

Water assessment in a peri-urban watershed in Mexico City: A focus on an ecosystem services approach



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ABSTRACT

Among hydrological ecosystem services, water supply is one of the most relevant to society because of its role in human wellbeing; accordingly, it has been significantly modified worldwide. There has been a recent increase in the necessity of combining methods and tools to create interdisciplinary evaluations of water ecosystem services, especially in developing countries where there is a lack of systematized and updated socioenvironmental information. We propose a framework for the assessment of water supply ecosystem services that includes environmental, social and economic dimensions. We describe and develop each of these dimensions with a particular focus on identifying the key variables that are needed to answer them. First, we performed research of the literature regarding the evaluation methods that are sufficiently flexible to apply them to local scales in countries where information is limited. Then, we chose the Magdalena River Watershed to apply this perspective because it is an illustrative area of vital importance to Mexico City's ecosystem services. We believe that this proposal has outlined basic guidelines to help decision makers improve water management and may provide an opportunity to change public policies on peri-urban ecosystems.

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1. Introduction

Among all ecosystem services (ES), the ES that are related to water (ESw) are some of the most relevant to society because of their role in human wellbeing (Falkenmark and Folke, 2003; Brauman et al., 2007). In particular, water supply (ESws) is one of the ES that has been significantly modified worldwide because of century-old sociopolitical issues that have induced intensive and extensive land transformations (Rockström et al., 2009).

Authors such as Pahl-Wostl et al. (2011) and Maass (2012) suggest that water management must be conducted holistically by contemplating the following three basic aspects: a) to view water as an integrated natural resource in a particular socio-ecosystem context; b) to use an ES approach to translate the biophysical

functioning of ecosystems and their processes into terms that relate to human welfare; and c) to recognize watersheds as the natural ecosystem's functional units.

Watersheds have integral multidimensional and multifunctional scenarios that are ideal for promoting transdisciplinary research where biophysical and social processes can be analyzed together. Additionally, the use of watersheds as management units allows the identification of geographical areas where ES are generated and consumed and the location of the stakeholders and beneficiaries who are associated with these service dynamics (Flotemersch et al., 2015).

Peri-urban watersheds are the main source of ES for urban populations (Bouland and Hunhammar, 2009). Despite this importance, the value of peri-urban watersheds has been underestimated and has resulted in ecologically unsustainable land-use planning (Niemelä et al., 2010). This situation is concerning given that the ES that these areas provide heavily depend on land management strategies, which, in turn, depend on landowners'

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views and level of control over ecosystems and resources (Kroll et al., 2012; Cáceres et al., 2015).

The relationship between cities and ESws is crucial, particularly in large cities that require a substantial amount of water and consequently produce a considerable amount of domestic and industrial wastewater, which negatively affects their freshwater systems (UNESCO, 2010). Therefore, an ES approach to water management would help to convince authorities to integrate natural ecosystems into city management programs (Niemelä et al., 2010) because this approach elucidates how ecosystems affect human welfare.

In recent years, several proposals have been made to evaluate ESw. Although the conceptual framework of ES is understood from an interdisciplinary perspective, these types of studies have been atomized (Cáceres et al., 2015). Most studies have focused either on biophysical assessments or economic value (Hackbart et al., 2017; Villegas-Palacio et al., 2016), and few studies have addressed the social assessment (Chan et al., 2012; Martín-López et al., 2012; Cáceres et al., 2015).

In this sense, Brauman et al. (2007) proposes an assessment framework that considers the evaluation of ESw from a more holistic point of view. However, no specification of the methods to evaluate the daily practice is provided, and applying the method in specific contexts is complicated. Thus, it has been recently increasingly necessary to combine methods and tools to create interdisciplinary evaluations of ESw (Hackbart et al., 2017).

Another obstacle is that developing countries lack socioenvironmental information that is systematized and updated. In these

countries, interdisciplinary evaluations are urgent because the maintenance of the environment is more vulnerable because of their current sociopolitical dynamics (Starkl et al., 2013). Consequently, to move from theory to reality in a region, it is necessary to improve past assessment frameworks by using the available information and evaluation methods.

Given the ESws is the most evident to human populations, an integrated evaluation of ESws must be present for the planning of public policies (Cowling et al., 2008). Based on the above discussion, our work poses the following research question: how can we assess ESws in areas with limited information?

Our objectives are to i) identify the methods to evaluate ESws from an interdisciplinary perspective that conforms to the previously mentioned limitations and ii) apply these methods to a case study of a peri-urban watershed in one of the largest cities in the world.

