Evaluating functions and benefits of constructed wetlands

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Abstract

The use of constructed wetlands for treatment of wastewater has steadily increased in the last decades. Besides the direct benefits of water purification, these systems are also associated with high ancillary benefits deriving from the creation of a natural habitat that is aesthetically pleasant, supports local wildlife and is suitable for recreational and cultural activities. This paper aims at identifying the wide range of benefits associated with constructed wetlands. For this purpose we embrace an analysis anchored on an economic perspective on constructed wetlands values. The resulting framework is the starting point for discussing the possibility of estimating these values in monetary terms. Suggestions are made about which economic valuation method can address which type of constructed wetland value. The possibility of using benefit transfer from studies concerning natural wetlands is also discussed. The results of such an economic valuation exercise reveal to be crucial for cost-benefit analysis and for public policy guidance.

1. An introduction to constructed wetlands

The recognition of the existence of water purification processes within wetland systems has led in the last decades to the development of new strategies of wastewater treatment that include the creation of artificial wetlands. In one of the most widely accepted definitions, constructed wetlands are "man-made complexes of saturated substrate, emergent and submerged vegetation, animal life and water that simulate natural wetlands for human use and benefits" (Hammer and Bastian, 1989).

The application of constructed wetlands for treatment of municipal wastewater is constantly increasing due to good treatment performances and low construction and operating costs (Kadlec *et al.* 2000). As polishing step of conventionally engineered wastewater treatment plants, constructed wetlands seem to represent an effective, technologically simple and economically affordable solution to the increasing pressure on surface waters. As a linkage-system between municipal wastewater treatment plant and (re)use of treated wastewater, they also represent a sustainable eco-technological application of integrated water management that can significantly contribute to compliance with the European Water Framework Directive (EU 2000/60). Their high quality effluents can be suitable for reuse in various forms.

Constructed wetlands for wastewater treatment are generally classified on the basis of the wastewater flow type into the categories of (i) free water surface and (ii) subsurface flow systems.

In the former water flows horizontally over the sediment, while in the latter it flows either horizontally or vertically through permeable sediments.

Constructed wetlands may provide, to a certain extent, most of the benefits associated with natural wetlands. Of the mentioned design configurations, free water surface systems offer the largest range of ancillary benefits. This paper aims at developing a framework for the identification of the benefits associated to the use of free water surface constructed wetlands for polishing effluents of medium to large treatment plants. An economic perspective is embraced throughout the paper and the possibility of using economic valuation methods to estimate the benefits in monetary terms is discussed.

Section 2 presents the motivations to perform an economic valuation of constructed wetlands and discusses the opportunity of using the results of such a valuation exercise for public policy guidance in cost-benefit analysis. Section 3 develops framework to identify and classify wetland functions and benefits. Section 4 discusses the opportunity of using market and non-market valuation methods to estimate the value of each of the benefits. Suggestions are made about which economic valuation method can address which type of constructed wetland value. Section 5 suggests the opportunity of transferring to constructed wetlands benefits from studies concerning natural wetlands and identifies the conditions under which this transfer is possible. Finally some conclusions from the previous sections are summarised.

2. The economic perspective: motivation and methods of economic valuation

To estimate the value of an environmental asset from an economic perspective means to embrace an anthropogenic and instrumental analysis. This implies that the value of the environmental asset is determined on the basis of the goods and services it provides to humans or, in other words, on its impacts on human welfare. From the viewpoint of economics, the value of the asset is determined by the production and consumption opportunities it provides (Nunes and Vergano, 2005).

Economic valuation of an environmental asset implies to express its value in monetary terms. Monetary indicators serve however as means and not as an end in the valuation. They are used as a common unit for the comparison and ranking of alternative scenarios and policy options (Nunes and Vergano, 2005). The economic value is not estimated in absolute terms but it rather represents an estimate of a welfare variation in response to a certain policy or environmental change. "The theoretical basis of economic valuation is monetary (income) variation as a compensation or equivalent for direct and indirect impact(s)" on human welfare associated to the change (Nunes *et al.* 2004).

