

**ECOSYSTEM SERVICES: CONCEPTS, METHODOLOGIES  
AND INSTRUMENTS FOR RESEARCH AND APPLIED USE**

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# MONETARY VALUATION OF URBAN ECOSYSTEM SERVICES-OPERATIONALIZATION OR TRAGEDY OF WELL-INTENTIONED VALUATION? AN ILLUSTRATED EXAMPLE

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## 1. INTRODUCTION

A recent review of published monetary valuation methods of ecosystem services found that only a small fraction of studies discussed how estimates were or could be used for different kinds of decision-support (Laurans et al., 2013). Possible explanations range from decision-makers not having sufficient training in economics, the cost of valuation, inaccuracies of monetary valuation, political strategies requiring opacity or ambiguity, regulatory frameworks not being conducive to ecosystem service valuation and finally, fundamental inadequacies of valuation. Kallis et al. (2013) summarise four fundamental reasons why monetary valuation of ecosystems is inadequate, including ecosystems' high complexity and interconnectedness, multiple rationalities and values; dependence of values on distributional and institutional settings, and the fact that valuation is a social processes conditioned by value articulating institutions. Gomez-Baggethun and Barton (2013) review a number of additional technical challenges with valuing ecosystem services in urban contexts. Despite the large number of practical and theoretical limitations on monetary valuation, Kallis et al. (2013) suggest that monetary valuation of ES can still be policy relevant if it meets several ecological economic and political economic criteria. Failure to address these criteria can result in 'well-intentioned valuation', contributing to deterioration of environmental conditions, inequalities and redistribution of power, suppression of other languages of valuation and enclosure of the commons.

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In this chapter we test these criteria on four valuation studies conducted in Oslo by the EU FP7 project OpenNESS, which used a mix of original studies and value transfers (Barton et al., 2015a):

1. Meta-analysis of willingness-to-pay for green spaces in the built zone
2. Hedonic pricing of green infrastructure in the built zone of Oslo
3. Time use value of Marka peri-urban forest outside the built zone of Oslo
4. Liability value of urban trees in the built zone

The two methods looking at recreation in green spaces (1) and the peri-urban forest (3) found annual values between one and several billion Norwegian kroner. The value of green spaces in property prices (2) and the liability value of city trees (4) revealed capital values in the range of tens of billions of Norwegian kroner. The study was quite widely reported in the Norwegian press and online. However, several of the valuation studies do not pass Kallis et al. criteria for when monetary valuation is desirable. Were the methods applied examples of ‘the tragedy of well-intentioned valuation?’

## 2. FUNDAMENTAL INADEQUACIES OF MONETARY VALUATION — AN ILLUSTRATED GUIDE

Kallis et al. (2013) detail what Laurens et al. (2013) also call ‘fundamental inadequacies’ of monetary valuation of ecosystem services:

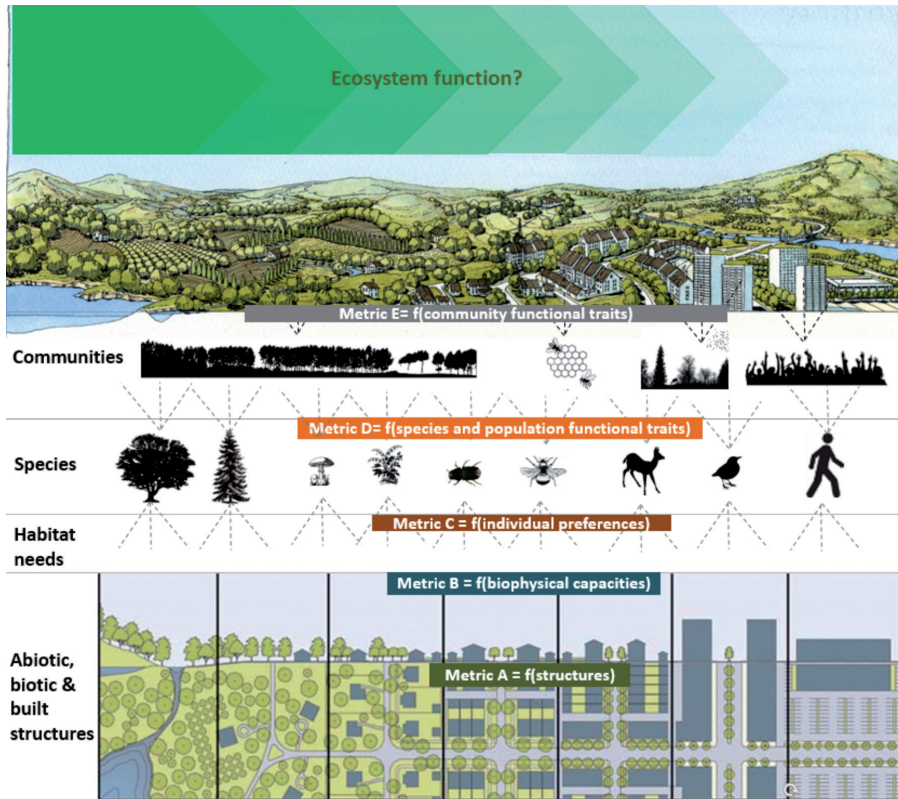
1. Ecosystems are highly complex and interconnected (critical species and systems). Their values cannot be compressed into a single metric.
2. Multiple rationalities entail multiple values and other relevant valuation languages than those expressed in monetary terms
3. There is no unique value for environmental goods and services independent of the distributional and institutional settings within which such values are expressed.
4. Social processes of valuation, including monetary valuation, are value articulating institutions (VAIs). Different people exhibit different values depending on the socio-institutional environment in which they express them

Together these constitute a fundamental plea for plural values and plural value-articulating institutions. The key to Kallis et al.(2013) paper is that their plea does not exclude monetary valuation methods, but suggests that valuation languages are context dependent. The next sections provide an illustrated guide to some fundamental challenges for valuation of urban ecosystem services.

