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STAKEHOLDERS' PERCEPTIONS OF SUSTAINABILITY MEASUREMENT AT FARM LEVEL

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Abstract

An increased attention for sustainability in agricultural production within the food sector has enlarged the need for accurate farm-level information. This study aims to explore stakeholders' perceptions of sustainability measurement at farm level. A qualitative research approach was used, conducting discussion groups and semi-structured interviews in nine European countries. Stakeholders consulted identified that the main factors that influence the information flows are the alignment of the external requirements with the farm information systems and farm objectives, the expectations associated with the information provision and the level of cooperation among non-farmers users of farm level indicators. In addition to the indicators´ characteristics, perception of feasibility and usefulness of an indicator is determined by (i) the measurement system in which it is inserted, (ii) farm characteristics and (iii) farmers' attitude toward the measurement.

Keywords

Stakeholder involvement, farm level sustainability indicators, qualitative research.

1 Introduction

As a response to the multiple pressures of climate change, natural resource degradation, societal demands and global markets, the food sector is facing the challenge of moving toward sustainable development, driven by regulatory frameworks and by changes occurring along the agricultural supply chain (HIGGINS et al., 2010). Progress toward sustainability is measured through the use of indicators. Indicators are defined by DAC-OECD (2002) as a "quantitative or qualitative factor or variable that provides a simple and reliable means to measure achievement, in order to reflect the changes connected to an intervention, or to help assess the performance of a development actor". In an effort to have clearly defined components for analysis and communication, sustainability of a system is generally reduced in to a scheme with a limited number of indicators (SCHINDLER et al., 2015). Suits of indicators comprising ecological, social and economic dimensions are used for monitoring, assessing and understanding effectiveness of management measures (RICE AND ROCHET, 2005).

The selection of indicators has been found to be a science-led process where the political or managerial context in which indicators are used is not fully recognized (TURNHOUT, et al., 2007; RAMETSTEINER, et al., 2011). However, the linear model of science, with its abstracting assumptions, does not appropriately address untamed problems, where multiple values are in conflict, outcomes are uncertain and there exist significant scientific disagreement (BATIE, 2008). As measurement tools that are expected to prompt behavioral responses, indicators require a dialogue between the designers and users in order to achieve transparency, relevance, ownership and public legitimacy (MOXEY et al., 1998).

The aim of this study is to explore stakeholders' perceptions regarding the feasibility and usefulness of the introduction of sustainability indicators in an existing farm level monitoring

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system. Using FREEMAN (1984) definition of stakeholders, we consider the perceptions of those individuals or groups who affect, or are affected, by the introduction of sustainability indicators.

This research is part of the project Farm Level Indicators for New Topics in Policy Evaluation (FLINT) [2]. The objective of FLINT is to test the feasibility to establish a common standard set of farm-level indicators for policy evaluation in nine countries of the Europe Union (EU), ideally linked with the Farm Accountancy Data Network (FADN) [3]. This paper describes the methods used to collect stakeholders' perceptions, the main results and the conclusions.

2 Background

Values and perceptions of stakeholders can be divergent, turning a complex problem into a "wicked" problem, such as sustainability, that cannot be solved, only managed (BATIE, 2008; PETERSON, 2013). This condition has made the stakeholder engagement a major topic in the field of program evaluation as a way to increase the likelihood of evaluation utilization (TAUT, 2008) and a missing step regarding indicator validation (CLOQUELL-BALLESTER et al., 2006). Indicator quality assessment is usually based on a list of criteria. The best known and frequently used criteria are those developed by OECD (2001): policy relevance, responsiveness, analytical soundness, and data availability. However, in general, there is not a universal set of criteria to judge indicators and there is no common understanding of the definitions of the criteria. JOUMARD AND GUDMUNDSSON (2010) concluded that the criteria to judge indicators can be classified in categories, according to the three indicators' functions: scientific unit, measurement unit and policy element.

