TOWARDS A BIOFUEL-SPECIFIC CLASSIFICATION OF ECOSYSTEM SERVICES FOR ASSESSING BIOFUEL TRADE-OFFS

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Several developed and developing countries have promoted biofuel production and use in the past decade. However the understanding about the impacts of this expansion is, in several instances, lagging behind. Even though biofuel production and use has been identified as an emerging threat to biodiversity and ecosystems, largely due to the extensive monocultures usually adopted for feedstock production, studies concerned with other biofuel-related environmental and socioeconomic impacts have reached highly contradictory conclusions (Gasparatos and Stromberg, 2012).

This is partly due to the lack of a comprehensive conceptual framework that can synthesize meaningfully the existing biofuel-related evidence from the natural and the social sciences (Gasparatos et al., 2011a; 2011b) and, as an extension, of appropriate integrated assessment tools that can evaluate meaningfully the diverse biofuel trade-offs (Robertson et al., 2008; Tilman et al., 2009).

This paper highlights why the ecosystem services approach can be used to bridge these two gaps in literature and practice. Considering the almost non-existent research explicitly linking biofuels and ecosystem services (biofuels were neglected by the MA and were given minimal consideration by TEEB) the paper proceeds by identifying key research areas for the ecological economics community in the interface of biofuels and ecosystem services and particularly the need to develop appropriate valuation mechanisms.

Thereafter different ways to conceptualize biofuels, and the implications for valuation that arise when using any of these conceptualizations, are explored for the existing ecosystem services typologies. For example when following the MA and the TEEB conceptual frameworks, biofuels can be either perceived as a single ecosystem service (i.e. a provisioning service providing energy) or an activity that provides and/or compromises a number of services such as fuel, climate mitigation and air quality regulation among others. In the conceptual framework developed for the UK National Ecosystem Assessment biofuels can be perceived as a single good (fuel) or an activity that can provide/compromise multiple ecosystem outputs and services (UK-NEA, 2011).

Subsequently we propose a biofuel-specific typology of ecosystem services that incorporates the latest lessons learnt within the ecological economics community (Boyd and Banzhaf, 2007; Costanza, 2008; Fisher et al., 2009; TEEB, 2010; UK-NEA, 2011) and we adapt it for the specific case of Brazilian bioethanol.

Lastly, by considering the nature and the type of the different ecosystem services provided/compromised by Brazilian bioethanol production and use, we employ the concept of value articulating institutions (Vatn, 2009) to provide suggestions on how to choose the most appropriate valuation tool(s) amongst the different biophysical, monetary and indicator-based valuation tools commonly used for ecosystem services valuation (TEEB, 2010).

In this respect this paper lays the foundations for developing the first comprehensive assessment framework for evaluating biofuel trade-offs based on the ecosystem services approach (Gasparatos et al., 2011a; 2011b).

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