Chapter 8
Applying Benefit Transfer with Limited Data: Unit Value Transfers in Practice

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Abstract Unit value or point value transfers from individual source studies remain the oldest and most common form of benefit transfer. Although practitioners generally recommend benefit function transfers, these are not always possible. Where unit value transfers are to be performed, appropriate protocols must be followed to select source studies, transfer values, and perform necessary value adjustments. This chapter demonstrates the processes and challenges involved in the implementation of unit value transfers, using case studies of environmental values in a peri-urban community on the east coast of Australia where key ecosystems ranged from coastal beaches to inland forests. Key issues in evaluating the potential for benefit transfer included the availability and quality of source studies, the extent of overlap between source studies and the target site, the need for different forms of adjustment to account for variations in scope and scale, and the limitations to unit value transfers.

Keywords Benefit transfer · Unit values · Value adjustment · Australia · Peri-urban

8.1 Introduction

There is a growing demand for environmental valuations to support cost-benefit assessments and improve environmental policy and management decisions. In many situations (e.g., cases in which no primary valuations have been conducted

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and resources are restricted), it is necessary to use research results from pre-existing primary studies at one or more sites or policy contexts (often called study sites) to predict welfare estimates or related information at target policy sites; this process is known as benefit transfer (Brouwer 2000; Johnston and Rosenberger 2010; Navrud and Ready 2007; Rolfe and Bennett 2006).

Benefit transfer methods are generally classified into two primary categories: unit value transfers and benefit function transfers (Johnston and Rosenberger 2010; Navrud and Ready 2007; Rolfe 2006). A unit value transfer involves the transfer of a single value estimate or set of value estimates from source studies as point source estimates, while a benefit function transfer involves the transfer of a parameterized benefit function. This function is combined with at least some information (on independent variables) drawn from the policy site to generate an adjusted welfare estimate for that site. One key difference between these two approaches is that unit values from source studies are typically transferred with limited or no adjustments. Adjustments, where they occur, are generally performed ex post and ad hoc. In contrast, adjustments within benefit function transfers are primarily based on the underlying function(s) estimated at the study site, combined with information on independent variables observed at the policy site. As such, adjustments within benefit function transfer may be viewed as a natural extension of the originally estimated function, albeit at a new site. Another difference is that unit value transfers are often transferred from single source studies,[1] while benefit function transfers can be generated from single source studies or a meta-analysis that synthesizes information from a number of source studies.

Many authors have recommended the transfer of benefit functions because these allow for adjustments to be made according to a variety of factors that can influence values, including site and population differences (Johnston and Rosenberger 2010; Morrison and Bergland 2006; Rolfe 2006; Rosenberger and Stanley 2006). Yet despite the limitations of unit value transfer, it is still commonly applied (see Chaps. 3–6). Unit value transfers are simple to use, are often the only approach available when source studies are limited or when benefit functions are not reported, and can provide relatively accurate results under certain conditions (Bateman et al. 2011; Colombo and Hanley 2008). Moreover, although the literature suggests that function transfers generally outperform unit value transfers (e.g. Kaul et al. 2013), the evidence on this issue is somewhat mixed (Colombo and Hanley 2008; Johnston and Rosenberger 2010). Bateman et al. (2011), for example, suggest that unit value transfers may be more appropriate and generate lower transfer errors where source and target sites are similar, but that benefit function transfers will outperform unit value transfers as differences across sites increase.[2] In addition, the concepts and

[1]Although sometimes values from several source studies are assessed before choosing a single unit value for transfer. Unit value transfers may also transfer a mean or median value from prior studies.

[2]They note that value functions explicitly incorporate differences between sites and hence are appropriate where differences between source and target sites are involved, but may be over-parameterized when limited differences between sites exist.

applications within unit value transfers are often easier to communicate (due to the simplicity of the methods), and hence the results may be more acceptable to policy makers.

At the same time, the apparent simplicity of unit value transfer masks a number of issues that can lead to unacceptably large transfer errors. For example, the accuracy of point source estimates that are transferred with unit values are very dependent on the quality of the source study, the extent of alignment between source and target sites, and the appropriateness of any ex post adjustments to unit values that are made. The selection of source studies, the performance of the benefit transfer and any adjustment to values all require expert judgment, as variations in any step of the process can lead to large differences in prediction. The experience and skills of the analyst can also be critical, in part because the process remains a combination of art and science. Not all unit value transfers are conducted accurately or appropriately, and a major concern is that the individual judgments involved in the process make it difficult for outside analysts to assess the quality of transfers.