### 2.1. Ecosystems complexity and interconnectedness

“Ecosystems complexity and interconnectedness cannot be compressed into a single metric” (Kallis et al., 2013). This is a theoretical position as much as it is practically evident when reviewing approaches to ecosystem mapping and modeling. A number of different metrics at different spatial scales and levels of species, population, and community organization are used to describe ecological importance or ‘ecological value’ (Figure 1).

Figure 1 Different levels of ecosystem function metrics



Source: own elaboration based on Duany Plater-Berk & Company landscape gradient illustration at [reassociationdesign.files.wordpress.com](http://reassociationdesign.files.wordpress.com)

- Metric type A — mapping of green **structures** and nature types indicate important green infrastructure features;
- Metric type B — structures and nature types have biophysical **capacities** as habitats in terms of food resources, shelter, range etc.;

- Metric type C — individual organisms, including humans, have observable habitat choices/**preferences**;
- Metric type D — individual organisms' habitat occupancy are mediated by **functional traits** and they are of importance for other organisms;
- Metric type E — groups of organisms have **functional traits** of importance for other communities;
- Metric type F — functional diversity define ecosystems and their capacity to provide ES. Functional traits have a spatial and temporal definition which define ecosystem functions' spatial and temporal extent.

Mapping and modeling of metrics A-F provide (i) insight into multiple 'ecological values' and (ii) alternative spatial definitions of 'ecosystem', 'ecosystem function' and 'ecosystem service' along rural-urban gradients of green space fragmentation and built area. Monetary valuation of ecosystem services assumes that ecosystem services can be spatially and temporally demarcated. At the same time this makes ecological functions invisible across boundaries of commodification assumed implicitly or explicitly by monetary valuation method (Vatn, 2005b). Even a simplification such as in Figure 1 makes it evident that using only monetary valuation of ES for decision-support leads to a large loss of information. In the case study from Oslo we question whether there are decision-support contexts where monetary valuation may still be informative without the 'ecological resolution' outlined in Figure 1.

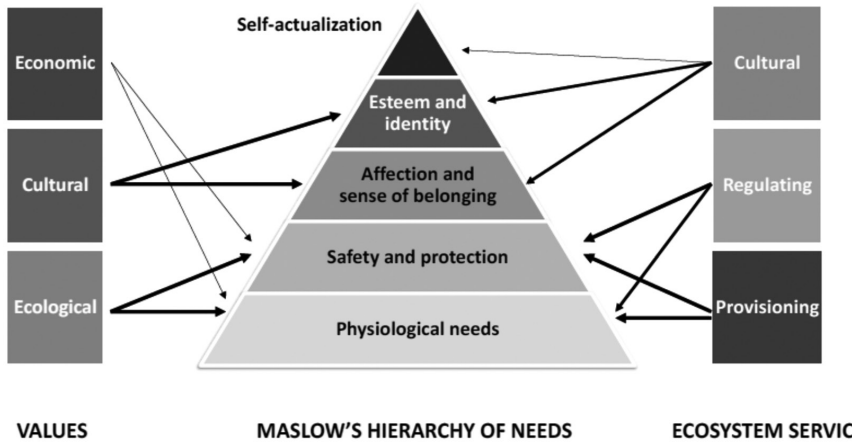
## 2.2. Other relevant valuation languages

*"There are other relevant valuation languages than those expressed in monetary terms"* (Kallis et al., 2013). Figure 2 shows the hypothetical relationships between different kinds of values, human needs, and ecosystem services (Gómez-Baggethun et al., 2014). A given ecosystem services satisfies a set of needs at different levels —conceptualized here using Maslow's (1943) needs hierarchy. In turn, economic, cultural and ecological values stem from different combination of needs at different levels. There is no a priori commensurability between the different types of needs in the hierarchy (Max-Neef, 1992). All the different needs must be met integrally for a human being to be a healthy and happy —they are so— called 'functionalized elements' of an individual (Vatn, 2005a). By extension different types of values and ecosystem services are non-commensurable. Recognizing multiple values is required to capture the diversity of needs and wants that nature can contribute to fulfill for society and individuals (Gómez-Baggethun et al., 2014).

The links in the model are hypotheses that need further evaluation. For example, in Figure 2 economic values are not relevant for the 'higher needs' of affections and sense of belonging, esteem and identity and self-actualization (self-realisation). These needs are on the other side associated with cultural ecosystem services. Interpreting the conceptual model literally suggests that economic values — and by extension monetary valuation — is not appropriate to address cultural ecosystem services. In the case study from Oslo we apply monetary valuation to several recreational

(cultural) ecosystem services. Which types of needs are satisfied by recreation in urban green infrastructure? Can we argue that we are valuing cultural ecosystem services and if so are these monetary valuation examples fundamentally inadequate?

Figure 2. Different levels of human needs as a basis for different valuation languages.



Source: Gómez-Baggethun et al. (2014)

