



An assessment framework for measuring agroecosystem health



Erin E. Peterson^{a,*}, Saul A. Cunningham^{b,2}, Mark Thomas^c, Simon Collings^d,
Graham D. Bonnett^e, Bronwyn Harch^f

^a CSIRO, Box 2583, Brisbane 4001, Australia

^b CSIRO, Box 1700, Canberra 2601, Australia

^c CSIRO Land and Water, Glen Osmond 5064, Australia

^d CSIRO, Underwood Avenue, Floreat, 6014, Australia

^e CSIRO, Bioscience Precinct, 306 Carmody Rd., St. Lucia 4067, Australia

^f Institute for Future Environments, Queensland University of Technology (QUT), Brisbane, 4000, Australia

ARTICLE INFO

Keywords:

Agroecosystem health
Assessment
Sustainability
Indicators
Environmental assets
Monitoring

ABSTRACT

There are inherent social, environmental, and economic trade-offs in agricultural systems, which by definition have been altered from their natural state by humans for food and fibre production. Consumers are increasingly concerned about the environmental and social impacts of agriculture, and with the increasing influence of social media, agribusinesses and industries can be held accountable for their actions in the public domain. Thus, environmental sustainability reporting is increasingly being viewed as a cost of doing business in agriculture. There are a number of approaches used to measure agroecosystem health (AEH) around the world, but they are generally designed to make comparisons at coarse spatial scales (i.e. nations) or report on specific management actions implemented at the local scale (i.e. farm, catchment, or sub-region). Here we present a simple, yet scientifically robust assessment framework that can be used to benchmark and monitor the specific impacts of agricultural management practices on the environment. The general principles are drawn from environmental monitoring and experiences gained in environmental assessments that are not necessarily agriculturally focussed. However, many commonly used environmental indicators are not suitable for AEH assessment because they do not explicitly link environmental outcomes to management actions; or they fail to separate specific agricultural impacts from broader cumulative impacts resulting from other industries or land uses. We recommend using a combination of diagnostic, outcome-based indicators, in addition to practice- and product-based measures to communicate efforts to improve agroecosystem health outcomes. The framework presented here enables assessments at local scales, but can be aggregated or disaggregated to report at finer or coarser scales. This flexibility ensures that the assessment is relevant to the proponent and stakeholders, while also providing a way to make comparisons between producers, industries, or regions as part of an adaptive monitoring and assessment framework. This also opens the door for industry-based AEH monitoring program to provide, or make use of information from government-funded environmental monitoring programs, with benefits to both.

1. Introduction

There are many different definitions of agroecosystem health (AEH), but underpinning these is the concept that a healthy agroecosystem is economically viable, managed in a socially responsible manner, and environmentally sustainable for present and future generations (Schaller, 1989; Gitau et al., 2008; Ikerd, 2008). However, there are inherent trade-offs among economic, social and environmental out-

comes in these systems (Tilman et al., 2002; Ikerd 2008; Gitau et al., 2008). Increasing demand for agricultural production is placing pressures on the environment, with significant negative consequences (Foley et al., 2005; OECD, 2013; Madeau et al., 2014). As a result, the public, media, and non-governmental organisations (NGOs) often have negative perceptions of agricultural industries (Luhman and Theuvsen, 2016). Consumers are increasingly concerned about the social and environmental impacts of agriculture, and with the advent of

* Corresponding author.

E-mail address: Erin.Peterson@qut.edu.au (E.E. Peterson).

¹ Present: ARC Centre of Excellence for Mathematical & Statistical Frontiers (ACEMS) and the Institute for Future Environments, Queensland University of Technology (QUT), Gardens Point Campus, Room Y-803, Brisbane, 4000, Australia.

² Present: Fenner School of Environment and Society, Australian National University, Canberra, 2601, Australia.

the internet and social media, agribusinesses and industries can be held accountable for their actions in the public domain (Ross et al., 2015). Public campaigns focussing on pollution (e.g. Jay, 2007), human health (e.g. Pew Charitable Trusts, 2012), or animal welfare (e.g. Healy and Burns, 2013) issues can damage an industry's social license-to-operate (Maloni and Brown, 2006; Luhmann and Theuvsen, 2016), and subsequently lead to loss of market access, increased regulatory conditions imposed by government (Jay, 2007), and financial losses associated with damage to brand name (Ross et al., 2015). Thus, environmental sustainability reporting is increasingly being viewed as a cost of doing business in the agricultural domain (Porter and Kramer, 2006). Although the drivers for environmental assessment within the agricultural industry are different than those in a traditional environmental monitoring program, we believe that many of the lessons learned are transferable to the private sector and can be used to develop a rigorous and targeted approach to AEH assessment.

Agricultural endeavours in most countries occur in a market-driven context, where the private economic benefit derived from selling products is a primary driver of decision making (Neher, 1992; OECD, 2013). At the same time, producers are often responsible for the management of large areas of land (Tilman et al., 2001), with consequences for many public-good outcomes, such as clean water, climate regulation and maintenance of biodiversity (Tilman et al., 2002). Although the food and fibre produced on farms is traded in markets, there is little empirical evidence to suggest that the general public is willing to pay a significant price premium for environmentally responsible products in the absence of social, animal welfare, or personal health benefits (Loureiro et al., 2002; Tully and Winer 2014; Verhoef and van Doorn, 2016); or that sustainability performance will lead to increased stock market performance (Porter and Kramer 2006). Instead, there appears to be an expectation that an agricultural industry's standard practice should include operating in an environmentally responsible manner (Maloni and Brown 2006). Yet private industry cannot bear the financial cost of measuring all off-farm, public-good outcomes; instead they must identify and target those outcomes that are most relevant to their business (Porter and Kramer 2006).