The key challenge in any benefit transfer exercise, including unit value transfers, is to avoid errors that lead to improper inferences regarding welfare effects and misguided policy. These would include errors transferred from the original primary studies (*measurement errors*) and errors generated by the transfer process itself (*generalization errors*). Compared to other types of transfer, unit value transfers often face greater challenges related to both types of error. The standard reliance on individual source studies for point source estimates potentially magnifies risks related to the possible selection of a single inaccurate or inappropriate source study for transfer, thereby increasing the risk of measurement errors. In addition, the lack of a benefit function to support value adjustments can lead to greater generalization errors, particularly when the policy and study sites are not closely matched. These challenges imply that an analyst applying unit value transfers must give particular attention to the quality and appropriateness of source studies and to the similarity between study and policy sites (or valuation contexts).

This chapter reviews and illustrates the basic steps and protocols involved in unit value transfers. The goal is to provide clear methodological guidance and illustrations for this type of transfer when more sophisticated types of transfer are infeasible or otherwise considered inappropriate. We give particular attention to the decisions and assumptions involved in selecting primary studies and values that best match policy sites and needs. Steps and protocols are illustrated using a case study addressing ecosystem changes in a peri-urban community on the eastern seaboard of Australia. The chapter begins with a review of methodology for unit value transfers. This is followed by the case study application, illustrating the practical steps involved and discussing some of the caveats and concerns that must be considered when conducting unit value transfers.

8.2 Methodology for Unit Value Transfers

Unit value estimates can be transferred from a single study or multiple studies, and either transferred directly or adjusted in some way to account for variations between the source and target sites and contexts. The value of changes in an environmental asset may be influenced by factors such as the change in provision (i.e., the extent of quantity or quality change), characteristics of the site (including special features), the availability of substitutes and the characteristics of the population (Bateman et al. 2011). Care must be taken to assure that the economic framework is appropriate and that the concepts being measured are consistent between source and target applications (e.g., that willingness to pay (WTP) measures are not being used to predict willingness to accept (WTA) values).

A number of different steps are involved in conducting a benefit transfer (see Chap. 2). These can be grouped into three broad stages (Table 8.1). The first step is to establish the context and framework for a benefit transfer exercise. The second is to identify and evaluate the source studies that are available and to select the benefit transfer approach to be used. The third is performing the benefit transfer. This final

Table 8.1 The key tasks and objectives to conduct a benefit transfer

Task	Objective
Stage 1: establishing the context and framework	
1. Define the benefit transfer context	Scope the valuation and policy context
2. Establish the need for benefit transfer	Evaluate whether benefit transfer is preferred over a primary study
3. Define the policy, good and population	Establish the characteristics of the "target" study
4. Define and quantify policy options and changes in goods	Quantify the marginal changes to be valued
Stage 2: selecting source studies and transfer methods	
5. Gather and evaluate valuation data and evidence	Identify, screen and evaluate source studies, and any additional data requirements
6. Determine benefit transfer methods	Select appropriate method(s), given the policy site characteristics and availability of source studies
Stage 3: performing the benefit transfers	
7. Design and implement transfers	Select source studies to be used, perform benefit transfer and adjust value estimates where necessary and appropriate
8. Aggregate values over populations, area and time	Extrapolate values from unit or benefit function transfers to the population, area and time frame relevant to the target study
9. Conduct sensitivity analysis and test reliability	Test sensitivity of transfer estimates to changes in assumptions and treatment of the data; identify limiting factors
10. Report results	Detail the procedures, data and testing involved

step includes implementing adjustments and extrapolation of values as appropriate, along with appropriate sensitivity testing and reporting.

8.2.1 Stage 1: Establishing the Context and Framework for a Benefit Transfer Exercise

The key steps here are largely uniform across both unit value and benefit function approaches. However, information from step 1 (the benefit transfer context) can identify key factors that influence the choice of unit value versus benefit function transfer. As discussed in Chap. 2, the context in which the information will be used, the level of accuracy that is needed, and the limitations over time and resources are important guides to the selection of the benefit transfer method. Unit value transfers tend to be more appropriate for applications in which the pragmatic need for welfare estimates outweigh the need for accuracy, and in which available time and resources are limited (Brookshire and Neill 1992).

8.2.2 Stage 2: Selecting Source Studies and Transfer Methods

The initial focus of the second stage is to identify and evaluate the availability and quality of potential source studies and other relevant information. The type of material available will determine whether it is possible to conduct a benefit transfer, and if so, the type of transfer that might be applied. It is recommended that some protocol be applied to restrict the extent of the initial literature search and to ensure some form of quality control on the selected studies (Johnston and Rosenberger 2010; Smith and Pattanayak 2002).