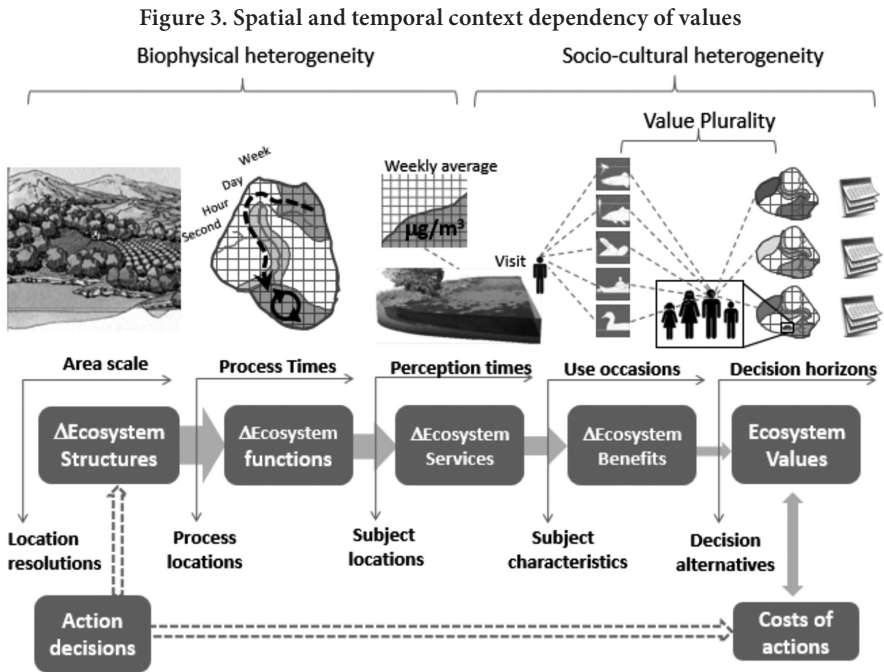
### 2.3. Context dependent values of ecosystem services

“There is no unique value for environmental goods and services independent of the distributional and institutional settings within which such values are expressed” (Kallis et al., 2013). Valuation of ecosystem services is decision-context specific because values are an expression of preferences for alternative courses of action with alternative benefits and values. In this sense “total economic valuation” of ecosystems has limited usefulness for decision support (Brouwer et al., 2013). Figure 3 uses the ecosystem services cascade framework (Haines-Young and Potschin, 2010) to illustrate decision context dependency of values. The example from Barton et al. (2015a) is for catchment nutrient run-off, eutrophication and recreational lake use. The example illustrates the functional interaction of regulating and cultural services, but any cascade of effects would serve the same illustrative purpose.

The combination of spatial scale and resolution determines information about *ecosystem structure*. The number of locations and time steps in the catchment monitoring programme determine the information about *ecological function* of the catchment system. The number of locations and times we record perceptions determine the extent of our knowledge about the *ecosystem services* of nutrient mitigation provided by blue-green infrastructure in the catchment. The combined variation across ecosystem structures, function and service end-points describes *biophysical*

*heterogeneity*. *Ecosystem benefits* are determined by how well we can identify potential lake user occasions and the population of lake users’ personal characteristics (child, man, woman, family, single etc.). Different catchment management measures determine the potential improvement in lake suitability according to a regulatory classification system for lake ecological status (red-yellow, red-green etc.). Individual willingness-to-pay for nutrient mitigation measures depends on how the management decisions are framed in terms of the number of management choice alternatives, and the time between investment in mitigation and improvement in lake ecological status. The extent to which researchers have identified the decision alternatives and horizons and the different individuals’ reactions to them, determine their knowledge of *ecosystem values*. In summary, values are plural because they are place, time, group and person specific. The combined variation from ecosystem service end-point, benefits and values is what we called *socio-cultural heterogeneity* in Figure 3.

Even for this relatively simple example of a rural catchment experiencing lake eutrophication we can envisage a large number of value contexts. For the Oslo urban example below we are dealing with a more complex picture, including fragmentation of green structures, high population density and high cultural diversity. Cities are ‘high context density environments’. They represent one of the most challenging contexts for ecosystem service valuation (Gómez-Baggethun and Barton, 2013).



Source: adapted from Barton *et al.* (2015a)



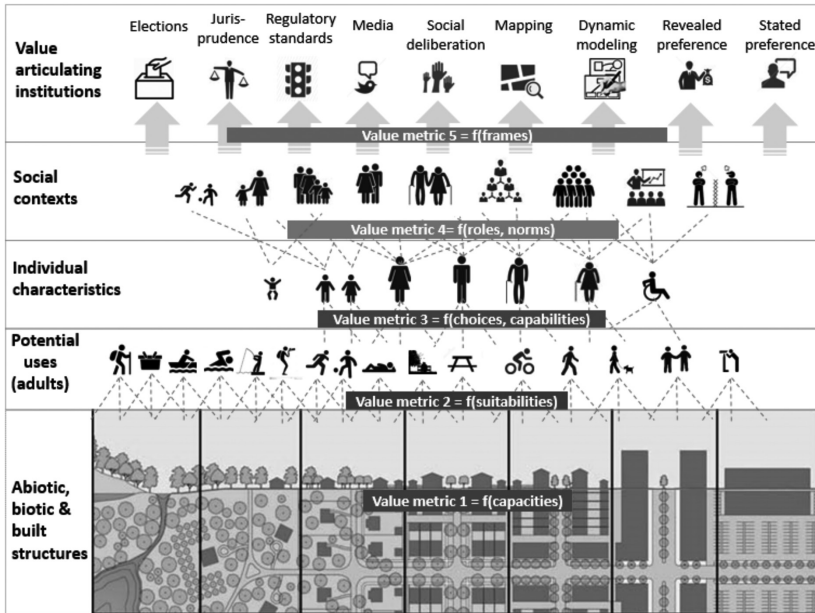
## 2.4. Social processes of valuation, including monetary valuation are value articulating institutions

“Different people exhibit different values depending on the socio-institutional environment in which they express them” (Kallis et al., 2013). Social processes of valuation, including monetary valuation, are value articulating institutions (VAIs) (Vatn, 2005a). The issue here is the value elicitation context which must frame respondents choices and statements about choices in an institutional setting for them to be credible. Values plurality is the combined diversity of fragmented urban nature, citizens’ perspectives on fragments, and different institutional valuation frames (Figure 4). Sources of variation can be grouped into at least five types of value metric at different levels of organisation:

