Environmental value transfer: an application for the South East Queensland waterways

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Abstract Economic valuations of the environmental resources provided by the waterways of South East Queensland are required for the evaluation of proposed environmental management strategies. Due to time and funding constraints it is unlikely that the environmental resources for each tributary of the river system will be subject to individual and explicit valuation. This paper reviews the literature about the validity of environmental benefit transfer, identifying the protocol for undertaking such a study. It then describes a study designed to transfer the estimated value of water quality improvements for the Bremer River to other waterways in South East Queensland. The study addresses some of the shortcomings of stated preference techniques to value the environment, including improving the quality of the information provided to survey respondents and the reliability of their responses by adopting a citizens’ jury approach to the valuation exercise. In addition, the study is expected to provide the results in a form that will facilitate the estimation of a demand function for water quality improvements that will be meaningful for environmental value transfer to other sites with similar water quality issues.

Keywords Benefit transfer; citizens’ jury; choice modelling; economic valuation; South East Queensland waterways

Introduction
Management of the coastal and estuary zones 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. In a situation where there are competing potential users and uses of a scarce resource, the issue of optimal allocation arises. 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. Where markets do not exist or there is a failure of the market to value environmental resources, there is a need to intervene and for techniques to be applied that effectively mimic the market by estimating a value for these resources. Resource managers are 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 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 benefits from taking action are at least equal to the 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.
Due to time and research funding constraints, it is unlikely that all resources in coastal areas, including the South East Queensland waterways, will be subject to individual and explicit valuation. It is therefore necessary to investigate the opportunities that are available for the use of environmental value transfer, more commonly referred to as benefit transfer (BT).

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). The use of survey information about people’s preferences for environmental resources provides an estimate of the price they would be willing to pay if these goods and services were sold through a competitive market. BT, because it uses existing empirical models to estimate people’s preferences for another site, can only be regarded as an approximation and studies using BT need to be aware of the reliability of previous studies and to balance the likely errors with the costs and inherent errors of a new study.

The BT approach is regarded as useful not only because surveys are expensive and because 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 should be approached with caution.

Despite the extensive discussion about the reliability of BT, it is applied routinely by environmental protection agencies (EPA), including the EPA in Queensland. BT is implicitly assumed by regulatory agencies controlling the level of waste emissions into a watercourse or into the atmosphere when the same standard for emissions, for example wastewater standards, set according to National Standards, is applied across an entire geographical area encompassing a number of environmental sites. It can be argued that authorities have assumed, rightly or wrongly, 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.

The remainder of this paper is organised to first, provide a brief summary of the established protocol for undertaking BT, particularly with respect to identification of an appropriate valuation technique. Second, it considers the role of public participation and expert opinion in valuation studies. Third, it outlines the approach adopted by the Coastal CRC for the valuation of the South East Queensland waterways with particular reference to the Bremer River as the study site. Finally, a number of concluding comments are made about the initial acceptance of BT and the citizens’ jury approach by community organizations and resource managers.

The protocol for undertaking BT

Numerous studies undertaken in recent years and dealing with the reliability of BT suggest a protocol for its use (see for example Desvousges et al. (1992); Kirchhoff et al. (1997) and Brouwer (2000). 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 or attributes; 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 are scrutable. Studies being considered for BT to a policy site should provide appropriate regression results.

In addition, to test the validity of a BT estimate, a pilot study on the policy site or inter-site studies are 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 techniques provide the most valid estimates for BT. Specifically, what properties make one valuation technique more or less amenable for valid BT? Desvousges et al. (1992) recommend that research is required to 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 before transferring the benefits to a policy site.

Valuation technique: mean willingness to pay or demand function

BT is generally approached as either direct benefit transfer (DBT) or benefit function transfer (BFT). DBT involves the transfer of mean willingness to pay (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 findings from a study by Kirchhoff 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. Kirchhoff et al. are more cautious, suggesting that the information commonly incorporated in bid functions is not necessarily sufficient for BFT. They recommend that economists undertaking BT should be attentive to 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.

Proponents of the choice modelling environmental valuation technique argue that this survey-based technique is more suited to BT than other contingent valuation studies because it provides information about consumer preferences for individual site characteristics from which a demand function can be derived and modified for policy sites. 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 the choice sets are presented as different levels of a number of attributes and where one choice set is always the “do nothing” 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. A recent study by Morrison and Bennett (2000) suggests that the estimated mean values from one site are not necessarily suitable for DBT, because the levels of attributes available at a study site might be different to those available at the policy site. 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 measured at a study site are available at a policy site.
**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’ valuations 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.

