A framework for guiding sustainability assessment and on-farm strategic decision making

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Abstract

Responding to future challenges and societal needs, various actions are taken in agriculture to evolve towards more sustainable farming practices. These actions simply strategic choices and suppose adequate sustainability assessments to identify, measure, evaluate and communicate sustainable development. However, literature is scarce on the link between strategic decision making and sustainability assessment. As questions emerge on how, what and when to measure, the objective of this paper is to construct a framework for guiding sustainability assessment and on-farm strategic decision making. Qualitative research on own experiences from the past and a recent project revealed four categories of actual needs farmers, advisors and experts have regarding sustainability assessment: context, flexibility, focus on farm and farmer and communication. These stakeholders' needs are then incorporated into a two-dimensional framework that marries the intrinsic complexity of sustainability assessment tools and the time frame of strategic decision making. The framework allows a farm-specific and flexible approach leading to harmonized actions towards sustainable farming. As this framework is mainly a procedural instrument to guide the use of sustainability assessment tools within strategic decision making, it fits to incorporate, even guide, future research on sustainability assessment tools themselves and on their adoption on farms.

Keywords: Sustainability assessment Farm level Framework On-farm strategic decision making Sustainability assessment tools

1. Introduction

Agriculture is increasingly facing extreme challenges such as climate change, scarcity of natural resources and societal demands. In highly urbanized regions, such as Flanders, stakeholders are confronted with specific challenges such as land availability ensuing specialization and intensification in function of higher yields for global markets (Hubeau et al., 2015; Platteau et al., 2014). To tackle these challenges, farmers and stakeholders at sector level strongly feel the urge to evolve towards more sustainable farming practices (Nevens et al., 2008). Although some farmers already anticipate to future challenges and societal needs in their strategic decision making, Nevens et al. (2008) point out that moving towards new or adapted farming systems is often difficult to put in practice. Last decades, many initiatives already popped up to support strategic and sustainable decision making in farming systems and efforts are made to develop, identify, measure, evaluate and communicate sustainable development. Literature on sustainability assessment and sustainability assessment tools to support decision making is rapidly growing (Binder et al., 2010; Bockstaller and Guichard, 2009; Bond et al., 2012; Carof et al., 2013; Gasparatos and Scolobig, 2012; Marchand et al., 2014; Ness et al., 2007). Sustainability assessment has found its way both at policy and corporate level (Gibson, 2006; Hugé and Waas, 2011; Pope, 2006; Pope et al., 2004) and many definitions of sustainability assessment exist.

Despite a growing interest in sustainability assessments and the existence of numerous assessment tools, barriers to adoption in practice remain. Especially, the complexity of the sustainability concept and assessment methods and the uncertainties about both future challenges and strategic choices play a dominant role. Sustainability assessment can be seen as “a range of processes that all have the broad aim to integrate sustainability concepts into decision making” (Pope, 2006) or as “a process by which the implications of an initiative on sustainability are evaluated” (Pope et al., 2004). Such an initiative can range from an existing policy, to a plan, programme, project, a current practice or activity (Pope

et al., 2004). Furthermore, Hugé et al. (2013) describe sustainability assessment as a process that aims at operationalising sustainable development as a guide for decision making by identifying the future consequences of current and planned actions. Tools are developed to assess sustainability and facilitate sustainability assessments (Gasparatos and Scolobig, 2012; Ness et al., 2007). However, there is a lack of insights regarding tool choice and effective use of tools and methodologies in sustainability assessment literature (De Ridder et al., 2007). Furthermore, while aiming to make the sustainability concept operational, they raise questions about the definition or interpretational limits. Sustainability and sustainable development are contested concepts and opinions differ on how to define them (Bond et al., 2013; Hopwood et al., 2005; Pope et al., 2004; Waas et al., 2011). This is also why different stakeholders can accept or condemn the outcomes of an assessment and why it is important to clearly define sustainability within an assessment (Bond et al., 2013).

Moving to an actual on-farm adoption of sustainability assessment and the link with strategic decision making will thus need more than process insights, a definition's agreement or the ultimate assessment tool. Essential to adoption of sustainability assessment and its link with strategic choices is communication about the progress towards sustainability, both for the different agricultural sub-sectors (benchmarking) and society (stakeholder involvement). As opinions still differ on how to define, plan and measure the progress towards sustainable development (Bond et al., 2012; Gasparatos and Scolobig, 2012), the need emerges to install a procedure that allows both the farmers and the societal stakeholders to follow-up and improve sustainable development. In fact, there is a need for more guidance and harmonisation of strategic decision making and the choice of currently available tools as actions to measure and assess progress are often uncoordinated (Russillo and Pintér, 2009).