- Metric type 1 — *Capacity* of blue-green structures and spaces for different uses. Environmental quality. Amenity. Capacity is a metric of potential demand and value.
- Metric type 2 — *Suitability* for different uses, defined by minimum user requirements relative to capacity. Suitability is also a potential demand and value.
- Metric type 3 — Individual activity-location *choices* are conditional on blue-green structures’ capacity and suitability, and individuals *capabilities*. Individuals capabilities condition potential demand and value. Information on choices made by individuals defines what economists mean by demand. In this framing stated choices are indicators of potential demand, similar to value metric 1 and 2. Actual choices reflect actual demand, what economists call revealed preferences.
- Metric type 4 — Individual roles in *social contexts* determine norms which condition choices. Individuals can have different roles in different choice settings, enriching understanding of value plurality.
- Metric type 5 — *Value articulating institutions (VAI)* are different contexts where choices are constructed and importance stated, or *frames* (Kahneman and Tversky, 2000) where actual choices are revealed. Valuation methods are considered institutions in the theory of VAI. Conversely, institutions can be considered implicit valuation context, where for example opportunity costs follow from referendum choice, jurisprudence or regulation.

In the context of the Oslo case study below we compare monetary values generated using four different monetary valuation methods, which have their basis in four different institutional framings: willingness to pay *municipal fees* for park maintenance; value of recreation time in *open access* forests; hedonic pricing of green spaces in the *property market*; and compensation value of city trees as an economic *liability on municipal property*. We ask the question whether any of these value articulating institutions are favoured by Kallis et al. (2013) framework for monetary valuation.

Figure 4. Different value articulating institutions’ frame preference formation and elicitation in different socio-cultural, individual, and physical contexts



Source: own elaboration based on Duany Plater-Berk & Company landscape gradient illustration at [freeassociationdesign.files.wordpress.com](http://freeassociationdesign.files.wordpress.com)

Table 1 Guiding framework criteria for desirable monetary valuation

Question (Criterion)	Don't value	Maybe	Do Value
1. Will it improve the environmental conditions at stake? (Additionality).	No	...	Yes
2. Will it reduce inequalities and redistribute power? (Equality).	No	...	Yes
3. Is it likely to suppress other languages of valuation and value articulating institutions? (Complexity blinding)	Yes	...	No
4. Will it serve processes of enclosure of the commons (Accumulation by dispossession/neo-liberalism)?	Yes	...	No

Source: based on Kallis et al. (2013)

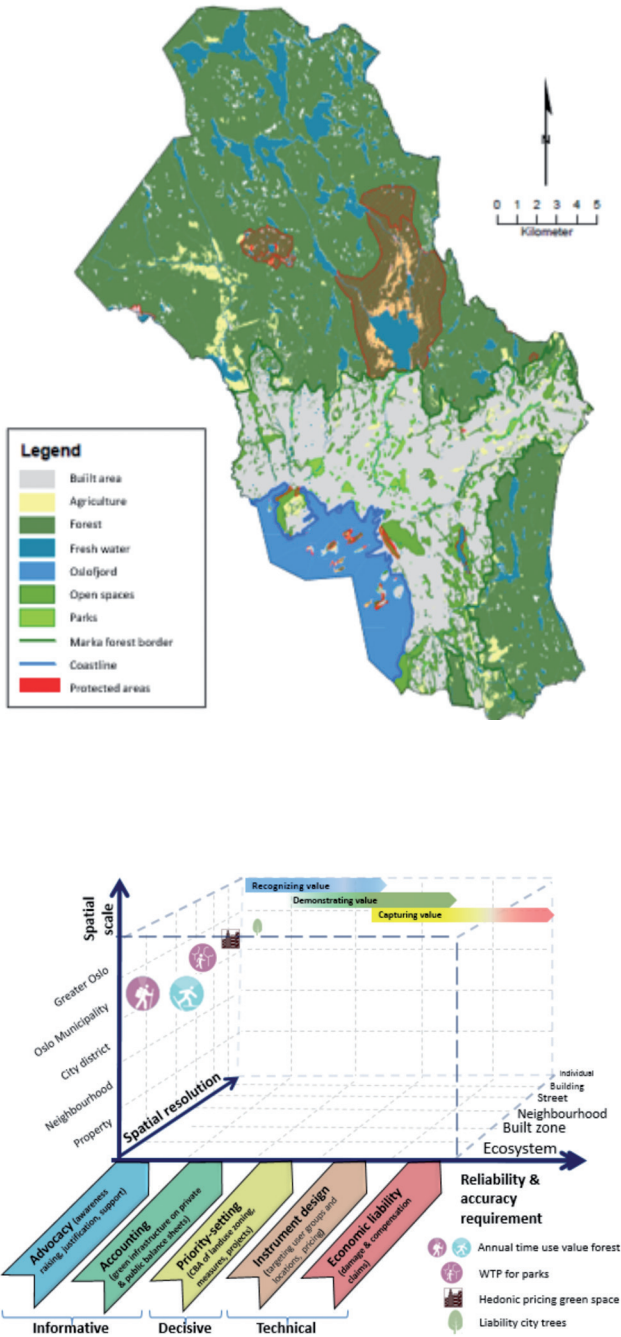
### 3. GUIDING FRAMEWORK FOR MONETARY VALUATION

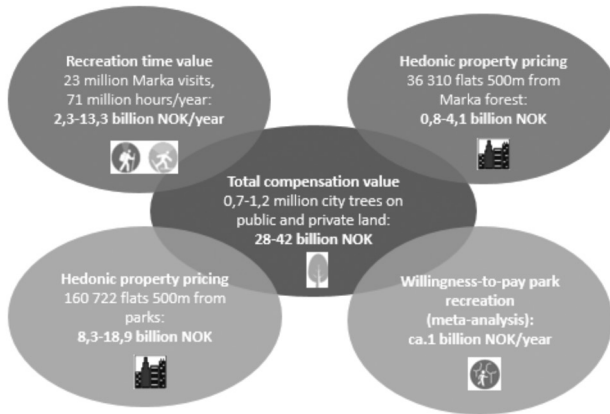
Kallis et al. (2013) suggest that the question is not “to value, or not to value” ecosystem services in monetary terms, but rather when and where to value monetarily. They propose a Guiding Framework of control questions for when monetary valuation of ecosystem services can be ‘desirable’. Table 1 summarises the questions which define the contexts in which monetary valuation is desirable from an ecological and political economic point of view.

