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Short communication

Do we need a unified appraisal framework to synthesize biofuel impacts?

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ABSTRACT

In the past decade a significant evidence base has been built about biofuels' environmental and socioeconomic impacts. What is still missing is a discussion about whether it is desirable, or even feasible, to synthesize this evidence in a clear, coherent and policy-relevant manner, and if so, how exactly such a synthesis should be conducted. This Short Communication presents arguments for and against the adoption of a unified framework for synthesizing biofuel impacts, and seeks common ground between the two perspectives.

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1. Background

Biofuels are a class of liquid fuels (e.g. bioethanol, biodiesel) mainly derived from sugar, starch and oil-bearing crops, animal fats and lignocellulosic material through diverse chemical and biological processes [1]. Biofuel production and consumption have expanded rapidly in several parts of the world due to interconnected policy concerns such as energy security, rural development and climate change [2]. Biofuel production and the biofuel-related literature have followed

very similar trends (Fig. 1). According to Scopus more than 4000 biofuel-related academic papers were published in 2011 alone, compared to just under one hundred ten years earlier (Fig. 1).

Fig. 1 shows that the biofuel literature has expanded significantly since 2005 and particularly during periods when major biofuel policies were decided, such as the EU Renewable Energy Directive (EU-RED) in 2009 and the US Energy Independence Act in 2007. It seems that the biofuel controversy that erupted during the preparation of these policies catalyzed biofuel research across the world. As a result, rather than

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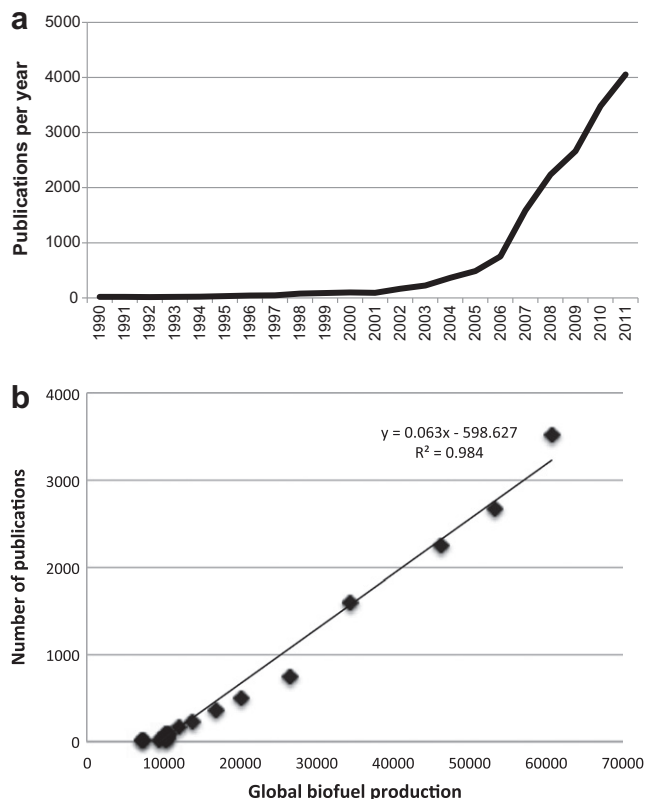


Fig. 1 – Number of peer-reviewed biofuel publications in Scopus per year (1a) and correlation between global biofuel production and number of publications in Scopus (1990–2010) (1b).

being curiosity-driven, this research has been overwhelmingly driven by a demand from policymakers, civil society and the private sector for better evidence about biofuels' profitability and sustainability.

Discussions about biofuel sustainability usually focus on a relatively small number of impacts, notably food security, economic profitability, and greenhouse gas (GHG) emissions. Recent biofuel research has brought attention to numerous other important impacts such as biodiversity loss, water consumption/pollution, soil erosion, and social conflicts, which are nevertheless often overlooked in the wider biofuel debate. Additionally, research initiatives such as the Scope International Biofuel Project have identified and discussed these different biofuel impacts but have not attempted to provide comprehensive and coherent conceptual frameworks that can put these diverse impacts and trade-offs into perspective and help to structure the biofuel debate [3]. This has been identified as a major gap in biofuel research and practice [4–6].

This lack of efforts toward the development and use of frameworks that can synthesize in a comprehensive and consistent manner the multitude of biofuel impacts raises a dilemma that has rarely been addressed by biofuel experts. Should we synthesize the existing evidence of biofuels' diverse environmental and socioeconomic impacts through a single, coherent and unified framework, or should we instead illustrate the various, often mutually incompatible

perspectives embraced by the different biofuel appraisal approaches in a disaggregated manner?

In this Short Communication, we present arguments for both viewpoints ('thesis' and 'antithesis'), and conclude by seeking common ground between the two. While broadly agreeing on the problem definition, the authors of this article hold different views on the desirability of a unified synthesis framework. The "thesis", presented in the next section, is defended by AS and PS, whereas ML puts forward the "antithesis" in Section 3.

2. Thesis: synthesizing the biofuel literature with a unified framework can improve biofuel policymaking (AS and PS)

Concerns over biofuel sustainability have become more prevalent in the past few years, as numerous policy instruments that aim to promote biofuel sustainability have been put in place [7]. For example, policies such as the EU-RED have specified some sustainability criteria (e.g. GHG emissions, biodiversity loss, impact on food security) that a biofuel practice needs to fulfill before it can be widely adopted within the EU. Voluntary certification schemes have articulated several additional social and environmental sustainability criteria for biofuels and biofuel feedstocks [8,9].

An array of powerful appraisal techniques ranging from life cycle assessment (LCA)-based techniques to remote sensing, econometric models and complex land use change models, to name just a few, has been employed to assess the broad range of sustainability impacts associated with biofuel production and use. Yet, we are still missing a way to synthesize this body of evidence in a clear, cohesive and policy-relevant manner. Considering the demand for sustainable biofuels, the research community has to at least assess the feasibility and the benefits that such syntheses can offer.

We argue that synthesizing biofuels' trade-offs through a consistent conceptual framework is as important as ensuring a robust assessment of individual sustainability impacts. In our opinion, the lack of such unified syntheses contributes to a piecemeal understanding of biofuel sustainability and may have already compromised the effectiveness of policies concerned with biofuel sustainability such as the ones mentioned above.

We suggest that two very promising unifying frameworks are sustainability science and the ecosystem services (ES) approach. Sustainability science is an emerging field of research that deals with the interactions between natural and social systems, in particular with the ways in which these interactions can meet the needs of current and future generations [10]. The ES approach, in turn, aims to identify and assess the multiple benefits that humans derive from ecosystems (directly and indirectly) as well as the mechanisms through which ecosystem degradation can compromise human wellbeing [11,12]. There are at least four interrelated reasons why we believe that the synthesis of the available biofuel evidence with these two frameworks can contribute positively to the current biofuel debate.

First, both frameworks employ a systems-perspective. They explicitly seek to link environmental impacts and human wellbeing, two key elements of the biofuel debate

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