

# Improving the Reliability of Environmental Value Transfer

**J. Robinson<sup>a,b</sup>, G. Thomas<sup>a,c</sup> and J. Asafu-Adjaye<sup>b</sup>**

*a. CRC Coastal Zone, Estuary and Waterway Management ([Jackie.Robinson@dnr.qld.gov.au](mailto:Jackie.Robinson@dnr.qld.gov.au))*

*b. School of Economics, The University of Queensland*

*c. Department of Natural Resources and Mines*

**Abstract:** Economic valuations of environmental resources in the coastal zone of Australia are required for the evaluation of proposed environmental management strategies. Due to time and funding constraints it is unlikely that all environmental resources will be subject to individual and explicit valuation. This paper reviews the literature about the validity of environmental benefit transfer identifying guidelines for undertaking such an exercise and the circumstances that would warrant its adoption. It considers the nature of information provided by existing valuation approaches to identify an approach that would be of most use for benefit transfer. Finally, it describes a study currently underway for the CRC for Coastal Zone, Estuary and Waterway Management to value water quality improvement in the Bremer River (South East Queensland) that will frame survey questions in such a way that the estimated demand function would be meaningful for transfer to policy sites in other coastal areas. In addition, to address some of the problems associated with survey-based approaches to estimating willingness to pay, a citizens' jury approach is considered.

**Keywords:** Valuation of environmental resources; Benefit transfer; Demand function; Citizens' jury

## 1. INTRODUCTION

Management of the coastal zone in Australia will necessarily involve the identification and reconciliation of the trade-offs between the negative externalities created by urban and industry developments and protection of recreational areas, important natural habitat areas, biodiversity as well as areas of natural beauty. From an economic perspective, the optimal allocation of a resource relies on the criterion of economic efficiency. Where there is a competitive market functioning, the price mechanism will ensure an economically efficient allocation of resources. Where markets do not exist or there is a failure of the market to value resources, there is a need to intervene and for techniques to be applied that effectively mimic the market by estimating a value for environmental resources. The CRC for Coastal Zone, Estuary and Waterway Management (Coastal CRC) is likely to require information about the economic value of environmental resources in coastal areas to assist with identifying the appropriate use to which coastal and estuary resources should be put; to provide

justification for management to protect environmental resources; to provide a basis for "polluter pays" principles to deter polluters; to assess the worth of environmental assets and finally to simply stimulate awareness of environmental issues.

Environmental management requires information to be provided by scientists to verify the extent and magnitude of possible and perceived resource degradation. However, this information is not necessarily sufficient for government agencies to take action to avoid, reduce or minimise the degradation risks. Information is required that would determine if the expected economic benefits from taking action are at least equal to the economic costs. There is a real danger that if no quantitative measure of the value of environmental resources is available, then it could be perceived that they have little or no value to society and can therefore be exploited.

Economic valuations for a number of environmental resources in the coastal zone are likely to be required for evaluation of

management of this area. Due to time and research funding constraints, it is unlikely that all of these resources will be subject to individual and explicit valuation. It is therefore necessary to consider the opportunities that are available for the use of environmental value transfer, more commonly referred to as benefit transfer (BT).

## 2. BENEFIT TRANSFER

BT is defined as transferring values that have been estimated for one environmental attribute or group of attributes from one site or location (termed the study site) to assess the benefits of a similar site or location (termed the policy site) [Devousges et al., 1992]. If we acknowledge that BT is capable of providing only an approximation of an environmental value, then the objective becomes one of balancing or trading-off the errors. The objective of BT can be expressed as estimating the value of an environmental resource for a policy site such that the mean square errors (MSE) are minimized subject to time and research funding constraints. Devousges et al., [1992] express this objective as:

$$\text{MinMSE}(\hat{\theta}) = \text{Var}(\hat{\theta}) + (\text{Bias}(\hat{\theta}))^2 \quad (1)$$

subject to  $AF = AF^0$  and  $AT = AT^0$

Where  $\hat{\theta}$  is the estimated benefit  
AF is the available funds  
AT is the available time

The bias component addresses the question of the validity or credibility of the benefit estimation method, and the variance component addresses the concept of reliability or accuracy of the benefit estimation method.

