ENVIRONMENTAL SHADOW PRICING: SOME ISSUES RELATED TO SALINITY MANAGEMENT IN VICTORIA

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1. INTRODUCTION

Salinity is Victoria's greatest environmental problem. It is widespread and increasing throughout the State, particularly in the northern, western and south-eastern parts. The impact of salinity varies from localised effects to wider regional effects. It is estimated that the direct cost of salinity to Victoria's economy through productivity losses is in the order of fifty million dollars per year (Salt Action:Joint Action, Victoria 1988). Other costs such as environmental degradation, lowering of drinking water quality, and the deterioration in infrastructure facilities (such as roads) have not been estimated, but are believed to be significant.

The Victorian Government's strategy to control and manage salinity is through joint government-community planning for the major salt-affected catchments and selected sub-regions. Salinity Management Plans (SMPs) have been formulated for four such sub-regions, while at least six more plans are to be released within the next couple of years. In all the SMPs completed to date the cost of salinity damage has been accounted only with respect to productivity losses. A major limitation in the salinity management planning process has been the inability to account for the impact of salinity on the environment.

A picture of "doom and gloom" prevails in the environmental scenario of salinity management planning. While some of the environmental impacts of salinity may be real and could threaten environmental values, others may only be of marginal significance. The Guidelines for the Preparation of SMPs in Victoria (1988:18), state: " Environmental effects considered to be significant should be costed in dollar terms, and included in the economic account wherever possible...".

It is therefore imperative that environmental benefits of salinity be properly accounted in the salinity management planning process. This paper is the first step in fulfilling the above requirement. It discusses the most applicable methods available to value environmental amenities affected by salinity.

The primary objective of the paper is to discuss the Hedonic Price (HP), Travel Cost (TC) and Contingent Valuation (CV) methods for valuing environmental commodities and to enumerate on their respective major strengths and weaknesses.

Section two addresses the environmental impacts of salinity and section three the problems associated with valuing environmental commodities. Section four discusses the three methods mentioned above. In section five the potential to use the different valuation methods in salinity management planning to value environmental amenities is highlighted, followed by conclusions.

2. ENVIRONMENTAL IMPACTS OF SALINITY

Salinity has wide ranging impacts on the environment. It affects farm land through rising water tables resulting in productivity losses and in the long run a decline in land values. Salinity directly affects the environmental ecosystem such as wetlands (inland lakes, swamps, billabongs and depressions), streams and rivers, other terrestrial vegetation, natural flora and fauna.

The environmental quality of wetlands range from very fresh to fresh (< 4,000 EC) to brackish to saline to hyper-saline (>100,000 EC). In the Kerang Lakes sub-region currently about 40% of the wetlands are saline to hyper-saline and this proportion is expected to increase if the effects of salinity continue unabated. Whilst no such comparable statistics are available for other SMPs, it is expected that if salinity is not controlled, the environment will continue to degrade in these catchments.

In the case of natural vegetation, rare flora such as the swamp sheoak are threatened, while other natural floral reserves such as grey box, black box, red river gum and murray pine are also affected. Increasing salinity has reduced the area of freshwater habitats available to waterbirds and other aquatic vegetation. It also affects other wild life habitats, which in turn affects the recreational values of such environments.

3. THE VALUATION PROBLEM

Environmental amenities unlike other goods and services do not operate through established markets, and consequently, do not have observable prices "....because the universal and important feature of these things is their lack of a monetary price, ..." (Sinden and Worrell, 1979:12). The lack of a monetary price is primarily due to the environmental amenity being viewed as a public good with no defined property rights; i.e. they are characterised by the conditions of non-excludability (open to the general public) and non-rivalry (consumption by one person does not reduce the level of amenities available to anyone else). The absence of property rights is due to social conventions or the nature of the amenity itself.

It is possible to create a market for the consumption of some environmental amenities such as swimming, sailing, bird watching or hunting. However, it may be too costly or administratively prohibitive to do so.

The problem of valuation is further confounded by the fact that the benefits of some environmental amenities such as aesthetic values and biological diversity are less discernible. Similarly, the benefit of some environmental amenities accrue to people who may be away from the site. This benefit is the knowledge that environmental amenities (parks, lakes, etc.) exist and are available for future use. This knowledge or 'existence' benefit is present even though they may never use it.

4. METHODS FOR VALUING ENVIRONMENTAL COMMODITIES

Over the last couple of decades methodologies have been developed to provide monetary estimates of value people place on environmental amenities. These include indirect methods which rely on behaviour of households in similar markets to reveal the value placed on such unpriced commodities and direct methods using survey techniques. The HP and TC methods fall into the former category, while the CV method is a direct method.

