Ecological Indicators 48 (2015) 292–302

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

An ecological-economic approach to the valuation of ecosystem services to support biodiversity policy. A case study for nitrogen retention by Mediterranean rivers and lakes

Alessandra La Notte[a,b,*], Camino Liquete[c], Bruna Grizzetti[c], Joachim Maes[c], Benis N. Egoh[c,d], Maria Luisa Paracchini[c]

[a] University of Torino, Lungo Dora Siena 100 A, 10153 Torino, Italy
[b] Department of Agriculture of the Autonomous Province of Trento, Via Trener 3, 38131 Trento, Italy
[c] Joint Research Centre of the European Commission, Via Fermi 2749, 21027 Ispra, VA, Italy
[d] School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, Private Bag X01, Scottsville 3209, South Africa

ARTICLE INFO

Article history:
Received 26 September 2013
Received in revised form 29 July 2014
Accepted 4 August 2014

Keywords:
Ecosystem services
Economic valuation
Conservation policies
Water purification
Nitrogen retention

ABSTRACT

Several international initiatives have highlighted the need to prove the relevance of ecosystem services in monetary terms in order to make a comprehensive and compelling case for conservation of biodiversity. The different approaches and frameworks used so far have shown that there is no economic or monetary estimate of ecosystems or ecosystem services with absolute validity: any valuation exercise is always context-related and the theoretical rationale behind the applied valuation technique does matter. This study presents an approach for assessing ecosystem services in monetary terms to support conservation policies at the regional and continental scale. First we briefly review the foundation of environmental and ecological economics, second we explore the differences between economic models and the application of valuation techniques, third we try to pick the difference between the mainstream economic valuation approach and the translation of biophysical models' outcomes in monetary terms. Then we present and discuss a methodology suitable for associating a monetary cost to ecosystem services when the purpose addresses conservation policies. In order to provide a contribution, we show a practical case study on water purification in the northern Mediterranean region.

© 2014 Elsevier Ltd. All rights reserved.

1. Introduction

Biodiversity underpins most ecosystem processes and its decline affects the delivery of many ecosystem services (Isbell et al., 2011; Cardinale, 2011; Mace et al., 2012). The Millennium Ecosystem Assessment (MEA, 2005) has increased the awareness of the negative consequences of biodiversity loss by emphasizing the role of biodiversity in sustaining livelihood (e.g. local fisheries), economies (e.g. touristic sector) and human wellbeing (e.g. clean air or water). The recent policies at the global and European level have complemented the targets of biodiversity conservation with the arguments of maintaining the delivery of ecosystem services. The Convention on Biological Diversity (CBD) calls for the development of strategic plans envisioning that by 2020 ecosystems are resilient and they continue to provide essential services, thereby securing the planet's variety of life and contributing to human wellbeing. In the European Union (EU), in line with the CBD targets for 2020, the EU Biodiversity Strategy (European Commission, 2011; European Parliament, 2012) emphasizes the link of biodiversity with human well-being through ecosystem services, and seeks to improve the integration of biodiversity conservation in key sectoral policies, including environmental, agriculture, forest and fisheries sectors (COM(2011)244). The European Union is now implementing its updated strategy to mainstream the value of natural capital in diverse sectoral policies, such as the policies on resource efficiency (European Commission, 2011, COM(2011)571 final), environment (COM(2012)710 final), water (COM(2012)673 final) and Green Infrastructure (COM(2012)249). The EU Biodiversity Strategy to 2020 specifically demands that Member States map ecosystem services in their national territories by 2014 and value

* Corresponding author at: Department of Agriculture of the Autonomous Province of Trento, Via Trener 3, 38131 Trento, Italy. Tel.: +39 320 6788318.
E-mail addresses: alelanotte@gmail.com, alessandra.lanotte@unito.it (A. La Notte).

http://dx.doi.org/10.1016/j.ecolind.2014.08.006
1470-160X/© 2014 Elsevier Ltd. All rights reserved.

them by 2020. This involves the assessment of the spatial and temporal changes of ecosystem services at the regional scale and their economic valuation (Maes et al., 2012, 2013).

Some studies have shown a positive relationship between biodiversity and ecosystem services in different parts of the world (Chan et al., 2006; Egoh et al., 2009; Maes et al., 2012). Although the relationship is complex and currently debated, biodiversity has key roles in ecosystem processes and services (Mace et al., 2012). For example, Cardinale (2011) showed that biodiversity has a positive effect on nitrogen retention, which reduces nitrogen pollution in water bodies. At the same time, biodiversity in freshwater and coastal waters is threatened by high nutrient loadings, which produce hypoxia, fish kills, algal blooms and consequent negative impacts on human and ecosystem health (Diaz et al., 2010; Grizzetti et al., 2011; Sutton et al., 2013). Thus nitrogen retention benefits humans and biodiversity and concurrently is enhanced by biodiversity. Proving the relevance of biodiversity through their contribution to the provision of ecosystem services and valuing them in economic terms can make a comprehensive and compelling case for biodiversity conservation (TEEB, 2010). However, valuing ecosystems or the services they provide is very challenging and can be done using different approaches. Liu et al. (2010) track the milestones in the history of ecosystem service valuation. There is no economic or monetary estimate of ecosystems or ecosystem services with absolute validity: any valuation exercise is always context-related (i.e. the monetary valuation of ecosystem services is always useful as far as its purpose and application are clearly defined). Attributing monetary estimates to ecosystem services, in particular in the context of conservation, is not always without controversy (Farley, 2008; Gowdy et al., 2010; Abson and Termansen, 2011; Spangenberg and Settele, 2010).[1]