The BT approach is regarded as useful not only because surveys are expensive and many evaluation projects are time constrained but also because there are many instances where an indicative value for the resource is all that is required for environmental planning purposes. However, the validity of BT is debated extensively in the environmental literature. For the most part, BT is acknowledged as a feasible approach for many applications but the literature suggests proceeding with caution. Brouwer [2000] notes that, to date, testing of environmental value transfer has been unable to validate the practice and, more importantly, no study has, to date, been able to show under which conditions BT is entirely valid.

Despite the extensive discussion about the reliability of BT, this approach is applied routinely by environmental protection agencies. It is implicitly assumed by regulatory agencies controlling the level of waste emissions into a watercourse or into the atmosphere. If the same standard for emissions, for example wastewater, is applied across an entire geographical area encompassing a number of environmental sites, then it can be argued that authorities have assumed that equivalent environmental benefits are available at all sites and locations in the area. As a general rule, BT is regarded as relevant if it provides broad information for policy formation, such as setting emission standards but it is not regarded as relevant for studies requiring specific valuation for uses such as determining compensation or for studies where there is expected to be a large environmental impact.

### 2.1 The Protocol for Benefit Transfer

Numerous studies undertaken in recent years and dealing with the reliability of BT suggest a protocol for its use.<sup>1</sup> The literature identifies a number of fundamental conditions that are essential for BT to be meaningful. These include, that the environmental good in both sites, including any proposed change in provision levels should have approximately the same characteristics; that the socio-economic characteristics of the population in both areas should be similar; that values estimated for the study site should not be dated; that the availability and price of substitutes should be the same; that the technical quality of the study site, including adequate data, sound economic methods and appropriate analytical techniques needs to be determined. Studies being considered for BT to a policy site should provide regression results.

In addition, to test the validity of a BT estimate, a pilot study on the policy site or inter-site studies is recommended to compare the results with those found for the study site. A pilot study would provide information about the accuracy or statistical validity of BT and the extent of any bias.

An important consideration for BT is to identify which valuation approaches provide the most valid estimates for BT. Specifically, what properties make one valuation approach more or less amenable for valid BT? Devousges et al., [1992] recommend that research is required to

<sup>1</sup> See for example Devousges et al., [1992]; Kirchhoff et al., [1997] and Brouwer [2000]

establish the validity of existing valuation studies with a view to their adoption for BT. The question of how the previous study was undertaken and what the estimated values actually reflect, that is, the framing of the study needs to be considered carefully.

### **3. VALUATION TECHNIQUE: MEAN WTP OR DEMAND FUNCTION**

BT is generally approached as either direct benefit transfer (DBT) or benefit function transfer (BFT). DBT involves the transfer of mean WTP values from a study site to a policy site. BFT involves the transfer of the estimated bid function or demand function for a study site to a policy site. Frequently, the demand function would have been modified to more closely represent the attributes of the policy site.

The proponents of choice modelling surveys argue that this stated preference contingent valuation (CV) technique is more suited to BT than other CV studies because it provides information about consumer preferences for individual site characteristics from which a demand function can be derived. Choice modelling or choice experiments are forms of conjoint analysis that require the respondent to rank or rate (as the case may be) two or more resource uses or resource management options for which a dollar value to the household has been assigned for its implementation. The respondent is required to make a series of choices, selecting one from a number of possible choice sets where one choice set is always the 'no change' scenario. The data are analysed using a conditional multinomial logit regression model, from which values for the resource's individual services or attributes as well the aggregate value of the resource are derived.

Morrison and Bennett [2000] report the validity of BT of two studies conducted using choice modelling to estimate the value of two wetland areas in NSW (the Macquarie Marshes and the Gwydir Wetlands). The study reports the validity of BT (using convergent validity) across the two sites as well as the validity of BT across populations. The results for the transferability of benefits across sites revealed that the implicit prices were equivalent, except for one specific site characteristic while for the transfer across populations the implicit prices were equivalent except for area. Valuations from choice modelling techniques are recommended to be more useful for BT, and in particular for BFT, because, unlike many CV studies, they estimate a demand function that would be amenable to

modification to reflect the degree to which attributes of environmental quality are available at a policy site.