The selection of a set of indicators has been argued to be both a scientifically and politically iterative process (MCCOOL & STANKEY, 2004), located in a fuzzy area between the production and use of scientific knowledge (TURNHOUT, et al., 2007). Multiple approaches have been developed to select indicators, including rating, standardization, weighting, and combining (RICE AND ROCHET, 2005). Nevertheless, it is difficult to separate ambiguities and subjectivities even with complex methods of summarizing (JOUMARD AND GUDMUNDSSON, 2010). The value of a process of selecting indicators consists of allowing relevant stakeholders to be involved in the decision making process, thus taking into account the given complexity of systems, uncertainty, and multiple legitimate perspectives (JOUMARD AND GUDMUNDSSON, 2010; RICE AND ROCHET, 2005).

3 Research methods

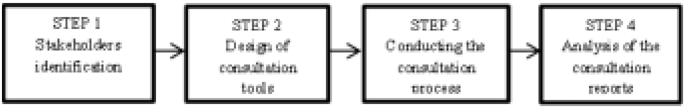
The study was conducted using an inductive qualitative research approach. Qualitative methods are appropriate when it is necessary to involve participants with a specific interest and personal experience but the results need not to be generalized to a population (BITSCH AND OLYNK, 2007). Hence, these methods are applicable for evaluation and the development of policy recommendations as well as in action research (BITSCH, 2005). In our case, four steps were carried out: (i) preliminary identification of stakeholders and their main interests (ii) design and pilot testing of the involvement techniques to be used, (iii) conducting and report-

[2] FLINT project website: http://www3.lei.wur.nl/flint/index.html

[3] FADN is an instrument for evaluating the income of agricultural holdings and the impacts of the Common Agricultural Policy, launched in 1965, through Council Regulation 79/65. It consists of an annual survey carried out by the Member States of the European Union that is derived from national surveys, and constitutes the only harmonized source of microeconomic data of agricultural holdings across EU member states. More information can be found at: http://ec.europa.eu/agriculture/rica/concept_en.cfm#

ing the consulting process and (iv) analysis of the data obtained in the stakeholder involvement process (Figure 1).

Figure 3: Research process



Source: Author's own elaboration

The steps (1) – (3) of the research process were executed by project partners for every country involved in the project. The country-level results of the consultation analysis were aggregated in to one consolidated report.

3.1 Stakeholders' identification

The identification of stakeholders and their interest in the project was done in order to develop the methods of consultation, design of the tools, and the overall strategy of involvement. Every project partner identified relevant stakeholders based on six questions: (1) Who needs what information? Who is involved in collecting, storing, analysing and reporting the information? (2)Which actors along the value chain are interested in farm level measurement regarding economic, environmental and social achievements? (3)Who is a potential user of the information? (4)Who could oppose the project activities, making it very difficult to proceed? As a result, a matrix composed of a list of probable stakeholders to be consulted and their main stakes was developed.

3.2 Design of consultation tools

A visualized group discussion tool [4] and semi-structure interviews were designed considering (a) the expected level of availability of stakeholders and (b) the list of preselected sustainability indicators (Table 1). The discussion group was pilot tested with farmers and farm advisors in order to adapt the relevance of the questions and methods. The discussion groups and semi-structured interviews tools consisted of two parts. During the first part, stakeholders answer open-ended questions related with their experience and opinions about sustainability data collection and use (Q1. How is farming being influenced by changes and demands coming from society, consumers, policy, trade partners?; Q2. What kind of data is requested from you/do you request?; Q3 What is your experience collecting and/or using that data?). In the second part, stakeholders assess the feasibility and usefulness of each indicator using a two-pole scale (--, -, +/-, + and ++) expressing their reasons for the assessment.

[4] Set of structured methods that aim to obtain in a short period of time the individual opinions of participants, clustering and discussing the ideas, and upgrading individual perceptions to a common built perspective. It is based on the formulation of relevant and simple questions adapted to participants' contexts, characteristics and previous knowledge. The visualization creates a situation with "four essentials" for comprehension in communication: simplicity and comprehensibility, brevity and conciseness, structure and good organization and further stimulation (HOFFMANN, 2000).