In situations with limited data sources, there is less opportunity to identify source studies that closely match the target site (site similarity). Consequently, a key issue is to identify limitations in source data that can be remediated during the transfer process, as well as limitations that make benefit transfer unsuitable. In some cases, ex post adjustments can be applied to the transferred values (e.g. to account for site differences), while in other cases, there may be underlying disparities in values for the amenity that cannot be remediated or adjusted in some way. However, in some situations an admittedly imprecise value might be satisfactory (or better than no value at all)—for example when the primary goal of valuation is environmental advocacy rather than policy analysis (Kline and Mazzotta 2012). In such cases it is important to clearly identify and outline the limitations of the transferred value estimate.

When evaluating unit values in this way, analysts must consider both the representativeness and quality of source studies. *Representativeness* relates to the similarity of the source and target case studies. It is largely focused on site similarity (including populations), although methodological differences may also be important. The analyst must identify source studies that correspond to the target site across all relevant dimensions, as well as evaluate the extent of divergence. One way of judging representativeness is to consider the extent to which the definition of the good and the context in which it is valued can be transferred accurately with or without adjustments to the resulting unit values. A related consideration is the availability of information required to inform any related value adjustments. If the definition and/or contexts differ to the extent that accurate transfers are unlikely regardless of any possible adjustments, then the transfer fails the representativeness criteria. For example, if the underlying commodity valued by potential source studies does not correspond closely to that for which values are required at the target (or policy) site, then available studies are not sufficiently representative.[3]

It is also important that source studies are of appropriate *quality*, otherwise measurement errors from the source study can be transferred to the target site. Relevant dimensions of primary study quality include both accuracy and robustness. These are influenced by the appropriateness of the methodology used to generate value estimates. It is often difficult to identify the quality of source studies; Bateman et al. (2011), Nelson and Kennedy (2009), and Rosenberger and Johnston (2009) note this in relation to meta-analysis, but similar issues are relevant to all benefit transfer techniques. Although the analyst can make a case-by-case evaluation of potential source studies for unit value transfers, many issues of incomplete information about studies often remain.

The second key aim of stage 2 involves identifying whether a unit value transfer or a benefit function transfer is to be performed. In most cases the choice is determined by the availability and suitability of source studies as discussed above. Also relevant to this decision are the time and resources available, the precision of estimates that are required and the level of expertise available (Johnston and Rosenberger 2010; also see Chap. 2).

8.2.3 Stage 3: Performing the Benefit Transfers

The third stage involves implementing the benefit transfer. While most unit value transfers involve point estimates from single studies, transfers are sometimes made from multiple source studies. Typical approaches include the transfer of a weighted or unweighted mean of welfare estimates provided by the set of available studies. In other cases the protocols outlined in stage 2 are used to select a preferred study from available options to implement the transfer.

As described above, the implementation of unit value transfers often includes ex post adjustments to the source data with the aim of improving the accuracy of the

[3]See discussions of commodity consistency in Johnston and Rosenberger (2010).

benefit transfer, and to meet with the requirements of value aggregation in transfer step 8 (Table 8.1). Most unit value transfers involve some relatively standard adjustments. For example, source study welfare estimates are generally adjusted to current prices. Household or individual values from the source study might also be extrapolated to the total population at the target site. The extent of the population expected to hold values for a given environmental change will depend on the relative importance of the environmental asset, the distance between the asset and the relevant population, and the proportion of the population likely to have values for the asset in question.[4] These values will also frequently decline with distance (distance decay)—a pattern that is often difficult to accommodate within unit value transfers (Bateman et al. 2006). In practice, unit value transfers typically require subjective decisions about (a) the extent of the relevant population; (b) the proportion of the population that is deemed to hold similar values as that of the population sample; and (c) any adjustments to account for variations in the values held by the population of interest (for example, decays in values with increasing distance of the population from the asset of interest).

With a few exceptions (e.g., adjustments to account for changes in currency value over time), these and other adjustments for unit value transfers, such as those used to account for variations in site or population characteristics between source and target situations, typically occur on an ad hoc basis. The rationale and performance of these adjustments should be detailed in step 10 (reporting), and may also be tested in step 9 (sensitivity testing).

8.3 Case Study Details and Application of Benefit Transfer

This section presents a practical example of a unit value benefit transfer. To illustrate the process (see Table 8.1), we use a case study application to a peri-urban community on the east coast of Australia, where the local government wanted to assess the value of key ecosystems that ranged from coastal beaches to inland forests. This exemplifies a typical situation in which unit value transfers are put to use. Specifically, an initial literature review failed to identify any suitable source studies for combined ecosystem values in peri-urban communities that would allow a benefit transfer function to be applied. Thus options were limited for benefit transfer to a series of unit value transfers for each ecosystem of interest.

[4]This is related to the concept of the economic jurisdiction, or the size of the population that holds value for a given environmental change (Loomis 2000).