The findings from a study by Kirchoff et al., [1997] to evaluate the performance of DBT and BFT were consistent with the findings of Loomis [1992] rejecting the transfer of mean site benefit estimates or DBT. Brouwer [2000] cites one of the advantages of BFT as enabling more information to be transferred and adjusted to address the possible instability of values over time. However, Kirchoff et al., suggest that the information commonly incorporated in bid functions is not necessarily sufficient for BFT. They recommend that economists contemplating undertaking BT should be attentive of the attributes of the resource requiring valuation, including the existence of substitutes. This is likely to require specific contact with stakeholders at both the study and policy sites to identify what could be critical differences in the resource. In addition, a number of inter-site studies would be appropriate to identify significant site characteristics.

#### **3.1 Expert Opinion and Public Participation in Valuation Studies**

Although choice modelling surveys provide valuable information about the value of specific attributes of a resource and are identified as particularly suitable for BT, they suffer from many of the criticisms that have been levelled at stated preference surveys generally. These criticisms include bias in the quality and quantity of information supplied to respondents, on the welfare measure used WTP or willingness to accept (WTA) compensation, a bias in the design of the bidding, for example, whether an open-ended question about WTP, a closed-ended question, a dichotomous choice, an iterative bidding or, a series of dichotomous choice questions, and on the acceptability of the payment vehicle to respondents [Blamey, 1998].

Blamey et al., [2000] take up discussions of this nature when they support the "need for methods of public participation with stronger emphasis on information and deliberation" (p.7). Blamey et al., suggest that referenda-type surveys be replaced with citizens' juries, where citizens act in the position of jurors representing the interests of others and are therefore assumed, "ceteris paribus, to feel greater responsibility to make a well-informed and deliberated decision than referendum voters" [Blamey et al., 2000: 13].

Closely related to public participation in valuation of the environment is the use of expert opinion. Although the knowledge base of survey respondents has been identified as a problem for stated preference approaches to valuation reliant on surveys, expert opinion, adopted as an alternative to population surveys, will only be as good as the information informing the experts and the skill of the experts. With respect to environmental valuation, the integrity of the expert opinion needs to be established as it could seriously impact on the degree of credibility and reliability of the valuation. Garrod and Willis [1999] describe the use of expert judgement and intuition for BT as "perhaps the most ubiquitous form by which BT is accomplished" (p.334).

There are two examples of the use of expert opinion in the literature, one to modify a demand function for BT of recreational values by the US Forest Service, and the other, to estimate the value of externalities to the population living in proximity to the third London airport. In the 1970s-1980s the US Forest Service adopted an approach termed the "unit day value" to estimate a value for recreational use. Values for recreational use were determined on a per day basis for different standards of recreation. When applied to a new site, the values were adjusted on the basis of the demand functions of site visitors. Demand was assumed to be determined by a number of site characteristics, which it was acknowledged would not be the same across all sites. Because it could not be expected that these characteristics would be the same across all sites, expert judgement was used to adjust the estimated value to a new site.

The other study that adopted the judgement of experts was the estimation of the environmental externalities arising from the proposed Third London Airport [Commission on the Third London Airport, 1970]. The Commission supported adopting expert real estate agents' opinion about the effect of noise on real estate on the grounds of their professional skill and knowledge-base. However, there are a number of studies refuting these claims referring to large discrepancies between estate agents valuation of the same property. Where valuations using expert opinion are used to direct policy towards environmental protection, the use of expert opinion might be capable of providing appropriate order-of-magnitude information. However, where information is likely to be used to estimate compensation payments, such as in the case of real estate valuations for the Third London Airport, then the use of expert opinion might be regarded as open to bias.

The use of expert opinion is not fully endorsed in the literature. It is suggested that more objective estimates are likely to provide a more accurate estimate of environmental values.