Table 1: Indicators of sustainability at farm level by dimension of sustainability

Environmental	Economic and Innovation *	Social
E1-Permanent grassland E2-Ecological Focus Areas E3-Semi-natural farmland areas E4-Pesticide usage E5-Nutrient balance (N, P) E6-Soil organic matter in arable land E7-Indirect energy usage E8-Direct energy usage E9-On farm renewable energy production E10-Farm management to reduce nitrate leaching E11-Farm management to reduce soil erosion E 12-Use of legumes E 13-GHG emissions per ha E 14-GHG emissions per product E 15-Carbon sequestering land uses E 16-Water usage and storage E 17-Irrigation practices	EI 1-Innovation EI 2-Producing under a label or brand EI 3-Types of market outlet El 4-Past/future duration in farming EI 5-Efficiency field parcel EI 6-Modernization of the farm investment EI 7-Insurance: production, personal and farm (building structure) EI 8-Share of output under contract with fixed price delivery contracts EI 9-Non-agricultural activities	S1- Advisory services S2-Education and training S3-Ownership-management S4-Social engagement/participation S5-Employment and working conditions S6-Quality of life/decision Making S7-Social diversification: image of farmers/ agriculture in local communities

Source: FLINT project. List of indicators selected after an extensive literature review, analysis of information gaps and project's team discussions.
*Indicators part of current FADN Farm Return are not included in the list.

3.3 Conducting the consultation process

Sixteen group discussions and 42 individual interviews were held from September 2014 until January 2015. In total, 174 stakeholders were consulted (Table 2) through discussion groups, face to face individual interviews, group interviews, interviews by phone and interviews by email.

Table 2: Number of reports, by methodology of data collection

	Finland	France	Germany	Greece	Hungary	Ireland	Nether lands	Poland	Spain	Total
Group discussions		1	1	2	2	2	2	2	2	16
Semi-structured interviews	9	7	3		2	6	6	4*	9	42
Total	**9**	**8**	**4**	**2**	**4**	**8**	**8**	**6**	**11**	**61**

Source: Authors' own elaboration
* Multiple interviews were reported as one aggregated document.

3.4 Analysis of the data

Analysis of the answers of the open-ended questions and qualitative comments on the indicators was made through the use of coding with the help of the software atlas.ti in two steps: (1) an initial open coding of the qualitative answers, aiming to delimit categories, commonalities and differences; and (2) a second coding based on the categories detected in the first stage, searching for patterns and generalized relations. Results of the coding process are presented in the sections 4.1 and 4.2.

4 Results

Eight stakeholder groups are identified within the total group of participants (Table 3). Farmers and farm-data collectors of the FADN system are 33% and 26% of the persons consulted, and more than 50% of them came from Spain and Poland. FADN representatives and actors involved in national policy evaluation initiatives account for 10% of the respondents. Other stakeholders not directly involved in the current FADN measurement system, but potential users of the information (such as farmer representatives, researchers and value chain actors), represent 28% of the total group consulted.

Table 3: Stakeholder groups consulted

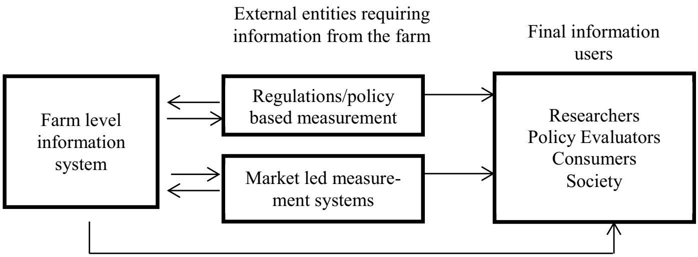
Stakeholder group	Description
Farmers (58)	Diary, beef, arable and mixed crops farmers.
Farm advisors (13)	Technical experts or specialists, extension agents, and advisory and accountancy services whose work is realized at farm level.
Farm data collectors (46)	Professional data collectors and farm advisors who are involved in FADN data collection.
FADN representatives (9)	Contact persons of FADN liaison institutes, statistical offices, national representatives, coordinator or contact person of national FADN system.
Policy makers and/ or policy evaluators (9)	Experts and head of units of agricultural authorities, directorates for agricultural ministries sections, policy evaluators and planners, rural development experts.
Scientific and academics (11)	Professors of universities, scientists of research institutes
Farmers representatives (3)	Policy expert of a chamber of agriculture, a research director of farmers union, and a farmers' union representative.
Value chain actors (14)	Sustainability manager, farm service director and representative of dairy processors and milk cooperative, director of a sugar company, director of a trade company, representative of a federation of agri-food industry, members of institutes for organic food associations and food chain quality, an organic bakery, marketing personnel of a food company.