One of the reasons why economic valuation of environmental assets is undertaken is that the results of such monetary assessment can be used in cost-benefit analysis. Cost-benefit analysis (CBA) is a well-established policy guidance tool that aims at evaluating the social welfare changes associated to one or more alternative courses of public action. CBA allows to identify among a series of alternative policies, programmes or other governmental interventions the one that induces the most efficient allocation of resources. In order to apply such an approach, one needs to identify, estimate in monetary terms and compare all of the costs and benefits of a particular course of action to society as a whole. [1]

The identification of social benefits and costs and their monetization are a challenging task when environmental assets are valued, since most of the goods and services at stake are not market priced. In this context, markets are not able to capture the total value of these goods and services and we assist to a market failure. It is important to emphasise that the absence of market prices for certain environmental benefits does not imply that these have little or no value. It is rather the consequence of the public good nature of these benefits.

A constant increase in the interest and in the research towards the economic valuation of non-market goods and services has led to the formulation of economic tools that aim at shading light at the total economic value of any environmental good under consideration. These economic valuation methodologies are usually referred to as non-market valuation methods. Non-market valuation methods can be classified into the two categories of stated preference methods and revealed preference methods according to the nature of the data used for modelling and estimation. Stated preference methods are survey-based and the respondents are either asked to directly state their willingness to pay for a certain environmental good (contingent valuation method) or to express their preference among different choice alternatives (attribute-based methods using choice, rating or ranking as response formats). Revealed preference methods infer monetary values for environmental assets directly from transactions occurring in related markets (travel cost method, hedonic method, averting behaviour, etc.). Table 1 presents the most common non-market valuation methods. [2]

[1] The theoretical background of CBA and examples of application can be found in Boardman *et al.*, 1996.
[2] For a more in-depth discussion of the various methods see Champ *et al.*, 2003.

Table 1. Common non-market valuation methods	
Stated choice	Contingent valuation
	Attribute based method (choice, ranking, rating)
Revealed preference	Travel cost
	Hedonic price
	Averting behaviour

In the next sections, we will identify the benefits provided by constructed wetland functions and discuss the opportunity to estimate their value making use, where appropriate, of non-market valuation methods. This is possible in consideration of the fact that many of the benefits provided by constructed wetlands have characteristics of public goods, and thus no market price is directly attached to them.

3. Functions and benefits of constructed wetlands

Constructed wetlands perform many functions that provide goods and services to society. Following a classification proposed by a Wetland Reserve Program report for natural wetlands (WRP, 1994a) wetland functions can be grouped into the four broad categories of (i) hydrology/water quality, (ii) landscape enhancement, (iii) fish and wildlife habitat, (iv) recreational and educational activities. The wetland function related to hydrology and water quality includes supply of treated water suitable to be reused in several applications, increase of surface quality and recharge of aquifers. The development of a habitat for fish and wildlife may provide benefits related to production of food and fiber through harvesting, protection of fisheries, aquaculture as well as educational and cultural activities. According to the land context in which they are placed, free water surface constructed wetlands can also significantly enhance landscape aesthetics by introducing a pleasant natural element in the landscape. Closely related to the habitat and landscape functions is the provision of opportunities for recreationists.

Table 2 summarizes the economic goods and services that may be associated to free water surface constructed wetlands together with the wetland function that give rise to the economic value. Obviously not all these benefits necessarily coexist in a specific project, not just because of different design configurations, but especially because the existence and significance of a benefit are strongly dependent on the local conditions and on the local demand for the provided good or service.

Economic goods and services provided by constructed wetlands through the four main functions are grouped in Table 2 into goods and services to which a price is attached in relevant markets and goods and services for which no relevant market exists (non-market benefits). The former include supply of reusable water, food and fiber production, protection of fisheries and aquaculture. The latter are increase of surface- and groundwater quality, aquifer recharge, educational, cultural and recreational activities, land development and existence and bequest of biodiversity. Lambert (2003) points out that "market failures related to ecosystems include the fact that many wetlands (1) provide services that are public goods, (2) many wetlands services are affected by externalities and (3) property rights related to ecosystems and their services are often not clearly defined".

Table 2. Constructed wetland functions, related economic values and suggested valuation methods.

