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A protocol for evaluating the sustainability of agri-food production systems—A case study on potato production in peri-urban agriculture in The Netherlands

E.D. van Asselt[a,*], L.G.J. van Bussel[a], H. van der Voet[b], G.W.A.M. van der Heijden[b], S.O. Tromp[c], H. Rijgersberg[c], F. van Evert[b], C.P.A. Van Wagenberg[d], H.J. van der Fels-Klerx[a]

[a] RIKILT Wageningen UR (University and Research Centre), P.O. Box 230, 6700 AE Wageningen, The Netherlands
[b] Plant Research International Wageningen UR (University and Research Centre), P.O. Box 16, 6700 AA Wageningen, The Netherlands
[c] Food & Biobased Research Wageningen UR (University and Research Centre), P.O. Box 17, 6700 AA Wageningen, The Netherlands
[d] LEI Wageningen UR (University and Research Centre), P.O. Box 29703, 2502 LS The Hague, The Netherlands

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ABSTRACT

Frameworks describing the overall assessment of sustainability are limited and usually not well described. This study proposes a protocol for the selection and quantification of indicators that can be used to discuss and communicate the sustainability of agri-food production systems. A gross list of indicators was established covering the social, environmental and economic dimensions. Core indicators were selected from this gross list using predefined criteria. Then, sustainability limits were set for these core indicators to evaluate their sustainability impact. Policy makers can determine the effects of different weights and the extent to which indicators can compensate each other (compensability) either at the level of the individual indicator or on the overall sustainability. The protocol was tested in a case study comparing potato production in peri-urban agriculture to conventional and to organic agriculture. Data were based on literature, expert opinion and additional calculations. Application in the case study showed that the protocol can be a valuable tool in assessing the sustainability of agri-food production systems. It enables more transparent policy decisions and facilitates communication with stakeholders about these decisions.

1. Introduction

At policy level, there is a need to assess sustainability in a holistic approach incorporating economic, social and environmental dimensions (Binder et al., 2012; Rinne et al., 2013; Singh et al., 2012). For this purpose, indicators can be used that are defined as quantitative measures against which some aspects of the expected performance of a policy or a management strategy can be assessed (Glenn and Pannell, 1998). Indicators are used to make a complex system understandable and to give meaningful information (Bélanger et al., 2012; Bockstaller et al., 2009; Rametsteiner et al., 2011; Singh et al., 2012). Furthermore, they are increasingly seen as important tools in assessing agricultural sustainability (Roy and Chan, 2012; Van Passel and Meul, 2012). In the last two decades much attention has been paid to establishing indicator lists (Bockstaller et al., 2009; Rametsteiner et al., 2011; Rinne et al., 2013; Roy and Chan, 2012; Van Passel and Meul, 2012; Yli-Viikari et al., 2011). However, the selection of these indicator lists is not always clearly described (Rametsteiner et al., 2011; Van Passel and Meul, 2012), the lists contain both qualitative and quantitative indicators (Van Passel and Meul, 2012; Yli-Viikari et al., 2011), and they do not equally address all three dimensions (Binder et al., 2012; Roy and Chan, 2012; Singh et al., 2012).

Once indicators are selected, they should be evaluated against reference or target levels as the establishment of indicators alone is not useful for evaluating sustainability (Binder et al., 2012; Roy and Chan, 2012; Van Passel and Meul, 2012). These limits should be set using scientists, policy makers and other stakeholders (Roy and Chan, 2012) and can be based on policy targets, best available practices (Van Passel and Meul, 2012) and legislation (Binder et al., 2012).

As indicators have different dimensions or operate at different levels, it is often difficult to compare them and come to an overall assessment of sustainability (Binder et al., 2012; Singh et al., 2012;

* Corresponding author. Tel.: +31 317 480268; fax: +31 317 417717.
E-mail address: esther.vanasselt@wur.nl (E.D. van Asselt).

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Yli-Viikari et al., 2011). Therefore, a consistent approach towards the use of indicators and their comparison is needed. Composite indicators can help in comparing policy options to facilitate the decision making process of policy makers (Gómez-Limón and Riesgo, 2009; Van Passel and Meul, 2012). Furthermore, they can help in communicating with the public (Gómez-Limón and Riesgo, 2009). However, frameworks for integrating information and data into an assessment of sustainability are currently lacking (Binder et al., 2012; Gómez-Limón and Riesgo, 2009; Van Passel and Meul, 2012). Moreover, as the outcome of sustainability assessments is to be used by policy makers they should be clearly involved in the process (Rametsteiner et al., 2011).

