

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/81788> holds various files of this Leiden University dissertation.

**Author:** Schild, J.E.M.

**Title:** The monetary valuation of water-related ecosystem services

**Issue Date:** 2019-12-11

# Summary

Ecosystems are vital for life on earth. They provide food and freshwater, sequester carbon, purify water, prevent soil erosion, and provide opportunities for recreation and tourism, amongst others. While ecosystems thus have concrete benefits for human society, these benefits are typically overlooked in policymaking. This is problematic because ecosystems – and thus the benefits that ecosystems provide – are under increasing pressure from human actions. The ecosystem services concept aims to better reflect the benefits of ecosystems for human well-being, such that the human impact on ecosystems can better be accounted for in policy and decision-making.

As a tool to quantify ecosystem services, their value is often estimated in monetary terms. This thesis investigates whether this approach is valid in ecological terms: do monetary value estimates adequately reflect the ecological status of the ecosystem? Two sets of water-related services in two different types of regions have been investigated: water quantity-related services in global drylands (chapters 2 and 3) and water quality-related services in the Scheldt river basin (chapters 4 and 5).

Chapter 2 investigates the factors that determine the estimated monetary values for water quantity-related services in drylands. As the ecological status of the ecosystem is expected to determine the ecosystem services that can be produced, but their impact on monetary values has only been limitedly investigated so far, this chapter focuses on analyzing an extensive set of indicators that reflect the ecological status of the drylands under consideration. This chapter is based on a comprehensive meta-analysis of 559 observations that have been collected from 66 valuation studies in drylands worldwide, to which local indicators for ecosystem and beneficiary characteristics have been added (in addition to indicators for the selected methodological approach). This allows to examine the relative importance of various indicators in explaining the monetary value estimates for nine water quantity-related services by means of a multiple regression analysis. The results show that ecosystem and beneficiary conditions are marginally important in explaining estimated values, indicating that local dryland conditions are not sufficiently captured with current monetary valuation approaches, while methodological factors, including valuation method and study extent, heavily influence estimated values. This suggests that monetary valuation outcomes are largely determined by the selected methodology. These findings emphasize the need to improve monetary valuation methods so that they better capture local dryland conditions in order to be able to serve as a meaningful tool for decision-making.

Given that monetary valuation has been found to depend on the type of ecosystem under consideration and the choice of valuation method, chapter 3 further explores these factors for the monetary valuation of water quantity-related services and their impact on value aggregation. This chapter investigates monetary value estimates for water quantity-related services in a quantitative manner using a dataset of 512 observations collected from 57 studies located in drylands worldwide. Results reveal that estimated monetary values for water quantity-related services depend on the type of ecosystem and valuation method under consideration. Cultivated lands had high mean values for provisioning services, in particular food provision, but low

values for regulating services. In dry forests, biodiversity-related services were estimated high, in contrast to those in semi-deserts and arid wetlands. Compared to other valuation methods, market pricing estimated low values for climate regulation and high values for biological regulation. Several of these differential effects have a significant impact on aggregated mean values for water quantity-related services. For instance, market pricing was found to significantly affect the mean value for climate and biological regulation. These results highlight the importance of explicit consideration of valuation methods and ecosystem types in monetary valuation, which could lead to more accurate approximation of monetary values for ecosystem services.

Whereas chapters 2 and 3 analyze a wide array of different valuation methods, chapter 4 zooms in on the willingness to pay method, which is a commonly used method to estimate the monetary value of ecosystem services by asking people for their willingness to pay for a service. Chapter 4 investigates whether spatial characteristics of the landscape influence values for water quality-related services in the Scheldt river basin. The role of actual, empirically measured water quality, distance to the nearest water body and local land cover are analyzed – next to effects for socio-economic, respondent and survey characteristics. The role of these different types of characteristics has been analyzed using regression analysis for two different types of willingness to pay questions: a dichotomous choice (yes or no) question and an open-ended question. When evaluating the effect sizes of the different groups of characteristics, both types of willingness to pay are best explained by survey and socio-economic characteristics. Specifically, bid price, certainty about the bid, income, region and credibility of the policy measure are most important in explaining variation in willingness to pay. Spatial characteristics, and particularly actual water quality, only play a small role in explaining willingness to pay. Hence, also here specific methodological characteristics appear to be of major influence on monetary values for water quality-related services, while only a minor part of the variation is explained by actual water quality – the key ecosystem characteristic – and other spatial characteristics. This finding casts doubts upon the use of willingness to pay as a method to estimate the public benefits of water quality improvements.

While chapter 4 thus finds that willingness to pay is only marginally explained by actual water quality, it also finds that perceptions of water quality influence the willingness to pay to some extent. These findings raise the question whether perceptions of water quality are actually related to the actual water quality. This question is highly relevant as public perceptions of water quality are essential for the public support for water quality improvements, especially for river basins that do not yet meet good standards such as the Scheldt river basin in western Europe. Chapter 5 therefore examines whether the perception of local water quality and the importance attached to water quality improvements are related to the actual, measured water quality and how this relation is affected by socio-economic conditions of the local inhabitants. This was analyzed for a dataset of 1,036 observations using ordered logistic regression. The results show that although people can differentiate between ‘good’ and ‘not good’ water quality, they cannot distinguish between more subtle differences in water quality status. As such, they take actual water quality incorrectly into account, if they take it into account at all. Especially men appear to misjudge the water quality. It is also found that most of the respondents find water quality improvements important, irrespective of the actual water quality. Together, this shows that public understanding of the actual water quality is often lacking. Hence, it is not

surprising that actual water quality only marginally affected willingness to pay as estimated in chapter 4. The findings also imply that it is vital to improve public understanding of actual water quality and its impact on the delivery of water quality-related services in order to win public support for water quality improvement programs.

Jointly, the results of this thesis show that the selected methodological approach to estimate the value of ecosystem services in monetary terms has a dominant impact on value estimates for water-related services, while the ecological status of the ecosystem is of minor importance. This finding casts doubts upon the validity of monetary valuation as a means to take the ecological status of ecosystems into account in public decision-making. For the ecosystem services concept to be truly of value for policy and decision-making, valuation methods need to be further improved such that they better account for the ecosystem's ecological status. Specifically, this asks for a thorough exploration how the ecological status of the ecosystem can be better integrated in ecosystem services valuation.