A major thrust in salinity management planning is the control of water tables through drainage and other farm land improvements. Quantitative assessment of the additional benefits of farm improvements is necessary to help both individuals and the government to make investment decisions on salinity control. The impact of salinity control on land values is a significant benefit. The hedonic or implicit price method is a technique which can be used to estimate this.

4.1 The Hedonic Price Method

The HP method is based on the premise that some commodities have bundles of characteristics and treats demand as depending on a good's attributes. Rural amenities like farm land have certain attributes such as soil condition, land improvements, etc., expenditure on which may be reasonably assumed to embody the value of the attribute of interest. For example, if there are two properties in a salinity affected region which are similar in all respects but one has sub surface drainage and other land improvements to manage salinity, then differences in prices would reflect the value of farm improvements.

The theoretical and conceptual basis of the method are detailed in Fisher (1985), Anderson and Bishop (1986) and King and Sinden (1986). The method calculates the implicit marginal price of the attributes of interest by regressing expenditure on the relevant market good on measurable characteristics including the attribute of interest. It should be noted that only farm land characteristics are included in the model. The implicit price function is expressed as:

$$P = Z(Z_1, Z_2^*, \ldots Z_n^*)$$

where P is the price of the good, Z_1 is the environmental attribute being measured and $Z_2^* \ldots Z_n^*$ are optimal quantities of the other farm land characteristics.

The HP method has been most widely applied to value environmental amenities such as air quality (Schulze et al 1981; Brookshire et al 1982) and noise pollution (Nelson 1981) in the urban property market. More recently, it has been applied to study the impact of soil conservation investment on farm land values (Gardner and Barrows 1985; King and Sinden 1988; Palmquist and Danielson 1989). Miranowski and Hammes (1984) applied the method to study the impact of soil characteristics on farm land values. The general conclusion from these studies indicate that the market recognised land condition as an environmental quality, with better or improved land fetching higher prices.

The above studies clearly demonstrate the potential of this method to determine the impact of salinity control practices such as drainage on rural land values in Victoria.

The successful application of the method is based on certain assumptions: the presence of an active land market; a diversity of buyers with full information about the various packages of characteristics; a wide spectrum of properties across the range of characteristics; and, buyers and sellers must actively recognise and react to changes in land conditions (King and Sinden 1988). Assuming that the above conditions are fulfilled, the HP method will be a useful tool in the planning and evaluation of salinity management plans in Victoria.

A limitation of the HP method is its inability to provide estimates of values of the off-site impacts of land improvements. A further shortcoming of the method is that it cannot estimate non market benefits of rural land improvements such as conservation or aesthetic values. Such values stem from the fact that people have the knowledge that farm improvements are beneficial, but are unable to directly consume such benefits. To value such non-market and non-use benefits we have to turn to other valuation techniques.

4.2 The Travel Cost Method

In addition to enhancing rural land values, salinity control has a significant effect in improving the quality of environmental amenities such as recreation. The valuation of such environmental amenities can be approached by using the TC method. The TC method is an indirect way of determining the value that consumers place on a non marketed good by observing their behaviour in actual markets.

The method is based on the premise that visitors to a recreational site pay an implicit price for the sites amenities embodied in the travel cost and other cost incurred in visiting the site. A detailed discussion of the method is provided in Anderson and Bishop (1986), Smith, Desvousges and Fisher (1986), Ward and Loomis (1986) and Mendelsohn and Brown (1983). The method derives a demand equation for a particular recreation site i by specifying the number of visits (V_i) to the site during a predefined period (usually a season), the implicit price of a trip (C_i) including both vehicle costs for the round trip and the time costs of travel, a vector of implicit price of substitute sites j (P_{ij}), individuals income (Y_i) and a vector of socioeconomic variables (Z_i) of significance. The trip generating function is:

$$V_i = V(C_i, Y_i, \overline{P}_{ij}, \overline{Z}_i)$$

Much of the above information can be obtained through a survey of recreationists either by on-site sampling or household surveys.

An estimated ordinary demand curve is shown in figure 1. An improvement in the environmental quality of a recreation site will shift the demand curve to the right and the increase in consumer surplus is a measure of the willingness to pay for the improvement. However, this is only true if the condition of "weak complementarity" holds.[1]

[1] A public good and a private good are weakly complementary if, when the quantity demanded of a private good is zero, the marginal value or marginal utility for the public good is also zero.

