some high rainfall sites, where the forestry site index is high, tree planting is economic (e.g. Draft Loddon SMP 1993). In most other situations when the opportunity cost of alternative land uses is taken into account, the discounted net present value of tree planting programs is negative. This may even be so when non-salinity agricultural benefits such as shade and shelter are taken into account, although Loane (1993) shows examples where windbreak plantings can be profitable at "commercial" discount rates when managed for agro-forestry benefits in addition.

In general, the tree planting programs of dryland plans show BCRs of 0.7. The rational approach would be to reduce the scale of support for these programs to the point where the BCR was similar to other salinity options which should be close to that obtainable in other natural resource management programs and the economy as a whole. This would limit tree planting to high forestry index sites and to multiple use farm sites (timber plus shade and shelter). There are additional unpriced benefits which may top up the BCR and extend the use of trees beyond these limits. The amenity and wildlife habitat benefits may be sufficient to justify further increases and the ecological/farm interaction may lead to improved efficiency. Some estimation of amenity value of tress in rural areas has been attempted overseas. There does not appear to have been any attempt to establish the response function relating trees and amenity though Carey and Barr (1991) have examined the attitude of rural landholders to trees and tree planting in relation to other values and motives. There has been no dollar allowance for direct amenity and environmental benefits of trees (other than through salinity effects on agriculture and domestic/industrial water quality) in Victorian dryland salinity plans. Rather, the decision maker has been left with the break even scenario question "Is the community willing to pay 30 cents in the dollar of the tree planting budget out of consumption expenditure (or taxes) or would they rather further investment in development of productive capital". There appears to be plenty of scope for economists to examine this area and assist decision makers by attempting valuation of environmental benefits. If all benefits and costs can be scheduled and quantified, estimates of the optimal distribution and proportion of land uses within a catchment will be made with greater certainty. In the meantime, salinity mitigation appears to be one of the more attractive areas to direct tree planting funding made available through the political process such as Decade of Landcare and One Billion Trees programs.

5.2 Crops and Pastures

Most agricultural programs in dryland plans are aimed at increasing on-site water use. The consensus outlines an information failure as the reason for non-adoption of practices that will increase farm income. However, increased water use by crops and pastures has a dual benefit. The beneficial use of a climatic opportunity is increased and downward percolation is reduced. On site agricultural and off-site salinity (agricultural and domestic and environmental) benefits accrue. The cost sharing guidelines used for funding of salinity control programs are mainly based on beneficiary pays principle (except where readily identifiable significant polluters exist). The expected on-site agricultural benefits alone will more than cover the cost of proposed extension programs. In this case a private interest market based approach should secure most of the expected salinity benefits without the need for intervention on behalf of off-site beneficiaries. To apply the cost sharing principle it is necessary to estimate the value of off-site salinity benefits and often the environmental benefits are significant in biological terms. Dollar valuation of these benefits would assist cost sharing decisions.

5.3 Water Supply

An estimate of the conservation and heritage value of the Wimmera River was used to assist decisions regarding pipelining of the Wimmera-Mallee stock and domestic water supply. Water savings resulting from the change from leaky earthen channels to pipes are to be used for environmental flow in the river. The high conservation value of the river improved the overall economics of the scheme.

6. Non-market Values of Development?

Non-market valuation has been generally directed toward pricing environmental parameters. Sinden (*op. cit*) has valued community concern for soil conservation and it is interesting to contemplate how much of the expressed willingness to pay related to individual preferences for the existence of productive agriculture rather than just conservation *per se*. Particularly so considering the estimated community willingness to pay (WTP) for soil conservation in NSW was 35 times higher than the threshold value calculated by Saddler *et al.* (*op. cit.*) for the preservation of the south west Tasmanian wilderness. Perhaps there is a case to include the existence value of development in addition to the market price of technological products. If so, this would have the effect of increasing the opportunity cost of conservation proposals.

7. Conclusion

Finally, we might consider the aim for natural resource managers as firstly a responsibility to strive for a harmonious confusion of trade-offs, secondly to identify the order in the interrelationships of multiple objectives and thirdly there remains the task for valuation of all things in such a way that they become comparable in commensurable terms.

> The groves of *Eden*, vanished now so long,
> Live in description, and look green in song:
> *These* , were my breast inspired with equal flame,
> Like them in beauty, should be like in fame.
> Here hills and vales, the woodland and the plain,
> Here earth and water seem to strive again;
> Not *chaos*-like together crushed and bruised,
> But, as the world harmoniously confused:
> Where Order in Variety we see,
> And where, though all things differ, all agree.

Alexander Pope (1713)

There is scope for more identification and valuation of non-market goods to assist the rational integration of natural resource management options. Natural resource management is a complex subject which will forever challenge the efficiency seeking welfare economist because many so benefits are individual preferences incapable of aggregation.

6. References

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