		Wetland function	Good or service provided	Valuation Method
Market benefits		Hydrology / Water Quality	Supply of reusable water	market price
		Fish and Wildlife Habitat	Food and fiber production (harvesting)	market price
			Protection of fisheries / Aquaculture	market price
Non-market benefits	Use Values	Hydrology / Water Quality	Increase of surface water quality	contingent valuation, avoided cost analysis
			Groundwater recharge	contingent valuation, avoided cost analysis
		Fish and Wildlife Habitat	Educational/cultural activities	contingent valuation, travel cost
		Recreation and aesthetics	Recreational activities	contingent valuation, travel cost
		Landscape enhancement	Land development	stated preference methods, hedonic method
	Non-use values	Fish and Wildlife Habitat	Existence and bequest value of biodiversity and biological resources	contingent valuation

4. Framework for evaluation of economic benefits of constructed wetlands

This section critically discusses the possibility of valuating in monetary terms each of the benefits identified in Table 2. The focus will be on two of the basic steps in CBA proposed by Boardman *et al.* (1996), namely on (i) identifying the functions of constructed wetlands that lead to welfare impacts and selecting appropriate measurement indicators (measurement units) and (ii) assessing the applicability of economic valuation methods to the monetization of the impacts. It is stressed that in this section only methods for primary valuation studies are taken into account. The opportunity of using benefit transfer and meta-analysis to evaluate benefits of constructed wetlands is discussed more in-depth in the Section 4.

Here below each of the benefits in Table 2 is discussed according to the already described classification in four wetland functions.

(i) Hydrology/water quality

Supply of reusable water

Constructed wetlands are already in use in many wastewater reclamation and reuse schemes worldwide (see Bixio *et al.,* 2004). The good quality of the polished effluent makes it suitable for various forms of reuse including agriculture, industry and in general for medium to low contact applications. [3]

Measurement indicators

The most obvious indicator of the benefits provided is the quantity of wastewater reused. The residual concentration of polluting substances (like nutrients, toxic elements or suspended solids) can however highly affect the benefit from reusing the wastewater. When the polished effluent is used in agriculture, a high concentration of nutrients can induce the positive effect of reducing (or eliminating) the need to use fertilizers. These cost savings need to be included in the economic valuation. Hussain *et al.* (2001) point out, however, that in some cases the nutrients might be supplied in excess of crop requirements, and thus nutrient content value approach results may overestimate actual economic worth of nutrients in the wastewater. When the reuse application involves contact with human beings, considerations about risk to human health induced by the possible presence of toxic elements in the wastewater cannot be avoided in the valuation. Finally, for applications in industrial processes, residual concentration of suspended solids may lead to problems with sedimentation and clogging and thus to a reduction of the benefits.

Valuation considerations

Even when a price of water exists and it is assumed to be an appropriate indicator on which to base the valuation, difficulties in valuating the benefits arise from the fact that water price is often not the result of market transactions but it is kept to a sub-optimal level by political, legal or historical factors. In other words the price of water may not reflect the true value of water to the consumer but, typically, it underestimates it. When this is the case, Hussain *et al.* (2001) suggest to derive the

[3] For a more in-depth discussion on appropriate reuse applications and on water quality parameters to be monitored see Ghermandi *et al.* (2005).

shadow price for water using hedonic price analysis or assuming the cost of energy required to use an alternative technology to deliver the same quantity of water.

When the reuse of water in agriculture induces a reduction in the use of fertilizers, the amount of this reduction at the market price of fertilizers shall be included in the valuation.

Taking into account non-market-based effects like the increase of risk for human health is not so straightforward. Several attempts to estimate human health risk with stated preference methods have been reported in literature.

Increase of surface water quality

Constructed wetlands provide a tool to reanimate the “dead” treated wastewater and transform it into usable natural surface water. This aspect of the treatment with constructed wetland has been extensively studied in the “Waterharmonica” project in the Netherlands (see for instance Kampf and Claassen, 2004). The key point of the “Waterharmonica” concept is that free water surface constructed wetlands not only provide a significant reduction of key contaminants (like chemical oxygen demand, pathogens, nutrients etc.) but their effluent is much more similar to a natural healthy surface water than the effluent of a conventional mechanical treatment plant. A more natural daily trend in the dissolved oxygen concentration is observed and suspended solids are of a different kind, biomass instead of activated sludge flocks.

The capacity of constructed wetlands of buffering treatment failures in the previous treatment steps is included in this section. During extreme events, conventional mechanical treatment plants may fail to achieve the treatment goals or may bypass part of the influent to the outlet after primary treatment only. Under these circumstances the wetland basin can contain the failures and provide treatment of the wastewater prior to the discharge into the receiving surface water body. Excessive loading can however lead to damages in the wetland itself and to remobilisation of sediment-associated contaminants with the results of flushing them to the outlet at high concentrations.

