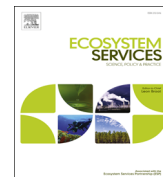




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A guiding framework for ecosystem services monetization in ecological–economic modeling



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ABSTRACT

Monetary valuation techniques are often used for evaluating the effect of a change in ecosystem services on components of human wellbeing, even though they face several drawbacks. This paper seeks to reconcile monetary valuation techniques with methods that address ecosystem–economy interactions by developing a guiding framework that limits the use of monetary valuation to various market simulations. Simulations of scenarios of environmental measures are carried out with a semi-dynamic hybrid input–output model. The guiding framework ensures that monetary valuation techniques contribute to the understanding of the impact of economic activities on changes in ecosystems services and the feedback impact of these changes on economic activities. The framework operates according to three criteria: (i) the category of ecosystem components (intermediate products, ecosystem services, benefits obtained from the ecosystem), (ii) existence of a market, intention to exchange or possibility for restoration or preservation, and (iii) direct/indirect monetary valuation techniques. The methodology is then tested with a case-study.

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1. Introduction

The ecosystem services paradigm¹ favors a better apprehension of interactions between the functioning of parts of ecosystems and components of human wellbeing such as leisure time, health, education, income, purchasing power, etc. (Fisher et al., 2009; Millennium Ecosystem Assessment (MA), 2005; Carpenter et al., 2006; Sachs and Reid, 2006). It focuses on preserving the ecosystem as a whole rather than on managing specific natural resources and uses. As a result, it provides a policy shift from previous resource- and species-centered visions of environmental preservation towards a new environmental policy vision based on the preservation of ecological functions and ecosystem services.

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¹ See definitions of the concept of ecosystem service in Millennium Ecosystem Assessment (MA) (2005), Costanza et al. (1997), Daily (1997), Boyd and Banzhaf (2007) and Fisher et al. (2009).

Monetary valuation techniques are often used for evaluating the effect of a change in ecosystem services on components of human wellbeing as they are a way to guide trade-offs in decision-making processes (Wincler, 2006). Many papers deal with the difficulty of valuating ecosystem services (e.g. Costanza et al., 1997; de Groot et al., 2002) and the complexity to apprehend interactions between ecological functionalities and the production of ecosystem services used by humans (Daily et al., 2009; Polasky et al., 2011). Other authors claim that monetary techniques may not correctly assess interactions between intermediate products provided by the ecosystem (biological structures or processes and ecological functions) and final products (ecosystem services and benefits) (Ackerman, 2004; Venkatachalam, 2007).

The classical methods for valuating non marketed goods are the direct and indirect valuation approaches (Smith et al., 1986). Contingent valuation is probably the best-known direct² valuation technique. Even though every precaution is taken in building up the

² Stated preference methods (contingent valuation, choice models) are named “direct approaches” because they consist in directly interviewing individuals and ask them the amount they would be willing to pay to restore one more unit of ecosystem service (e.g. create one more hectare of forest, increase marine fish population by one thousand individuals, etc.).

