Sustainbeef

Methodological guide

Implementation of co-definition and evaluation of sustainable farming systems

Deliverable 4.5

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1 Foreword

This methodological guide aims to provide advice to future researchers who wish to evaluate sustainable and innovative agricultural systems. We will present our own methodology based on case study farm modelling and the identification of potential innovations. We looked closer at the facilitators and barriers to implementation faced by those innovations. We developed scenarios of adoption and identified incentives required in order to implement these new practices.

Our project focused on the feed – food competition but the scope of the study can be broadened in other research fields, especially those looking at sustainable farming systems.

This Guide is based on both the methodology we used and on the lessons learned from our experience. We support our methodological choices using existing literature.

2 Introduction

Agriculture is the basis of humans' survival due to its ability to supply food and provide raw materials.. However, the sector is currently facing a number of different challenges: growing population, need to produce and distribute food equitably, mitigating its impacts on the environment, fair revenues for farmers (Ertl et al., 2015; Schader et al., 2015; Stassart et al., 2013). To address these issues, farming systems need to shift towards more sustainable practices; this includes environmental sustainability, economic viability and social acceptability (Vayssières et al., 2011). Meynard (2017) suggests that innovations adapted to local conditions should be developed in order to carry out this transition. Researchers can propose new farming systems but change is often a gradual process. Lacombe et al. (2018) and Shiferaw et al. (2005) suggest supporting farmers by following a continuous improvement loop through diagnostics and practices.

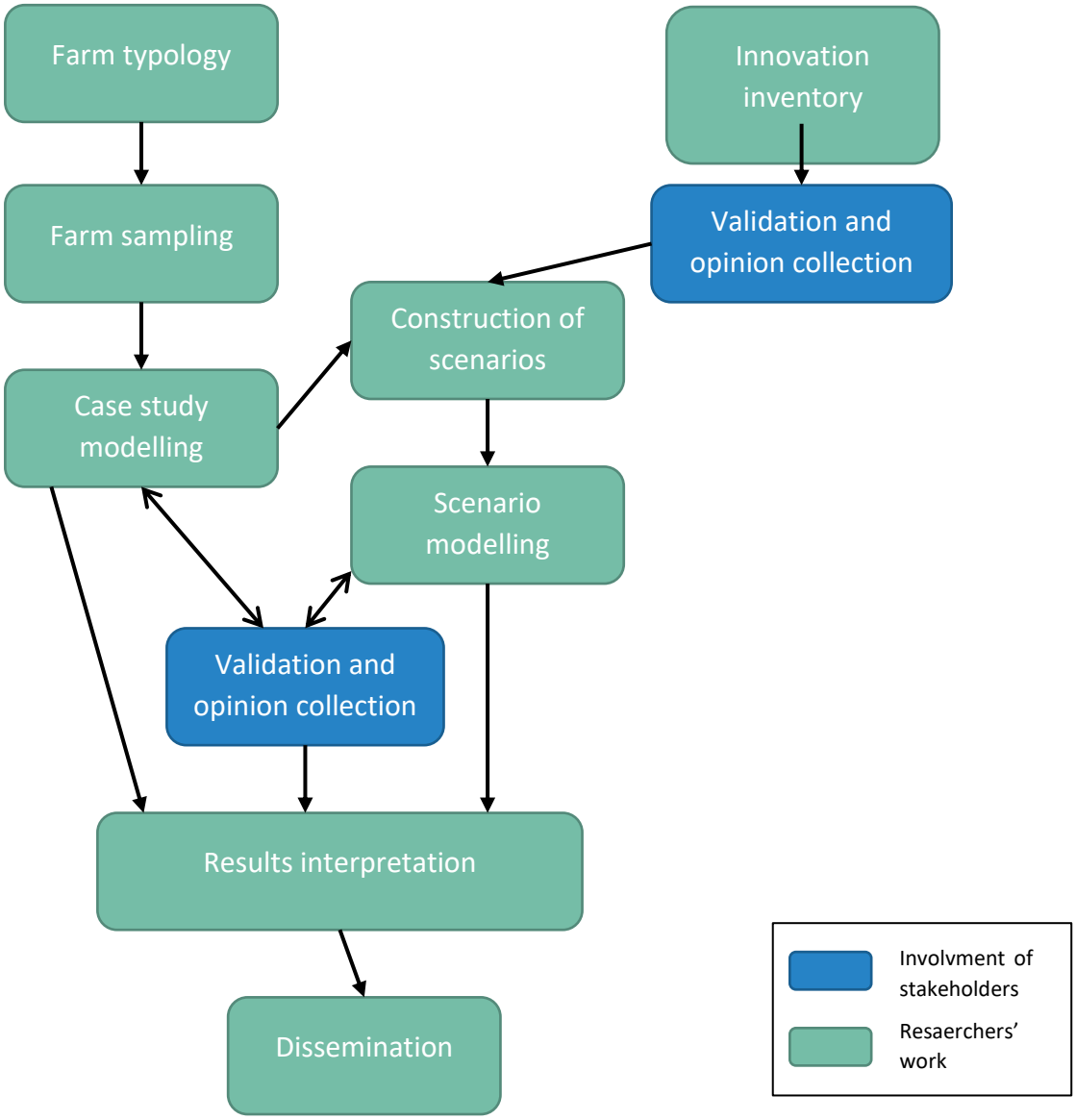
Lacombe et al. (2018) and Le Gal et al. (2011) identified several methodologies for researchers to design or support the design of innovative agricultural production systems. These include the use of models during the study or the scaling-out of tools and methods. They also stress the importance of the participation of stakeholders during the design process as opposed to a linear diffusion from researcher to farmers going through advisors (Knickel et al., 2009; Le Gal et al., 2011)

Dühr and Nadin (2007) considered that transnational cooperation could help tackle common issues more efficiently than if regions worked separately. Halland et al. (2020) also suggest involving researchers from different disciplines as well as stakeholders would help addressing problems correctly and ensure greater impact.

The Sustainbeef project is a transnational project covering a diversity of European regions involved in beef production. They are often interlinked and face similar issues. The majority of researchers were agronomist, some specialized in economy, one was an anthropologist and another one a physics scientist. Such diversity helps in deepening expertise on certain aspects of the project.

In practice, the SustainBeef project could be cut down into two main actions: identification of relevant innovations (section 3) and modelling of current and hypothetic farming systems (section 4). This project is research-oriented (Lacombe et al., 2018) and its final objective is to inform other researchers, policy makers and advisors as well as farmers about the potential innovations to support or implement in the transition towards more sustainable farming systems. The timing of the design process is defined by that of the funded project. Stakeholders, including farmers, are involved as knowledge providers at different steps of the project, in an iterative cycle. They contribute in discussions held during participatory workshops. We first gather their opinions on potential innovation, which influences the modelling. The results produced in the model are then fine-tuned by the stakeholders and finalized by the researchers. Stakeholders are chosen in order to represent the diversity existing among the value chains and farming systems. The SustainBeef project tries to go beyond the usual pool of solicited farmers. The hope is that stakeholders will learn from the participatory workshops, even if this is a secondary objective.

The Sustainbeef project looks at feed-food competition (section 5) as a way to improve sustainability. Meat production raises environmental, social and economic concerns. About one-third of crop production worldwide (on a mass basis) is allocated to animal feed affecting the share of crop production allocated to food (Foley et al., 2011). Yet, the former role of livestock was to transform products inedible by humans in high value food (Leip et al., 2015).



In this context, herbivores, such as ruminants, play a key role as they can value grass and by-products, which are not edible by humans, into food with high nutritional value (Wilkinson, 2011). Beef meat, however, is often pointed out as the most problematic animal product (Vainio et al., 2016). We thus studied the actual role of beef production in feed-food competition and the strategies to reach its full potential for sustainability improvement.

Figure 1 : Project progress

3 Identifying potential innovations

To propose sustainable farming systems, we need to identify which innovations (see Glossary), improve farm sustainability and what stakeholders (experts, farmers, other players from de value chain) think about them.

3.1 Literature inventory

This task can be broken down into 5 steps:

1. Identifying **potential avenues** for improvement and draw up a first list of them;
2. On the basis of these avenues, carrying out a deeper **bibliographical research**. The material gathered may both belong to scientific or grey literature. It might be interesting to keep track of the keywords used for the need of further researches.
3. Creating an **analytical grid** (see 3.1.3) adapted to the study in order to frame the research. This will also help organising and gather the information from literature.
4. **Interviewing experts** to get their opinions on the subject and validate or fine-tune the selection of innovations
5. Filling out **new description sheet** (see 3.1.5)

3.1.1 Potential avenues

The SustainBeef project was based off existing publications on the subject (see Appendix 1). At the beginning of the project, we made use of search engines in bibliographic database to have an insight of the current knowledge and opinions surrounding sustainability within beef farming systems and about feed-food competition. We used general keywords combinations including “feed efficiency”, “feed-food competition”, “livestock sustainable”, “livestock future”, “beef farming redesign”, “innovation livestock”. Based on those general publications, we could identify general themes and strategies addressing the studied issue. Together with researchers’ knowledge, we could establish a list of potential avenues aiming at improving feed-food competition. This will allow us to narrow our literature research.

3.1.2 Bibliographical research

The next step of the project was to search deeper into those various themes to identify and define more specific innovations. A variety of keywords combinations have been entered in the same search engines as for the first step. It included “beef genetics”; “livestock cover crops”; “decision support fodder”; “feed management cattle”; “precision feed beef”; “crossbred calves economic”; “red clover beef protein”; “beef agroforestry”; “legumes cattle”; “oilseed cake”; “beef by-products”; “alfalfa soymeal replace”; “cattle grass fattening”; “integrated crop livestock systems”; “dual purpose meat quality”; “nurse cows”. Complementary researches were conducted using classic search engines in order to identify knowledge finding place outside traditional academic peer-review processes, also known as “grey literature” (Adams et al., 2017). This was done to supplement information on more technical/practical innovations for which academic knowledge was lacking.