Measurement indicators

The key point of the analysis in this case is the identification of appropriate water quality standards to be used as indicators of the water quality status of the receiving surface water body. The already cited Wetland Reserve Program (1994a) reports a range of variables that have been used in 17 different methods to evaluate natural wetlands functions. The variables linked to the downstream water quality status include chemical parameters like dissolved oxygen, heavy metals nutrients, bacteria and sediments concentrations, conductivity, alkalinity and temperature in the effluent.

Further research is needed to identify and quantify the link between water quality standards in the treatment plant effluent and in the receiving surface water.

Valuation considerations

Moons (2003) reports a series of studies concerning the economic valuation of several water quality parameters. In particular nitrates, sulphates, chemical oxygen demand (COD) are valued. Most of the studies use a contingent valuation approach to assess the value of a certain improvement in the water quality standard (i.e. reduction of mean nitrate concentration) or of the safeguard of existing water quality. The results refer to different water uses (drinking water supply, ground- and surface water quality). In general the results of the studies show a high variability according to the level of information provided to the respondents and to the probability of the occurrence of the prospected pollution event. Some authors (see Breaux et al., 1995) suggest an alternative valuation technique based on avoided cost analysis to evaluate the costs related to the water quality improvement occurring in the wetland compared the costs of traditional treatment. Lambert (2003) observes that avoided cost analysis assumes that the cost of the substitutes match the original benefit. Many external circumstances, however, “may change the value of the original expected benefit and the method may therefore lead to under- or overestimates”.

Groundwater recharge

The polishing step of treatment provided by constructed wetlands can make the treated wastewater suitable for recharging the aquifers in areas of over-exploitation of groundwater resources and thus provide a beneficial effect in the water resources management. It must be observed that the groundwater recharge does not occur in the location of the constructed wetland itself since the permeability of the wetland bottom is typically very low to avoid infiltration of polluted wastewater into the soil.

Valuation methods

Engineering costs for providing groundwater recharge with alternative technologies are generally available and can be used to value the benefits of groundwater recharge by means of constructed wetlands. The benefit from the constructed wetland will equal the difference between the costs of supplying the water for the recharge by means of the constructed wetland and with the alternative source. If no alternative exists the value of groundwater recharge to the consumer must be estimated with other methods, like for instance stated preference methods (i.e. contingent valuation).

(ii) Fish and wildlife habitat

Protection of fisheries / Aquaculture – Food and fiber production (harvesting)

Application of wastewater treated in polishing constructed wetlands for creating conditions suitable to aquaculture activities can be found in several installations worldwide (see for instance the Arcata Marsh and Wildlife Sanctuary, California). Research conducted on the island of Texel (Netherlands) by Kampf *et al.* (1999) shows that toxicity effects due to biomagnification of heavy metals like copper and zinc in the food chain from zooplankton to fishes are limited under normal loading conditions. The possibility of linking constructed wetlands to aquaculture schemes and to use the material harvested for different applications in developing countries has been discussed by Yana (2004).

<u>Valuation methods</u>

Economic valuation in this case is determined by market conditions. The value of the wetland for production is given by the difference between net returns from production from wetland harvest and net returns from production from next best alternative (WRP, 1994b).

Existence and bequest of biodiversity and biological resources

The development of a complex ecosystem rich in biodiversity within free-surface constructed wetlands is reported in many studies worldwide. Plant and animal communities can carry a significant economic value for their mere existence and/or to ensure that future generations might enjoy this biodiversity. It must be noted, however, that plant and animal communities in a constructed wetland have generally a reduced habitat value if compared to natural wetlands because of the high load of nutrients carried by the influent wastewater (Tanner, 2002) and the presence of toxic substances.

For what concerns the difference between biodiversity and biological resources Nunes *et al.* (2001) report that ”whereas biodiversity refers to the variety of life, at various levels, biological resources refer to the manifestation of that variety”.

The values of the biological resources and the biodiversity in a constructed wetland are determined not only by the complexity and the degree of development of the wetland ecosystem, but also by the existence and the proximity of substitute habitat types on a local or regional scale.