**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 costs to improve the quality of the water, including upgrading of sewerage treatment plants, improvement in the quality of wastewater discharged into the rivers by industry as well the cost of restoring or rehabilitating riparian vegetation, are generally available. Not all of these costs will be absorbed by industry or from the general revenue of local councils. The community will, either directly, through local rates, or indirectly through reduced industry activity in an area, be asked to make a financial contribution to an improvement in water quality. The question that needs to be addressed by planning authorities is the extent to which the community is 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. The same ecological attributes are required for each of these river systems to ensure healthy habitats from which ecosystems services such as recreational fishing, swimming and potable water will result. In varying degrees, all of these rivers and creeks will require management to ensure an improvement in the condition of ecological attributes and a subsequent improvement in ecosystem services.

The Bremer River has been selected as a case study for this BT exercise because it has recently been the subject of intensive scientific research by the Coastal CRC and because the local community has identified improvement in water quality as a highly desirable objective. The local Council has undertaken studies to determine the cost of sewerage upgrades and local industry has been made aware of the need to reduce effluent discharge to the river.

**Water quality of the Bremer River**

The Bremer River is a tidally influenced freshwater system that flows into the Brisbane River and then into Moreton Bay in South East Queensland. Ipswich is a major provincial...
centre for the Bremer Catchment located at ca 15 km upstream on the Bremer River. The Bremer River has been subject to a long history of chronic nutrient enrichment due to agricultural runoff and discharge from wastewater treatment plants and abattoirs located along the waterway distributed through the catchment (Chaloupka et al., 2001). A review of ABS statistics shows that the economy of the Bremer Catchment is growing, putting increasing pressure on the condition of environmental resources in the catchment. Between 1986 and 2000 the estimated resident population in the Bremer Catchment increased by approximately 16.8% to a little over 134,000 people. Between 1986 and 1996, employment in the catchment increased by 11.7% with over 17.5% of the total employment in the catchment in 1996 located in manufacturing industries. These industries are dominated by a number of abattoirs that discharge effluent into the Bremer River.

The water quality of the Bremer River is monitored each month by the Queensland Environment Protection Agency. Recent statistical analyses of these data (Chaloupka et al., 2001) have shown that there are serious declines in Bremer River ecosystem health indicated by a decline in dissolved oxygen during the 1990s (Figure 1) and the increased turbidity since the mid-1990s following an anomalous series of droughts (Figure 1). Chlorophyll “a”, which is a simple measure of algal biomass in the river water, increased during the early 1990s (Figure 1) because of the decreased turbidity, which itself was a function of reduced stream flow because of the droughts and also because of the high nutrient availability caused by waste discharges to the river. Clearly, water quality in the Bremer River is declining and so too are the recreational opportunities of the local community that depend on a clean and safe waterway.

The estimated cost of returning the Bremer River, particularly the reach within the Ipswich precinct, to a pristine condition would be prohibitively expensive and achievable only if existing land use in the river catchment was returned to pre-European settlement conditions. Discussions with people who lived in the Bremer area in the 1950s (Nix, pers. com, 2001) suggest that the condition of the aquatic habitat at that time was markedly better than in 2001. A recent study on water quality in the Bremer River (Stratton, 2001) indicates

![Figure 1](https://iwaponline.com/wst/article-pdf/45/11/91/424706/91.pdf)

**Figure 1** Long term deseasonalised trends in monthly estimates of key water quality parameters in the Bremer River near Ipswich (1993–2000). Solid curve in each panel derived from a robust nonparametric regression time series decomposition procedure known as STL. Top panel shows trend in dissolved oxygen in the river. Middle panel shows trend in river turbidity or water clarity. Bottom panel shows trend in chlorophyll “a” in the river — chlorophyll “a” is a proxy measure of algal biomass. Source: Chaloupka et al., 2001.
that the water quality has deteriorated from an autotrophic condition (where the production of oxygen within the system meets the demand), to a heterotrophic system where the consumption of oxygen in the system is greater than production and has resulted in a loss of ecosystem services. If nothing is done to manage runoff or wastewater discharged directly or indirectly into the river, the “do nothing” scenario, then it is likely that the river will continue to deteriorate and become increasingly heterotrophic. 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 and the subsequent ecosystem services an improvement will provide? This information is required by authorities throughout South East Queensland charged with improving the quality of water in the river systems.

An important consideration for identifying suitable study sites for the Bremer River, is that the number of substitutes for services frequently identified as valuable to communities, including fishing, swimming and bird life, are numerous. For the most part, the availability of substitutes for swimming or fishing in the Bremer has reduced the meaningfulness of these as attributes achievable with an improvement in water quality.