8.3.1 Establishing the Context and Framework

The protection of local natural assets in peri-urban communities is a major issue in Australia, as the majority of the population lives on the coast and rapid population growth generates resource tradeoffs and pressure on natural resources (DSEWPC 2011). Nonmarket value estimates are needed to evaluate the tradeoffs involved in cases where increased housing, infrastructure, industry and services generate environmental losses (e.g., vegetation clearing) at the same time that communities desire improved environmental protection and attractive natural amenities. However, as limited financial resources typically restrict the ability of government agencies and other groups to requisition primary valuation studies, benefit transfer must often be used to provide needed value estimates. In this study, details of the target site were generalized to represent a wide range of coastal areas, so that the benefit transfers could potentially be used in different coastal regions in Australia.

The target site for the illustrative case study was a town in a peri-urban environment (i.e., not a major urban city) that included urban residential and rural residential areas. The local council jurisdiction covered an area of between 500 and 800 km^2. At the time of the study the rural residential areas were surrounded by native vegetation, while smaller vegetation patches still existed in urban residential areas. The study area also included some wetland areas. There were several waterways in the catchment but no large rivers (river order four). Only river orders 2 and 3 were considered (not the smallest streams—river order 1). See Fig. 8.1 for an illustrative example of the four river order classifications.

The town had an expanding population of approximately 100,000. The main pressure on the environmental assets came from population growth and increased human activity. There was growing demand for new land to be released for housing

Fig. 8.1 Illustrative example of the four river order classifications

Table 8.2 Source study site selection: desirable and undesirable characteristics

Key criteria	Characteristic	Desirable	Less desirable
Scope similarity	Physical characteristics	Peri-urban contexts	Rural, urban iconic/famous sites
Measurement similarity	Quantitative/qualitative changes	Loss in area/length/extent/quality	Gain in area/length/extent/quality
Framing similarity	Type of policy changes	Urban development (population pressures)	Rural development (agricultural development)
	Types of impact (attributes in the valuation)	General descriptions for remnant vegetation, wetlands, waterways	Specific or specialized ecosystem types
Scale similarity	Site size/valuation range	Similar to target	Much larger or smaller than target
Population similarity	Population sample	Local	External

Note The relative importance of the different criteria will be case study-specific; expert opinion is often required to identify the significance of variations

development (causing remnant native vegetation to be cleared), and more people were accessing natural areas to detrimental effects (i.e., rubbish dumping, trail bike-riding). This meant that a comprehensive valuation of environmental changes would need to account for both quantitative changes (loss in area) as well as qualitative changes (both loss and improvement in condition). The following environment assets were included in the valuation:

- *Remnant native vegetation*: Up to 50,000 ha with condition ranging from good in some areas to degraded and fragmented in other areas.
- *Wetlands*: Up to 5000 ha with condition ranging from good in some areas to degraded and fragmented in others.
- *Waterways*: Up to 1000 km of waterways (limited use for recreation)
- *Beaches*: Up to 50 km of beaches used for recreation

The key selection criteria to assess the contexts (or study sites) addressed by source studies for site similarity are outlined in Table 8.2.

8.3.2 Selecting Source Studies and Transfer Methods

Two threshold criteria were specified to establish a literature search protocol and to maintain a degree of quality control. These criteria are designed to minimize concerns about transferability over space and time; valuation studies conducted overseas and any Australian studies that were more than 15 years old were excluded. International studies were excluded because of potential differences among populations (e.g., income, exchange rates, attitudes, knowledge, culture) and sites (e.g., potential differences in priorities for conservation). The time limit on studies was imposed for a several reasons: the accuracy of valuation studies has improved over the past 30 years; people's preferences may have changed over a 15-year period; population dynamics may mean source communities are more likely to have changed over longer time periods; and missing data on population characteristics make it difficult to perform adjustments (cf. Rosenberger and Johnston 2009).

Relatively few source studies were identified in the initial literature search. Studies were mainly sourced from the peer-reviewed published literature, with studies in publically available reports also considered. Where results appeared in multiple outlets, the results of only a single publication were considered, preferably from a peer-reviewed journal article.

Potential source studies were then evaluated for relevance using the key factors identified in Table 8.2. There is no inherent ordering or priority of issues, so both the issues and their relative importance had to be determined and evaluated on a case-by-case basis. In this case, the key issues related to factors expected to generate significant differences in welfare estimates, based on theory and prior evidence in the literature. The issues identified in Table 8.2 are relatively simplistic, but as is shown in the subsequent analysis, the small sample of available source studies in Australia meant that even these limited criteria narrowed the choices of studies available for unit value transfers.

The selection of benefit transfer studies and unit values for each environmental asset is outlined below. In the interests of brevity, full case study information is provided for the remnant vegetation asset and summary details for the remaining assets.