<u>Valuation considerations</u>

The economic valuation of biodiversity and biological resources has been object of a large number of studies. In a survey and evaluation of empirical studies, Nunes *et al.* (2001) report that contingent valuation is by far the most used method since it is the only method able to estimate non-use values of biodiversity like existence, option and bequest. Contingent valuation is one of the most controversial non-market valuation methods. One of the most important critics is that there cannot be the certainty that people would actually pay the amount stated. Nevertheless the importance of contingent valuation is given by the fact that it is one of the few methods that allow to estimate non-use values.

(iii) Recreational and educational activities

Recreational activities

Recreational activities that may potentially take place in a constructed wetland include consumptive and non-consumptive uses. In the former mainly hunting is included, while the latter refers to bird- and wildlife watching.

Birdwatching is probably the most important recreational activity related to constructed wetlands. Birds often use wetlands as nesting places or as feeding and resting place during the migration and constructed wetlands are often considered optimal spots for birdwatching. This recreational function of constructed wetlands is obviously closely linked to the wildlife habitat function.

Recreational and cultural activities can assume a very relevant economic value. It has been estimated for example that over 150.000 people a year visit the Arcata Marsh and Wildlife Sanctuary in California for passive recreation, birdwatching or scientific study.

Valuation considerations

The most commonly used valuation method to assess the economic value of recreational activities is the travel cost method. This method has been recently applied to evaluate the recreational benefits produced by the free water surface constructed wetlands in Empuriabrava (Spain). In this installation, the wetland effluent feeds the otherwise drying out Laguna del Cortalet in the Empordà Park (Seguì, 2004). It must be observed that the use of this method involves the risk to overestimate the value of the recreational service since visiting the site may not be the only reason for travelling to the wetland area. The existence of substitutes for the recreational activities must be taken into account in the analysis.

Contingent valuation can be applied when evaluating the expected benefits from the future construction of a wetland.

Educational and cultural activities

Constructed wetlands may provide opportunities for environmental education and for raising awareness among citizens. Information centres are often created to welcome visitors and explain the scientific background of the wastewater treatment processes and the value of wetland ecosystem. An example of educational activities successfully taking place in a constructed wetland is given by the Arcata Interpretive Center in Arcata, California, in which information about wastewater treatment functions of the wetlands and tutorials are handed out to the visitors.

Valuation considerations

The already cited Wetland Reserve Report (1994a) points out that economic valuation is seldom attempted for these values, since "it is often difficult to separate educational/cultural services from the provision of other goods and services". Accessibility of the site and existence of substitutes in the region are key elements that determine the educational value of a wetland. Though no example of application of valuation methods to estimate the educational/cultural value of a constructed wetland could be found in the literature, it seems that, like for recreational values, contingent valuation might be a suitable method to be used in *ex ante* cost-benefit analyses while travel cost seems more appropriate to *ex post* analyses.

(iv) Landscape enhancement

Free water surface constructed wetlands can carry high landscape values when they are integrated with recreational areas in water parks. This landscape values are higher in urban development sites than in rural areas since in urban areas free water surface constructed wetlands and water parks introduce a valuable natural element. To assess this value the existence of substitutes in the region under consideration is a key aspect that must be included in the analysis. The higher price of land in urban areas is a limitation to the implementation of such schemes.

Measurement indicators

According to the Wetland Reserve Program report (1994b), information needs to be taken into account for the valuation are size and configuration of the wetland, proximity to roads and to other infrastructures. For what concerns the configuration of the wetland, according to the same authors open water and marshy wetlands are generally preferred from an aesthetic viewpoint to thickly vegetated swamps where visual access is impaired. Similarly, irregular edges and mosaic patterns of vegetation are generally considered of a higher visual value. In some cases (see for instance the free water surface constructed wetland in Empuriabrava, Spain) small artificial islands are created in the middle of the wetland both to provide a higher aesthetic value as well as a suitable nesting spot for birds.

Valuation considerations

Stated preference methods like contingent valuation or stated choice method can be used to estimate respondents' willingness to pay for the landscape improvement. Hedonic valuation or appraisal method can be applied where the constructed wetlands is expected to affect the market of surrounding residential areas.