A valuation method is desirable if it improves environmental conditions, reduces inequalities or redistributes power to the weak, does not suppress other valuation language and value articulating institutions, and does not serve a process of enclosing commons. Valuation may be acceptable if some of the criteria are met only partially, depending on the context.

In the example from Oslo we ask whether the additionality and equality criteria can be evaluated *ex ante* or in the short term if environmental and distribution impacts of policies take time to observe. We have to interpret questions 1 and 2 in terms of subjective prior likelihoods. Question 3 must be assessed on the contents of the study at hand. Is a monetary valuation study that does not refer to other types of values interpreted as suppressing other languages, or can it be seen as one more type of advocacy in public for a with many voices? Kallis et al. (2013) hold monetary valuation to high standards based on the assumption that monetisation is already a dominant language, but this assumption has also been questioned (Laurans et al., 2013). Question 4 is also difficult to answer in the context of decision-support. Strictly speaking, it is possible to answer by looking at the rights allocation assumptions of the monetary valuation method. However, enclosure from privatization of rights ultimately depends on how policy-makers use information from valuation studies in the policy process. As a whole, Kallis et al. (2013) guiding framework could be seen as a form of ‘safe minimum standards’ for monetary valuation. We also note that Kallis and co-authors examples all concern implementation of economic instruments (damage compensation, water pricing, markets and public payments for ecosystem services). Their examples do not address ecosystem service assessment and valuation methods *per se*. In the case study below we therefore subject four monetary valuation methods to criteria in the Guiding Framework laid out in Table 1.

Figure 7. Overlapping monetary values of urban cultural ecosystem services for the purpose of advocacy in Oslo





#### 4. CASE STUDY ASSESSMENT OF MONETARY VALUATION METHODS

Oslo Municipality covers an area of 454 km<sup>2</sup> of which 287 km<sup>2</sup> are forest, and 28 km<sup>2</sup> of green space within the built zone (grey area in upper panel Figure 7). Norway's capital has a population of 650 000 (2015), predicted to rise to 820 000 by 2030 (OsloKommune, 2015). It is Europe's fastest growing capital city in percentage terms. Oslo's peri-urban forest border, or 'Markagrense', is protected by law, obliging the municipality's population growth to be accommodated through a densification strategy around transport nodes, in industrial transformation zones, or de facto through growth into neighbouring municipalities.

Several monetary valuation studies were carried out at municipal level (Barton et al., 2015a; Barton et al., 2015b) and neighbourhood/project level (Reinvang et al., 2014) in the same period as the public hearing process for the municipal plan for 2030 was under way (OsloKommune, 2015). Here we focus on the municipal level studies for the purposes of 'awareness-raising', or 'advocacy' sensu Laurens et al. (2013) (middle panel Figure 7). The methods used were

1. Willingness-to-pay for parks based on a meta-analysis benefits transfer
2. Hedonic property pricing green space proximity
3. Value of annual recreation time in Marka forest
4. Compensation value for city trees using economic liability on municipal land

The two methods looking at recreation in green spaces (1) and the peri-urban forest (3) found annual values between one and several billion Norwegian kroner. The value of green spaces in property prices (2) and the liability value of city trees

(4) revealed capital values in the range of tens of billions of Norwegian kroner. Cultural ecosystem service values are derived from assessments of trees and forest in different partially overlapping spatial contexts (illustration lower panel, Figure 7). Barton et al. (2015) acknowledge that monetary values overlap and are ‘double counted’ in some cases. Following Kallis et al. (2013) we next subject each monetary valuation method to the four questions of the guiding framework. Conclusions are summarised in Table 2.

Table 2. To do or not to do valuation for the purpose of advocacy?

Valuation study	Improves environment?	Reduces inequalities?	Suppresses other valuation language?	Promotes enclosure?	Value?
1. Willingness-to-pay for parks	No	No	No	Maybe	No
2. Hedonic property pricing of green space	Maybe	No?	No	No	Maybe
3. Value of recreational time use in forests	No	No	No	No	Maybe
4. Economic liability for city trees	Yes?	Yes?	No	No	Yes

#### 4.1. WILLINGNESS-TO-PAY FOR PARKS BASED ON A META-ANALYSIS BENEFITS TRANSFER?

Barton et al. (2015) calculated total WTP for green spaces in Oslo using a meta-analysis function of willingness-to-pay to conserve green space (Brander and Koetse, 2011) adjusting for income and green space area. *Will the environment be improved by using this valuation method?* No. Probably not given the existing protected status that most green spaces have as parks in city landuse zoning. Unless a bespoke WTP study was targeted at the smallest unregulated green spaces in the city, it is difficult to argue that monetary estimates would make any contribution to existing zoning plans. For new neighbourhoods we might be able to answer ‘yes’ only if we can demonstrate that WTP was a decisive argument in establishing new parks. That does not seem likely. *Is inequality reduced?* No. Probably not, unless WTP provided the decisive argument for planning new parks in poor neighbourhoods with low access to green spaces. The value transfer does not have this spatial resolution. *Does the valuation method suppress value plurality?* No. Given that the discussion on valuation of urban ecosystem services is only a few years old in Norway (Lindhjem and Sørheim, 2012) and there are few previous examples of monetary valuation of urban green space in Oslo (Strand and Wahl, 1997; Sælen and Ericson, 2013) I would argue that it has not been familiar in urban planning circles. If that

is true monetary valuation actually adds a valuation language to the debate in Oslo on urban planning. *Is a process of enclosure of the commons promoted by the valuation method?* Maybe. The premise for WTP estimates transferred to Oslo from other studies is that households would pay a municipal tax that would go towards conserving green space. If the municipal taxes were not introduced, parks in Oslo would probably not decline, thanks to protection in the zoning plan. The services delivered by parks are not obviously conditional on a new tax. The language of the WTP contributes to a ‘discourse of enclosure’, but a municipal tax earmarked parks would not change the right of free access to parks. On the other hand, the reliability of the WTP estimates are open to attack on purely methodological grounds for being transferred to an inappropriate institutional context. In summary, the Guidance Framework would probably council ‘do not value’ city parks ecosystem services using value transfer of WTP. At best the value transfer method is an (admittedly low cost) undertaking with little impact on operational city planning. At worst it promotes a discourse of enclosure.