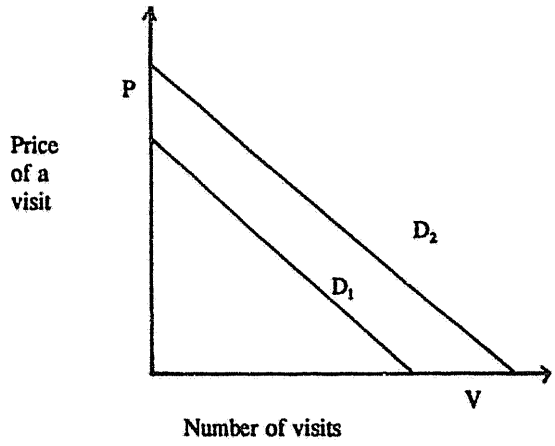

Figure 1 - Illustration of an improvement in environmental quality with a shift in the demand curve from D_1 to D_2

The TC method has been widely applied to estimate the demand for recreational facilities such as water quality (Smith, Desvousges and Fisher 1986), goose hunting (Bishop and Heberlein 1979), Marine fishing (McConnell 1979) and park recreation (Hanley 1989).

The method is not without its problems, a major issue being the valuation of travel time. The time taken to travel from a destination to a particular recreational site has an opportunity cost. Based on urban transport studies, Cesario (1976) estimated that the value of non work time spent in transportation usually fell between one-fourth and one-half the wage rate (in Anderson and Bishop 1986). Bishop and Heberlein (1979) in their study of goose hunting used both the above values for travel time and found that the consumer surplus of a goose hunting permit varied between 56% and 28% respectively below the benchmark value determined using a simulated market. Their results highlight the problem of arbitrarily setting a value of time at some percentage of wage rate as suggested by Cesario. There are other issues in the determination of the travel cost variable *(C_i)*. For instance there has been some debate as to the value of time spent at the recreation site itself (Ward and Loomis 1986), while Bishop and Heberlein question the assumption of the treatment of travel costs as equivalent to admission costs.

Bishop and Heberlein (1979) also point out that there are other potential sources of biases: substantial differences in the recreationists tastes and preferences; access to substitute sites; and the assumption that recreational quality remains constant over the range from zero to full use (i.e. the effects of crowding on environmental quality). They further raise other conceptual problems such as handling multipurpose trips (recreation and work) or multiple-site trips (vacations including several stops). Bishop and Heberlein conclude that the above biases have significant impact on the travel cost values for recreation and extra market goods.

In recent years research on the TC method has concentrated on overcoming some of the problems, thus strengthening the applicability of the method. Mendelsohn and Brown (1983) discuss the hedonic travel cost method, which is used to determine the value of different levels of characteristics of recreation sites. However, such a technique requires more extensive and higher quality data than the simple TC method.

The simple TC method, in spite of some shortcomings, is a potential tool to determine the recreational value derived from an existing site. This value will be useful for example, in making policy decisions associated with wetlands conservation in the salinity management planning process in Victoria.

The HP and TC methods discussed above measure the on-site benefits of land improvements and recreational amenities respectively. Most travel cost studies attempt to value the 'recreation experience' (Young and Allen 1986); i.e. the user benefits of recreation such as game hunting or general outdoor recreation. However, there are other non-user values such as existence value and option value[2] which have to be considered in valuing environmental amenities. The HP and TC methods cannot be used to estimate the above non-user values. The CV method described in section 4.3 can be applied to value both user and non-user values.

4.3 The Contingent Valuation Method

The CV method uses survey questions to elicit people's preferences for public goods by finding out what they would be willing to pay for specified improvements in them (Mitchell and Carson 1989:2). The CV method presents the consumer with a hypothetical market in which to buy the product in question. The hypothetical market is constructed in detail so as to present the consumer as complete a picture as possible to help him/her value the commodity in question. The willingness to pay for the commodity in monetary terms is elicited through a bidding game. The bidding process is iterative with the respondent reacting to a variation in price as posed by the researcher. The bidding process is continued until the desired bid (price) is realised, at which point the process is terminated.

Individual willingness to pay is dependent on factors such as income, tastes or preferences and other socioeconomic variables. It is therefore important that when eliciting willingness to pay, data is also collected on other variables related to the bid. A bid curve is then estimated for individual i as follows:

$$W_i = F(Q_i, Y_i, T_i, \bar{S}_i)$$

where W is willingness to pay, Q is the quantity or quality of the environmental commodity, Y is income level, T measures preferences and S is a vector of other socioeconomic variables.