**Technique to value water quality improvements in the Bremer**

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 that might be suitable for BT revealed that, although a number of studies had been undertaken in the past on improved water quality, the information provided about study sites was non-specific. A description of the study sites, 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 Queensland requiring valuation, a valuation of water quality improvements in the Bremer River is expected to provide information for BT to other sites. Of particular interest to the Coastal CRC are the selection of the valuation technique and the design of the survey. A choice modelling valuation technique, which estimates a demand function for improved water quality where the variables include a range of scientifically valid indicators or attributes of habitat condition together with the socio-economic characteristics of the respondents, has been adopted. The use of scientific indicators as measures of a healthy ecosystem for construction of the choice sets has been identified as conceptually more rigorous than more standard indicators such as degrees of availability of fishing or swimming in the river and more useful for transfer to a policy site. The transfer of study site attributes to a policy site is expected to be facilitated through modification of the estimated demand function of the study site attributes 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 someway 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 modelling and monitoring the condition of the Bremer River, it would be possible to use all of the available information as well as facilitate a discursive approach to the valuation exercise. By providing an opportunity for respondents to gain knowledge about the issues associated with water quality improvements in the Bremer, rather than simply being made aware, which is often the objective of survey-based valuation techniques, the outcome is expected...
Designing the choice experiment

Respondents to a choice modelling survey are typically presented with several choice sets each containing a “do nothing” option and a number of alternatives (see Table 1). Respondents are required to indicate the alternative within each choice set they prefer. Each alternative within a choice set is presented as a series of levels of specific attributes, where one attribute is the cost of implementation to the householder. The levels of the attributes describing the alternatives are varied according to an experimental design that permits estimates of the relative importance of each attribute describing the alternatives to be calculated.

Prior to holding a citizens’ jury, the choice experiments or sets for modelling the value of the proposed changes in site attributes need to be identified. Focus groups or community discussion groups are recognised as a vital part of the determination of the attributes that should be included in the choice sets as well as to trial the survey design. For this study, the opinion of the community as well as scientific experts has been sought. Community consultation has identified the ecosystem services the community would like to see improved. These ecosystem services would result from an improved freshwater aquatic ecosystem habitat.

Scientific experts have identified the attributes of a healthy freshwater ecosystem habitat to include an abundance of submerged aquatic vegetation (SAV) comprised of macrophytes (aquatic plants), an abundance of emergent aquatic vegetation (EAV) comprised of grasses, sedges and reeds, as well as riparian vegetation, sandy beaches and clear water. The advantage of adopting bundles of these attributes of a healthy aquatic ecosystem for the choice sets representing different management options or regimes is that these attributes are readily identifiable and transferable to other sites. This is particularly important as the context for the Bremer study is to be able to use the information for the valuation of other sites. Standard attributes such as swimability or recreational fishing are not meaningful for many of the freshwater rivers in South East Queensland because there are so many close substitutes available to households.

It would be a gross oversight if levels of improvement in site attributes were presented to respondents as attainable options and then to discover that such improvements were unattainable, unrealistically priced or unattainable within one or two decades. To put forward the ability to swim or the return of native fish available for recreational fishing in the Bremer as attributes of improved water quality would be misleading. An improved aquatic ecosystem habitat would no doubt lead to the availability of swimming or recreational

Table 1 An example of a choice set presented to respondents. A respondent would typically be presented with 3 to 6 sets and would be required to rank the options within each set

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Option 1 (current situation)</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in area of wetland</td>
<td>none</td>
<td>5,000 ha</td>
<td>1,000 ha</td>
</tr>
<tr>
<td>Increase in number of native fish species</td>
<td>– 10%</td>
<td>25%</td>
<td>10%</td>
</tr>
<tr>
<td>Increase in number of water birds</td>
<td>none</td>
<td>35%</td>
<td>20%</td>
</tr>
<tr>
<td>Increase in riparian vegetation</td>
<td>1,000 ha</td>
<td>1,000 ha</td>
<td>200 ha</td>
</tr>
<tr>
<td>Increase in land rates</td>
<td>None</td>
<td>20%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Please tick the box under the option you prefer □ □ □
fishing of native fish species but only at a time in the future that would be outside the scope of most economic valuation exercises. Because respondents will be informed about the indicators of a healthy aquatic habitat and subsequent improvements in ecosystem services in a discursive setting, it is expected that it will be possible to introduce a more scientific basis to the attributes provided in the choice sets that will be more meaningful than standard attributes.

**Concluding comments**

There is a need to establish at the outset of any study designed to estimate a value for environmental resources, that a value estimated for a good or service outside of a freely operating market will, at best, only be an estimate and BT, because it modifies estimates from previous studies, can only be regarded as an approximation or as an order of magnitude. 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. It is not recommended when more precise values are required, as might be the case for determining compensation payments. 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 currently underway to value an improvement in water quality for the Bremer River in South East Queensland that has been designed at the outset to be used for BT to other sites in South East Queensland. The study has adopted a choice modelling approach that estimates 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 has adopted a citizens’ jury approach to determining the amount citizens would be willing to pay for an improvement in water quality. One important aspect of the Bremer study is the adoption of scientifically valid and meaningful attributes of improvements in freshwater aquatic ecosystem habitat to represent different management options presented in the choice sets.

**References**