8.3.2.1 Remnant Vegetation (Up to 50,000 ha)

Although several potential source studies were identified, none closely matched the conditions of the target site, raising the potential for generalization errors. There was only one source study for which the amount of the asset involved (henceforth referred to as scale) and the general valuation context matched the target site.

Mallawaarachchi et al. (2006) valued vegetation change in a peri-urban area under pressure from population growth and new housing development. However, the native vegetation attribute in this study was not well-suited to transfer in the present case, as it related only to rare or unique vegetation, there was no payment period specified for the annual payments, and the study was conducted in 1999. As a result, this study was considered unsuitable for benefit transfer in this case. Another study by Concu (2007) was deemed potentially suitable for transfer, as the site was in an urban area (Perth), and one of the valuation attributes related to public access to bush land. However, after further review this study was disqualified, as the public access attribute was not significant in the data analysis and no time-frame details were reported for the cost attribute (an annual payment). Other studies were considered, but were excluded if only specific vegetation types (e.g., river red gums) or land types (e.g., riparian vegetation) were used, as these were unlikely to be representative.

After discarding Concu (2007) and Mallawaarachchi et al. (2006) as potential sources for the transfer, seven source (choice modeling) studies involving 10 value estimates were given further consideration. Value estimates from these studies were converted into 2012 values (AUD) and to lump sum [present] values if annual payments were used (Table 8.3).[5] Present value estimates ranged from $0.06/ha to $4.79/ha, using a 15 % discount rate to reflect the relatively high social discount rate that has been found in valuation studies (e.g. Kovacs and Larson 2008). Given this range in the value estimate, the challenge was to select the study/studies that best matched the target site.

Comparisons between the target site and the source studies revealed that none of the latter focused entirely on native vegetation, with only one relevant attribute in each study that would be suitable for transfer. None of these studies matched the scope of the target site, as all related to large rural areas. Neither did any match the context of the target site (pressure from urban development), as the source studies were focused on tradeoffs between agricultural development and environmental protection (studies RV1-RV6) or tradeoffs around wetland management (study RV7). In addition, the target site involved very fragmented vegetation communities, including small patches in urban settings that were not replicated in the source studies. All of these reflect differences relevant to generalization errors in unit value transfers.

There were also differences in the quantities involved. Based on theory and empirical evidence, economists generally expect that the larger the scale or size of the valued asset (i.e., the good or service being valued), the lower will be the expected value for marginal changes, all else held constant. Corresponding to this general intuition, the present values per household, for a marginal improvement of 1000 ha of remnant vegetation (in good condition) were the lowest for the Fitzroy Basin in Queensland (studies RV2-RV5), the largest area under valuation. The relatively low value in the South Australian study (study RV7), given the smaller scale involved, was possibly because it was primarily focused on wetlands, which may have diminished the relative importance of other remnant vegetation. The influence of scale on valuation estimates was most clearly represented in the New South Wales study (study RV1). The area of the 10 % case study most closely aligns with the target site (i.e., 50,000 ha of remnant vegetation). This is the only value ($4.79/household/1000 ha) identified that would be suitable for benefit transfer in terms of scale, although the study does not meet other desirable conditions for transfer.

A further challenge was to adapt transferred unit values to represent marginal changes in quantity and quality dimensions. The target site involved both losses in the area of vegetation as well as declines in the amount of vegetation in good condition. In contrast, the source studies all described the relevant attribute in terms

[5]Note: in this chapter all dollar values refer to Australian dollars.

Table 8.3 Source Study details for remnant vegetation (target: up to 50,000 ha)

#	Source	Site/year	Attributes in CM valuation[a]	Current size at time of valuation (*1000 ha)	Size range under valuation (*1000 ha)	Sample	Value in 2012 $[b]	Present value
RV1	Mazur and Bennett (2009)	Namoi catchment NSW 2008	• **Native vegetation in good condition** • Native species • Healthy waterways • People working in agriculture	1. 10 %: 18 2. 50 %: 90 3. 100 %; 180	1. 10 % = 18–60 2. 50 % = 90–300 3. 100 % = 180–600	Local External Local	1. $1.43 2. $0.66 3. $0.11	1. $4.79 2. $2.21 3. $0.37
RV2	Rolfe et al. (2002)	Fitzroy River Basin Qld 2000	• **Healthy remnant vegetation** • Healthy waterways • People leaving country areas • Amount of water left unallocated	>50 % of area cleared (total area = 142,000 km^2)	20–50 % (2800–7000)	Local	$0.01	$0.06
RV3	Rolfe and Windle (2003)	Fitzroy River Basin Qld 2001	• **Healthy remnant vegetation** • Healthy waterways • Protection of Aboriginal cultural sites • Unallocated water	>50 % of area cleared (total area = 142,000 km^2)	20–50 % (2800–7000)	Local	$0.02	$0.14
RV4	Rolfe and Bennett (2009)	Fitzroy River Basin Qld 2002	• **Healthy remnant vegetation** • Healthy waterways • People leaving country areas • Amount of water left in reserve	>50 % of area cleared (total area = 142,000 km^2)	20–30 % (2800–4200)	External	$0.03	$0.17