3.1.3 Analytical grid

The knowledge gathered through said bibliographic searches was processed and each innovation was described in an individual table to have a general view of the innovations identified. The information included in the table has been selected in relation to the project objectives. Indeed, it was important for us to know to which type of farm (case study) these innovations could potentially be applied, the necessary figures to model their impact on farming system performances and the barriers and levers that the implementation of this innovation could encounter in order to assess its relevance and feasibility.

Table 1 Proposed analytical grid for the inventory of potential innovations

Innovation title	What is the innovation?
Innovation description	What does the innovation consist of?
Condition of application	In what context can this innovation be implemented (pedo-climatic, socio-technical, farming system and/or political conditions)
Expected performances	What is the quantitative objective we expect to achieve?
Barriers	What prevents or would prevent the innovation from being developed (social, technical, policy, lock-in)
Levers	What are the levers to operate in order to facilitate the adoption of the innovation?
Advantages	What are the benefits that drive these innovations?
Innovation's region	In which countr(y/ies) or region(s) has the innovation been implemented?
References	Where did you find the information about the innovation?
Experts to interview (Country)	Which expert could help us to find out more about the innovation?

3.1.4 Interviews of experts

As part of the literature review process, we conducted interviews of experts to determine if the innovations identified fitted the field reality and if some innovations were missing. We define experts, as researchers, advisors, representatives of the agricultural beef sector. We suggest conducting semi-structured interviews. Longhurst (2009) defines them as "*a verbal interchange where one person, the interviewer, attempts to elicit information from another person by asking questions. Although the interviewer prepares a list of predetermined questions, semi-structured interviews unfold in a conversational manner offering participants the chance to explore issues*". Adhering to this process gives the opportunity to identify any points of disagreement or misunderstanding about the study. For example, in the case of the *Sustainbeef* project, the interviews with the experts highlighted the need to define the "innovation" concept more precisely. We thus suggest starting the interview by questioning the perception of the scope of the project by the respondent. Then you can focus on gathering his/her suggestions of innovations.

In our case, we interviewed four experts. This number may vary but it should cover the diversity of experts concerned by the topic. You might stop interviewing new experts once

responses tend to overlap and no new ideas emerge. This refers to the saturation principle (Weller et al., 2018)

How to proceed

Here is a methodology proposal. It is important that all partners follow the same method in order to be able to compare and compile the results of the interviews from the different regions.
Depending on the respondent and the interviewer's capacity to make him/her talk, the interview can take from 45 minutes to 2 hours.

Getting started

- Introduce yourself and the project in general
- Ensure confidentiality and explain how you will protect privacy (referring to GDPR[1])
    - No personal data shared with any third party companies
    - Anonymous results
    - Make them sign a letter of consent (Appendix 2)
- Tell interviewees that their views are very important to you and the project then explain why
    - Having the vision of the field is important to meet the needs of the sector
    - Being experts in their own field, their opinions allows us to identify more specialized experiences/innovations
- Ask permission to record interviews by tape-recording (and in writing)
- Make interviewees feel comfortable by asking them how they are or by making some other appropriate small talk

Starting the interview

- Ask them what are the (innovative) solutions to limit feed-food competition according to them
    - Without mentioning the innovations you have already identified
    - They should not limit themselves. Indeed, there is a risk of missing certain innovations because there are currently barriers to achieving them.

During the interview

The interviewer should not influence the answers of the respondent and the way of asking questions should be as neutral as possible. The way questions are asked might lead to different answers.

In order to structure the interview, it is important to have a common interview guide. However, it should not be seen as a rigid framework but rather a support for the interviewer.

Thus, the guide contains the main questions to be asked during the interview as well as sub-questions that allow the interviewer to check that all the topics of interest to him have been addressed; they also serve to stimulate the farmer if he/ she does not address some of these aspects by him/herself.

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1528874672298&uri=CELEX%3A32016R0679

These questions are prepared in a logical order but this order is not mandatory and varies from one interview to another. The preparation of the questions makes it possible to discuss the same subjects with all the respondents, which allows us to compare the different answers later.

During the interview, the questions must remain open and their wording must be adapted to the respondent. In addition, the questionnaire must have a funnel structure in order to move from the most general to the most specific topics. As a result, specific questions are not directly addressed, which allows for a dynamic discussion.

Here are the things that can create bias:

- Asking leading questions
- Failing to follow up on or omitting topics that the interviewee introduces
- Redirecting the story or interrupting it
- Failing to recognize reactions of the interviewee to the interviewer's personal characteristics, including dress, age, race, gender, body size or apparent social status
- Asking questions including or suggesting the desired responses, i.e. be aware of how you influence the respondent
- Using non-verbal cues to indicate the right answer to a question, or the response with which the researcher agrees
- Stating opinions on an issue. Researchers should avoid volunteering opinions at all, and if forced to do so, they should wait until after the interview is over

While the interview is being conducted, you can encourage additional information by:

- Using neutral agreement (*Ok; Yes; I see*)
- Repeating what the person has said in a questioning way
    - The echo question technique *(Respondent: "I am not convinced by this solution" – Interviewer: "Not convinced? …")*
    - The rephrasing method (*If I understood well you mean that the farmers…*)
- Asking for more information *(What do cattle feed on in your area? What types of innovative systems have you encountered in your work?)*
- Asking for clarification *(What do you mean by…?)*
- Asking for an opinion
- Not being afraid of silences. They generally are a time for reflection, necessary for the respondent.

The researcher must ensure that the expert can express him/herself while remaining within the initial theme, in our case, the responses to feed-food competition. If the person gets off-topic, you can:

- Reintroduce the topic in a natural way
- Decide whether or not pursue new ideas and directions

Concluding the interview

When the interviewee does not have any more ideas, you can mention quickly the innovations you have identified if they ask for it. Sometimes it brings new ideas to their mind but be careful to take into account the fact that those innovations might have been inspired by your suggestions.
You can also ask for contacts that could be interesting to interview individually or during the focus groups sessions.
Finally, tell the interviewee you will keep in touch with him/her for the following steps of the projects and thank him/her for giving you their time.

How to maintain a positive interviewer-respondent relationship?

- Avoid offering opinions or making judgments about what the interviewee says, despite having strong feelings on the topic. Judgments will influence respondents' ideas and answers.
- Avoid showing surprise, disgust, or other strong emotions, regardless of personal opinion.
- Accept hospitality when offered.

References:
Adapted from Margaret D. LeCompte, Jean J. Schensul and Stephen L. Schensul, Essential Ethnographic Methods, Ethnographer's Toolkit, 1999, Altamira Press in Mary Richardson's (s.d.)
Kling-Eveillard F. (2012). Les enquêtes qualitatives en agriculture : De la conception à l'analyse des résultats. Méthodes et Outils, Institut de l'Élevage, Paris, France.

We suggest summarizing the interviews and listing the ideas in a common frame (Table 2). Over the course of processing data, the ideas can be reformulated to summarize similar ideas expressed by various experts.

Table 2 Proposed classification of the innovations emerging from the interviews of experts

Inno #	Innovation	Category	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

The mentioned innovations can be organized according to a constructed classification specific to your project or you can use one that already exists. In the Sustainbeef project, we constructed a categorization based on the type of practice/strategy involved. We also used an existing typology referred to as the "ESR" approach. This conceptual framework is designed to characterize farmers' transition towards sustainable agriculture following three steps: eco-efficiency, substitution and redesign (Estevez et al., 2000). In their transitions, farmers do not necessarily follow every step of the ESR, they can enter at any stage. Furthermore, one practice may involve several strategies of the ESR framework (Wezel et al., 2014).

3.1.5 New description sheet

If the interviews of experts brought new innovations or new information about already identified innovations, you can add it to your existing innovation list from 3.1.3

3.2 Focus groups

The participation of stakeholder in the design process contributes to identifying the relevant innovations by considering farmers' needs and constraints, taking into account their knowledge and evaluating the feasibility of such innovations (Le Gal et al., 2011). Focus groups are relevant methodology to understand the problems from the most concerned people's point of view (Leclerc et al., 2011a). It empowers the participants of those focus groups and give them the opportunity to share their reality and suggest solutions adapted to their needs (Leclerc et al., 2011a).

3.2.1 What are focus groups?

Focus group is a qualitative method (Table 3). The terms "focus group" refers to a broad set of meanings, as it is generally underlined in literature (Barbour and Kitzinger, 1998; Baribeau, 2010; Duchesne and Haegel, 2004a), because of its diversified uses.

According to Barbour and Kitzinger:

> *"Focus groups are group discussions exploring a specific set of issues. The group is "focused" in that it involves some kind of collective activity – such as viewing a video, examining a single health promotion message, or simply debating a set of questions. Crucially, focus groups are distinguished from the broader category of group interviews by the explicit use of group interaction to generate data. Instead of asking questions of each person in turn, focus group researchers encourage participants to talk to one another: asking questions, exchanging anecdotes, and commenting on reach others' experiences and point of view. At the very least, research participants create an audience for one another.* […] *However, any group discussion may be called a "focus group" as long as the researcher is actively encouraging of, and attentive to, the group interaction"* (pp.4-5) (Barbour and Kitzinger, 1998)

This definition emphasizes the importance of interactions. The objective of the facilitator is therefore to encourage the participants to express and to interact with others and identify the agreements/ disagreements and confront them. That is why it is particularly important to let participants express themselves: the speech distribution must be near 90% for participants, 10% for facilitator. Please note: the role of focus groups is not to be in full agreement on all matters. It is be useful to tell the participants this upon introduction (Leclerc et al., 2011b).