#### **4.2. Hedonic property pricing of green space proximity?**

Barton et al. (2015) calculated the total incremental capital value of apartments’ proximity to parks, open spaces, water features in parks, Oslo’s coastline and peri-urban forest. *Will the environment be improved by using this valuation method?* Maybe. Not from applying the method itself. However, if estimates are found credible by planners, property developers and apartment owners, it advocates more use of green and blue structures in planning of new neighbourhoods, and conservation of green infrastructure in the face of urban densification. *Is inequality reduced?* No. Not initially. The hedonic value of green spaces is expressed through the property market and preferences of home-buyers who by definition have access to enough capital and have incomes to maintain a mortgage. If there is reason to believe their preferences for proximity to green space are different from those of households without access to mortgages, and hedonic pricing results are used to target particular types of green space, then hedonic pricing may increase inequality. The questions cannot be answered without knowing how value estimates are used for decision-support. *Does the valuation method suppress value plurality?* No. The hedonic pricing method on its own does not recognise other types of value, but if reported in context with other valuation methods it promotes value plurality, as argued above. *Is a process of enclosure of the commons promoted by the valuation method?* No. The property market—used to reveal hedonic values of proximity to green space—is already ‘enclosed’ or commodified. On the contrary, the hedonic property method derives value from the fact that the proximal green spaces are public and open access to the private property owner. In summary, the Guidance Framework would council ‘maybe value’, depending on some further assumptions about the preferences of the poor for green space, and how the valuation results would be used for decision-support.



### 4.3. Value of annual recreation time in Marka forest?

Barton et al. (2015) calculated the total annual visits and hours spent in Oslo's peri-urban 'Marka' forest using existing survey data for the adult population of Oslo (Synnovate, 2011). Total time spent in the forest is valued using different methods to test robustness: opportunity costs of labour after tax, choice experiment and travel cost from a previous studies (Sælen and Ericson, 2013). *Will the environment be improved by using this valuation method?* No. Not directly for the same reasons as under 4.1. The Marka forest is protected by a special law which regulates the management of the forest for recreational purposes. The aggregate valuation does not address trade-offs in how different recreational activities are zoned within the forest, nor forestry impact on recreation. *Is inequality reduced?* No. We cannot argue that aggregate estimates of value across a whole forest ecosystem helps groups with poor access. In fact, the method only accounts for time spent by adults responding to surveys. Time spent by children is not captured, and immigrants are often poorly represented in panels used for surveys of Oslo's population. *Does the valuation method suppress value plurality?* No. In this case non-monetary methods (time use) were used together with stated and revealed preference valuation methods. *Is a process of enclosure of the commons promoted by the valuation method?* No. The valuation methods make no assumptions about changes in property or use rights in order to elicit values. In summary, the Guidance Framework would probably council 'maybe value'. The valuation methods are low cost, but also unlikely to make any operational impacts on zoning of forest landuses.

### 4.4. Compensation value for city trees using economic liability on municipal land?

Barton et al. (2015) used Oslo municipality's VAT03 assessment method for compensation value of damaged city trees (Randrup, 2005) to estimate the total economic liability value of 700 000–1,2 million city trees taller than 5 meters in Oslo's built zone. *Will the environment be improved by using this valuation method?* Yes. The VAT03 assessment method is already applied to calculate compensation values for damage to individual trees on municipal land, arguably providing an additional incentive to protect Oslo's trees. One could argue that using the method to calculate an aggregate potential economic liability contributes to making the responsibility for city trees more widely known in the population. However, we have no data on actual environmental impact of the VAT03 method, only a hypothesis awaiting further impact analysis. *Is inequality reduced?* Maybe. If we can argue that street trees are conserved to a greater extent, then we can also make a case that this favours poorer households in the inner city disproportionately, because the greatest concentration of trees on municipal land are found here. In the outer city, most individual trees are on private property, or in parks accessible to the whole population. *Does the valuation method suppress value plurality?* No. The compensation value of municipal trees complements municipal regulation protecting trees. Compensation value comes into play in situations of negligent

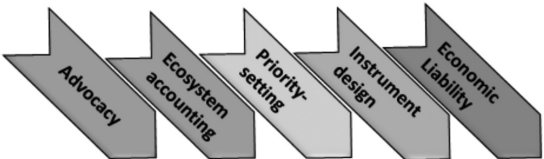


or wilful damage, motivated by the multiple ecosystem services values that are qualified in the VAT03 assessment methodology. *Is a process of enclosure of the commons promoted by the valuation method?* No. Quite the reverse. Applying the VAT03 method also to city trees on private land actually promotes the idea that there are public values of privately owned trees. In summary, the Guidance Framework would probably council ‘to value’.