5. Transferring benefits from natural to constructed wetlands?

From the considerations developed in the previous sections, it emerges that constructed wetlands provide, at least to a certain extent, most of the benefits of natural wetlands. Nevertheless little research work has been done up to date to evaluate the benefits of constructed wetlands in monetary terms. On the other hand a much larger database of studies exists in literature concerning the economic valuation of natural wetlands (see for instance Schuyt and Brander, 2004). It is interesting thus to assess whether it is feasible and under which conditions it is possible to transfer to constructed wetlands the results of valuation exercises concerning natural wetlands.

Benefit transfer is used in economics to apply to the policy site under consideration monetary value estimate from alternative study sites. This kind of analysis is often undertaken when time and budget considerations limit the possibility of conducting a primary study like those described in the previous section. Different approaches to benefit transfer have been used in the literature. A first possibility is to directly transfer the unit value to the site under consideration from an alternative site, which is as similar as possible. Benefit function transfer still considers a single alternative site, but instead of directly transferring the unit value, it applies a benefit function whose parameters take into account environmental quality, characteristics of both sites, availability of substitutes and other socio-economic characteristics. A third approach consists in applying statistical tools to a large collection of results from individual studies. This third approach has the advantage of being more neutral and transparent but involves on the other hand the difficulty to cope with results obtained with different methods and the disadvantage to be biased towards studies with significant results (insignificant studies are not likely to be published). [4]

Whatever approach is applied it must be noted that constructed wetlands have peculiar characteristics compared to natural wetlands. This must be taken into account before undertaking an

[4] For a more complete description of the benefit transfer method and of pros and contras of each approach, the reader is referred to Chapter 9 of Nunes, 2002.

evaluation effort that is not always justified. Some of the characteristics of constructed versus natural wetlands that might affect economic values and valuation techniques are summarised below. It shall be reminded that in this paper only free-surface constructed wetlands for advanced treatment are discussed in this paper. Very different considerations should be developed for other constructed wetland design configurations (with respect for instance to recreational values) and for systems used in different stages of the treatment (with respect for instance to reuse of the effluent).

- The main goal in designing of a constructed wetland is the treatment of wastewater. Design common practices are often meant to maximise only this function and do not take into due account the other valuable functions.
- Wildlife habitat and ecological complexity of a constructed wetland are different from those of a natural wetland. In general nutrient overfeeding and the presence of toxic compounds reduce the complexity of vegetal and animal communities and thus decrease the value of the related biological resources and biodiversity.
- The size of constructed wetlands is often small if compared to that of natural wetlands. Benefits from landscape enhancement, groundwater recharge or recreational activities are, *ceteris paribus*, directly related to the size of the wetland and thus are expected to be smaller for constructed wetlands than for natural ones. These considerations must be taken into account before undertaking a valuation that though costly and time-consuming might produce non-significant results.
- Constructed wetlands carry costs that are not only those of initial investment. Operation and maintenance costs are usually a significant section in cost-benefit analysis.
- Constructed wetlands have benefits that natural wetlands do not possess: effluent of natural wetlands is hardly of sufficient quality for reuse; being a part of a larger scheme of wastewater treatment, constructed wetlands provide more opportunities for recreational and cultural activities which include information about water chain, water reuse, processes of wastewater treatment in the wetland and in the treatment plant, etc. Being close to a treatment plant and thus to a residential area, constructed wetlands are generally more easily reachable by users than natural wetlands.

Conclusions

From the considerations developed in the previous section it is evident that constructed wetlands as polishing step of the wastewater treatment can provide a large series of ancillary economic benefits that go far beyond the improvement of water quality in the effluent from the conventional wastewater treatment plant.

Up to date, little work has been done to evaluate these benefits and, as for natural wetlands, the separation between benefits is in some cases unclear.

The previous sections have shown that economic valuation methods can be used and in some cases have been used in the past to evaluate the benefits of constructed wetlands. There are however some limitations to the use of these techniques to natural systems like wetlands, which are given by lack of full scientific understanding of the complexity of these systems, availability of time and resources. In many cases it is advisable to focus on the estimation of a specific relevant benefit or to use the benefit transfer method to avoid expensive and time-consuming primary studies. These limitations have nevertheless implications for the use of the results in cost-benefit analysis and thus for decision-making. When primary valuation of a good or service is attempted it is of the outmost importance to choose a method that is appropriate to the specific case under consideration. Economic valuation exercises have in any case the big advantage of making values visible and easily understandable to people that might be otherwise unaware of them.

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