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[2] *Existence value* is defined by Bishop (1978:15) as '...the utility that people receive from simply knowing that something exists'. (see Mitchell and Carson 1989:63, for a discussion of this concept).

Option value is the value attributable to the option of making future use of an amenity. (see Bishop 1982 for an exposition of this concept).

The CV method has had wide applications. More recent applications include valuations of the scenic beauty of lake sites (Loomis 1989), rivers (Boyle and Bishop 1988; Boyle et al 1988), natural parks (Hanley 1979), valuing changes in water quality (Smith et al 1986), prime agricultural land (Bergstrom *et al* 1985) and air pollution (Brookshire et al 1982). Contingent valuation studies done to value recreational benefits are for deer and wild game hunting (Boyle et al 1985; Bishop et al 1984), fishing (Samples 1985), and wild fowl hunting (Bishop et al 1983; Hammack and Brown 1981).

Apart from valuing the user benefits of non-market commodities, CV can also be used to value non-user benefits such as existence values. This was demonstrated by Bennet (1984) in his study to estimate the existence value of the Nadgee Nature Reserve in New South Wales.

The CV method also has its criticisms and weaknesses. The major criticism of the method has centred on its hypothetical nature aptly summed up by Scott (1965): "Ask a hypothetical question and you get a hypothetical answer" (cited by Anderson and Bishop in Bromley 1986:125). The hypothetical nature of the method gives rise to a number of biases such as starting point bias, strategic bias, hypothetical bias, information bias and payment vehicle bias.

Starting point bias: Starting point bias arises when the initial bid posited by the interviewer influences the respondent's final bid. Unlike in the case of normal market commodities, people are not familiar with the concept of expressing values for non-market commodities. Consequently, the starting bid suggested by the interviewer conveys some market information to the respondent which may assist the latter to arrive at the final bid for the commodity being valued. Furthermore, due to the hypothetical nature of the CV market, if the commodity being valued is poorly defined or not distinctly perceived by the respondent, starting point bias may result. It is also contended that if the starting bid is very different from the respondent's actual final bid, then the iterative process may bore and tire the respondent, who may then prematurely terminate the bid.

The evidence regarding the presence of starting point bias in CV studies is inconclusive. Schulze et al (1981) reviewed six studies and concluded that starting point bias was not significant in three of them. Boyle, Bishop and Welsh (1985) on the other hand reviewed three other studies and found that starting point bias was clearly present when a hypothetical market was used. However, in one of the studies reviewed by them, which used a simulated market starting point bias was not evident leading them to conclude that starting point bias was an artefact of hypothetical markets. Samples (1985) using widely disparate starting bids in a study to value the benefits of recreational fishing, showed that starting bids influenced final bids.

To overcome the shortcoming of starting point bias in CV studies alternative valuation techniques such as the payment card, dichotomous choice and open-ended questions have been suggested. There is no general consensus as to which is the best technique, different researchers opting to use the technique that suits their research best. For instance, Bishop and Boyle (1988) compared iterative bidding estimates with payment cards and dichotomous choice estimates in their study to determine the scenic value along the lower

Wisconsin river. They concluded that each technique had its strengths and weaknesses and no single technique is neutral in the elicitation of consumer surplus for non-market goods.

Strategic bias: Strategic bias arises where individuals may attempt to influence the outcome of the result by not responding truthfully. For example, if individuals suspect that the costs of environmental amenity would be borne by others, they may overstate bids. Conversely, if they believe that their bid may result in increasing costs to them, they will attempt to understate the bid. However, contrary to theoretical expectations, strategic bias appears to be more the exception than the rule in several CV studies investigated for this error (Bishop and Heberlein in Kerr and Sharp 1985, Schulze et al 1981).

Hypothetical bias: Because we are dealing with a hypothetical market in CV a potential error may be induced by not confronting the respondent with an actual situation. Thus Schulze *et al* suggest that the non-market attribute being valued should be accurately depicted and be believable by the respondent. Recent studies have used a variety of instruments including visual aids, photographs, maps and charts such as the water quality ladder (Mitchell and Carson 1981), to provide a clear and unambiguous picture of the commodity being valued.

Information bias: Information bias is induced by the lack of or type of information given to the consumer in the contingent market. The evidence of information bias in CV studies is mixed. However in a recent experiment to determine the impact of information on willingness to pay, Bergstrom *et al* (1990) show that information is important for accurate environmental commodity consumer valuations.