We aim at investigating how to integrate ecological and economic valuation metrics for the production of scientifically rigorous and politically relevant assessments. This paper presents an approach to attribute a monetary value to ecosystem services when the purpose is to support conservation policies related to both biodiversity and ecosystem services at the regional and continental scale. The approach is developed to allow mainstreaming biodiversity conservation into sectoral policies, using the concept of ecosystem services and their monetary valuation as stated above. This research is justified by the pressing requirements for monetary valuation by the new conservation policy strategies at the European scale that require incorporating ecosystem services into policy-making (Maes et al., 2012). The paper is organized in four parts. First it revisits the theoretical assumptions on which our statements are based, that is, the foundations of ecological economics. Secondly, it presents the proposed approach for linking ecosystem services and human well-being in conservation policies. Next, we show its application in a case study: the monetary valuation of the water purification (specifically nitrogen retention) service in the northern Mediterranean region. Finally, the paper discusses the key elements of the analysis undertaken.

2. The foundation of the economic valuation of nature. From environmental to ecological economics

A vast literature has been developed presenting arguments for the practical integration of natural and social sciences in the field of ecosystem services, in particular from an economic perspective (e.g. De Groot et al., 2002; Turner et al., 2003; Liu et al., 2010; Seppelt et al., 2011). Before linking ecological models with economic valuation techniques it is important to examine which economic paradigms are useful for integration. In this section we review the difference between environmental and ecological economics to explain the approach proposed in the paper.

Environmental economics was developed in the 19th century to correct market failures in the provision and use of environmental goods and services (Perman et al., 2011). At its core is the theory of externalities and its aim is the optimal allocation and the efficiency in the use of scarce resources. Externalities refer to the cost or benefit of an activity spilling over on a third party such as an ecosystem. In environmental economics, the interaction between economic agents and nature is implicit since the environment is considered as a sub-component of the economy. From a methodological point of view, environmental economics is based on the same concepts and tools as neoclassical economics. Among the main economic concepts are individualism,[2] rationality,[3] marginalism,[4] efficiency criterion[5] and general equilibrium models[6] extended to environmental issues. The major advantage of environmental economics lies in its analytical rigour and theoretical consistency due to the fact that the only discipline involved is economics even when dealing with environmental issues. The results are thus internally consistent. However, in some cases, environmental economics can be considered precise but not realistic (Bartelmus, 2008) in the sense that a single discipline cannot claim to provide an explanation of the complex dynamics of ecosystems. Eppink and van den Bergh (2007) illustrate that economic models applied to biodiversity conservation show a common trend: the inclusion of model components that address or aim to explain patterns of species diversity declines with increasing complexity of the economic model components. While cost-effectiveness and resource extraction models manage to include biodiversity at some level, macroeconomic growth and general equilibrium models do not. It would be scientifically very challenging to include ecological complexity in economic models without losing the capacity to obtain analytical solutions.

Ecological economics is a more recent discipline, finding its origin in the 1980s (Røpke, 2004; Gowdy and Erickson, 2005) and, unlike environmental economics, it is based on natural science. The role of the economic system is inserted in the global ecological system, which is characterized by limited resources and very high complexity. Under the ecological economics paradigm, different scientific disciplines need to interact and the final result is not necessarily expressed in monetary terms but other useful metrics can be used, such Ecological Footprint,[7] Habitat Equivalency Analysis,[8] Emergy[9] or DALY[10] (disability adjusted life year). Its major drawback is that different approaches to value ecosystems might not be comparable and consistent. Under this perspective economic activity is the main reason for environmental decline, so the studies are long-term, they support the precautionary principle, and they

[1] Some of those critiques are made explicit and discussed in Section 5.

[2] It emphasizes the moral worth of the individual and promote the exercise of one's goals and desires.

[3] The quality of being consistent with are based on logic. A rational decision is one that is reasoned and also optimal for achieving a goal or solving a problem.

[4] The difference made by one extra unit of something. Marginal utility is how much extra utility a person gets from consuming (or doing) an extra unit of something.

[5] It refers to the use of resources to maximize the production of goods and services.

[6] General equilibrium models explain the behaviour of supply, demand, and prices in a whole economy, in contrast to partial equilibrium models which analyze single markets.

[7] References and reports can be found at http://www.footprintnetwork.org/en/index.php/GFN/.

[8] The description of the tool and its application can be found on the NOAA website (http://www.darrp.noaa.gov/economics/papers.html).

[9] References and reports can be found at http://www.cep.ees.ufl.edu/emergy/index.shtml.

[10] Definition and statistics can be found on the WHO website (http://www.who.int/healthinfo/global_burden_disease/metrics_daly/en/).

Download English Version:

https://daneshyari.com/en/article/6295009

Download Persian Version:

https://daneshyari.com/article/6295009

Daneshyari.com