(continued)

Table 8.3 (continued)

#	Source	Site/year	Attributes in CM valuation[a]	Current size at time of valuation (*1000 ha)	Size range under valuation (*1000 ha)	Sample	Value in 2012 $[b]	Present value
RV5	Windle and Rolfe (2005)	Fitzroy River Basin Qld 2003	• **Healthy remnant vegetation** • Healthy waterways • Protection of Aboriginal cultural sites • River estuary in good health	>50 % of area cleared (total area = 142,000 km^2)	20–50 % (2800–7000)	External	$0.03	$0.20
RV6	Rolfe and Windle (2008)	1. S.E Qld 2. Cent Coast Qld 2005	• **Healthy remnant vegetation** • Soils in good condition • Healthy waterways	1. 45 % = 1035 2. 65 % = 585	1 = 25–40 % (575–920) 2 = 45–65 % (405–585)	Local Local	1. $0.16 2. $0.33	1. $0.93 2. $1.92
RV7	Whitten and Bennett (2006)	Upper SE, SA 2001	• **Healthy remnant vegetation** • Healthy wetlands • Threatened species that benefit • Ducks hunted	Not reported	50–100	Local and external	$1.25	$1.25

[a]Attributes in bold are those given further consideration for benefit transfer
[b]Willingness to pay per household for a marginal change of 1000 ha

of changes in the area in good condition, without distinguishing between quantity and quality changes. This limited the potential for benefit transfer values to be tailored to different scenarios for vegetation protection, including the potential for improvements to vegetation condition.

All the potential source studies identified for remnant vegetation were from choice modelling experiments[6] used to estimate WTP for increased protection, which meant that there were no important methodological variations to consider. Not all source studies provided a local population sample (Table 8.3), which was required at the target site. However, these differences were not considered as important as those outlined above, because some of the studies reported no significant difference in the value estimates between local and non-local samples.

In summary, after the initial review, none of the source studies was considered suitable for direct unit value transfer. Reasons included:

- *Scope differences*: All source studies were set in a rural context, rather than a peri-urban setting. It is not currently known how these differences affect value estimates for either quantitative or qualitative changes;
- *Measurement differences*: All source studies referred to vegetation in good condition, which limited their potential application;
- *Framing differences*: No source studies were framed in the context of increased population pressure;
- *Scale differences*: Only one study matched the scale of the target site (study RV.1), but adjustments could be applied; and
- *Population differences*: Not all studies assessed values from a local population.

In this case, value adjustments could potentially be used to accommodate some but not all differences between the source study and a target application. For example, adjustments for scale differences could be estimated from the split-sample experiments in study RV1 (as reported in Rolfe et al. (2013), while one could follow methods of Morrison et al. (2002) and Morrison and Bennett (2004) to adjust for differences between the values of local and non-local populations. However, no information was available to allow adjustments for scope, measurement and framing differences. Given these limitations, the recommendation was to not continue with a benefit transfer for remnant vegetation.

8.3.2.2 Wetlands (Up to 5000 ha)

Seven potential source studies were identified for wetlands, but two were removed due to attribute misspecification.[7] Of the remaining five studies (Table 8.4), two

[6]Choice modelling is a stated preference technique capable of estimating both use and nonuse values (Bateman et al. 2002; Rolfe and Bennett 2006).

[7]Both Mallawaarachchi et al. (2001) and Morrison and Bennett (2004) included a wetlands attribute in their choice modelling studies, but in both cases riparian vegetation was also included in the description, making it unsuitable to transfer to the target site.

used measurement units that did not relate to any specified ecological quality (studies WL1 and WL2). Only Study WL1 related to a loss in area, although the study did not match the scope or policy frame of the target site. None of the remaining studies was considered suitable for benefit transfer. The main issues of concern (summarized in Table 8.4) matched those outlined for the remnant vegetation asset.

8.3.2.3 Waterways (Up to 1000 km: River Orders 2 and 3)

Ten potential source studies were identified for waterways. Since many studies overlapped with those identified for other environmental assets as described above, the key issues and lack of suitability remained the same (Table 8.5). In this case, the river order (the main river versus smaller tributaries) added another level of complexity to the issue of site similarity. The large, catchment-scale source studies referred to the length of rivers and did not distinguish among river orders. There was an implicit assumption that details of river length referred to large (main) rivers (river order 4 and possibly river order 3) and not to smaller tributaries (river order 2). In contrast, although there were several hundred kilometers of waterways at the target site, they were all small rivers with limited options for recreation.