Source: Authors' own elaboration

4.1 Identification of current sustainability monitoring systems

Stakeholders consulted identify three types of measurement systems: (a) regulations-based measurement; (b) market- led measurements and (c) own farm measurement system. Regulations-based monitoring systems have as a purpose compliance with government rules or policy evaluation, e.g., cross compliance mechanisms. Market-led measurement initiatives request information based on the commercial arrangements between farmers and their customers, e.g., information that is asked by traders, retailers or consumers. Farm monitoring systems include all information management (digitalized or not) carried out within the farm. According to the interviews, those systems can be complementary or even "redundant", depending on the characteristics and requirements of the value chain and the national contexts (Figure 2).

Figure 2: Current sustainability information flows identified by stakeholders



Source: Authors' own elaboration

Most of the interviewees agree that data gathering is a two- side exchange of information. Moreover, this exchange may be a time consuming and expensive process, with a high variability on the willingness to participate by farmers. Based on the responses and experiences collected, how easy and accurate the information exchange is, relies on four factors: (a) alignment of the farm system information with the required information; (b) alignment of the farm objectives with the objectives behind the indicator asked; (c) expectations of the information exchange, including trust among actors, expected benefits and expected risks and (d) cooperation of users beyond the farm level about the analysis, calculation, and the availability of information. Those factors are explained in the following.

Alignment of required information with own farm management information system. The information exchange is determined by how available the information is at farm level. Information that requires additional investments, time or knowledge from the farmers' side, makes the process more difficult. The current state of bookkeeping and use of digitalized information tools at farm level is highly variable, according to the type of farming and the region.

Alignment of the required information to the farm's objectives. Interviewees stated that information provision is easier if the information can be used at farm level for planning and decision making regarding business strategies or production factor use: "it can be used as part of nutrient management plan."

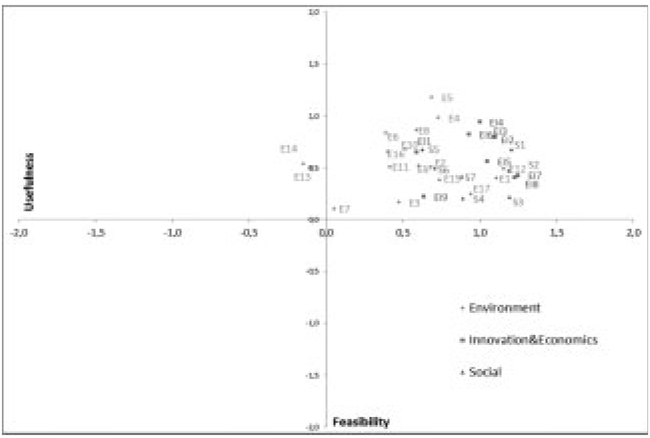
Expected outcome of the information exchange. Interviewees mentioned that awareness of who the information is for and the rationale behind the information requested are determinants, as well as the level of trust. A data collector should be a reliable agent, sufficiently trained on the information to be collected and knowledgeable of the area and local farms in order to validate the data during the collection phase. The provision of accurate information can be highly influenced if the data is linked to an incentive or penalty. Farm advisors and other non-farm stakeholders also mentioned that it is important to make clear that data gathering is not simply one-sided data provision, but an exchange of knowledge, even in the short term. Three main benefits to the farmer were mentioned: professional support, a farm level customized report, and the possibility of benchmarking.