In our case (i.e. Sustainbeef), focus groups are used as a "collective interview". The objective is to understand the points of view, the opinions, the representations … of the participants when interacting with others. These interviews are:

- Research interviews, i.e. discursive material reserved for analysis, provoked and collected by researchers on a theme they have themselves defined but which must be a matter of concern for the participants.
- Collective interviews: that implies to take into account the interactions. Participants are not simple recipients of what the others say, they influence one another (Davila and Dominguez, 2010; Duchesne and Haegel, 2004a).

Table 3 – Quantitative and qualitative methods: which differences?

Quantitative methods	Qualitative methods
To measure, quantify	To understand
Few information about a lot of individuals	A lot of information about few individuals
Survey, questionnaire	Interview guide, grid, field notes
Statistical representativeness	Saturation (see below)
Statistical tools	Coding, content analysis
Quantified extrapolation	Identification of cultural models

The principle of saturation refers to two aspects in qualitative methods. When composing the sample, the saturation means that the researcher needs to take into account the diversity within the group he/ she organizes (e.g. in our case, the diversity of breeding systems need to be represented in the breeders' group). Saturation also means "no new information comes out of the interviews": the collect of data can therefore stop (Pires, 1997).

3.2.2 When to choose focus groups methodology?

According to Barbour and Kitzinger:

> *"Focus groups are ideal for exploring people's experiences, opinions, wishes and concerns. The method is particularly useful for allowing participants to generate their own questions, frames and concepts and to pursue their own priorities on their own terms, in their own vocabulary. Focus groups also enable researchers to examine people's different perspectives as they operate within a social network. Crucially, group work explores how accounts are articulated, censured, opposed and changed through social interaction and how this relates to peer communication and group norms. Indeed, depending on the researcher's theoretical approach, focus group data can go further and challenge the notion that opinions are attributes of subjects at all rather than utterances produced in specific situations"* (p.5) (Barbour and Kitzinger, 1998).

As a research method, focus group can be used for diversified purposes that require increasing involvement of participants (from "data providers" to "actors", by way of "participants") (Table 4) (Leclerc et al., 2011b; Touré, 2010).

Table 4 – Epistemological grounds

Type of research	Approach	Objective	Status of the interviewees

Experimental research	Deductive approach	To confirm hypotheses, data	Data providers
Exploratory research	Inductive approach	To evolve hypotheses, to ground theory on empirical data	Participants
Action research	Interventionist approach	To act toward change	Actors

In our case, focus groups are combined with literature reviews and open-ended interviews with experts in order to identify and characterize innovations that allow reducing feed-food competition in beef production. The aim of focus groups is to identify innovations from the breeders' (and value chain actors) point of view, and to take into account their opinions about innovations identified through literature and experts' interviews in order to help us to define scenarios (see 4.4). Moreover, the focus groups and interviews participants will validate these scenarios thereafter.

Please note that during analysis, we will concentrate on the discursive material produced by the groups more than on the groups themselves and their dynamic.

3.2.3 How to proceed?

The interview guide

Usually, focus groups are semi-directed. They are therefore based on an interview guide, which is built to go from general to specific topics (it is usually symbolized by an inverted pyramid). The interview guide helps reframing the discussion and brings a guideline. Please note that the interview guide contents the questions that participants will have to answer to, or in other words, the objectives of the focus groups translated into questions. It is therefore important to take care of the wording of the questions (Duchesne and Haegel, 2004a).

The interview guide may include "stimuli" as video, newspaper's articles, pictures…, about which the researcher wants to collect the participants' reactions (Duchesne and Haegel, 2004a). In our case, the stimuli can be the presentation of the innovations identified in the literature and through open-ended interviews. Note that this presentation should not be too early and not too long, in order to avoid conditioning the group's thinking (Touré, 2010).

The panel

- ***Participants characteristics***

In qualitative methods, the construction of the panel is based on saturation of the positions in the social space, not statistical representativeness (Table 3). The panel has to be relevant and suitable according to the research's objectives. Significant regularities are sought rather than repetitions (Davila and Dominguez, 2010).

When selecting participants, take caution surrounding the following aspects:

- The focus theme of the group must be a matter of concern for the participants.

- They speak for themselves, not "in the name of". That is why it is advisable to avoid "representatives"[2].
- Symmetry in the relations between participants (Duchesne and Haegel, 2004a; Leclerc et al., 2011b; Touré, 2010) or in other words homogeneity within the group in terms of "status". Indeed, in order to avoid risk of self-censorship, it is advisable to seek social proximity within the group. In this way, people feel more "comfortable" to express themselves. They have to feel equal to others, like peers. In addition, it should also be avoided to isolate a member in a group (e.g. a woman among a group of men).
- If social homogeneity is advisable, we look for diversity within the group (enough to provoke debate, but not too much – they have to share a common interest) and between the groups. The profile of the group can be homogeneous according to one variable and at the same time heterogeneous according to another (Davila and Dominguez, 2010).
- Take care of the logistical constraints, in particular the distance to cover and the hours have to be suitable for the participants.

- ***The recruitment***

Artificial or Natural groups?

There are different strategies available when it comes to forming groups (Table 5). Generally, focus groups rely on artificial groups, i.e. groups "created" by the researcher. At the other end of the spectrum, focus groups can involve "natural groups", i.e. pre-existing groups organised by the researcher. A third strategy consists in bringing together people who live in the same environment without necessary knowing each-others (neighbourhood, institution...) (Davila and Dominguez, 2010; Duchesne and Haegel, 2004a). The choice of the strategy relies on the objectives and the subject of the research, but also on the logistical constraints the researcher has to deal with.

Table 5 – Characteristics of artificial and natural groups

Artificial	Natural
The researcher controls the size, the duration, the dynamic and the composition of the group Groups stop once focus groups are over	Pre-existing group: size, composition and dynamics are beyond the researcher's control. The group continues once the focus group is over → Risk of self-censorship (in order to avoid compromising future discussions)

[2] They could be representatives as long as all participants are so.

Participants do not know each- others (or, if they live in the same environment, they do not have, at any rate, in-depth relations)	Participants know each- others beforehand
Need for an “icebreaker” phase	Time saving (does not really require an “ice-breaking” phase)
	Discussions seem less artificial
	Risk of implicitness of the discussion (participants do not need to express what they have in common that is potentially unknown to the researcher)

In the SustainBeef case, artificial groups are more relevant in order to represent the diversity of farm types and stakeholders.

Snowball sampling

In snowball sampling, the researcher uses the network of relay actors and participants to form groups.

In our case, advisers can be mobilised to identify potential participants according to a set of criteria. You can contact these potential participants directly to invite them and ensure that their participation is relevant according to the objectives. If they decline, you can invite them to indicate other potential participants. Please note that this method of sampling might lead to a lack of diversity in terms of representations, opinions and points of view (Demers, 2010).

Ideally, focus groups involve between 8 and 10 participants. Below this number, debate levels can be poor. Above, the group will be difficult to manage and it may reduce expression (Duchesne and Haegel, 2004a; Leclerc et al., 2011b; Touré, 2010). Please note that it is generally advisable to recruit more participants than the number needed to ensure a sufficient number of participants. Moreover, a follow-up call 2 or 3 days before the scheduled day is advisable in order to ensure enough participants are present.

Initial contact

There are different approaches surrounding the initial contact. It is necessary to provoke the interest of the participants without revealing too much about the objectives (to avoid the risk of influencing the debate).

But on the other side, authors stress that the search for spontaneity should not be confused with a “surprise effect”. Participants must be informed of what awaits them. The invitation must therefore include the project’s aims and the programme of the day (Leclerc et al., 2011b; Van der Maren, 2010).

The facilitation

The facilitation of focus groups implies multiple roles, i.e. facilitator, co-facilitator, observer, time keeper and reporter.

The facilitator guarantees the framework and interactions. It guides form, not content. It presents an active listening capacity, in order to get participants to clarify what they are talking about, and should be as neutral as possible: the facilitator does not participate in the debate. He shows empathy. Its role is to encourage participants to express themselves and interact

with others. As in the individual interview, the use of techniques such as non-verbal encouragement, rephrasing, silence, ..., can be useful (Leclerc et al., 2011b).

As facilitator, rely on a co-facilitator could be helpful. The co-facilitator writes on flipchart, distributes material, plays the role of timekeeper. As co-facilitator, he does not take part in the debate, even to frame it.

Most preferably focus groups should be recorded. It could be very also helpful to be able to rely on a reporter. The reporter writes down everything that is said, how things are said and by whom they are said. This role eases the transcription's phase.

Finally, it is usually advisable to rely on an observer. The observer records all the non-verbal communication during interactions what facilitates the analysis of the dynamic of the group.

In our case, please note that we do not really need an observer, because of our purpose (i.e. the analysis of the discursive material produced by the group, rather than the analysis of the group itself and his dynamic).

To encourage the spontaneous expression of each participant and the exchanges, you can rely on animation tools. In the Sustainbeef project, we used several methods and media (see Appendixes 3 to 7)

The logistical aspects

It is particularly important to take care about some logistical aspects like the place, the time and the recording of the focus groups. The place of the focus group must be suitable in terms of:

- Distance (not too far for the participants)
- Accessibility (easy to find)
- « Image » (not connoted)
- Size of the room(s) (depending on the size of the group, but also the techniques used)
- Material : the room offers all the material you need (projection screen, internet, …)
- Conviviality (take care about hospitality)

The hours need to be suitable too. An invitation must be sent to participants with all the details needed. Finally, as the purpose of focus groups is to analyse the discursive material produced during interactions, it is absolutely necessary to record interactions. Duchesne and Haegel (2004) recommend the use of video recording. In our case, sound recording is sufficient. Please note that participants have to give their consent to be recorded (see appendix 2 for adapted letter of consent). Prior testing of the recording is also highly recommended.

3.2.4 Analysis

3.2.4.1 Materials

The diversity of materials to analyse

Focus groups produce many materials:

- The sound recording and its transcription
- The notes from de note keeper
- The notes from the co-facilitator (flipcharts 'sheets,…)
- Pictures
- …

All these materials are generally included in the analysis: the transcription as main matter of concern, the other materials as background information (Duchesne and Haegel, 2004a).