Blamey et al., [2000] have acknowledged two important shortcomings of stated preference techniques for environmental valuation which they have gone some way to addressing in their development of a citizens' jury approach to environmental management. This approach could be particularly useful for BT using stakeholder participation. The first is undertaking valuations when the respondents have limited information. The second is distinguishing between respondents who respond as citizens and respondents who respond as consumers. Both of these situations could lead to biased results.

Stakeholder participation in resource management, and this includes valuation of environmental resources, is an increasingly acceptable way to empower communities to be involved in decision-making. If BT was perceived as an approach to value environmental resources that would provide the information required for decision-making, then a citizens' jury could well provide the framework for meaningful community involvement. By selecting a jury as a stratified random sample of the affected population and informing the jury that their decisions will count and provide the direction for environmental management, it might be possible to considerably reduce the biases inherent in general survey work. In addition, by calling in experts to provide "evidence" to the jury and allowing discussion and feedback to take place between the jury and the experts, greater use is likely to be made of the available information.

#### **4. PROPOSED APPROACH FOR VALUING IMPROVEMENTS IN WATER QUALITY FOR SOUTH EAST QUEENSLAND WATERWAYS**

An improvement in the water quality of the river systems flowing into Moreton Bay has been identified as a desirable goal for the management of the waterways of South East Queensland. To this end, the Coastal CRC has undertaken numerous studies to monitor and model water quality in the rivers flowing into Moreton Bay. Estimates of the direct costs to improve the quality of the water, including upgrading of sewerage treatment plants and improvement in the quality of wastewater discharged into the rivers by industry, is generally available. However, the question that needs to be addressed

by planning authorities is the extent to which the community are willing to pay to improve the quality of water.

The river systems flowing into Moreton Bay include the Brisbane River, the Logan River, South Pine River and the Caboolture River. In addition, there are a number of creeks flowing into the Bay. Each river system is, in turn, influenced by a number of tributaries, such as the Bremer River which flows into the Brisbane River. In varying degrees, all of these rivers and creeks will require water management to ensure an improvement in water quality.

Considerable research has been undertaken by the Coastal CRC on the Bremer River, a tributary of the Brisbane River, located approximately 50 km upstream of the city of Brisbane. The Bremer River is described as being in poor ecological health, showing apparent high levels of eutrophy and heterotrophy [Stratton, 2001]. The estimated cost of returning the Bremer River to a pristine condition would be prohibitively expensive and only achievable if existing land use in the river catchment was returned to pre-European settlement conditions. At the other end of the spectrum, if nothing is done to manage wastewater discharged directly or indirectly into the river, then it is likely that the river will die. The question that decision-makers need to address is the level of improvement in water quality that would be affordable and best meet the needs of the community. In brief, the question is: what is the community willing to pay for an improvement in water quality? This information is required by authorities throughout South East Queensland charged with improving the quality of water in the river systems.

To estimate the WTP for water quality improvements in a number of waterways in South East Queensland to assist policy formation a valuation approach is required that is economical in relation to time and funding resources. A review of *ENVALUE* [NSW EPA, 1998] to determine the availability of recent studies estimating the value of an improvement in water quality of a tidally influenced river system revealed that although a number of studies had been undertaken in the past on improved water quality, the information provided about the study sites was non specific. A description of the study site, including the specific attributes of the river and the socio-economic characteristics of the population initially surveyed was limited. For the most part, information to enable a demand function to be derived was incomplete. In addition, detailed information about the statistical analysis of the

results was general and, for the most part, the analysis was dated.

Given funding and time constraints and the relatively large number of river systems in South East Qld requiring valuation, the Coastal CRC is currently undertaking a valuation study on an improvement in water quality for the Bremer River that would be specifically designed for BT to a number of policy sites. Of particular interest to the Coastal CRC is the selection of the valuation technique and the design of the survey. A choice modelling valuation approach, which estimates a demand function for improved water quality where the variables include a range of environmental attributes such as degrees to which recreational services are likely to be available, the degree of variety in flora and fauna in the river as well as the socio-economic characteristics of the respondents, has been identified as more amenable for transfer to a policy site because there is some opportunity for modification of the site attributes and socio-economic characteristics to more accurately reflect a policy site.