The objective of our research is to find starting points to solve the problem of non-harmonisation and the lack of guidance in tool choice by identifying the needs farmers and advisors have regarding sustainability assessment. We elucidate these needs from qualitative research on own case study experiences and literature and use them to develop a framework at farm and sector level, workable for guiding strategic decision making of farmers based on their farm sustainability assessment. In this framework the farmer plays a central role and choices for different assessments, with different views on sustainability, can be made.

The paper is structured as follows. First, the methods section presents the research questions and how results were obtained. Second, the results and discussion section describes the needs stakeholders have regarding sustainable assessment and how they are integrated in a framework by discussing its use. Although results were obtained in an interactive and iterative way, the paper format forces us to describe it more linearly. Therefore, results and discussion are put together.

2. Methodology

2.1. From past experiences to research questions

As authors of current paper, we have been involved in different projects in which sustainability assessment tools were developed and implemented. Through these experiences, we noticed a gap between the needs of stakeholders and the goal of the project. This was also the case for one of our most recent projects, a participatory research project originating from a specific demand from the main farmers' union (FU), Boerenbond, in Flanders. This FU developed a road map towards a more

sustainable agriculture for the region. A particular focus was the development of farm strategies towards a more sustainable farming system. To reify this, they requested scientists, the authors of this paper, to design a sustainability assessment tool for five different agricultural sectors. We used a participatory approach to develop the assessment tools, which entails the collection and analysis of information on sustainable development of farming practices, involving scientists, advisors, farmers and experts in all phases of the research. At a certain point, we noticed a gap between the needs of the advisors from the FU and the goal of the project itself. Change was needed to succeed. This critical point was the trigger for our study and led to the objective of this research, guiding sustainability assessment and on-farm strategic decision making. We distinguished the following research questions: i) What are the needs farmers, advisors and experts have regarding sustainability assessment? and ii) What kind of framework can guide them and link on-farm strategic decision making to the use of sustainability assessment tools? The following paragraphs elaborate on the method used to answer these questions.

2.2. Identification of the farmers', advisors' and experts' needs regarding sustainability assessment

To clearly grasp the needs farmers, advisors and experts have regarding sustainability assessment and strategy design, a qualitative research was done based on data from three different sources, presented in table 1. The first data source is the participatory research project with the FU. The project focused on the fruit production sector, the beef production sector, the greenhouse production sector, the dairy sector and the arable farming sector. Notes and reports of meetings and workshops from the tool development process were used. Both the second and third source are scientific publications from two other cases in which we were involved. We analyzed in particular the lessons learned and reflections from the development and implementation of the Monitoring Tool for Integrated Farm Sustainability (MOTIFS) and the Public Goods Tool (PGT). We coded and clustered the quotes from empirical data and literature sources in categories related to the needs of farmers, advisors and experts.

Table 1: Data sources

Participatory tool development process FU	Number of workshops and meetings*
<i>Fruit production sector</i>	4 (1)
<i>Arable farming sector</i>	5 (1)
<i>Greenhouse production sector</i>	3
<i>Dairy sector</i>	1
<i>Meat production sector</i>	4 (1)
<i>Project meetings</i>	7 (3)
	Literature source
MOTIFS	De Mey et al., 2011; Marchand et al., 2014, 2010; Meul et al., 2008; Triste et al., 2014
PGT	Gerrard et al., 2012, 2011; Marchand et al., 2014

**numbers between brackets are those workshops and meetings addressing the “framework” research question*

2.3 Development of the framework

The development of a framework encompassing possible trajectories for sustainability assessment was based on the determined needs. Because of the close cooperation with the FU, we were able to use their practical knowledge and comprehensive network within the agricultural sector. The framework was developed in an iterative way through discussions with researchers and by regularly consulting experts and advisors of the five sectors, guaranteeing a profound validation. Four internal meetings with the researchers took place. Furthermore, we organized validation sessions on the framework during the regular workshops and meetings, the number of meetings encompassing these discussions are highlighted between brackets in Table 1.

During both phases, data triangulation and methodological triangulation (Guion et al., 2002) were used to increase the validity of the research. Data triangulation was ensured by consulting different sources such as farmers, advisors, accountants and researchers. Methodological triangulation was applied by using different types of data sources for the analysis such as workshops, project meetings, one-on-one meetings, discussion notes, reports and scientific articles.