How to transcribe?

In our case, the purpose of the analysis is not to focus mainly on the interactions, but more on the opinions, the content. The following elements are however important: speech's succession, silences, uncertainties, laughs,…

Here are some rules to transcribe the sound recording without loose this information:

- **=** is used to notify that a participant has the floor directly after another participant or even interrupts him or her (the first one, however, leaves the floor for him or her)
- **[** is used when two (or many) people talk in the same time;
- **(.)** is used to notify a short break. If the break is longer than 1 or 2 seconds, then it is generally indicated in {} (see below);
- **…** is used to notify something not audible;
- **{}** is used to notify details about the tone of voice, the manner the things are said,… ;
- The **underline** is used to notify insistence;
- The **BLOCK LETTERS** are used when the tones go up (Duchesne and Haegel, 2004a).

*If these rules are too complicated, then indicate all this information between **[]**.*

3.2.4.2 The analysis

What is analysed?

In our case, the analysis focuses on the group, the content of its opinions, more than on the interactions and the way the opinions arise. However, it is important to pay attention to interactions (e.g. the silences of some participants can be signs of self-censorship, social desirability, disagreements…).

As we will focus on the content of the opinions expressed, we will first describe and characterize the group, then summarize the content of the discussions, and finally compare the groups between them (Duchesne and Haegel, 2004a).

How to analyse?

First: "immerse" yourself in the material through the reading of the transcription and all the materials. In this phase, it is important to "open up your mind" and distance yourself from your own assumptions. Here are some main principles:

- Pay attention that the same expression/term does not necessarily cover the same thing for everyone (or even for the same individual over time).

- Do not exclude an opinion, as it would be “out of topic”: by contrast, try to understand how it relates to the discussion.
- Wonder about what you do not understand (Duchesne and Haegel, 2004a; Lejeune, 2016).

After this immersion’s phase, there are two ways for analysing: coding or using an interpretative framework.

In our case, we analysed the thematic content of the discussion, we focused on the ideas expressed to validate or refute the hypothesis we made (relevance or not of the identified innovations). We also noted the consensus and disagreements.

We produced a report for each focus group and a general analysis grid, based on the content of the focus groups. We then analysed every focus group individually and then we did a transversal analysis to identify similarities and differences.

The report includes the description of participants, their verbatims, responses to surveys, and votes as well as the analysis of those, and finally the conclusion with key points, tested or invalidated hypothesis, consensus and disagreements.

4 Modelling alternative systems

Farming systems are complex and modelling tools can be helpful in studying them (Vayssières et al., 2011). These tools can also be a medium for discussion with stakeholders during participatory research.

4.1 Identifying current systems

In order to be able to model the impact of changes within farming systems, it is first necessary to represent the diversity of the study groups (Vayssières et al., 2011). We constructed a typology based on existing data, such as expert knowledge, national statistics or commercial farm data. We took into account the characteristics on which the study focused, which was beef production and feed-food competition. For each farm type, a case study is required for modelling. Vayssières et al. (2011) listed four options to define them: (i) random selection of actual farms, (ii) construction of average farms, (iii) construction of representative farms, and (iv) selection of actual representative farm. The authors suggest following the latter option because it allows (i) the validation of the chosen case study in contrast to random selection and (ii) avoids obtaining unrealistic constructed farms in contrast to the construction of average and representative farms. However, there might be bias regarding the criteria used to choose such representative farm according to the sensitivity of the expert. It is thus important to confront this selection with other stakeholders (see 4.5).

Each partner defined the most relevant farm types for their region and the leaders of this task made sure that the overall selection covered the diversity of European beef farming systems as much as possible. The researchers then described the characteristics of those systems following a common framework gathering the quantitative and qualitative data needed. The description form included six sections:

- General information : Name, localisation of the case study, reference year of the data
- Structure : Labour, land area farmed, herd size, livestock buildings, other buildings and equipment
- Crops and grassland : Fertilisation, plant protection treatments, number of harvest and crop yields
- Herd composition : Annual purchases and sales of animals, animal performance indicators
- Growth and diet : Daily diet and annual feedstuff resources of different groups of animals
- Economic results : Output, expenses, capital

This information was pooled and standardized, providing a full understanding of the technical and economical functioning of the case study farms. An overview of each case study can be found in Deliverable 2.1[3].

4.2 Modelling case studies

The following section is dedicated to understand how farms, and in particular case farms, will react to various changes in their environment, i.e. the introduction of innovations. Bio-economic models can be helpful tools when data on the adoption and inclusion of innovations is not yet observed (Ashfield et al., 2013; Shiferaw et al., 2005). They integrate both economic behaviours and biophysical processes. Bio-economic models may serve to predict the adoption and impact of new practices or policies, to make sensitivity analyses or to lead further research by revealing knowledge gaps and research priorities (Shiferaw et al., 2005). They can take into account the variability of performance linked to area conditions and time periods (Delmotte et al., 2017). They are, however, limited by the availability of current data and by the scope of the model, meaning that some innovations cannot be depicted in a model (Delmotte et al., 2017).

In our case, we adapted the existing FarmDyn model to our needs. It is a farm-scale bioeconomic model that allows users to simulating farms with different enterprises or combination of enterprises such as dairy, mother cows, beef fattening and arable farming. The model was initially developed to measure greenhouse gas abatement costs[4] of German dairy farms. It functions as a flexible modular template design optimization model. The framework enables simulations of farm management and investment under changing conditions, for example price changes, policy interaction or differing environmental conditions.

Of particular importance for the case studies at hand are the bio-physical relationships between emissions and agricultural practice, as well as the associated costs and workload. Key elements for the assessment are the representation of the herd, feeding activities, manure handling and on-field activities, for e.g. fodder production, as these are meant to have the greatest impact on the indicators of interest. The representation of those elements in FARMDYN is explained in the following.

The herd demographics are captured in monthly resolution. Herds are differentiated using age, gender, breeds and production objective. Cattle herds are further broken down into cows, bulls, heifers, male and female calves, for different feeding regimes and production intensities, defined by daily weight gains and milk yield per animal. The herds are adjusted dynamically with consideration of new born animals and the rearing process up to the stage of heifers or young bulls. Heifers can then be further fed with different intensities and

[3] For more information please contact us by e-mail at l.legein@cra.wallonie.be or s.hennart@cra.wallonie.be or visit our institution website www.cra.wallonie.be

[4] Abatement costs refer to expenditures which reduce the direct pressures on natural assets (https://stats.oecd.org/glossary/detail.asp?ID=6343)

therefore different production lengths until they enter the active herd or be sold. One can define several heifers and/or bulls weight gain or slaughter age, leading to different requirement and, therefore, different feeding requirements. Heifers can also be purchased from the market. Animals can also leave the herd and be slaughtered/sold at the end of their actual production phase.

The feeding of the herd is constrained by various nutritional requirement functions. These functions include energy requirements, maximum dry matter intake, maximum/minimum dry matter shares from roughages and concentrates, maximum starch and sugar shares as well as the ruminal nitrogen balance of the animals. The requirements are adapted throughout the lactation phase of a cow, or growing phases of other cattle. In order to fulfil these requirements, different feeding activities link the amount of on-farm fodder grown to the animals requirements. Additionally, different varieties of fodder and concentrates can be bought from the market. The feed-mix eventually chosen by the model is determined by cost efficiency while ensuring the metabolic constraints of the specific animal category are met.

The manure module in the model comprises the management of manure on the farm including animal excretion, storage and its application to the land. Manure excretion is based on fixed factors considering animal types, yield levels and feeding practice and accounts for organic N, total ammonia N, P and total manure volume. The manure can then be stored in a subfloor-storage under the animal house or in outside stores with different cover options. If animals are grazing, the excretion on pastures is considered in an own pool with similar nutrient sub pools. Further constraints ensure minimum requirements for storage capacity and a complete emptying of the storage spaces in spring. Manure application is conducted via contractors with several optional application techniques being available such as drag hose (trailing shoe), broad spreader or injection.

On-field activities are managed by the crop module and the grassland module. The agricultural land farmed is separated in arable land, grassland and permanent pastures. The on-field activity is dictated by land availability, variable costs, yields, machinery and fertilizer use, and available field working days. The grassland can be used as pastures or for fodder production with different intensities (fertilization, number of cuts) and hence different yields. Crop rotational constraints are determined by maximum shares meaning that certain crops are restricted to be grown only on a certain share of the land representing rotational breaks.

For labour on the farm, the model considers a fixed amount of work for general administrative work (not depending on farm enterprise or farm size), and management work (which depends on the size of the different farm enterprises), and labour need for different farm operations in stables and on fields. Furthermore, the possibility of off-farm work can be chosen. Labour need for animals varies by animal type and stable size, while labour need for field activities varies by crop, month, and fertilizer type and amount applied. Additionally, the availability of field working days limits the number of days where specific field operations are possible due to climatic or soil conditions.

The current state of the model has benefited from numerous adaptations in order to depict the characteristics of the farm types and the properties of the defined innovations. A detailed,

up-to-date description of the model and all its features can be found in the new online model documentation[5]

In the course of the project, a continuous improvement strategy was applied in order to obtain simulations as close as possible to the observed case study farms. Given the high degree of heterogeneity in the farming systems covered in the project this was considered good practice as the initial model parameterization for Germany was not sufficient to fully capture the special features of each farm.