2. Methods

To identify the method to evaluate ESws, we propose an assessment framework that is based on other evaluation proposals (Brauman et al., 2007; Cáceres et al., 2015; Villegas-Palacio et al., 2016; Harrison-Atlas et al., 2016). Given that 1) all the components of the ecosystem have the same relevance in the evaluation and that 2) there is a certain liberty in the selection of evaluation methods, 3) this approach presents a transdisciplinary perspective to evaluate the service. The present assessment framework was

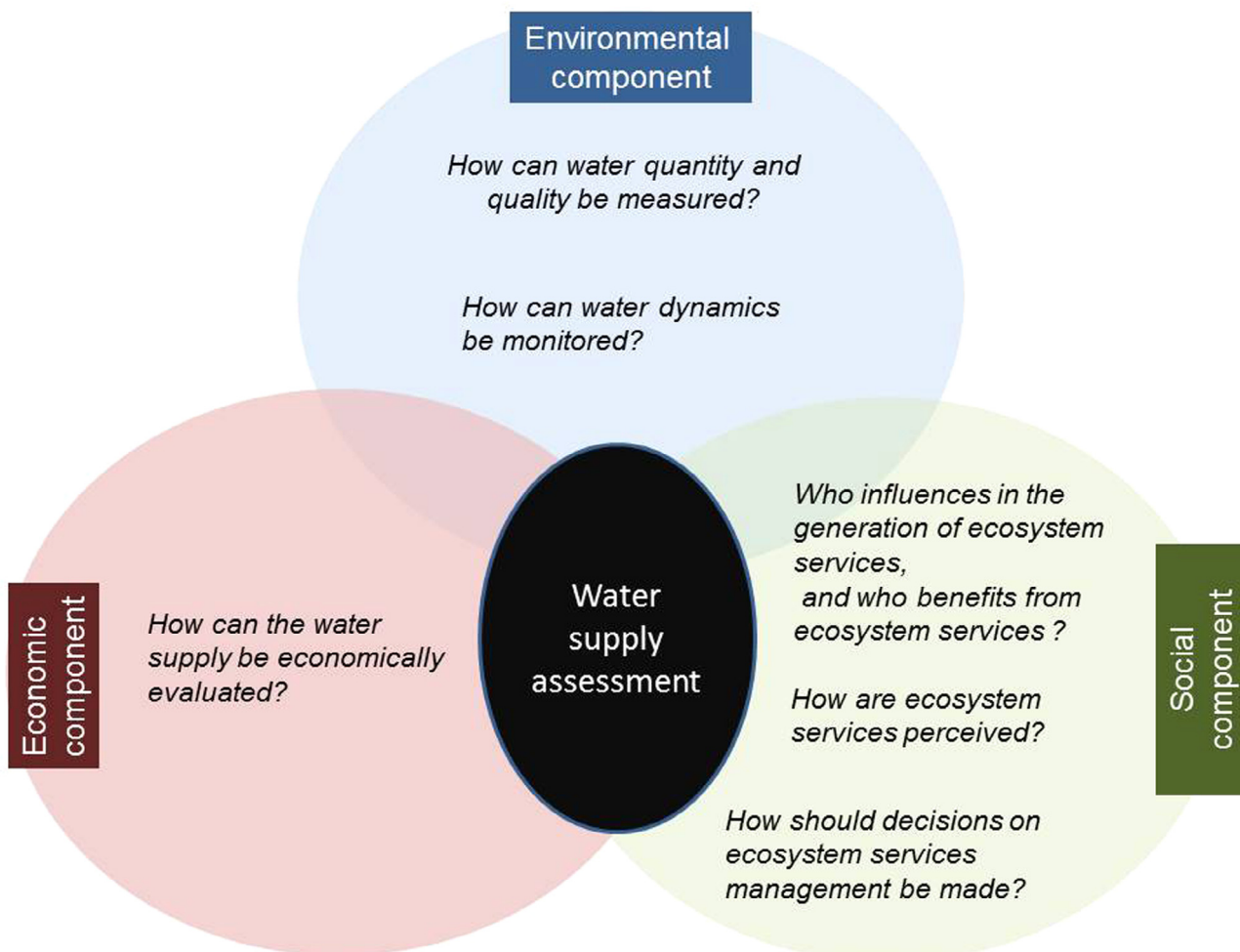


Fig. 1. Assessment framework for ecosystem service water supply.

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