3. Results and discussion

Analysis revealed four different needs regarding sustainability assessment, each need is elaborated and illustrated with quotes from farmers or other stakeholders. The framework is based on these needs and supports sustainability assessment at farm and sector level.

3.1 Needs

3.1.1 Context

Analysis reveals that the context plays a major role when conducting sustainability assessments. First, during the development of the assessment tool for the FU, we noticed differences in attitudes towards sustainability between advisors and farmers within the different agricultural sectors. Advisors and farmers within the fruit and greenhouse production sector were more positive towards sustainability in comparison with the arable farming sector (Coteur et al., 2014). Within the dairy sector, action to monitor sustainability was already taken and further development of a more thorough tool was not desired by the advisors. However, the same advisors did point out that within the beef production sector progress could be made towards sustainable farming. So far, not much attention has been paid to this sector regarding monitoring and improving sustainability. These findings reveal that each agricultural sector or farm operates in a different context, which influences the decision making process of the farmer.

"The farmers who tested the tool were enthusiastic. Sustainability is a hot issue in this sector, but yet hard to measure and score. Therefore an instrument like this is convenient." (Advisor fruit production sector)

"We cannot compare one region in Flanders with another one, not regarding water use. One region will not irrigate, while the other cannot produce goods without irrigation. It wouldn't be correct to compare them."; "Soil quality depends on the region and the specific soil structure of the field, which a farmer cannot always choose for instance in case of lease." (Advisors arable farming sector)

Second, the implementation of MOTIFS and PGT tool revealed that context influenced results. De Mey et al. (2011) showed that the attitude of different model users towards sustainability varied between

users and might influence their uptake of results. During implementation of the PGT tool, researchers discovered that the farm type and the advisor could be linked to the scores and thus the results of the assessment (Gerrard et al., 2012; 2011).

"Profound analysis of the PGT results showed whether the variation in the scores for the spurs is influenced by certain factors such as farm type, advisor carrying out the assessment, level of agri-environmental participation (OELS/Higher Level Stewardship – HLS), whether or not the farm was solely grassland, length of time the farm has been fully organic, or status of ownership (short-term tenant versus owner-occupier). (...) For some factors such as farm type, whether or not the farm is grassland and the advisor carrying out the assessment significant differences on more than one spur were detected. Tenancy and length of time the farm has been fully organic had low impact on the spur scores."

Another factor that emerged from our analysis is the difference in meaning or definition of the concept of sustainability between our three case studies. Marchand et al. (2014) already described the concept of sustainability for the MOTIFS and PGT case and Table 2 presents these different views together with the view from the FU.

Table 2: Comparison of the concept of sustainability in the case of MOTIFS, PGT and the FU (adapted from Marchand et al., 2014)

MOTIFS	Sustainability concept of the Brundtland report (WCED 1987)
PGT	Providing a “public good” beyond the simple production of food, adjusted with farm related sustainability aspects
Farmers Union, Boerenbond	“Integrate the three dimensions of sustainability. Economic sustainability is crucial, but to realize economic sustainability Flemish agriculture should achieve anchorage in society (social sustainability). Ecologic sustainability is a requirement for economic sustainability. Ecologic sustainability means that resources will not be depleted and that future generations will be able to use these resources.”

Also literature highlights the importance and role of these different views on sustainability. According to Bond and Morrison-Saunders (2013) in Bond et al. (2013) “the interpretation of sustainability is dependent both on the decision-context (of those in power), and on the context defined by time, place and culture”. This means that sustainability needs to be defined for every sustainability assessment, while considering the context in which the assessment occurs, and that it is unique for every assessment (Bond and Morrison-Saunders, 2013 in Bond et al., 2013). Pope and Morrison-Saunders (2013) conclude that pluralism should be embraced and seen as an essential aspect of the practice of sustainability assessment. Pluralism should be incorporated in the design of sustainability assessment processes to deal with expectations and reflect different views and values in the process and decision (Pope and Morrison-Saunders, 2013 in Bond et al., 2013).

Based on our analysis, the approach and results of a sustainability assessment have to be put into the context which encompasses factors as sustainability discourses within the sector, the farm type, the attitude and skills of a farmer or advisor. Taking into account this specific context should allow us to approach individual farms and every agricultural sector differently. This is confirmed by literature sources. For example, Darnhofer et al. (2010a) mark the influence and importance of the context on

the decision making process of the farmer. In consequence of this specific context, participation methods and the way of involving stakeholders should be adapted (Reed, 2008).