During the project, two development tasks were conducted:

- A complete set of sustainability indicators is now available in the output of the model. These are based on the Life cycle assessment methodology. (see 4.3)
- Several innovations are available in the simulation. We focused on Farm-scale innovation for which data were available in the literature. (see 4.4)

4.3 Definition of multi-criteria assessment methodology

Many methods for assessing the sustainability of agricultural farms already exists, such as the IDEA (Vilain, 2008), TREE (Pervanchon, 2004) or DIAMOND (Litt et al., 2012) method. However, these are not adapted to the data from simulations and do not include indicators dealing with food safety or more particularly, feed/food competition. There is indeed no consensus around this type of indicators, which is emerging in the literature and not yet widely applied (Laisse et al., 2019; Wilkinson, 2011). We thus decided to establish a methodology (see Deliverable 2.2[6]) for assessing the sustainability of European beef cattle systems based on existing methods and adapted it to the available data from bio-economic simulations.

The first step in creating a new evaluation method was to clarify its specifications. This consisted of i) setting the goal of the evaluation, ii) defining the system and its scale and, iii) discussing the strategy and the available data.

By adapting different evaluation methods to our requirements, we built a model (or evaluation tree) to assess the sustainability of the selected farm-types. The strategy to build this evaluation tree was first to carry out a bibliographic search as existing methods are not always agreed upon (Barbier and Ridaura, 2010). The evaluation method was thus based on different existing methods, including: the *ex ante* sustainability assessment tool for SAMAPs (Terrier, 2009), the SAFA framework (Scialabba et al., 2013), the IBEA diagnostic tool (IBEA, 2013), the sustainability diagnostic of the Sustainable Agriculture Network (Réseau agriculture

[5] http://www.ilr.uni-bonn.de/em/rsrch/farmdyn/farmDynDoku/

[6] For more information please contact us by e-mail at l.legein@cra.wallonie.be or s.hennart@cra.wallonie.be or visit our institution website www.cra.wallonie.be

durable, 2016), IDEA (Vilain, 2008), and the EcoAlim database (Wilfart et al., 2016). These have been adapted to the needs of the project by including the feed/food competition dimension.

The data used to calculate the indicators should be based on objective and not on subjective data from expert's opinion, as could be the case when conducting field surveys on farms. These data were generated and calculated by a bioeconomic farm model (FarmDyn for the sustainbeef project), modelling each farm individually.

The three main branches of the evaluation tree were the three pillars of sustainability (1st hierarchical level) environmental, economic and social (ENV, ECO and SOC respectively). Each pillar is divided into smaller branches called 'components' (2nd level), themselves subdivided into smaller branches called 'criteria' (3rd level) and 'sub-criteria' (4th level) that define them. The calculated data at the end of a branch is called an 'indicator' (5th and last level). An indicator is the synthesis or simplification of data deemed relevant to report the impacts of a practice. Causal indicators report on practices while effect indicators report on impacts.

Due to the model boundaries, the preselected indicators had to be further stripped down. All indicators have to be applicable to the model in some form. If the input data for the indicator calculation is part of the output of FarmDyn the indicator is potentially applicable. The application then can be conducted in two forms: model internal, meaning the indicator is computed as part of the optimization problem, or post model, meaning the indicator is calculated based on the model results. Both approaches have their advantages and disadvantages: The internal calculation of the indicators bares mathematical restrictions depending on the technical realization of the model. In the case of FarmDyn the technical realization is conducted as a mixed integer programming optimization model meaning that all equations that are part of the optimization have to be linear. The calculation of indicators post model has no such restrictions, but is not usable for extended analysis, for example, the estimation of abatement costs or the implementation of emission caps[7] or taxes as those require for the indicator calculation to be part of the mathematical optimization.

Furthermore, the sample of typical beef producing farms requires flexibility in the parameterization to incorporate local conditions while keeping a level of simplicity to be usable within a reasonable workload. Especially the data acquisition for the parameterization of some indicators can be time intensive. This oftentimes restricts not only the indicator itself but the methodology to calculate it. There is always a compromise between level of detail, simplicity and explanatory power. Even if an indicator is applicable it is not necessarily significant. "Essentially, all models are wrong, but some are useful", George E. Box once stated. This is also true for the FarmDyn model: essentially all modeled indicators are "wrong" but given a precautious approach in interpreting them some can be useful in ex-ante impact assessment of innovations and policy scenarios. Others that are relying on model exogenous

[7] The cap on greenhouse gas emissions that drive global warming is a firm limit on pollution. (https://www.edf.org/climate/how-cap-and-trade-works)

assumptions (for e.g. changes on a higher spatial level such as regional or country level) or indicators that are highly aggregated (for e.g. food output of the whole farm vs. per branch or animal) might not be viable in predicting changes of the innovations or do not capture the most important impacts of an innovation. To prevent misinterpretation of indicators or drawing the wrong conclusion such indicators are left out.

4.4 Implementing innovations into representative farming systems

Innovations to be tested at farm scale were selected on the basis of the literature inventory and focus groups results. Once the sustainability indicators calculations are incorporated into the model, we are able to quantify the impact that these innovations would have on the case studies identified.

Simulations of the innovations, and their impacts on the farm sustainability, is produced in comparison with the case-study simulation. Since the FarmDyn simulation is based on an economic optimisation, three types of results are possible:

- The innovation allows the farmer to increase its economic performance (i.e: adding a new cheap high quality feed). In this case, the simulation performed directly the complete set of sustainability indicators.
- Partial use of the innovation leads to the economic optimum. This would be the case for example for *fast rotational grazing*, for which the area switching from continuous grazing to the new *fast rotational grazing* will be partial depending on the work time availability and grass quality/quantity gain, (i.e. 40% of the permanent grassland).
- When the innovation is not chosen at all by the model economic optimisation methodology, one has several choices to study the scenario anyways:
    a. "Forcing" the innovation would be appropriate, for instance, in the case where new types of animals (cross-bred, steers, early-maturing, etc.,) are tested. In this case, the case-study zootechnical part is not included and only the tested scenarios are considered for the optimization.
    b. A "sensitivity analysis" is performed when, for example, the price of a new feedstuff is too high to be selected by the model optimisation process. This is typically the case for an innovation such as the use of algae as in this project. The simulation is then performed considering several prices for this novel feed and the results will be visible as function of the feed price. It further gives information about the optimum price at which the farmer might buy this new feedstuff.

Uncertainties in the parametrisation of the innovation are propagated through the simulation to produce sensitivity analysis.

4.5 Restitution workshops

The scenarios defined by the members of the consortium have to be validated and/or fine-tuned with the stakeholders. To ensure continuity we invited the same people to the

restitution workshops as to the focus groups. These restitution workshops pursue the following objectives:

- Presenting data about the feed-food competition (FFC): current state of the FFC in each case-study and comparison with the other regions;
- Fine-tuning/validating the case-studies modelling: discussing and validating the hypotheses underlying the modelling of the case-studies;
- Fine-tuning/validating the scenarios: discussing and validating the hypotheses underlying the modelling of the scenarios; identify their consequences at farm and value chain scales;
- Identify incentives supporting the scenarios that have interesting results.

The participation of stakeholders is important in order to include the socioeconomic constraints they expect to face (Shiferaw et al., 2005). Furthermore, their participation would lead to more realistic scenario to fit reality and improve their usefulness and further adoption (Delmotte et al., 2017).

All the people used previously in the focus groups were invited, i.e. farmers, as well as farm advisors and value chain actors. The restitution workshops took the form of participatory meetings: unlike focus groups previously conducted, participants had less time to express themselves. In the case of the participatory meeting, the floor is shared between the facilitator(s) and the participants (Evrat-Georgel and Kling-Eveillard, 2018). It mixes phases of expression by the participants and presentations by the facilitator(s). Indeed, this meeting aimed at presenting the results obtained so far by the modelling to further gather feedbacks from the stakeholders and improve data and results. It may be useful to specify this element in the introduction to the day.

4.5.1 Reporting

The reports of the restitution workshops should include:

1. **The Minutes (the most detailed as possible) <u>of all the discussions</u>, and in particular:**
    - Their opinions on the hypotheses underlying the case studies' modelling
    - Their opinions on the state of the FFC in each case-study (take pictures)
    - The (positive as well as negative) consequences of the introduction of the innovations at farm/value chain scales they identify
    - The incentives they identify that could support each scenario

2. **The fine-tuning of the case-studies and scenarios**

The description of the changes you propose to do in the case studies and scenarios' modelling after these restitution workshops (if needed). The incentives you propose to deepen and to simulate.

3. **The summary of the evaluation sheets (if applied)**

This report will then serve as a basis for improvement of the hypothesis within the model. Furthermore, while the objective of the project is to influence further researches and incentives, levers and drawbacks, ideas and suggestions occurring outside the scope of the model, should be gathered in order to document the relevant scenarios to be further studied.

5 Feed – Food competition

5.1 State of FFC

The contribution of cattle farming to food security appears to be unfavourable when looking at recent scientific papers (Mosnier et al., submitted paper). The *Sustainbeef* project was thus aimed at studying the actual contribution of the diversity of European beef production systems to food security and to identify the key drivers of food security together with the potential levers for its improvement.

Cattle are regularly targeted because the quantities of feed needed to produce one kilogram of meat are higher than for pigs or poultry (Wilkinson, 2011). However, as ruminants, cattle are able to use resources that cannot be consumed by humans, such as grass or certain by-products of the agri-food industry, to produce food of high nutritional value (Wilkinson, 2011). Based on this reflection, several scientists (Ertl et al., 2015; Wilkinson, 2011) suggested evaluating net efficiency, in other words, the net contribution of animal production to food security.

According to the study of Laisse et al. (2017), on which our work is based, French beef cattle systems have various net efficiencies from one to another and there is therefore room for improvement within these systems.

Furthermore, only one-third of the global phytomass use is allocated to human food directly (Hou et al., 2016). The rest of this global plant biomass is shared between grassland (45%) and cropland (25%) for animal production, such as meat, eggs and milk. Among livestock, beef cattle mobilize half of this phytomass but rely mainly on grassland and crops by-products (Wirsenius, 2000). However, some grasslands are potentially convertible to arable land and some by-products, such as soybean cake, are considered as the main driver of land use and are thus competing with food (Mottet et al., 2017). To improve food security, Röös et al. (2016) suggest to limit meat production to systems based on biomass not edible or wanted by humans and to primarily allocate arable land to production of food directly edible by humans.