Beyond farm level: cooperation among sustainability information users. As identified by the stakeholders, data gathering is only the first step of knowledge generation. The change of the data into usable information is an equally critical process, and the steps include: calculating, interpreting, inferring, communicating and influencing decisions. Along the way, issues arise outside of the farm level: (a) calculation of indicators not standardized; (b) interpretation and inference of indicators can be misled without the necessary control variables and knowledge of the context; (c) indicators should be communicated back to the farmers, society or consumers in an understandable and complete way; and (d) conflicts between sustainability goals among entities who ask for information. For all these issues, cooperation between stakeholders is needed. Potential conflicts between databases could be avoided with "collective databases that can be accessed by different parties" or the implementation of "unique data codes for indicators". Both solutions imply the creation of norms that are not yet developed.

4.2 Assessment of feasibility and usefulness of sustainability indicators

For the whole group of stakeholders, on average, all indicators were considered useful, and with the exception of GHG emissions, all the indicators were considered feasible. Nevertheless, very few indicators are considered as very useful (Figure 3).

Figure 3: Stakeholders assessment of indicators according to perceived feasibility and usefulness



Scale: 2=++; 1=+; 0=+/-; -1=--; -2=--

Source: Author own elaboration

Contrasting with the average values for the whole group, stakeholder groups differ on the assessment of the indicators as shown in Table 4.

Table 4: Classification of indicators by stakeholders groups and dimensions of sustainability

	Usefulness level[1]				Feasibility level[2]
Stakeholder groups*	**Very useful**	**Moderately Useful**	**Limited usefulness**	**Not useful**	**Not feasible**
Environmental indicators					
Farmers	E5;E8	E4;E6;E10; E15;E14	E1;E11;E12;E16; E2;E3;E9	E13;E17;E7	E13; E14
Data collectors	E5	E4;E6;E13;E14; E16; E8	E1;E10;E11;E12; E15;E17;E2;E7;E9	E3	E14;E7
Farm advisors	E5;E8;E10;E11;E14	E1;E12;E16; E17;E2;E4;E6;E9	E13;E3;E7	E15	
Farmers representatives	E5; E8;E4;E7	E1;E10;E11;E2; E6;E9	E13	E12;E14;E15; E16;E17;E3	E13;E14;E5
FADN	E9;E14	E10;E12;E13;E16; E17;E4;E8	E1;E11;E15 ;E2;E5;E6	E3;E7	E13;E14;E3
Policy makers/evaluators	E5;E10;E9;E15; E17;E6	E1;E11;E12;E13; E16;E2;E3;E4;E7;E8			E7
Researchers	E5;E4;E16	E13;E15;E17; E2;E6;E8;E9	E1;E11;E12;E14;E3	E10;E7	E10;E11;E13; E14;E5;E6
Value Chain		E5;E10;E11;E13; E16;E2; ;E3;E4; E6;E8	E14;E17;E9	E1;E12;E15;E7	E7
Social indicators					
Farmers			S1;S5;S6	S2;S3;S4;S7	
Data collectors		S1;S2;S3;S5;S7	S4;S6		
Farm advisors	S5;S7	S1;S2;S4;S6	S3		
Farmers representatives	S1	S5;S6;S7	S2;S4	S3	
FADN	S5	S1;S6;S7	S2;S3	S4	
Policy makers/evaluators	S1;S2;S5	S4;S6;S7		S3	
Researchers	S5		S2;S3;S6;S7	S1;S4	
Value Chain			S1;S2	S3;S4;S5;S6;S7	S6
Economic and Innovation indicators					
Farmers		EI2; EI6; EI7	EI1; EI3; EI8; EI9	EI4; EI5	
Data collectors	EI2;EI4;EI6	EI1; EI3; EI5; EI8	EI7; EI9		
Farm advisors	EI1; EI3; EI4	EI2; EI7;EI8; EI9	EI6	EI5	
Farmers representatives	EI5	EI1; EI3; EI4	EI2	EI6; EI7; EI8; EI9	EI1; EI6; EI7; EI9
FADN	EI4; EI6	EI1; EI3; EI5; EI9	EI2; EI7; EI8		
Policy makers/evaluators	EI6	EI1; EI3; EI5	EI2; EI4	EI7; EI8; EI9	
Researchers	EI4	EI2; EI3; EI5; EI8	EI1	EI6; EI7; EI9	EI9
Value Chain			EI1; EI2; EI3; EI5; EI8	EI4; EI6; EI7; EI9	