3.1.2 Flexibility

Very clear from the analysis was that an individual farmer should be able to set his own path during the decision making process resulting in the need for sustainability assessments to be flexible and accommodate the different and alternating goals of farmers. In all agricultural sectors participating in the FU project, a primary need exists for quick and easy indicators that can provide a quick overview on the sustainability of a farm to reveal bottlenecks without the need for extensive data collection.

Opinion of several workshop participants: "Isn't it better to look at the measures a farmer takes instead of using complex indicators which are not able to compare different farms?" (Arable farming production sector)

"We want a set of measures which can make a difference regarding sustainability. Including the delicate topics within this sector." (Beef production sector)

For the fruit production sector in particular, farmers and advisors wanted follow-up actions. They desired to get more insight in the bottlenecks and therefore requested quantitative indicators. The latter includes a more profound data collection and the calculation of benchmarks on these bottlenecks resulting in a more complex tool (Marchand et al., 2014). Furthermore, farmers and advisors mentioned the importance of monitoring the progress of a farm over time. This was not only important in the beef production sector, focussing on communication about their progress towards sustainability. In general, the farmers wanted to be able to monitor the effectiveness of the implemented improvement strategies. As a result, when assessing the farm, there is a need for different types of sustainability assessment tools, with the function of a tool reflecting the goal of the farmer at that specific time.

"Isn't it better to monitor over time? Monitoring over time is better when communicating to retail and government, to show them where we are coming from and the direction we are going." (Arable farming production sector)

"Farmers do not only want to take measures. They also want to be able to score their progress in a quantitative way, which makes the comparison with other farmers easier." (Feedback workshop FU)

Literature does not provide many keys on the issue of varying needs during time and tool choice during a sustainability assessment. Tools as RISE and SAFA only focus on a flexible use of the tool itself by leaving the possibility to choose the indicators during the assessment (Häni et al., 2003; Van Cauwenbergh et al., 2007). We only found Marchand et al. (2014) and Van Passel and Meul (2012) who stress the need and importance for a complementary use of different sustainability assessment tools.

Within these lessons learned, we can unravel a time and complexity dimension which ideally has to become visible within the framework. Goals evolve through time and will ask for different sustainability assessment tools, requiring different types of data and different levels of calculations.

3.1.3 Focus on farm and farmer

Many quotes and codes addressed the need for sustainability assessments to focus on the involvement of the farmer and on the encouragement of sustainable practices at farm level. Furthermore, as an agricultural sector can only enhance its sustainability if the farms within that agricultural sector strive for sustainable farm practices, involving farmers from the start is of significant importance.

The reflections on the MOTIFS and PGT tool showed that farmers valued contact with colleagues and the opportunity to ask questions within the discussion groups (De Mey et al., 2011; Gerrard et al., 2011; Triste et al., 2014).

"Small, homogeneous groups and an informal setting are important" (De Mey et al., 2011); "Model users valued the contact with colleagues and the potential of learning through exchange of knowledge during discussion sessions" (De Mey et al., 2011); "Farmers indicated they were reluctant to use the tool because they perceived it as not user-friendly. (...) However, they did appreciate the use of discussion groups" (Triste et al., 2014)

"Reflecting the advisor's feeling that using an advisor to carry out the assessment allowed the farmer to engage in a positive and useful discussion and that verbal explanations are more valuable than written ones, another area in which farmers scored the PGT tool highly was the opportunity to ask questions" (Farmers about PGT tool in Gerrard et al., 2011)

During the FU project, farmers emphasised the importance of implementing sustainability assessment tools that focus on farm development. Specifically in the fruit production sector farmers expressed their aversion towards assessments for policy purpose or any form of control system. This was also a concern in the beef production sector. De Mey et al. (2011) point out that farmers' interests in sustainability and the willingness to alter farming practices can vary significantly within an agricultural sector.