5.2 Calculations of FFC

Feed-food competition was assessed by two indicators estimated at the beef production scale, the efficiency of conversion of edible resources in edible animal products, and the use of agricultural land (Mosnier et al., submitted paper).

First, we looked at the definition of efficiency. Indeed, the net efficiency, unlike the gross efficiency which is generally used, only takes into account the proteins or energy consumed and produced by animals that can be consumed by humans (see the boxes below).

$$Gross\ protein\ efficicency = \frac{Produced\ protein\ (carcass, milk, eggs)}{Protein\ consumed\ by\ the\ herd\ (all\ the\ feed)}$$

$$Net\ protein\ efficiency = \frac{Produced\ protein\ edible\ by\ humans}{Protein\ consumed\ by\ the\ herd\ and\ edible\ by\ humans}$$

$$Gross\ energy\ efficicency = \frac{Produced\ energy\ (carcass, milk, eggs)}{Energy\ consumed\ by\ the\ herd\ (all\ the\ feed)}$$

$$Net\ energy\ efficiency = \frac{Produced\ energy\ edible\ by\ humans}{Energy\ consumed\ by\ the\ herd\ and\ edible\ by\ humans}$$

If the net efficiency is greater than 1, it means that the system under consideration produce more protein or energy edible by humans than it consumes (Laisse et al., 2017). On the contrary, if the net efficiency is lower than 1, it means the system is a net consumer of protein or energy.

Secondly, we looked at the use of agricultural land to produce meat, and in particular beef meat. Regarding available data, we decided to calculate land use efficiency through the amount of tillable and non-tillable land required to produce one kilogram of meat carcass (Mosnier et al., submitted paper). We considered permanent grasslands as non-tillable since they are currently not in competition with food production due to low land productivity, land inaccessibility for machinery or regulatory constraints even though they might be tillable in the future. The current arable areas are considered here as tillable land directly in competition with food production. It includes cereals for feed, temporary grassland, fodder crops as well as lands required to produce the purchased feed (concentrates, fodder) (Mosnier et al., submitted paper). By-products, however, are not considered in the calculation so far.

$$Non-tillable\ land\ used\ to\ produce\ meat = \frac{on-farm\ non\ tillable\ land\ used\ to\ produce\ feed\ (m^2)}{Total\ carcasses\ (kg)}$$

$$Tillable\ land\ used\ to\ produce\ meat = \frac{on-farm\ tillable\ land\ used\ to\ produce\ feed\ (m^2) + Land\ equivalent\ for\ the\ purchased\ feed\ (m^2)}{Protein\ consumed\ by\ the\ herd\ and\ edible\ by\ humans}$$

Above, we only presented the calculations regarding feed – food competition in particular, but other indicators contribute to assess the contribution to food security of our case studies. For more details you may refer to Deliverable 2.2[8] of this project and to Jarousse et al.

[8] For more information please contact us by e-mail at l.legein@cra.wallonie.be or s.hennart@cra.wallonie.be or visit our institution website www.cra.wallonie.be

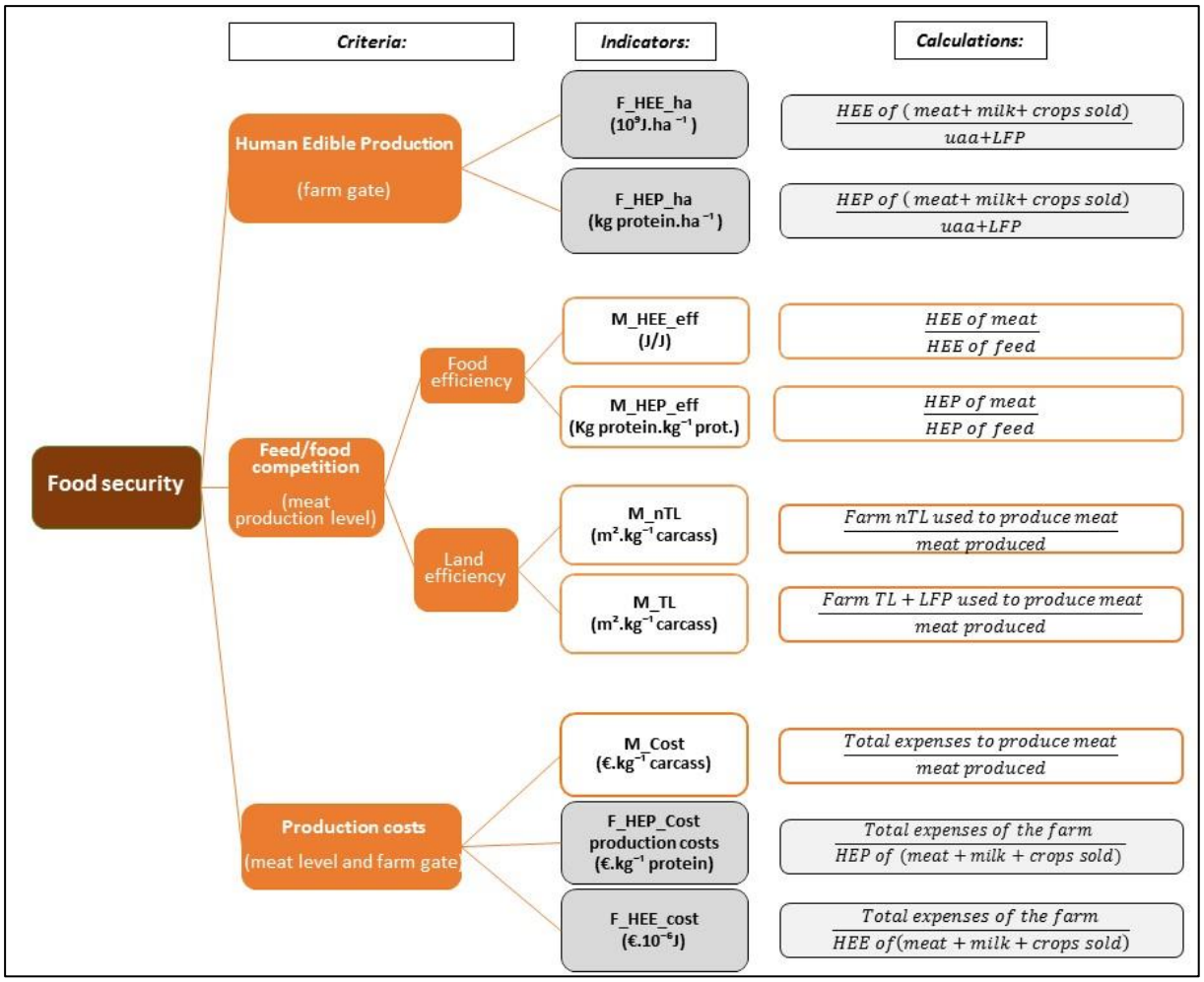


Figure 2 - Food security evalution tree (Jarousse et al., 2020)

Notes: in grey farm gate indicators, in white: meat production level indicators that include purchased inputs and inputs to produce the feed produced on the farm; HEE : Human Edible Energy and HEP Human Edible Protein; UAA: area of the holding; TL, nTL, LFP are resp. Tillable Land, non-Tillable Land and Land equivalent for the purchased feed; J joule.

6 Perspectives of the approach

Participatory research should be an iterative learning cycle. The above proposal for methodology is only the first loop in the process of supporting transition towards sustainable farming systems. However, further research should be undertaken. For example, the studied scenarios should later be adapted and tested at experimental and actual farms levels. Indeed, the whole diversity of systems, and conditions, cannot be totally covered by the models and participation of stakeholders through on-farm trials can help with taking this diversity into account and adapt the scenario to specific conditions (Shiferaw et al., 2005).

We need to keep in mind that it takes several years to implement both research-oriented and support-oriented approaches, which goes beyond the duration of current funded research (Lacombe et al., 2018).

We thus hope that our study has been able to set the basis for improving the state of feed – food competition of beef farming systems and that relevant scenarios will be further studied and implemented.

7 Recommendations

This methodology guide aims at transposing our approach into other projects looking at supporting transition towards more sustainable farming systems. We modified the methodology actually applied during the project to help other researchers avoid the same drawbacks as we did. To further extent, it might be useful to adapt this new approach to your particular need and the available skills within the consortium.

Firstly, we observed that project descriptions were not always using adequate vocabulary for particular concepts and methodology. Especially, in agricultural projects, the sociologic approach is often underestimated in terms of time and skills needed. Therefore, we suggest to involve experts on sociological approaches and/or to train researchers from a consortium to be aware of the importance of the participatory approaches. It is even more true in transnational projects since one expert might not be able to conduct all the sociologic tasks due to distance, time and language barriers.

Secondly, the consultation of stakeholders as well as our own experience suggest that feed – food competition is not a primary concern for farmers. Indeed, competition with plant-based fuel, Christmas trees or construction projects for roads or housing seem to worry them even more. Therefore, it is important to have a more holistic approach in the transition towards more sustainable farming systems.

Thirdly, we consider that stakeholders could be even more involved in so-called "participatory" projects. For instance, setting up on-farm trials could contribute to an improve in this aspect. Besides, stakeholders could be involved, or at least consulted, during the construction of the project. We realize that the current organization of scientific research funding make it difficult to involve them. It would be interesting to work on longer timeframe to be able to involve stakeholders by, for example, setting up a pre-project for stakeholders consultation.

Furthermore, the consultation of stakeholders raises the question of their remuneration. Indeed, we take their time and knowledge to feed the project and it would be logical to give them back something. We did not deepen this topic however. But we believe it is important to include this reflexion in further researches.