### 5. DECISION CONTEXT DEPENDENT USE OF MONETARY VALUATION METHODS

By applying Kallis et al. (2013) Guiding Framework we concluded that we should probably not apply value transfer using WTP, maybe apply hedonic pricing and time use valuation, maybe apply recreational time valuation, and probably value the economic liability for city trees (Table 2). The framework is able to discriminate monetary valuation methods in our case study, as it did for economic instruments in the original paper. However, we saw that many of the answers depended on assumptions about the purpose of the valuation study. Barton et al. (2015) reported aggregate values from different types of urban green infrastructure framed as awareness-raising, with low requirements for accuracy and reliability. Valuation of urban ecosystem services in this case is *advocacy* for conservation of urban green infrastructure. Should Kallis et al. (2013) criteria be applied less rigorously in such an advocacy context? In the context of Oslo we would have to assess whether the ‘monetary narrative’ of willingness-to-pay for conserving urban parks is outweighed by the danger of promoting a ‘discourse of enclosure’. The answer depends on the extent to which different narratives currently play a role in the debate in Oslo.

Table 3. To do or not to do monetary valuation for decisive and technical purposes?



Valuation method	Possible applications of method				
1. Willingness-to-pay for parks					
2. Hedonic property pricing of green space					
3. Value of recreational time use in forests					
4. Economic liability for city trees					

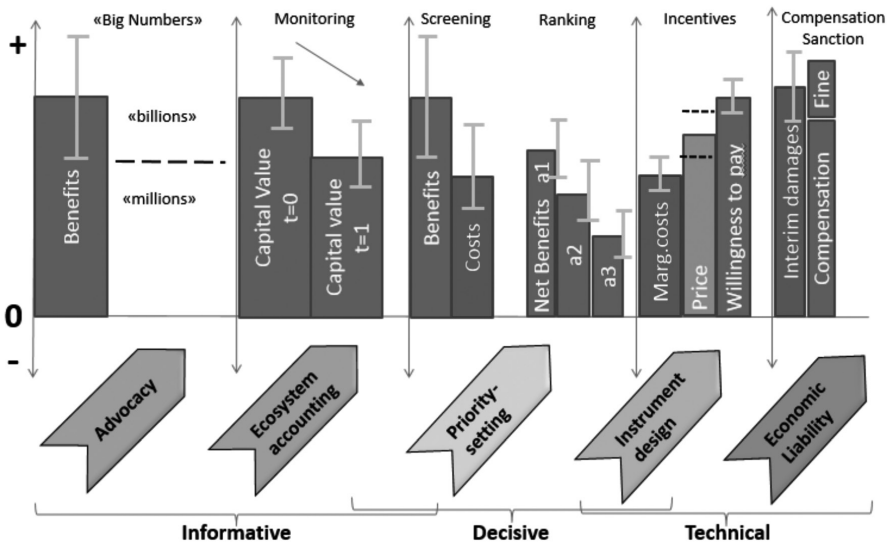
Source: based on Barton et al. (2015)

Barton et al. (2015) also assess the possible decisive and technical purposes that these valuation methods could be applied to if they had higher spatial resolution. Table 3 summarises these recommendations showing what types of contexts we found could potentially be relevant for the different valuation methods when higher resolution and more data was available. Should Kallis et al. criteria apply equally across all these purposes?

From the examples used by Kallis et al. (2013) they seem to have been devised mainly for the context of instrument design and liability. Monetary valuation methods as used in priority-setting or accounting is not tested with their framework.

If we look more closely at the first criteria of their Framework —whether monetary valuation reduces environmental impact—we can show how the purpose of the valuation determines whether we answer ‘yes’, ‘maybe’ or ‘no’. Figure 3 illustrates the hypothesis that lies behind the horizontal axis in Figure 7 (middle panel); requirements for reliability are increasing as we pass from informative, through decisive, to technical purposes of valuation (in the sense defined by Laurens et al. (2013)).

Figure 8. Increasing demands for accuracy of monetary valuation in different decision-support contexts.



In figure 3 *accuracy* is illustrated with error bars in relation to the expected value of benefits and costs (i.e. a coefficient of variation). *Reliability* refers to whether decisions can be made repeatedly with the confidence level required by the decision-maker using the valuation information (Schroter et al., 2014).

The *advocacy* in Barton et al. (2015a) uses monetary valuation methods to show that “nature in Oslo is worth billions”. Monetary valuation methods that only show “millions” for ecosystem services at municipal level do not have the same “big numbers” effect. What constitutes an ‘awareness-raising number’ depends on expectations and points of comparison. Billions are “big numbers” relative to site specific studies (Reinvang et al., 2014), and operate at the same magnitude as for example as municipal budgets. In the case of ecosystem *accounting*, the purpose is monitoring natural capital. Monetary valuation needs to have sufficient accuracy to identify trends in the value of ecosystem services. In *priority-setting* there are several distinctions to be made. A familiar distinction in benefit-cost analysis is between *screening* –taking action based on confidence about benefits being greater than costs —and *ranking*— identifying with confidence the decision alternative with the highest net benefits. Ranking requires greater accuracy than screening. For *instrument design*, such as water pricing or PES (Kallis et al., 2013), prices must either cover full economic costs, or in a role as incentives be higher than opportunity costs, but lower than willingness-to-pay (with some level of confidence). We see this as at least, or more, demanding than ranking. Finally, in a legal setting economic liability for interim damages (before ecosystem services recover) would seem to place the highest standards on monetary estimates. We assume here that reliability and accuracy of monetary valuation results must stand up to a high level of scrutiny in court by a jury. The extent to which punitive fines —negative incentives— are considered, complicates this picture.

Notwithstanding our simplifications, in each setting we can see that monetary valuation has insufficient reliability and accuracy if it leads to either no advocacy; no identification of trends; or even worse, to false positive errors in screening of policies; choosing a suboptimal design alternative; have no or perverse incentive effects; or entail lacking or excessive compensation and ‘unfairness’ to one of the parties. In each case we would argue that environmental impacts were not improved by the monetary valuation method because it was applied inappropriately for the requirements of the context.