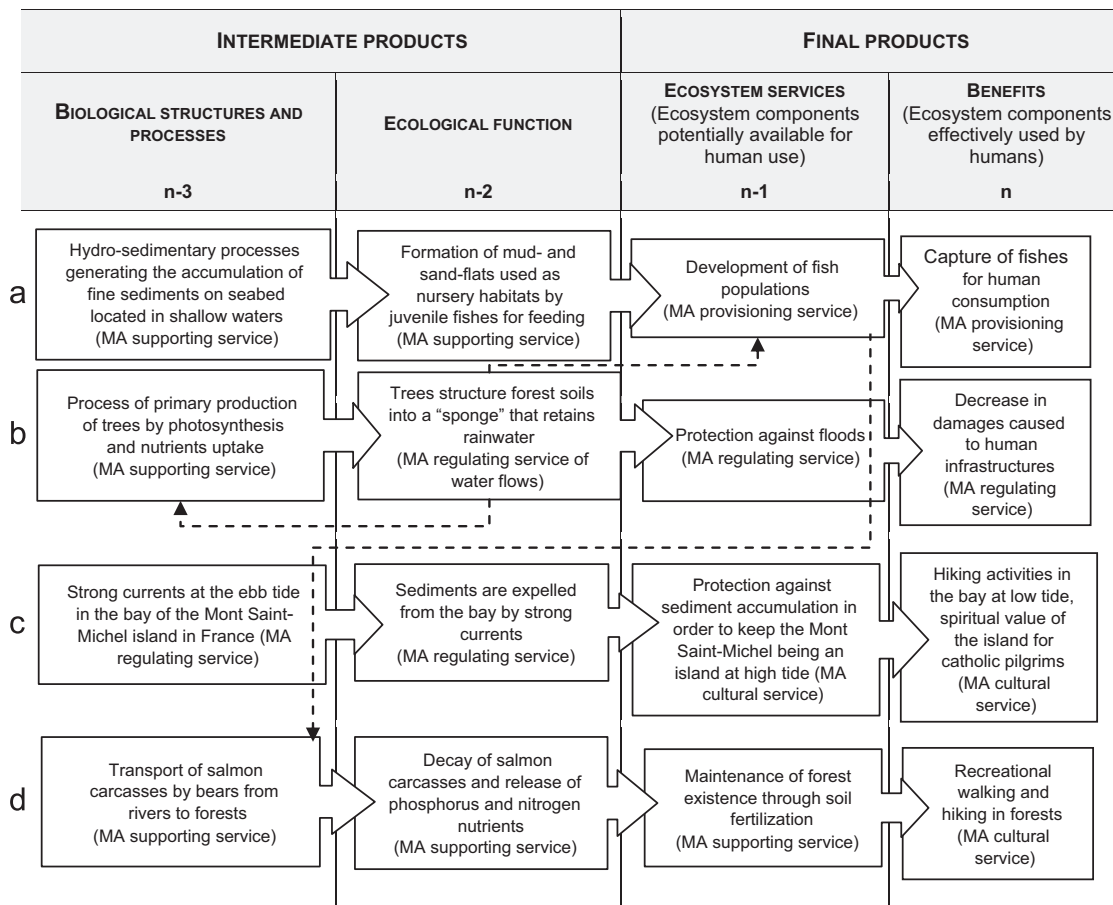


Fig. 1. Classification of ecosystem services based on the Haines-Young and Potschin (2010)'s cascade model.

questionnaire (Carson and Hanemann, 2005; Spash et al., 2009), some authors argue that most individuals would have problems weighing up complex or unfamiliar environmental issues with global effects occurring over a long period of time and/or large geographical scales (Markandya et al., 2005; O'Connor, 2000; Ashford, 1981) that can partly explain the price differential between environmental intention and action (Rowlands et al., 2003). Indirect³ methods, like hedonic pricing and travel cost, rely on observed behavior in related markets for valuing the ecosystems services.

Another valuation technique is that of benefit transfer (e.g. Plummer, 2009). If collecting primary data on the ecosystem service under consideration is either too expensive or too difficult, it is possible to transfer an existing valuation from an ecosystem (the study site) to a similar site in another location (the policy site). The procedure is to describe the policy site and the possible policy actions, to select existing studies providing a basis for a benefit transfer, to estimate a value for the relevant site and to apply it to the policy site or alternatively to draw up a benefit function relating an individual's willingness-to-pay (WTP) to a set of individual and site characteristics.

³ Revealed preference methods such as hedonic pricing are named "indirect approaches" because they estimate the willingness to pay without asking directly to people the amount they would pay for changes caused to ecosystem services. They utilize the fact that some market goods are in fact bundles of characteristics, some of which are ecosystem services (Pearce et al., 2006). By trading these market goods (e.g. houses in a neighborhood), consumers are thereby able to express their values for the ecosystem service (e.g. clean lake in the neighborhood), and these values can be uncovered through the use of statistical techniques used to estimate the price difference between houses located close to the clean lake and those located next to a polluted lake.

Whatever the method used, no one is exempt from criticism and even though a monetary valuation, albeit imperfect, has the advantage to bring about precious indications about ecosystem services, it can never be used as the sole decision making criterion as other social and ecological objectives (many of which may not be adequately captured by money metrics) must be considered as well.

That being said, although monetary valuation of ecosystem services suffers from several limits, this paper proposes a guiding framework for integrating monetary values into a larger approach based on the study of interactions between the ecosystem and the part of human wellbeing that depends on the economy. Carbone and Smith (2013) model the effect of air pollution on ecosystem services and health in a general equilibrium setting accounting for both use and non use services. They compute WTP measures of an ecosystem service and show that general equilibrium effects matter. This paper uses a different setting – an Input–Output (I–O) model – and limits the use of monetary valuation to "real"⁴ market simulations. Those market simulations, in which monetary values are inserted, are carried out inside a hybrid I–O model (Daly, 1968; Isard, 1968, Miller and Blair, 2009) that focuses on crossed interactions between components of the ecosystem and the economy and that has been semi-dynamized.

⁴ Real market simulations are considered later in the text but stated preference methods and constructed markets are also used in this paper and they obviously do not perfectly represent real market behavior. However, they can be considered as "potential market simulations" since we applied them to ecosystem services that could potentially be exchanged on a market (via a tax representing agents' WTP for example).

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