8 Glossary

Participatory approach: "*By participatory approaches, we mean any arrangement in which actors - stakeholders - of different types are brought together with the aim of contributing, in a more or less direct and more or less formal way, to the decision-making process. Thus, the concept of participation refers to the involvement in decision-making processes of persons outside the formal political-administrative circle who, by assumption, do not necessarily conform to the norms of the latter*." (UVED, n.d.)

Innovation: *"Innovation is the introduction of something new or improved into something that has a well-established character, such as products, processes, marketing or organizational methods. In other words, it means applying ideas, knowledge or practices that are new to a particular context with the purpose of creating positive change that will provide a way to meet needs, take on challenges or seize opportunities. Innovation is generally synonymous with risk-taking."* (BusinessDictionary, n.d.; CGIAR, n.d.; CNRTL, n.d.; European Commission and Directorate-General for Research and Innovation, 2013; French et al., 2014)

Bioeconomic models: "*Bioeconomic modelling nests essential biophysical processes within economic behavioural models. Their constrained optimisation perspective allows evaluating how technological and/or policy changes would affect economic welfare, sustainability, and environmental conditions over time."* (Shiferaw et al., 2005)

Feed – Food competition: *"generally refers to the tensions and trade-offs between two alternative uses for edible crops: direct consumption by humans versus feeding livestock"* (Breewood and Garnett, 2020).

Stakeholders: is "*an entity with a stake (interest) in the subject activity*"(McGrath and Whitty, 2017)

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10 Appendix

Appendix 1: Literature references from the project proposal

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Appendix 2: letter of consent (interviews)

"This interview is part of the …… project, funded by …….. under Grant Agreement number ……..

By taking part in this survey you give your consent that your responses will be recorded. Information will be stored, processed during data analysis and will be shown in project reports, which are restricted to the project consortium. The results of this investigation may be published in scientific journals or conferences and may be used in further studies. No personal data will be shared with any third party companies. Your authorization for the use and access to this information is valid until the end of the project, unless you decide to cancel your participation at any time. If you decide to withdraw your consent, please contact the researcher leading this survey (Name, First name, Country, e-mail). Your decision to give your consent for the use of information provided by you is completely voluntary.

To know more about the …… project privacy policy, please see our website ……."

Appendix 3: letter of consent (focus groups)

Madam, Sir,

You agreed to participate in a discussion group in the frame of the project …….. Hereafter, you will find some information about this project. As intended by the new European General Data Protection Regulation, you have to indicate your consent to participate. In order to do this, please sign the form on the last page and send it back to (name of your institution). If you have any questions, feel free to contact the supervisor (see contact details below).

Supervisor

(First name, last name)
(name of your institution)
(address of your institution)
(phone number)
(e-mail)

Objectives

To meet the challenges ……
……
……
……

The project …….. is ……
……
In addition to the scientific literature and expert opinions, discussion groups with breeders on the one hand and with value chain actors on the other hand are organized in order to co-design potential scenarios of evolution for more sustainable beef production systems.

Reason and nature of your participation

Your involvement will consist of participating in a discussion group. Composed mainly of breeders (some advisers should be also present), the aim of this group will be to reflect on "innovations" (from a technical or organizational point of view) that would improve the sustainability of beef production systems.

This group will meet once, during a full day (10h00-16h00). It will be facilitated by members of (name of your institution). The discussions will be recorded, in order to facilitate the analysis (anonymity and confidentiality will be respected).

A second meeting will be organized soon thereafter (in the spring). The aim of this second meeting will be to present "scenarios" (i.e. pathways toward more sustainable systems) based on the results of the discussion groups and experts' interviews. This second meeting will involve more participants: breeders, advisers, but also value chain and territorial actors. The

purpose will be to let the participants express themselves about these scenarios in order to improve them. A full day is also planned.

Advantages and disadvantages of your participation

Your participation is important to us. As a breeder, you are directly involved in the improvement of beef farming systems, your point of view counts. Your opinion and your knowledge of the field are valuable to us.

There is no disadvantage except to give us some of your time (2 days).

Voluntary nature of your participation

Your participation is voluntary. You are free to withdraw at any time, without having to justify yourself or suffer any prejudice.

However, as a focus group participant, it will not be possible to delete the recording. Your contribution will be retained in order to keep the consistency of the discussions.

Data processing

The data collected as part of the project will be stored on the secured network of (name of your institution).

Only information needed for the discussion group will be collected, namely :

- For selection and contact: name, first name, address, email address, telephone number, characteristics of your farm (type, size, localisation …).
- Discussion group's data: the audio recording of the discussion and its transcript. The audio recording will be retained until ……. project will be completed. The transcription will ensure the anonymization of confidential data and may, therefore, be kept for an unlimited period. The extracts used in the framework of the valorisation of the results (publications) must in no case allow your identification (direct or indirect).

At your request, we will send you the results of the project and the publications resulting from it.

Free and informed consent

Please, complete this form and send it back to:

(First name, last name)
(name of your institution)
(address of your institution)

Or by email : …….

I, the undersigned _____ (first and last name in block letters), declares that I have read and understood this form. I understand the nature and the reason for my participation in the …….. project. I had the opportunity to ask questions that were answered with satisfaction.

- ☐ I agree to be contacted again for other projects and authorize (name of your institution) to retain my contact information for this purpose.
- ☐ I do not agree to be contacted again for future projects. (Name of your institution) undertakes to delete my personal data once the …….. project is completed.

During this event, (name of your institution) would like to take pictures for two purposes:

- Pictures exclusively intended to facilitate analysis (treated as data). These pictures will be destroyed once the project is completed.
  - ☐ I authorize the (name of your institution) to take pictures of me for this purpose;
  - ☐ I do not authorize (name of your institution) to take pictures of me for this purpose.
- Pictures intended for communication on different media (Facebook and (name of your institution) website, in particular). This use is strictly reserved for the promotion of (name of your institution) activities.
  - ☐ I authorize the (name of your institution) to use pictures of me for the promotion of its activities.
  - ☐ I do not authorize the (name of your institution) to use pictures of me for the promotion of its activities.

Signature: _____

Done at _____, on _____

Appendix 4: Moving debate

The technique of the moving debate (also called “positioning game”) allows representing the opinions in the space.

The room is divided in two parts: on one side, people who agree with the assertion, and the other side, those who disagree. The middle symbolises the space for people without opinions. The further people move from the middle toward the wall, the more they agree/disagree.

The facilitator presents an assertion or asks a closed-ended question, and participants must position themselves in the space according to their opinion.

Then, the facilitator invites each participants to express himself and explain his position/opinion alternating between those who agree and those who disagree. Other participants can move through space as they hear each other's arguments. The facilitator remains neutral.

As it is lived as a “game”, this technique allows tempering the debate (“Débat Mouvant Resonance ASBL,” n.d., “Outils-Réseaux : DebatMouvant,” n.d.; Evrat-Georgel and Kling-Eveillard, 2018).

Material

- A clear space (in a room or outside)
- A object that symbolises the “boundary”, the middle
- A slide show with the assertion

Appendix 5: template for the in-depth reflection on the innovations identified by participants

Name of the innovation: …….	
Description:	
Conditions for its implementation:	
Expected performance:	
Other comment:	

Appendix 6: template for the evaluation of the more relevant innovations

Name of the innovation: ……

		Comment
Does this innovation have an impact on:		
The animal?	Yes / No	…… ……
The buildings?	Yes / No	…… ……
The feeding, the diet?	Yes / No	…… ……
The herd management?	Yes / No	…… ……
The microbism?	Yes / No	…… ……
The breeder?	Yes / No	…… ……
On a scale from zero to four, are the following criteria a barrier for the uptake of this innovation (zero = not a barrier at all / 4 = huge barrier)?		
The cost	0 1 2 3 4	…… ……
The work load	0 1 2 3 4	…… ……
The skills needed	0 1 2 3 4	…… ……
The equipment, the "pre-requisites" (conditions for implementation)	0 1 2 3 4	…… ……

The rapidity of the implementation (short, medium, long term)	0 1 2 3 4	…… ……
The reliability of the innovation according to its expected result (Still need a field and/or a scientific validation? Already proved, evaluated, tested?)	0 1 2 3 4	…… ……
The rapidity to obtain results	0 1 2 3 4	…… ……
The acceptance and the coordination with the value chain actors (up and down stream) (feedstuffs industry, slaughterhouse, distribution network, consumers, …)	0 1 2 3 4	…… ……
The legislative, regulatory and normative framework	0 1 2 3 4	…… ……
The expected impact (what does it bring in me)	0 1 2 3 4	…… ……
Other barriers:	…… …… ……	
By contrast, what are the elements, which would facilitate the uptake of this innovation, the levers you could rely on?		
…….	0 1 2 3 4	…… ……
…….	0 1 2 3 4	…… ……
…….	0 1 2 3 4	…… ……
…….	0 1 2 3 4	…… ……

Appendix 7: “Weather report”

This technique allows knowing how people feel using the analogy of a weather report.

Each participant is invited to choose the weather report that corresponds to his mood, his state of mind and then explains it. Either participant choose pictures you had previously prepared, or they draw their own weather report on the flipchart.

Figure 3 – Exemple of weather report

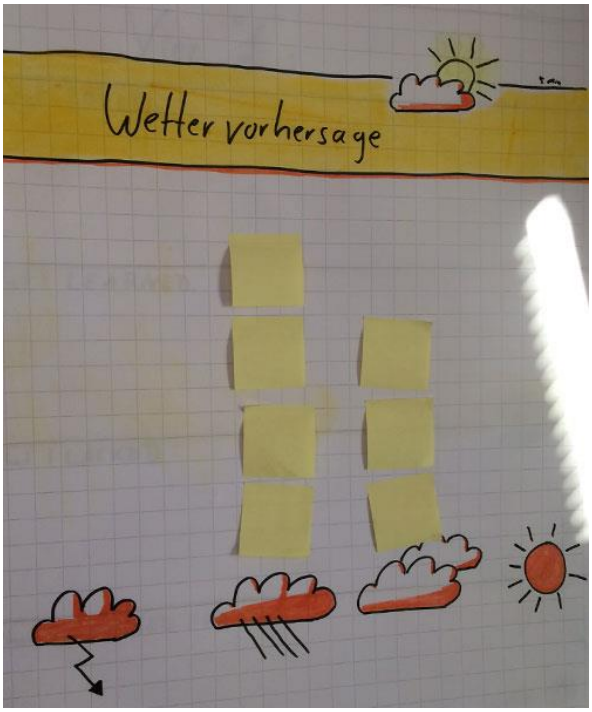


Photo by Philipp Flenker[9]

In our case, we used weather report at the end of the day for reflexive purpose, to know the perception of the participants about the focus group.