Payment vehicle bias: In order for respondents to come up with realistic values some specific mechanism for payment must be specified. Payment vehicles used in CV studies range from higher taxes, fee for services, license fees, etc. Depending on the payment mechanism for obtaining willingness to pay, outcomes may vary. Some researchers contend that this is a type of "information bias" (Schulze *et al* 1981). However, there is growing support for the view that payment vehicle, *should* be expected to affect willingness to pay amounts as it reflects the policy conditions under which the amenity will be provided (Mitchell and Carson 1989).

A second major issue in CV studies is the measure used to determine the change in welfare resulting from changes in the quality/quantity of the non-market commodity being valued. Two measures of welfare change have been used in CV studies; willingness to pay for an improvement in the commodity and willingness to accept compensation (compensation demanded) to go without the improvement.

Theoretically, the difference between willingness to pay and compensation demanded should be negligible provided income effects are small. Yet, a number of studies cited by Gregory and MCDaniels (1987) indicate that individuals compensation demanded has been consistently greater than their reported willingness to pay. They conclude that the above evidence clearly indicates a fundamental difference in the two approaches, and is also supported by certain theories in psychology. This decision has fundamental implications for benefit-cost analysis, for the acceptance of a difference between willingness to pay and

compensation demanded measures means one can no longer use willingness to pay as a surrogate for compensation demanded values (Gregory and MCDaniels).

Despite the above, willingness to pay has been the most commonly used measure due to the ease of eliciting this value in a CV market.

The potential of the CV method to value a diversity of environmental commodities has resulted in the method being widely applied. Increasingly, a number of studies support the contention that the CV method provides valid estimates of total willingness to pay for environmental commodities. For instance, Brookshire et al (1982) compared the CV method with the HP method in a study of air pollution and concluded that the CV method yielded estimates of willingness to pay for environmental improvement in an urban setting consistent with HP analysis. More recently, Loomis (1989) evaluated the reliability of the CV method by resurveying the same population nine months after the original survey and found that reported willingness to pay was reasonably stable over the time period studied.

5. NON-MARKET VALUATIONS AND SALINITY MANAGEMENT PLANNING

What potential do the three methodologies discussed have in relation to the measurement of environmental amenities in salinity management planning?

To the extent that environmental preferences are visible in market decisions, the related-market methods - HP and TC methods - are useful tools. The HP method has been used to determine the effect of land improvements on rural property values. As mentioned earlier, land improvements such as surface and sub-surface drainage, laser grading and whole farm layout are the principal components of on-farm options to control salinity. A measure of the benefits of such practices will provide individual land holders with valuable additional information to make investment decisions for salinity control. To the extent such improvements contribute to maintain on-farm production and reduce off-farm salinity effects, it will assist in determining the most appropriate level of cost share between private land holders and the government in salinity management planning.

The usefulness of the TC method is limited to the estimation of recreational benefits that involves travel. Recreation is a major environmental commodity provided by wetlands, particularly duck hunting. During the hunting season a large number of duck hunters visit the wetlands for this sport. The TC method can be used to measure the consumer surplus generated by this activity which will be an indicator of the benefit of wetlands. Other recreational benefits such as camping, bird watching, etc. if actively pursued in the wetlands can also be determined through the TC method.

The TC method can then be particularly useful to determine the existing value of recreation from the availability of a particular single recreation site. This value then represents the recreational benefits foregone if a particular project or land use alternative is adopted. This has direct applicability to salinity management planning where a decision has to be made as to whether a wetland, is to be used for saline water disposal or as a

evaporation basin. The method is also useful to determine the benefit (cost) if a single site's environmental quality is enhanced (reduced) in adopting a particular salinity control option.

Related-market methods have restricted applications, being able to measure only specific aspects of environmental commodities. The environmental benefits of salinity management planning go far beyond these. In all the SMPs to date the emphasis of the environmental benefits has been on the conservation values of the natural ecosystem; i.e. the wetlands and associated flora and fauna. Their value is embodied in the knowledge that they exist, though society may not have a direct use for them. The CV method is the most suitable to value such existence or non-user values of environmental commodities. The merit of the CV method lies in its capability to measure a wide range of environmental amenities having both user as well as non-user benefits. Hence it offers the greatest potential as a research tool to determine the environmental benefits of salinity management planning in Victoria.

6. CONCLUSION

No doubt each of the methods discussed above have their own strengths and weaknesses and hence, should be treated on their own merit. As commented by Anderson and Bishop (1986): "In a world where market values have tremendous clout in the political arena and where non-economists all too often treat unpriced environmental commodities as if they either had zero or infinite values, the policy relevance of non market valuation is assured". To decision makers any information provided by these methods is better than total ignorance.

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