"This is an exploratory phase, it will not be used in certification systems." (Advisor beef production sector)

"Farmers are interested to compare their own figures with other colleagues to learn from each other." (Advisor fruit production sector)

Many authors argue that involving stakeholders and more specifically farmer involvement is very valuable (Bernet et al., 2001; Bond et al., 2012; Lang et al., 2012; Stringer et al., 2006; van de Kerkhof, 2006) and this is also the case for designing a sustainability assessment for strategic decision making purposes (Bond et al., 2012; Triste et al., 2014). It will improve the acceptance of the problem definition, the used concept of sustainability but also the outcomes (De Mey et al., 2011), because results will include different viewpoints and different knowledge sources are brought together (Lang et al., 2012; Marchand et al. 2010). Furthermore, awareness and ownership can be created and farmers may accept their responsibility in the sustainable development of their agricultural sector (Lang et al., 2012; Triste et al., 2014). When sustainability assessment approaches include farmers from the start, learning of the individual farmer but also social learning can be stimulated, however not yet guaranteed (Marchand et al., 2010; Reed et al., 2010; Triste et al., 2014).

This need of sustainability assessments to focus on farm and farmer ensues from the aforementioned findings: i) a sustainable agricultural sector encompasses sustainable farms, ii) farmers value opinions from other farmers and want to avoid policy interference, and iii) involvement of farmers from the

start of the assessment results in many advantages such as acceptance of problem definition and outcome, raising awareness and reaching higher levels of learning. Based on this need, the framework should thus allow to design farm specific trajectories.

3.1.4 Communication

Farmers and sector stakeholders explicitly expressed the need that sustainability assessments at farm level should/can serve communication about the sustainable development to other players in the agro-food chain such as the food industry, retail and consumers. Every agricultural sector deals with specific challenges regarding demands from society and environmental, social and economic issues (Coteur et al., 2014). For the FU it is important to deal with these challenges and demands in a pro-active way. Being able to communicate about the sustainable development of a particular sector, may lead to a stronger position during price negotiations with the wholesale business or may help in restoring the connection between the community and agriculture. In the case of the FU, the dairy sector, the arable farming sector and the beef production sector were mostly interested and concerned about communicating their efforts through the use of a list of sustainability measures that assess the sustainability of the farms in their agricultural sector.

"Communicate to consumer that we produce high quality products"; "Wouldn't it be better to work with measures farmers take to increase soil quality instead of using quantitative data which are hard to measure. This will also give a positive image to the outside world." (Advisors arable farming production sector)

"We cannot keep saying 'We are doing well (regarding sustainability)' without figuring out how to measure and quantify what we are doing and where we stand now". (Advisor greenhouse production sector)

"At this point, farmers are not able to communicate about their sustainability efforts. There is a significant need for a sustainability assessment." (Advisor beef production sector)

Many tools as MOTIFS, Slow Food Presidia, RISE and SAFA express the importance of communication on results of sustainability assessments (De Mey et al., 2011; Häni et al., 2003; Peano et al., 2014; Triste et al., 2014; Van Cauwenbergh et al., 2007). However, our results suggest that links between farm and sector level on that matter are needed and therefore, the framework has to unhide different options and linkages between levels for communication.

3.2 Framework

The aforementioned needs cannot be fitted within one specific assessment or methodology. They are too complex and ask for a more flexible way of assessing farms to meet with the altering needs of a farmer. Therefore, we propose a two-dimensional framework (Figure 1) in which the two core dimensions incorporate both flexibility and farm specificity. This framework reflects the strategic decision making process of a farmer and the role of sustainability assessment tools in this process. It is constructed to support the farmer, who consciously chooses to assess his farm and thereby improves the farm sustainability. This section will explain the characteristics of the framework as presented in Figure 1, addressing each need individually. First, the context in which the framework is embedded will be explained, addressing the first need. Second, flexibility (need 2) will be discussed in the part about the two dimensions of the framework. Third, details about the farm specific trajectory will answer the

third need, the focus on the farm and farmer. At last, this section will address the fourth need, communication.

Figure 1: Two-dimensional framework which combines the time and complexity dimensions of sustainability assessment with the strategic decision making of a farmer

3.2.1 Context

The framework is embedded in the surrounding context, addressing the first need. This means that before assessing a farm it is recommended to observe the specific context of the farm to understand the position in which a farmer operates. This will help to understand the goals a farmer expresses and will assist the selection of the most appropriate trajectory. Gender, age, income, education, independence of the farmer, the position in social networks, the location of the farm itself, possible political restrictions of the farm and the ideologies and values of the farmer are factors which will influence the farmers' choices and decisions (Darnhofer et al., 2010; Meijer et al., 2014). Meijer et al. (2014) describe these factors as extrinsic factors, which influence the intrinsic factors knowledge, perception and attitude. To be more specific, they describe three extrinsic variables: characteristics of the farmer, the external environment and the new technology. The characteristics of the farmer include for instance personal characteristics (gender, age), socio-economic characteristics (education, income), their position in social networks (size network, frequency of interaction), status characteristics (control over political power or economic resources) and personality characteristics (self-confidence, independency). The characteristics of the external environment are the geographical settings, societal culture and political conditions. The characteristics of the new technology comprise the benefits and costs of the new practice (Meijer et al., 2014).