Nine choice modeling studies were identified as potential sources (Table 8.5). The first three studies were rejected because the key attribute did not align well with the target study. These are included in Table 8.5 to illustrate the scope differences in terms of river order. An additional meta-analysis (WW10) was also identified and included for comparative purposes.

The scale of the target site was within the valuation range of two source studies (WW8 and WW9), although the total size of the environmental asset at both sites was much larger than the target. The southeast Queensland site (study WW9) was in a peri-urban area and more closely matched the scope of the target. However, in both studies the associated attribute related only to waterways in good condition, which limited the potential extent of application at the target site. The present value for a 1 km improvement (of waterways in good condition) was estimated at $1.07 per household for study WW8 and at $1.21 for study WW9.[8] These values can be compared to an estimate generated from the meta-analysis function (study WW10), where allowing for 800 km of waterways generates value predictions of $1.24/km.

There were two limitations to consider, however. First, the source studies involved higher order (larger) rivers than the rivers in the target area, creating the potential for amenity mis-specification (or lack of commodity consistency) in the benefit transfer. Unfortunately there is no evidence in the current literature to help understand how values might vary between larger and smaller rivers. The second

[8]The higher value for study WW9 might be a reflection of the peri-urban context and/or higher values to avoid a loss than for a gain.

Table 8.4 Source study review for wetlands (target: up to 5000 ha)

ID	Source	Year	Valuation/ policy scenario	Method	Comment
WL1	Hatton MacDonald and Morrison (2010)	2003	Land use/ agricultural development	CM	**Scope and framing**: rural valuation context
					Measurement: *loss* in area—no specific quality
					Scale differences: 73,000–99,000 ha
WL2	Morrison et al. (2002)	1997	Water management for wetlands	CM	**Scope and framing**: rural valuation context
					Measurement: *increase* in area—no specific quality
					Scale differences: site 1 = 1000 km^2; site 2 = 400 km^2
WL3	Rolfe and Dyack (2010)	2006	Recreational use of iconic wetlands	TCM + CVM	**Scope and population differences**: iconic wetland site. External (visitors) sample rather than local sample
WL4	Tapsuwan et al. (2009)	2005/ 2006	Value of urban wetlands/ lakes	HP	**Scope and framing**: urban (capital city) valuation context
					Transfer challenges: additional data requirements from target site
WL5	Whitten and Bennett (2006)	2001	Wetland management	CM	**Scope, framing and population issues**: unsuitable valuation context; external sample
					Measurement: related only to area in good condition

CM choice modelling; *TCM* travel cost method; *CVM* contingent valuation method; *HP* hedonic pricing

limitation was that the values did not allow for differentiation between gains and losses or between varying changes in quality.

8.3.2.4 Beaches (Up to 50 km)

Beaches were assessed in terms of the transferability of recreational values. Only three source studies were identified that estimated beach recreation values, with one (B2) providing a value considered suitable for transfer (Table 8.6). This study was broad-scale, encompassing major regional urban centers as well as smaller population centers in regional areas of Queensland. There was no underlying reason to

Table 8.5 Source study review for waterways (target: <1000 km: river orders 2 and 3)

ID	Source	Year	Valuation/ policy scenario	Method	Comment
WW1	Bennett et al. (2008)	2005	Rivers and water quality/ development	CM	**Attribute misalignment**: percentage of waterways suitable for primary contact (n/a for target site)
WW2	Morrison and Bennett (2004)	2000	Rivers and water quality/ development	CM	**Attribute misalignment**: categorical not metric: suitable for either fishing or fishing and swimming for whole of river change (n/a for target site)
WW3	Van Bueren and Bennett (2004)	2000	Natural resource management in a rural area	CM	**Attribute misalignment**: per km waterways restored for fishing or swimming (n/a for target site)
					Scale: details not reported
WW4	Rolfe et al. (2002)	2000	Water resource and agricultural development	CM	**Scope and framing**: Rural valuation context
					Measurement: km in good condition
					Scale difference: 1500–2400 km
WW5	Rolfe and Windle (2003)	2001	Water resource and agricultural development	CM	Same site: comments as for Rolfe et al. (2002)
WW6	Rolfe and Bennett (2009)	2002	Water resource and agricultural development	CM	Same site: comments as for Rolfe et al. (2002)
WW7	Windle and Rolfe (2005)	2003	Water resource and agricultural development	CM	Same site: comments as for Rolfe et al. (2002)
WW8	Mazur and Bennett (2009)	2008	Natural resource management in a rural area	CM	**Scope and framing**: rural valuation context
					Measurement: km in good condition
					Scale: within range: 950–1500 km
WW9	Rolfe and Windle (2008)	2005	Natural resource management	CM	**Some scope and scale similarity**: 1 site included a more urbanised area with overlapping scale (700–1100 km)
					Measurement: km in good condition
WW10	Rolfe and Brouwer (2012)	Various	Various	Meta-analysis	Incorporated studies outlined above