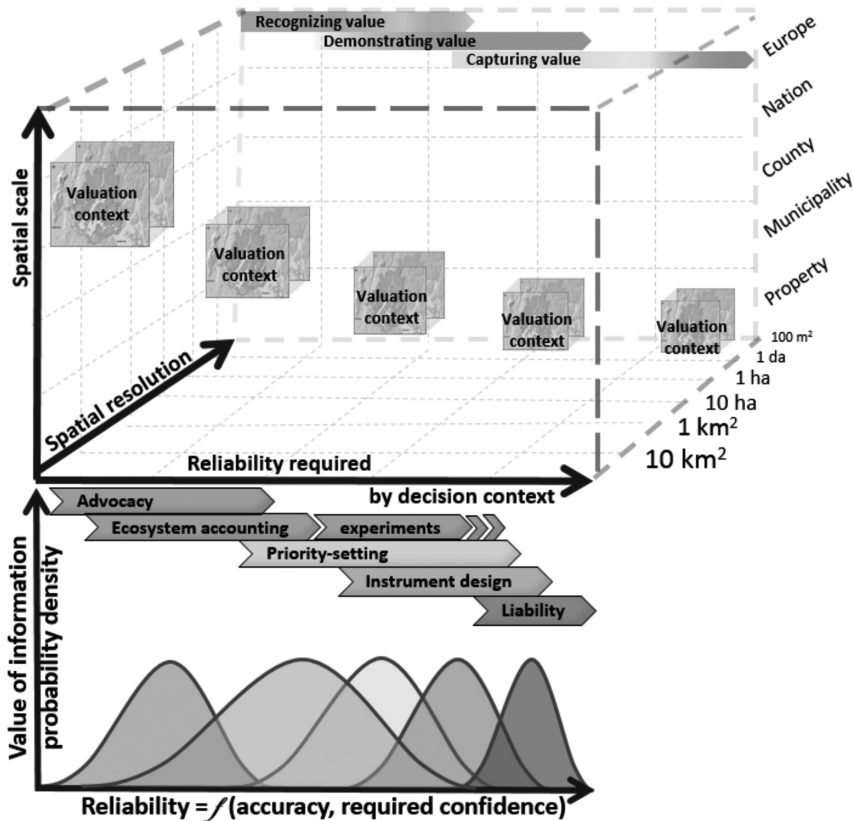
Criteria for ‘desirable’ valuation in one setting may lead to the opposite conclusion in another setting. For example, cultural ecosystem service values in Barton et al. (2015) should not be aggregated because they partially assess trees and forest in different overlapping spatial contexts in Oslo. This would lead to double counting in the context of national *accounts* or *priority-setting* using benefit-cost analysis. However, for the purpose of *advocacy*, we argue that overlapping values provide mutual support (providing they are of the same magnitude). What carries greater weight in public advocacy, one big aggregate value, or several mutually supporting values? One argument or many supporting arguments?

Different decision-support contexts with different requirements for reliability, mean that the information value of monetary valuation methods —of any valuation method— varies with purpose. Information value —the benefits of improved decisions— should also be judged against the information costs of

conducting different valuation methods (Figure 9). With the examples from Oslo we have implicitly been arguing that sometimes study costs may be justified if the information costs are low (value transfer), the purpose is advocacy, despite not meeting all the criteria for ‘desirable’ valuation.

As argued by Kallis et al. (2013) and illustrated in section 2, monetary values are highly context specific in a number of ways. Context specificity requires higher resolution of valuation methods. Urban ecosystem services challenge the capabilities of both socio-cultural and monetary valuation methods (Gómez-Baggethun and Barton, 2013). Further work is needed in exploring the boundaries of spatial and temporal resolution and decision-support contexts where monetary valuation methods complement one another. And where ecological and socio-cultural valuation methods start to have higher information value than monetary valuation methods.

Figure 9 To do or not to do monetary valuation is a question of a method’s information value relative to the accuracy and reliability requirements in different decision-support contexts.



Source: based on Gomez-Baggethun and Barton (2013) and Schröter et al. (2014)

## CONCLUSIONS

In this chapter we reviewed different ‘fundamental inadequacies’ of monetary valuation methods. We concluded that the principle inadequacies relate in some way or another to lacking recognition of context. We presented Kallis et al. (2013) Guiding Framework for monetary valuation and applied it to four examples from Oslo found in Barton et al. (2015). Based on this test, we suggest that criteria for applying monetary valuation should include the decision-support context for which monetary valuation is intended (Gomez-Baggethun and Barton, 2013). We argue that Kallis et al. (2013) criteria were developed for decision contexts where valuation is being used to inform *instrument design* and *economic liability*, but lack a discussion of monetary valuation for use in *priority-setting*, *accounting* and *advocacy*. We also argue that paying more attention to the required accuracy and reliability of monetary valuation, conditional on decision-support context, spatial scale and resolution, will go some way to providing further guidance on when monetary valuation can meet the ‘environmental additionality’ criteria.

Whether monetary valuation methods are fit-for-purpose will depend in large part on how much context specificity is required by decision-makers. Whether we can afford to obtain the information or not, there is a lower limit to the information value of a valuation method when information costs exceed the net benefits of the decision under scrutiny. This lower limit must be real in both a temporal and spatial sense, although there is little research to support where it lies (it will depend on the context...).

An underlying premise of Kallis et al. (2013) framework is that monetary valuation is the dominant discourse in the place where the method is being applied, and perhaps also that its influence is on the increase. Barton et al.(2015) argue that this is not the case in Norwegian nature management policy, nor in municipal planning in Oslo. While there is considerable interest from authorities in whether monetary valuation of ES can make a difference in planning and operational decisions at municipal level, it is difficult to argue that monetary valuation has or will soon gain a hegemony in public discourse.

To do or not to do monetary valuation is a question of a method’s information value relative to the reliability requirements of different decision-support contexts. Just as monetary values are conditioned by institutional and socio-cultural context, so are the answers to when valuation is desirable.

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