Material

- Flipchart
- Markers

[9] https://retromat.org/en/?id=3

Appendix 8: Régnier Abacus

The Régnier Abacus is a useful technique to collect opinions on a subject. It allows to every participant to express himself (individual phase) and then to discuss and confront his position (collective phase).

You will find a clear and simple description of this technique on this web page:

https://www.marine-ecosystem-services.eu/en/section-4/4-3-toolbox-for-scenario-building/4-3-5-regnier2019s-abacus

In our case, rather than asking the participants whether they more or less agree with the proposed innovations, we will ask them to assess their impact on their activities, or, in other words, their degree of admissibility. Therefore, we will use this notation scale:

- dark green: very positive impact
- light green: positive impact
- yellow: mixed impact (even no impact at all)
- light red: negative impact
- dark red: very negative impact
- white: no opinion
- black: no answer

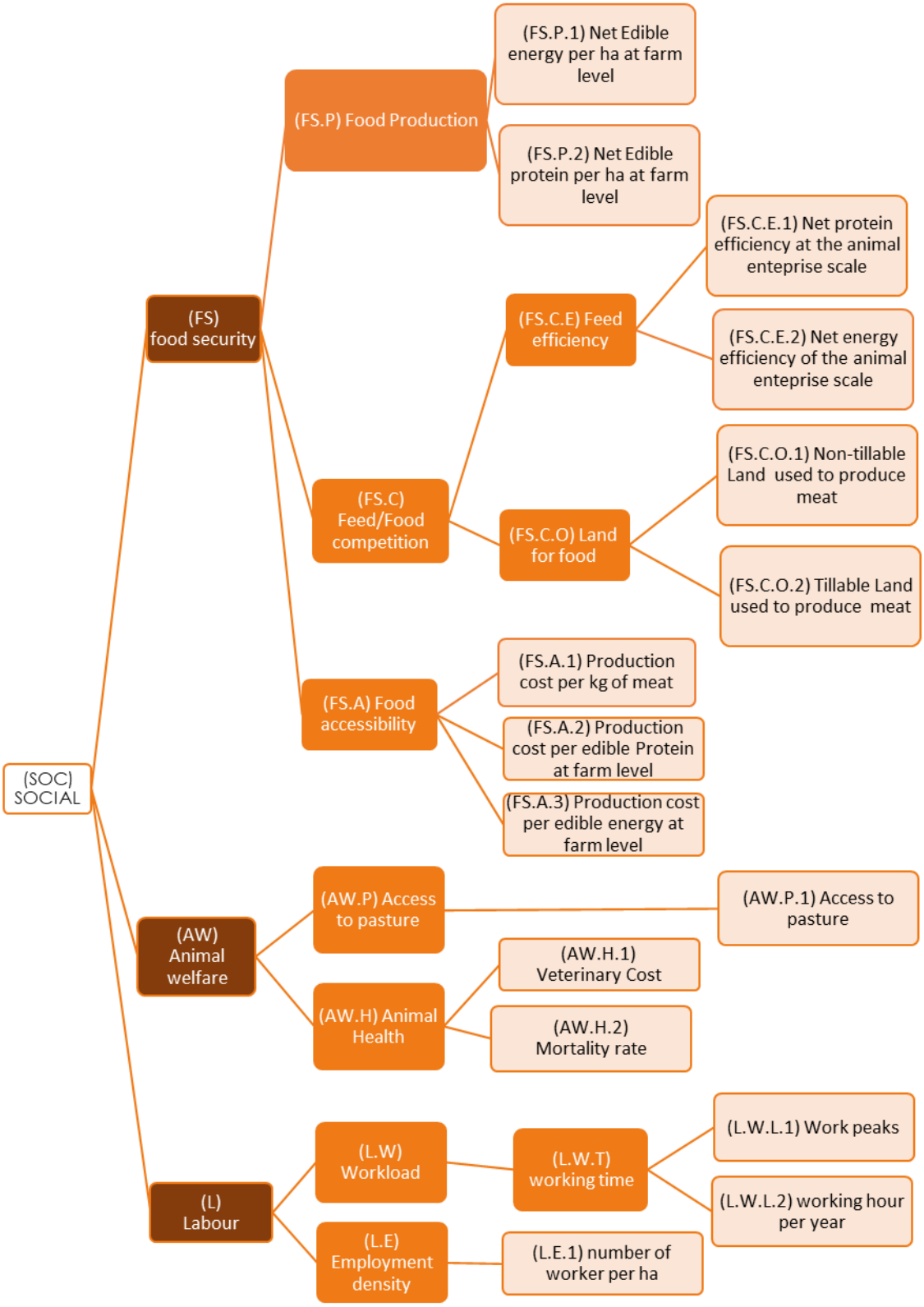
Please note that innovations must be formulated in a simple and as understandable way as possible.

Figure 4 – Example of the matrix of untreated results of a group of 5 participants confronted with 10 assertions

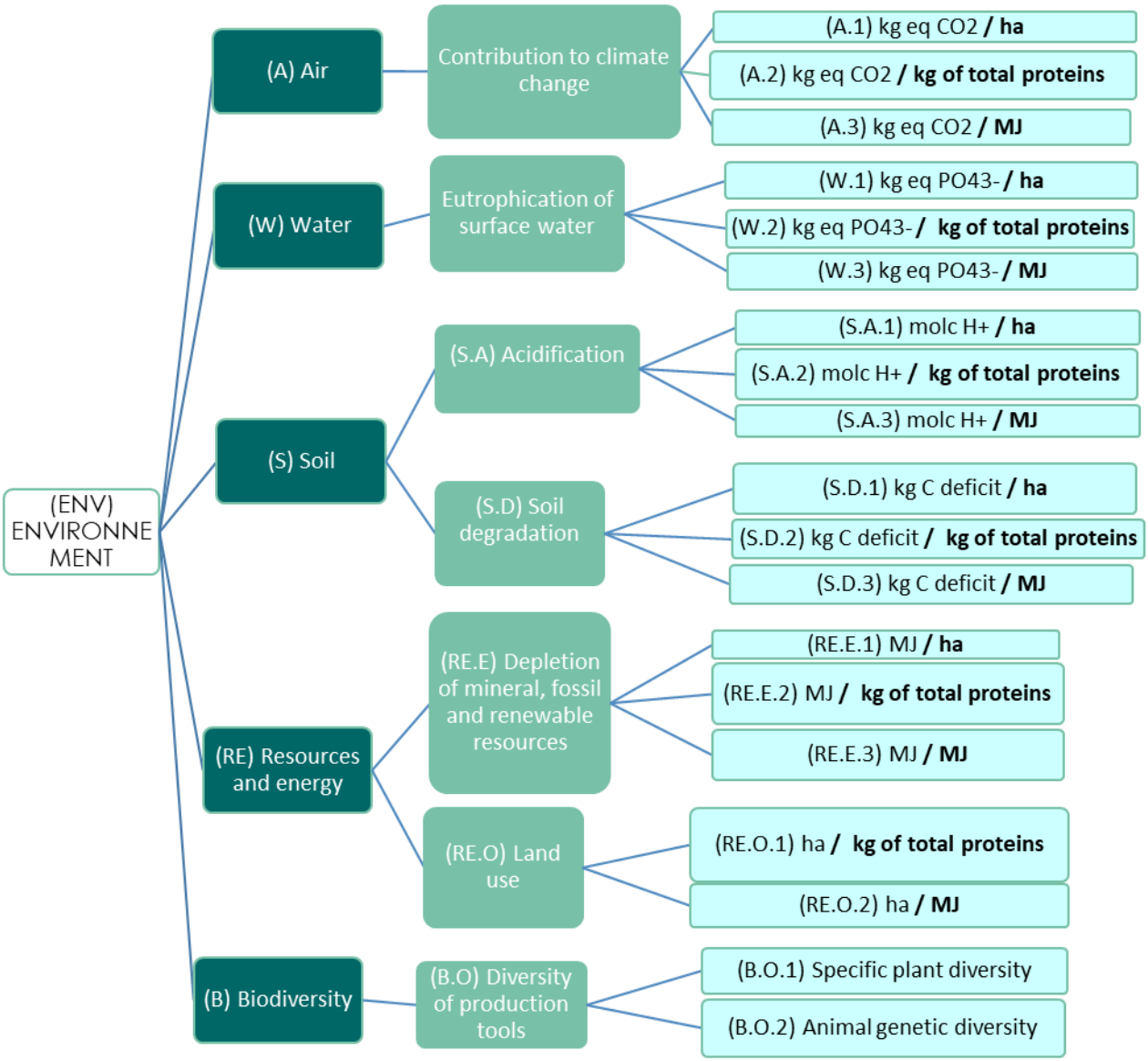
	P1	P2	P3	P4	P5
A1					
A2					
A3					
A4					
A5					
A6					
A7					
A8					
A9					
A10					

In this example, we see that the assertion n°1 is consensual, while the assertion n°6 is not. This matrix need to be sort. The assertions are classed according to their degree of admissibility.

Appendix 9: evaluation of the social pillar (D2.2)



Appendix 10: evaluation of the environmental pillar (D2.2)



Appendix 11: evaluation of the economic pillar