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Review

Deconstructing criteria and assessment tools to build agri-sustainability indicators and support farmers' decision-making process

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ABSTRACT

In the review of academic literature, numerous papers present either a list of indicator criteria or partially revised sustainability assessment tools of agri-food systems. However, neither a complete analysis and discussion about the criteria utilised by evaluators nor a compared examination and subsequent frameworks categorization have been fully developed by researchers. This study aims to fill this twofold gap by investigating the main issues related to the choice of a tool for the sustainability assessment of an agri-system. This task is conducted in three steps: firstly, we analyse the criteria an indicator should match to be included in an evaluation; secondly, we categorise 15 of the most important agriculture sustainability frameworks to discuss effectiveness in evaluating sustainability for each category, finally, we compare the categories and emphasise differences to highlight the possible application of each framework and hence guide the practitioner in the framework selection process. Our analysis identifies the complementarity between bottom-up and top-down approach and the impossibility of identifying a priori the best framework, although a combination of both approaches could prove to be a valuable, alternative option.

Contents

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1. Introduction

In a world constantly focused on technological developments, in which technology has evolved and continues to change countless aspects of everyday life, human beings still depend on agriculture as a primary source of food. In recent years, scandals and crisis generated by risky and hazardous agricultural practices have jeopardised people's health and, as a result, made the safety and sustainability of agricultural systems a key issue of public concern. For these reasons, in the academic arena the application of sustainability principles to the agricultural sector has become a crucial subject of study.

Nevertheless, in spite of widespread agreement on its importance, sustainability in agriculture lacks a consensus on both its definition and evaluation (Binder et al., 2010), so much that some authors doubt the actual usefulness of this concept (Hansen, 1996). However, international organisations, such as FAO (Food and Agricultural Organization) and the European Community agreed on two essential features of agricultural sustainability, namely multi-dimensionality and multi-functionality. This means that sustainability assessment of agri-systems must account for the balance of environmental, economic and social dimensions and address several key issues such as food security, landscape maintenance, and biodiversity conservation (Commission of the European Communities [CEC], 1999; FAO, 2005).

In recent years, driven by apprehension among both public and policy makers, the academic debate on agricultural sustainability produced a wide variety of tools and methods to evaluate sustainability of agri-systems. According to Binder et al. (2010), these tools are, among others: i. Indicators lists; ii. Environmental assessments of production alternatives; iii. Indexes or ecopoints; iv. Linear programming tools, and, v. Trade-off models. In the last years, the use of lists of indicators is considered the most common way of assessing agricultural sustainability (Roy and Weng Chan, 2012; van Asselt et al., 2014; Van Passel and Meul, 2012).

Indicators are defined as quantitative measures against which certain aspects of expected performance of a policy or management strategy can be assessed (Glenn and Pannell, 1998) and addressed, with the aim of improving decision making (Pannell and Glenn, 2000). In order to efficiently assess a system's sustainability, indicators must be checked against reference values, which can be determined in two main ways: identifying a minimum value for each indicator which represents the minimum accepted level of sustainability that a system is supposed to reach (vonWirén-Lehr, 2001), or benchmarking results between two systems, different either in spatial or time scale, to gauge which is the most sustainable (Van Passel and Meul, 2012).

The use of indicators has received considerable attention from authors. In general, indicators are used in three ways: individually, as part of a set, or combined into a composite index. Nevertheless, since the use of a single indicator may miss the opportunity to describe the complexity of a system, the use of a set of indicators, even when heterogeneous, is the preferred method (Bossel, 1999; Farrell and Hart, 1998; Van Passel and Meul, 2012).

However, the academic forum also revealed several problems that have arisen in recent years concerning the efficiency of indicator usage. Among others, the most relevant are the following:

- Indicator selection is not always clear and understandable, in particular for highly aggregated indicators (Bell and Morse, 2003). Moreover, certain lists of indicators are developed with a large number of traditional economic, environmental and social indicators, although without an underlying conceptual structure (Van Passel and Meul, 2012).
- Despite the conclusions of international organisations, most studies fail to consider the multi-functionality and the multi-dimensionality of models responsible for developing sustainability assessment; that not only they overlook the numerous functions of agriculture and its primary role of producing food and fibre (Rossing et al., 2007), but they also ignore one or two of the sustainability dimensions completely (Binder and Feola, 2010; vonWirén-Lehr, 2001).
- Authors often fail to either integrate data from different sources or to take into consideration the different needs and goals of different types of end-users (Bell and Morse, 2003; Binder et al., 2012; Seuring and Müller, 2008)
- Various research studies have focused on filling gaps in knowledge and technology but have not indicated the specific process for implementing said knowledge (Rossing et al., 2007) or for the practical utilisation of the results in decision-making. In particular, few studies contemplate the interaction and trade-off between indicators and, specially, the possibility of conflicting goals (Binder et al., 2012; Cornelissen et al., 2001; Lopez-Ridaura et al., 2002; Morse et al., 2001)

In order to correct some of these problems, in recent years, academic debate has produced a significant number of frameworks to assess agricultural sustainability (de Olde et al., 2016c; Schader et al., 2014; Schindler et al., 2015). Accordingly, a framework can be defined as a theoretical and procedural structure that underpins sustainability assessment. Firstly, frameworks select the indicators to include in the evaluation; then define the scale of assessment and identify the purpose of the study; and, finally, describe how data should be processed to generate results of interest.

A general and superficial understanding of sustainability frameworks could possibly be directed towards the identification of the framework which “best” evaluates sustainability. Additionally,