One recent development in environmental valuation has been to adopt a citizens' jury approach to survey design. This approach is advocated as going somewhat towards addressing problems of information bias encountered in some valuation techniques. In particular, by subjecting respondents to intensive information provided by a number of experts working on the environmental resource in question, it would be possible to use all of the available information as well as facilitate a discursive approach to the valuation exercise. In addition, by selecting respondents as a stratified random sample of the affected population, the sample could be reduced to relatively small numbers, perhaps 20 or 30 people. This is likely to reduce the costs of a survey as well as reduce the incidence of no-responses.

The valuation technique proposed for the Coastal CRC is a citizens' jury approach to a choice modelling exercise. It is envisaged that if the choice sets were carefully prepared in cooperation with community organizations and a number of experts, then the attributes of the environmental good at the study site, for example improved water quality in the Bremer River, would be similar to the attributes at a number of policy sites elsewhere in the Moreton Bay area. The demand function resulting from the choice modelling study would be relatively easily modified to a number of policy sites within the coastal zone requiring waterway management. This approach would not only address a number

of problems encountered in the valuation technique itself, but would improve the credibility and reliability of the study for BT.

## 5. CONCLUDING COMMENTS

This paper has identified BT as an approach to valuing environmental resources that would be useful when research time and funding are constrained. The protocol for its use recommends that BT values are appropriate when the information required is in the form of an indicative value for the resource in question required for policy formation. Valuation studies that have estimated a demand function for an environmental site where the WTP for the resource is estimated to be dependent on a number of site attributes as well as the socio-economic attributes of the affected population are regarded as most appropriate for BT. These studies are expected to provide sufficient information to enable the estimated demand function for a study site to be modified to more closely reflect the site attributes and socio-economic characteristics of the population at a policy site.

A study is proposed to value an improvement in water quality for the Bremer River in South East Queensland that will be designed at the outset to be used for BT to other sites in South East Queensland. The study is to adopt a choice modelling approach that will estimate a demand function rather than a mean value for water quality improvements. In order to address some of the problems with the dissemination of information to survey respondents, the study proposes to adopt a citizens' jury approach to determining the amount citizens would be willing to pay for an improvement in water quality.

## 6. REFERENCES

Blamey, R. K., Contingent valuation and the activation of environmental norms, *Ecological Economics*, 24: 47-72, 1998.

- Blamey, R. K., R.F. James, R. Smith and S. Niemeyer, Citizens' juries and environmental value assessment, *Citizens' Juries for Environmental Management*, No. 1, ANU, Canberra, 2000.
- Brouwer, R., Environmental value transfer: state of the art and future prospects, *Ecological Economics*, 32: 137-152, 2000.
- Commission on the Third London Airport, *Papers and Proceedings Vol.III (Parts 1 and 2) - Stage III Research and Investigation - Assessment of Short-listed Sites*, HMSO, London, 1970.
- Desvousges, W.H., M.C. Naughton and G.R. Parsons, Benefit transfer: conceptual problems in estimating water quality benefits using existing studies, *Water Resources Research*, 28 (3): 675-683, 1992.
- Garrod, G and K.G. Willis, *Economic Valuation of the Environment*, Edward Elgar, Cheltenham, 1999.
- Kirchhoff, S., B. Colby and J. LaFrance,, Evaluating the performance of benefit transfer: an empirical inquiry, *Journal of Environmental Economics and Management*, 33: 75-93, 1997.
- Loomis, J.B., The evaluation of a more rigorous approach to benefit transfer: benefit function transfer, *Water Resources Research*, 28 (3): 701-705, 1992.
- Morrison, M and J. Bennett, Choice modelling, non-use values and benefit transfer, *Economic Analysis and Policy*, 30(1): 13-32, 2000.
- NSW EPA, *ENVALUE*, EPA, Chatswood, 1998.
- Statton, H., *Estuarine Ecological Processes-Bremer River Pilot Study*, Unpublished draft project report for the South East Queensland Regional Water Quality Management Strategy, CRC for Coastal Zone, Estuary and Waterway Management, 2001.