Furthermore, the context also includes the interpretation of the sustainability concept. Therefore, transparency is needed about how sustainability is defined within different sustainability assessment

tools to properly choose a tool corresponding to the values and interests of the farmer. As a consequence we also have to acknowledge that there are various valid trajectories for a farmer to follow and that a farmer might prefer one specific trajectory (Darnhofer et al., 2010).

3.2.2 Two dimensions of the framework

The need for flexibility of an assessment to respond to the different goals of farmers is addressed in the proposed framework by distinguishing two dimensions: time and complexity. The time dimension of the framework is defined by five phases based on the framework of De Ridder et al. (2007). They propose four generic phases of an integrated assessment: (i) problem analysis; (ii) finding options; (iii) analysis and (iv) follow-up. In our case the problem analysis is divided into steps 1 and 2, according to the second and third need, flexibility and focus on the farm and farmer respectively. Problem analysis occurs through the implementation and use of an assessment tool in step 1 and by interpreting the results of the first step in step 2. The goal of these two steps is gaining insights on the sustainability of multiple farm aspects. The distinction between assessing the farm and interpreting the results is essential in this framework as the interpretation of results occurs preferably in different ways and depends on the tool choice. An appropriate step of interpretation will give the opportunity to react more flexible to the results of step 1. Finding options is done by developing improvement strategies in a third step. The improvement strategies will be implemented in a fourth step and correspond to the third analysis phase of de Ridder et al. (2007). The fifth and last step is the monitoring and benchmarking step (follow-up). During this step the improvement strategies will be evaluated by benchmarking the results in different ways. The benchmark can be a standard from literature, the results from previous years or the results of other farms or agricultural sectors. The complexity dimension incorporates three levels of sustainability assessment tools. These three levels can be placed within the continuum of assessment tools described by Marchand et al. (2014). They describe two extremes within this continuum: rapid sustainability assessment (RSA) and full sustainability assessment (FSA). The first level of our framework contains basic tools and fits within the RSA. This basic assessment is a very quick and easy way to assess a farm using farmer's knowledge and readily available data. Indicators are very simple and consist mainly of sustainability measures a farm may implement (for example, the re-use of water resources). In level two, the moderate assessment fits in the intersection of the RSA and FSA tools described by Marchand et al. (2014). Indicators used at this level can be quantitative or qualitative, simple or complex, but the data collection itself stays rather simple. In this level, the use of benchmarks allows us to compare farms within a specific agricultural sector. Level three consists of so-called full-scan tools and is equivalent to the FSA extreme. These tools require more complex, time consuming and often more expensive data collection. To assess a farm at level three, expert judgment and/or specific monitoring is required.

3.2.3 Farm specific trajectory

The combination of the first and second dimension results in a farm specific trajectory (Figure 1). This trajectory is formed by a sequence of steps, chosen by the farmer, throughout the two-dimensional framework. Each step represents a combination of an assessment phase and a complexity level. The trajectory chosen by a farmer has an impact on the decision making process as different steps yield different insights on farm sustainability. It is important to note that the order of complexity level 1 to level 3 is not binding. Each farmer can be triggered differently to either start at level 1, level 2 or level 3. Which next steps he chooses to follow, depends on the outcome of the assessment at a specific

complexity level. This section will explain each level of complexity by giving an example of an existing sustainability assessment tool and the related trajectory.