Table 8.6 Source study review for beaches (target: up to 50 km)

ID	Source	Year	Valuation/policy scenario	Method	Comment
B1	Blackwell (2007)	1999/2000	Recreational use of 4 beaches	TCM	Small scale study (n = 243) with unknown proportion of local visitors. Study (and analytical methods) dated
B2	Rolfe and Gregg (2012)	2010	Recreational use of 1400 km beaches	TCM	Broad scale study (n = 1049) of local residents. Best sample match
B3	Windle and Rolfe (2013)	2012	Recreational use of 250 km beaches in an urbanized area	TCM	Broad scale study (n = 1001) of nearby capital city residents. Average travel distance (80–100 km) greater than local users at target site

believe the estimated trip value for a beach visit would be significantly different at the target site, making this suitable for unit value transfer.

8.3.3 *Performing the Benefit Transfers*

Based on the assessments described above, unit value transfers were defensible only for beaches and to a lesser extent, waterways. Two suitable source studies and a meta-analysis were identified for the waterways asset, creating three possible options for transferring values.[9] The first was to apply the value of the $1.21/km from the southeast Queensland site (study WW9) because the site represented the "best fit" with the target. The second was to use the average value from the two single studies, WW8 and WW9, i.e. ($1.07 + $1.21)/2 = $1.14/km, while the third option was to apply the value of $1.24/km from the meta-analysis. The first option is the most common with unit value transfers.

Once source study values had been selected, adjustments were made to tailor and extrapolate values at the target site. Beginning with a present value of $1.21 per household for a one kilometer improvement in the length of waterways in good condition, the primary adjustment was to extrapolate this value to the population at the target site (assumed to be 40,000 households). The transferred value of $48,400 per kilometer should be applied only to assess the value of a marginal change in quality (not the total value of the asset), but could be applied to either gains or losses.[10]

[9]Note that the use of meta-analysis in this way is generally considered a type of benefit function transfer.

[10]In the source study, the status quo was set as a future base, with a lower level of provision than the current situation. All alternative levels represented an improvement on the future base, but

For beaches, the Rolfe and Gregg (2012) study provided a value estimate of $35.09 per visit. As there was no information about the frequency of beach trips at the target site, the visit rate information was also transferred from the source study (20 trips per adult per year). If the adult population at the target is assumed to be 50,000 adults, the annual value of beach recreation would be approximately $35 million. This is an estimate of total recreation value. Further information would be required to estimate values for marginal changes in quality. For example, the source study also provided information from a contingent behavior experiment about changes in visitation rates if water quality at beaches declined, reporting that a one percent decline in water quality reduced the value of a beach visit by $1.40.

The final steps in the benefit transfer involves sensitivity analysis, where standard procedures were applied (these are suppressed here for conciseness). It is also important in the final evaluation and reporting to outline the limitations of any selected source study estimates. These are outlined in the sections above.

8.4 Conclusion

This chapter outlines the process of conducting a unit value transfer and describes key issues that must be considered when conducting this type of transfer. To illustrate these concepts, it presents a case study example from Australia. Because unit value transfers provide little flexibility to adjust value estimates for differences between study and policy valuation contexts, the correspondence between these contexts is critical to accuracy.

Here, three main limiting factors constrained the pool of information available for transfer. The first was the limited pool of potential source site valuations. Having so few studies to draw upon not only limited the potential of finding a suitable match, but also provided little information to evaluate how values might differ across different types of contexts. Second, most source study valuations had been conducted in large scale rural catchments. These were not well matched to the small scale peri-urban coastal towns for which values were required (scale limitation). Third, the broad scale and rural focus of many source studies did not match the features of environmental assets in the targeted peri-urban residential areas (scope and context differences). While there was potential to make adjustments for scale differences, no information existed to help account for rural/urban context differences.

Based on this evaluation, unit value transfer was considered to be defensible only for two assets, beaches and waterways. The accuracy of these transfers was supported indirectly—at least for the waterways attribute—by the similarity of

(Footnote 10 continued)
were lower than the current level. Consequently, it is not clear if respondents were indicating their WTP to avoid a loss or achieve a gain.

value estimates from different source studies (from $1.07 to $1.24 per km). For other attributes, available source studies did not meet at least one of the necessary criteria for accurate unit value transfer (see Table 8.2). Empirical results such as these support the general contention of Bateman et al. (2011) that unit value transfers can be defensible in some cases. However, they also highlight the extremely restrictive conditions under which such transfers are expected to provide accurate results.

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