The aim of the current paper was to establish a protocol for assessing sustainability of agri-food production systems using transparent guidelines and objective criteria for selecting the most relevant indicators in order to facilitate the decision making process for policy makers. The protocol was tested in a case study on peri-urban agriculture in the Netherlands, which is defined as agriculture in the close vicinity of a city (Moustier, 2007). The case study was selected as peri-urban agriculture is an upcoming trend (Zasada, 2011) and its multifunctional character combines social, environmental and economic roles (De Bon et al., 2010; Moustier, 2007).

2. Materials and methods

2.1. A protocol for sustainability assessment

A protocol for sustainability assessment of agri-food production systems has been developed based on consultations with both a group of scientific experts and a policy maker (Fig. 1). An expert group of 13 scientists from Wageningen UR was established that covered expertise in the three dimensions of sustainability (social, environmental and economic). The expert group was involved in all the steps during the establishment of the protocol. Due to practicality reasons, it was not possible to involve a governmental policy maker in the procedure; therefore, an expert on sustainability and peri-urban agriculture was asked to perform this role. Although this person was not employed as a policy maker at the moment of the study, she was very familiar with the policy making process. She was not involved in the initial selection procedure of the indicators, but was solely involved in the protocol as indicated in Fig. 1: discussing the definition of the case study, evaluating the set of indicators and sustainability limits and discussing the outcome of the study. The protocol incorporates scientific and policy relevant issues and contains eight steps. These steps are described in the sections below.

2.1.1. Definition of case study

The first step of the protocol consists of defining the case study in close collaboration with the policy maker. In this step, geographic and time scale boundaries are discussed as well as precise definitions of scenarios that are to be studied.

2.1.2. Gross list of indicators

The second step is to establish a gross list of indicators, categorised in themes within the social, environmental and economic dimensions of sustainability within the agri-food production system. Based on literature and expert consultation, first a general set of themes was established that was discussed with the policy maker. Second, for each of the themes, specific indicators for the case study were selected using the following criteria:

- the indicator should be measurable (Dantsis et al., 2010; De Boer and Cornelissen, 2002; Gómez-Limón and Sanchez-Fernandez, 2010; Roy and Chan, 2012);
- the indicator should be sensitive to variations (Bélanger et al., 2012; De Boer and Cornelissen, 2002);
- the indicator should be relevant to the case study (Bélanger et al., 2012; Dantsis et al., 2010);
- the indicator should be related directly to the theme (established by expert group).

2.1.3. Core list of indicators

In step 3, the gross list of indicators is downsized to a list of core indicators that are most relevant for assessing sustainability in the case study (Roy and Chan, 2012), using the following criteria:

- for each dimension, at least one indicator should be selected, indicating the multi-dimensional character (Dillon et al., 2010; Kulig et al., 2007; UN, 2007);
- the economic dimension should contain an indicator for profitability (Dillon et al., 2010; Gómez-Limón and Sanchez-Fernandez, 2010);
- the list should contain an indicator that reflects the societal support, indicating policy relevance (Gómez-Limón and Sanchez-Fernandez, 2010; Kulig et al., 2007; OECD, 2003);
- preferably, broad indicators should be selected that provide a wide range of information (Kulig et al., 2007; UN, 2007);
- data should be available in order to quantify the indicator (Bélanger et al., 2012; De Boer and Cornelissen, 2002; Dillon et al., 2010; Gómez-Limón and Sanchez-Fernandez, 2010; OECD, 2003; Roy and Chan, 2012; UN, 2007).

2.1.4. Evaluation

In step 4, the list of core indicators is discussed with the policy maker to determine whether it contains all relevant indicators for assessing sustainability of the case study.

2.1.5. Sustainability limits

In step 5, limits are set against which sustainability of the indicators is assessed. In order to obtain a gradient in sustainability, sustainability limits (where an indicator is evaluated as sustainable), non-sustainability limits (where an indicator is evaluated as non-sustainable) and mid-sustainability limits (limit between the sustainability and non-sustainability limit) are set. This enables to determine to what extent the agri-food production system approaches the sustainability limit. Limits were derived based on legal norms, if available. Otherwise, limits were derived based on policy targets mentioned by the government. In case no legal norms or policy targets were available, limits were based on the best performing system. In the latter case, best practices are used to set the sustainability, the mid-sustainability limit is set at 115% of the best practice value and the non-sustainability limit at 130% of the best practice analogous to Haverkort et al. (2009). When only non-sustainability and sustainability limits were available, mid-sustainability limits were derived from these limits using the geometric mean assuming a lognormal distribution.

2.1.6. Data collection

In step 6 values are assigned to each of the core indicators for the policy scenario in the case study based on literature, expert knowledge and additional calculations.

2.1.7. Weighing tool

In step 7, the obtained values for the core indicators as well as their sustainability limits are inserted into a weighing tool. The tool can be used to perform an integral assessment of the