Complexity level 1

A logical first step is assessing the farm with a basic tool (complexity level 1). This basic tool will only provide a limited insight in the sustainability of the farm, but it can create awareness resulting in a higher willingness to search for more sustainable strategies at farm level. At this stage, it is not recommended to develop improvement strategies based on the results. It is advised to make the step to complexity level 2, where a more profound interaction between farmers and advisor is desirable. When the results of a basic sustainability assessment tool of several farms are aggregated, it is possible to communicate about the sustainability of an agricultural sector, thereby providing an answer to the fourth need. Writing and publishing a report on a regular basis may facilitate this and allows monitoring progress over time. The dairy sector in Flanders now focuses on this trajectory at agricultural sector level. They use a tool that can be situated at complexity level 1. This assessment tool is incorporated in the DQA (Dairy Quality Assurance) certification system, but is not compulsory. The assessment tool itself was developed by the dairy sector, farmers' organizations and the dairy processing sector to meet with the needs of purchasers, inform societal organizations or clients about the sustainability initiatives taken within the sector and secure their position at the international market (Interprofessionele taskforce duurzaamheid voor de zuivelsector, 2013). They selected 35 measures which can enhance the sustainable development of dairy farms. These measures are divided into seven themes: animal health, animal welfare, energy, environment, feed, water, soil and social sustainability. Each farmer can select the initiatives which are implemented at his or her farm. By repeating this assessment every year and aggregating results of all farms the dairy sector can communicate its efforts and progress towards sustainability.

Complexity level 2

An assessment at level two will give the farmer a clear view on the sustainability of his farm and will allow him to recognize its weak and strong points. Within the FU project two sector-specific assessment tools were developed which included indicators both at complexity level 1 and level 2. For the fruit production sector we developed a tool which consists of 15 themes related to the economic, ecologic and social sustainability of the farm: energy, water, waste, nutrients, soil quality, crop protection, biodiversity, landscape, public support and image, cooperation, labour, productivity, profitability, mean price and stability. At level 2, each theme comprises one or more quantitative and/or qualitative indicators. Data collection is based on farm accountancy data and documents which are readily available for the farmer. This reduces the time and cost to collect data. Indicator scores are given on a scale from 0-100 for all indicators. They are calculated with predesigned scores from literature or benchmarks based on a reference group of farmers. The scores for each theme are aggregated in a graph to get a quick and orderly view of the scores.

The next step is the interpretation of the results of the assessment. From level two, a more profound participation or interaction between farmers and advisors -individually or between farmers in discussion groups- is desired (third need). This interaction will lead to a more profound and versatile interpretation of the results because farmers have the opportunity to share their knowledge and ask questions. The graphic representation and indicator scores can be used to open and support the discussion. Discussion groups can be customised to the interest of the farmers and specific themes can

be discussed. The organisation of discussion groups was seen as a critical success factor for implementation in the MOTIFS case, determined by De Mey et al. (2011). These groups can be organized with or without an expert or advisor. Experiences from other case studies indicate that opinions differ about involving an expert. Vaarst (2007) and Vaarst et al. (2010) recommend discussion groups without an expert, as an expert may withhold the farmers to share their own experiences and knowledge. Advisors or experts should act as facilitators of the process only. It is, however, necessary to support experts and advisors when facilitating a discussion group, both their communication skills as well as their capacity to translate results from an assessment into advice should be enhanced (De Mey et al., 2011). In the case of the Dairyman project, farmers preferred the presence of an expert. Also Stringer et al. (2006) point out that the involvement of stakeholders is meaningful when social learning is stimulated and information about management decisions is exchanged by using focus groups, scenario development or workshops. The opportunity to combine and share scientific and traditional knowledge in various networks is important for farmers and is necessary to decision making (Darnhofer, 2010). After discussions with an advisor or in larger discussion groups, improvement strategies can be formed, implemented and evaluated.

Complexity level 3

To get to the core of a specific problem, level 3 offers tools that provide a farmer with a detailed assessment of one or more sustainability aspects. These tools do not necessarily offer a complete overview of the farm's sustainability, but mostly focus on one aspect. The example of sustainable crop protection is provided as an illustration. In general, sustainable use of crop protection products is promoted at farm level (Wustenberghs et al., 2012). Within the FU project, we used a brief inquiry as indicator for crop protection at level 2. This inquiry, however, does not account for the actual risk or harmfulness of specific crop protection products. To overcome this, farmers can make use of a full assessment tool DISCUSS, a Dual Indicator Set for Crop protection Sustainability Surveys. This dual indicator combines a risk indicator with a response indicator (Wustenberghs et al., 2013). The risk indicator is the quantitative indicator POCER, Pesticide Occupational and Environmental Risk Indicator (Vercruysse and Steurbaut, 2002), which assesses the harmfulness of plant protection products. Risk indices are calculated for operator, worker, bystander, consumer, soil persistence, groundwater, aquatic organisms, earthworms, birds, mammals, bees and beneficial arthropods. The response indicator is an inquiry with management related questions about integrated pest management, human safety and environmental protection. Knowledge, awareness and attitude about/towards crop protection and possible negative effects are also handled (Wustenberghs et al., 2013). This assessment can be considered a full assessment as it requires a thorough data collection. The Flemish fruit production sector is, however, very advanced in the field of sustainable use of crop protection products, and keeps a very detailed record of quantities and specific products used. This means fruit farmers are able to complete a full assessment of their farm at complexity level 3 by using DISCUSS. This allows farmers to obtain a more complete understanding of the risk related to their crop protection management and their score on the actual usage of the plant protection products. However, Wustenberghs et al. (2013) argues that, like tools of complexity level 2, DISCUSS needs to be implemented in small discussion groups with farmers to enhance the learning potential of the assessment.