*Does not include the individual assessment of two discussion groups where several stakeholders groups were present, due the difficulty to separate individual assessments of indicators.
1. Classification of level of usefulness according to the average value in the group: Very useful (>1.0); Moderately Useful (0.5-1.0); Limited usefulness (0-0.5); Not useful (<0.0)
2. Classification of level of feasibility according to the average value in the group: not feasible (<0.0)
Source: Authors own elaboration

4.3 Identification of factors that determine feasibility and usefulness of indicators

The reasons of the differences in assessment of indicators are identified grouping the concepts derived from the perceptions toward the indicators in to categories as shown in Table 5 and 6. The assessment of the feasibility of an indicator would not only depend on the characteristics of the indicator itself (type of data and evidence, level of measurement and allocation) but also on the characteristics of the measurement system in which it is embedded (availability of matching information), the farm characteristics (type, size, fragmentation) and the attitude of the farmer towards the measurement (Table 5).

Table 5: Factors that determine the perceived feasibility of indicators of sustainability

	Categories	Description and examples
INDICATOR'S ATTRIBUTES	**1.1 Type of data**	
	1.1.1 Evidence based data	Data measured with an established instrument and which is ascertainable: e.g. invoices, soil organic matter content.
	1.1.2 Best estimate data	Data that is estimated or approximated according to the knowledge of the farmer: e.g. manure usage, farm practices, water usage, innovation, advisory services.
	1.1.3 Calculation	Information that is deducted using normative scales or standard coefficients: e.g. GHG emissions.
	1.1.4 Perceptions	Subjective opinions which is not possible to measure physically: e.g quality of life perceptions.
	1.2 Level of data breakdown in collection and calculation	
	1.2.1 Household level	Level in which the measurement or collection of variables of the indicators take place. Examples: -soil organic matter is measured sampling plots -pesticide usage can be measured at crop, parcel or farm level -emissions can be calculated by hectare or product
	1.2.2 Farmer level	
	1.2.3 Farm level	
	1.2.4 Plot /Parcel/Crop/Field level	
	1.2.5 Product level	
MEASUREMENT SYSTEM	**2.1 Availability of data**	
	2.1.1 Part of the recording system of the farm	Data and information is kept in different types of recording systems within the farm: books, software, data bases, and sheets. In some cases is digitalized. Example: Farmers keep registers about pesticide usage, fertilization, cattle movements, investments, contracts, and financial bookkeeping.
	2.1.5 Part of existing external and accessible databases	Farm level information that is collected and stored in databases outside the farm: e.g. Land Parcel Identification System (LPIS), or projects' databases
	2.2 Agent asking for it	
	2.2.1 Regulations: mandatory at farm level	Information that is asked for comply with regulatory issues: e.g. pesticide usage for regulations; cross compliance check outs.
	2.2.2 Requested by clients: desirable or mandatory at supply chain level	Information that is required by traders or consumers: eg. antibiotics usage, quality assurance per product, certification schemes.
	2.2.3 Special programs: optional	Information that is requested by special programs: certification schemes, research projects, rural development programs.
FARM	**3.1 Farm characteristics**	
	3.1.1 Size	Size of the farm: small/big farms.
	3.1.2 Type	Type of agricultural system: livestock, horticulture, orchards.
	3.1.3 Fragmentation	Dispersion of the fields and parcels.
	3.1.4 Region	Region, context on which the farm is located.
FARMER	**4.1 Farmer attitude toward information provision**	
	4.1.1 Sensitiveness of the information	Information which provision can be seen as potentially harmful for the farmer: e.g personal/private information, part of their business strategy.
	4.1.2 Trust in researchers and policy makers	Degree of trust on the use of information: e.g. doubts about how the information will be used: new taxes, regulations, new requirements.