There are numerous private benefits for agribusinesses that implement and report on environmentally sustainable management actions. For example, a reduction in water or energy consumption will lead to lower input or overhead costs for many businesses (Ross et al., 2015). Direct financial incentives may also be made available (Pahl, 2007), including tax benefits to producers (Martin and Werren, 2009) who implement environmentally sustainable management practices. Industry may be motivated in other cases to evaluate impacts because of social license-to-operate issues relating to environmental stewardship (Jay 2007) or animal welfare (NPB, 2014). Increasingly, producers are also contractually required to report on the use of environmentally sustainable management actions to suppliers (Lehmann et al., 2012), who in turn sell to major retailers that want to demonstrate and market sustainability in their supply chain (Jay, 2007; Unilever, 2014; Ross et al., 2015). Thus, the challenge for agricultural industries is to identify and prioritize current sustainability issues that increase revenues or market access, reduce costs, or address sustainability issues that put them at greatest risk of public backlash (Ross et al., 2015), while also monitoring future issues as they evolve (Porter and Kramer, 2006).

Environmental aspects of AEH are typically assessed using two general approaches: 1) coordinated regional and national approaches and 2) industry-based efforts. Coordinated efforts include many well-established broad-scale programs designed to make comparisons across regions and nations (OECD, 2013; Madeau et al., 2014), with governments often acting as the proponents of these “top-down” programs. Coordinated efforts are useful for demonstrating the effectiveness of investments and guiding policy decisions at the regional (i.e. groups of nations) or national scale (Commission of the European Communities, 2007). As such, they are typically based on a fixed set of sustainability measures, which allow valid comparisons across regions. For example,

the European Union (EU) Common Agricultural Policy (CAP) program measures represent agricultural impacts related to erosion, nitrate and pesticide pollution, greenhouse-gas emissions, and biodiversity, which are assessed and compared across EU nations (EEA, 2005). However, these regional measures are not designed to respond to specific management actions that individual producers have control over and do not necessarily reflect local priorities (Olsson et al., 2009). Thus, the results of a coordinated regional assessment are unlikely to be useful for agricultural marketing purposes, assessing industry-specific impacts, or comparing on-farm management trade-offs (Maloni and Brown 2006).

Industry-based organisations, such as commodity boards, are usually the proponents of “bottom-up” efforts, which are designed to reflect the needs of producers (i.e. risk management, marketing, or social license-to-operate). The need to report on sustainability is a relatively new development for agribusinesses and the result is often a “hodgepodge approach” to sustainability initiative selection (Ross et al., 2015), rather than a strategic effort targeted towards industry-specific priority issues (Porter and Kramer, 2006). Sustainability measures are frequently selected based on readily available or inexpensive data that reflect best management practices (MPI, 2013), but these may be poor surrogates for priority environmental outcomes (Porter and Kramer 2006). In addition, there are no overarching standards for assessment frameworks or indicators in these circumstances (Porter and Kramer 2006). Instead, each industry develops their own assessment program and set of indicators, which then makes comparisons between regions or industries difficult (Ross et al., 2015), if not impossible (Olsson et al., 2009). As a result, many industry-based sustainability assessment programs fail to produce the desired outcomes (Porter and Kramer, 2006).

We believe that knowledge gained in environmental monitoring and assessment programs can be used to improve monitoring, assessing, and reporting in agricultural industries (Rao and Rogers, 2006). However, significant differences exist regarding the motivation for monitoring, the environmental processes or management action being measured and the methods used to measure them, as well as the manner in which results are communicated and the audience they are communicated to. Here we describe a flexible assessment framework that can be used to 1) assess the effectiveness of agricultural management actions on the environment; 2) reflect local priorities, while also allowing comparisons to be made between regions or industries at local, national, or regional scales; and 3) communicate results effectively to policy makers, suppliers, NGOs, consumers and the public.

2. A framework for assessing agroecosystem health

Standard environmental assessment frameworks provide a structured set of protocols that are used to meet a set of pre-determined goals (Gasparatos, 2010) and as such, form the basis of many established ecosystem-health monitoring, assessment, and reporting programs (e.g. Williams et al., 2009; Bunn et al., 2010; Connolly et al., 2013; Sbrocchi, 2013). There are many advantages to using a formal environmental monitoring and assessment framework, but to our knowledge these methods have not been used by an agricultural industry to improve environmental sustainability reporting. What follows is an overview of an environmental assessment framework (hereafter referred to as an AEH assessment framework), with step-by-step instructions that can be used to operationalise the assessment at multiple scales (e.g. farm, region, nation). We pay particular attention to indicator selection because many commonly used environmental indicators may not be the most effective choice in agricultural systems.

2.1. Develop an agroecosystem health vision

Although few would argue with the merit of agricultural sustainability as a goal, there will never be enough data to measure it in its comprehensive sense. As in any environmental monitoring program,

Download English Version:

<https://daneshyari.com/en/article/5741773>

Download Persian Version:

<https://daneshyari.com/article/5741773>

[Daneshyari.com](https://daneshyari.com)