3.2.4 Communication

Finally, the fourth need “communication” fits in the framework through various information transfers between levels, steps or framework cells and to the external environment. The framework allows for mapping different forms of communication, presented by the dotted arrows in Figure 1. A continuous stream of information can be communicated from each complexity level to the other. Within the complexity level 1, communication between agricultural sectors is possible when individual sectors have already assessed and evaluated sustainability themselves. Mutual communication between farmers at complexity level 2 is achievable through discussion groups. At level 3, results can be used, discussed and communicated to other farmers upon request by the farmers. Communication between farmers or agricultural sectors and the broader external environment is possible at each level of complexity. Different formats for communicating are possible depending on the situation, e.g. written reports, data sheets and mobile apps.

4. Conclusion

To provide starting points to solve the problem of non-harmonisation and/or lack of guidance in sustainability assessment tool choice, we identified four stakeholder needs from empirical data and literature sources. First, sustainability assessment needs to be embedded in a surrounding context. This context is a combination of the external environment with the attitude and values of farmers. While taking into account the context we can act upon the different goals of a farmer and approach individual farms and agricultural sectors differently. Second, a sustainability assessment needs to be flexible and accommodate the different and alternating goals of farmers through time. Third, a sustainability assessment needs to focus on the involvement of the farmer and on the sustainable development of the farm itself. Last and fourth, assessments should allow and stimulate communication about sustainable development to other players of the agro-food chain.

These identified needs can be seen as preconditions for a “good” sustainability assessment, but simply ticking them off is not a one-fits-all-solution, on the contrary, their interplay captures unique situations. To prevent generalisation and to explore uniqueness, we developed a framework that incorporates the before mentioned needs. Central to this framework are two dimensions, of which the first, time, represents the iterative steps of a sustainability assessment and the second, complexity, and refer to the complexity level of various sustainability assessment tools. These two dimensions answer the need for flexibility and farm specificity, as their combination results in a farm-specific trajectory, formed by a sequence of steps throughout the framework. A farmer chooses his own trajectory, which makes it possible to start at each level of complexity (flexibility) and to answer specific goals of a farmer (farm specificity). As such, the framework supplies the possibility to customize assessments according to the goals of a farmer by linking the time and complexity level of sustainability assessment and their accompanying assessment tools.

The two-dimensional framework thus allows for mapping the produced information and knowledge and their exchange according to time and complexity and will facilitate tool choice. The first complexity level, coinciding with a basic assessment, is suitable for communicating about the sustainable development of an agricultural sector and its specific efforts. Although basic, it may trigger farmers to assess their farm sustainability. Communication may restore the connection between the community and agriculture as purchasers, clients and societal organization ask questions about the sustainability of an agricultural sector. An assessment at complexity level 2, using more complex indicators to assess the farm, will give a farmer a more thorough insight into his farming practices. By incorporating

discussion groups in complexity level 2, involvement of the farmer and the encouragement of sustainability practices at farm level are stimulated. Complexity level 3 will tackle specific problems that ask for a more extensive data collection and detailed calculations. An assessment at this level will also focus on and stimulate sustainability practices at farm level. However, these practices are much more specific than the actions taken after assessing a farm at complexity level 2.

Navigating through the time and complexity dimensions of the framework and communicating about results support farm choices by acknowledging the intrinsic complexity of sustainability assessments and the time frame of strategic decision making. Hereby, starting points for more harmonised actions towards sustainable farming practices are set. Farmers can assess their farm in a structured, yet flexible, way and frequent assessment of farms will then lead to a progress towards sustainable development at farm or sectoral level. As this framework is mainly a procedural instrument to guide the trajectory of strategic sustainable development, future research should focus on sustainability assessment tool review related to the three levels of complexity.

5. References

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