Source: Authors own elaboration

How useful an indicator is, would depend mostly on the relevance of the objective behind the indicator for the stakeholders (Table 6). In two farmers' discussion groups, however, it was stated that is meaningful to collect some indicators even when they are not usable at farm level: a difference in the value for the farmer and a public value was highlighted.

For the interviewees, an indicator is a simplified metric of a complex reality expected to change, therefore, how well the indicator represents this reality is the second factor influencing the usefulness criterion. To infer and make valid conclusions, the adequate judgment would need to use contextual factors and control variables. As one consulted researcher pointed out: "There are facts, lies and statistics. It is not difficult to collect data; it is much more difficult to understand the data."

Table 6: Factors that determine the perceived usefulness of indicators at farm level

	Categories and coded attributes	Description and examples
INDICATOR'S ATTRIBUTES	**1.1 Relationship of the indicator with sustainability objectives**	
	1.1.1 Causality	Clear causality relationship between variables collected and objectives measured. From the scientific point of view, if the indicator is a valid representation of the expected problem to be measured.
	1.1.2 Interpretation	Existence of sufficient knowledge to interpret the indicator properly and link with management actions.
	1.1.3 Context variables	Availability of knowledge of "context variables" that make possible to infer valid conclusions and compare across time, farmers, countries, and regions.
	1.2 Level of breakdown in reporting	
	1.2.1 Farmer level	Level in which the data is transformed into information that can be used for decision making: Examples: - pesticide usage can be reported at crop, parcel or farm level -emissions can be calculated by hectare or product or reported by farm
	1.2.2 Farm level	
	1.2.3 Plot /Parcel/Crop/Field level	
	1.2.4 Product level	
MEASUREMENT SYSTEM	**2.1 Perceived relevance of problem measured with the indicator**	
	2.1.1 Farmer	Relevance of the objective measured through the indicator for the stakeholder. Examples: -Farm advisors are interested in to know overall performance of the farm - Consumers and society are interested in pesticide usage and emissions
	2.1.2 Farm advisors	
	2.1.3 Policy makers	
	2.1.4 Consumers	
	2.1.5 Society	
	2.2 Perceived potential use of the indicator	
	2.2.1 Decision making	Potential to use the indicators for planning and management at farm level, advisor level, sector level, national level, policy level
	2.2.2 Inform or communicate	Indicator main use is to inform other actors: researchers, policy makers, consumers, community
FARM	**3.1 Farm characteristics**	
	3.1.1 Size	Size of the farm: small/big farms.
	3.1.2 Type	Type of agricultural system: livestock, horticulture, orchards.
	3.1.4 Region	Region, context on which the farm is located.
FARME R	**4.1 Farmer´ objectives**	
	3.1.3 Farmer' objectives	Objective of the farmer. E.g. profit maximization, organic agriculture, protect environment.

Source: Authors own elaboration

4.4 Perceptions toward indicators according to sustainability dimension

Using the schemes presented on Table 5 and 6, this section discusses the stakeholders' perceptions of the indicators categorized in the three dimensions of sustainability.

About environmental indicators, stakeholders pointed out the importance to explain the rationale and links between indicators, taking into account the "cycles" in agriculture. National sustainability objectives could be translated at a farm level only if information could be consolidated or aggregated using a farm level balance. Evidence-based data (soil organic matter, water use, energy production, energy consumption) is perceived as more costly and difficult to measure accurately; however, much significant information is already part of farm records (fertilizers, pesticide usage). Many variables of the indicators are best estimates: farm practices, percentages of allocation (between crops, activities or at the farm /household level) or calculations (water usage, manure usage). Those indicators that measure changes in quality of production factors were identified as usable for farm planning and management to reduce costs, increase productivity and foresee future demand (E5, E12, E10, E8, E9, E6, E16). Those related with greening were linked with access to subsidies (E1, E2, E3). The pesticide usage indicator was associated with complying with regulations and customers' requirements. GHG emissions, on the contrary, is an "important" indicator used "to inform", not usable at farm level, and important for the consumer; therefore, highly valued by the value chain actors and policy makers and poorly valued by farmers. Most of the stakeholders – except for value chain stakeholders – considered measuring it as difficult. Indicators related with pesticide usage and nutrient balance were considered as possible sensitive indicators. The link between farm practice-impact was also stressed: there is the need to collect enough information to make the causality link possible; however, the complexity in some environmental indicators to establish this link was also pointed out: "some activities will lead to measurable changes over 20 years". The need for match information sources and methods using multiple databases, or measurement initiatives with the same indicators were concepts particularly claimed by policy makers, FADN representatives and data collectors.

Indicators of social sustainability at farm level are perceived by stakeholders as best estimate data and perceptions. In general, they are not asked for currently, except in specific rural development programs or specific research surveys. Like the other indicators, the need for clearer definitions of variables was mentioned. Social indicators are perceived as indicators for informative purposes: they are information already known by the farmer, with low relevance for farm decision making, high usability for policy making, and low importance in regard to informing consumers. Policy makers and researchers discussed the importance that social indicators have, and how they have been less present than economic and environmental indicators within the sustainability discussion, while farmers, farm advisors and value chain actors questioned to what extent their analysis will be effectively used. The indicator for employment and working conditions was assessed as the most useful one, despite the complexities of calculate seasonal labour and the number of working hours. Policy makers in particular found a link between social indicators and rural development programs, even though the fact that having a common exhaustive list that could be relevant and applicable for all regions could be a challenging task. The indicator based on subjective perceptions (S6) received divergent opinions from all stakeholder groups. Many stakeholders emphasized the importance of this measurement, but, for others, personal perceptions were regarded as beyond the objectives of policy, and the subjective nature of the questions and the influence of multiple non-controllable factors make analysis of indicators only useful for longitudinal research. Possible sensitive indicators identified were S1, S4, S6 and S7.

Most of the economic indicators presented to stakeholders are best estimates or are already accessible using existing bookkeeping in the farm, except for the innovation indicator. The innovation indicator needed to be explained further; while some stakeholders mentioned its importance as part of the objectives of the CAP, there was a high level of divergence on the concept, the way to measure it, the objective behind its measurement, and how it would be analysed. For some other indicators, the relationship with sustainability was not clear (EI2, EI, EI8). Market indicators such as labels and fixed contracts received many different opinions: they have a value important for the farm, but they do not represent a sustainability objective in themselves. Possibly sensitive indicators were also identified (EI8, EI9, EI6, EI4).

5 Conclusion

We have conducted a stakeholder analysis of the measurement of sustainability at farm level. Stakeholders acknowledge sustainability measurement as an important trend in the agricultural sector in which three information systems are identified: own farm system, regulation based system and market-led system. Every system has its own institutional arrangements, goals and incentives. Information exchange within those systems is influenced by (a) the level of alignment between the farm and the agent asking for it: objectives, information requirements, trust, expected benefits and expected risks and (b) the cooperation of indicators´ users beyond the farm level.

Stakeholders assessed 33 sustainability indicators based on feasibility and usefulness criteria. Overall, all indicators are perceived as useful and, except for GHG emissions, all are considered feasible to measure at farm level. Environmental indicators are perceived as the most useful for all eight groups of stakeholders, especially those indicators expected to be related with farm productivity. Innovation and economic indicators (different from indicators already included in FADN) are perceived more feasible but less useful for sustainability measurement. Social indicators are perceived as important from the policy and research point of view but less useful in farmers and value chain actors´ perspective. In general, divergences between stakeholders' perceptions arise for those indicators that are not expected to be used for planning and management at farm level. The differences in perceptions on how feasible and useful an indicator is, could be explained not only by the intrinsic attributes of the indicators but also on the measurement system asking for it, the farm characteristics and the attitude of the farmer towards the measurement. This confirms the value of scientific but also societal criteria in the selection of indicators.

Although the testing of indicators in a monitoring system will be done in project´s subsequent steps, stakeholders' consultation elicits the main arguments and different points of view that could potentially improve communication between researchers and users of information. It is needed further assessment of the influence of stakeholders analysis in the process of introduction of a set of indicators of sustainability and its contribution to the current discussion about efficiency, trade-offs and sustainability development at farm, sector or supply chain level.

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