Scenarios of innovations implementation

Deliverable 4.3

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2 Introduction

The document describes the scenarios defined by the members of the consortium with the participation of the stakeholders of the beef sector (task 4.2 part1). These scenarios implement the innovative practices identified (task 4.1) in the case studies defined (task 2.1). This document also reports on the restitution workshops that were organised to discuss and validate the scenarios (task 4.2 part2).

3 From the list of innovations to the scenarios

The list of innovations likely to address feed-food competition in beef production systems was drawn up through literature review and expert interviews (WP4 – Task 4.1 – Deliverable 4.1). In total, we identified 21 innovations (see Appendix 1, § 7.1 for the details).

These innovations were then discussed with stakeholders of the beef sector using focus groups (WP4 – Task 4.2 / part 1 – Deliverable 4.2) (see Appendix2, § 7.2 for the details). Among the innovations identified by the consortium for the various regions were:

- Lorraine (FR.LOR-BF):
    - Precision livestock farming
    - Genomic selection: favouring the milk production of suckler cows
    - Alfalfa and red clover as protein supplements in rations for young beef cattle
    - And to a lesser extent:
        - Crossbreeding (meat breed x breed adapted to grazing) (e.g. Angus X Salers)
        - New sources of proteins: insects, algae
        - Hay dried in barn
- Creuse (FR.LIM-CC):
    - Genomic selection for feed efficiency
    - new plant species for pastures
    - Fast rotational grazing and restructuring of the plots of land
    - And to a lesser extent:
        - Use of by-products
        - Agroforestry
- Cantal (FR-CANT-CC and FR-CANT-DCC):
    - Cattle fattening on pasture
    - Fast rotational grazing
    - Genomic selection for feed efficiency
    - And to a lesser extent:
        - Use of by-products
        - Precision livestock farming
- Veneto (IT.F-900 and IT.-F226):
    - New sources of proteins: insects, algae
    - Precision livestock farming
    - Production of fodders through cover crops
    - Genomic selection for food efficiency
    - And to a lesser extent:
        - Use of by-products
        - Genomic selection: favouring the milk production of suckler cows

            - Crossbreeding (meat breed x breed adapted to grazing) (e.g. Angus X Salers)
- Piemonte (not related to a specific case-study):
    - Cattle fattening on pasture
    - Use of by-products
    - Production of fodder through cover crops
    - Precision Livestock Farming
    - Terminal crossbreeding (beef breed on dairy herd)
- Wallonia (BE-CC1, BE-CC2 and BE-BF):
    - For the breeders and farm advisors:
        - Alfalfa and red clover as protein supplements in rations for young beef cattle
        - Production of fodder through cover crops
        - Cattle fattening on pasture
        - Fast rotational grazing
        - Integrated crop-livestock system
        - And to a lesser extent:
            - Use of by-products
            - Crossbreeding (meat breed x breed adapted to grazing) (e.g. Angus X Salers)
            - Spring calving
            - New sources of proteins (insects, algae)
    - For the value chain actors:
        - Alfalfa and red clover as protein supplements in rations for young beef cattle
        - Genomic selection: favouring the milk production of suckler cows
        - Genomic selection for food efficiency
        - Terminal crossbreeding (beef breed on dairy herd)
        - Then:
            - Use of by-products
            - Integrated crop-livestock system
            - Cattle fattening on pasture
            - Fast rotational grazing
            - Crossbreeding (meat breed x breed adapted to grazing) (e.g. Angus X Salers)
            - Precision livestock farming
        - And to a lesser extent:
            - New sources of proteins: algae

However, not all these innovations can be modelled for several reasons (see Appendix 3, §7.3 for the details). This is a limitation to the definition of scenarios, as they cannot include these innovations. The limitations are technical ones, related to the availability of data or time, or inherent to the innovations (territorial scale innovations). These limitations are even more constraining given that stakeholders' opinions are favourable to some of these innovations.

4 The scenarios defined by the members of the consortium

Based on the results of the focus groups and the possibilities to model the innovations, the consortium members defined scenarios to be further explored. Table 1 summarizes these scenarios.

Remark: We gave the priority to scenarios requiring the most changes in the systems, leading to more interrogations from the stakeholders and need for incentives. Furthermore, we observed that lowering feed-food competition was usually not the main concern of farmers and that the implementation of those innovations were rather motivated by the search for autonomy, better "storytelling" or profitability. This has to be taken into account while implementing the innovations. Another observation was that farmers usually do not implement a single innovation but a panel of interlinked ones.

Table 1 – Scenarios defined by the members of the consortium

	Case studies	Innovations
Germany	GE-Bav-F	Cross-Breeding - Use crosses of dairy Fleckvieh and BB instead of pure bred Fleckvieh calves Alternative feed products - Use of algae as a substitute for corn or soymeal Integrated crop-livestock systems - Use catch crop for fodder production
	GE-LS-F	Cross-Breeding - Use crosses of dairy Fleckvieh and BB instead of pure bred Fleckvieh calves Alternative feed products - Use of algae as a substitute for corn or soymeal Integrated crop-livestock systems - Use catch crop for fodder production
	GE-NRW-DF	Combination Sexing and Cross-Breeding - Use crosses of dairy Holstein and BB instead of pure bred dairy calves Fattening on Pastures - Fast rotational grazing
France	Cant-CC	Fast rotational grazing and cross-breeding and finishing Grass fattening - Fast rotational grazing
	Cant-DCC	Fast rotational grazing and cross-breeding and finishing the dairy animals (stop beef cattle) Grass fattening - Fast rotational grazing
	Lor-BF	Fast rotational grazing and cross-breeding and finishing Grass fattening - Fast rotational grazing Alternative feed products - Chlorella (Algae) as a new feedstuff
Italy	IT-F226	Combination Sexing and Cross-Breeding - Use crosses of dairy Holstein and BB instead of French suckler calves (reduction in input and output prices) Alternative feed products - Use of algae as a substitute for corn or soymeal

	IT-F913	Fattening on Pastures • Fast rotational grazing for grass fattening Combination Sexing and Cross-Breeding • Use crosses of dairy Holstein and BB instead of French suckler calves (reduction in input and output prices) Alternative feed products • Use of algae as a substitute for corn or soymeal Fattening on Pastures • Fast rotational grazing for grass fattening
Ireland	IR	Fattening on pastures Fast rotational grazing Cross breeding (dairy) on pasture Better genomic selection on animals
Belgium	BE-CC1	Grass growing/fattening **on cull cow:** • Legumes in pasture • Fast rotational grazing Switching to Breeder-fattener: • Using fast rotational grazing • And by-products
	BE-CC2	Grass growing/fattening **on cull cow** • Legumes in pasture • Fast rotational grazing
	BE-BF	Integrated crop-livestock system • Production of fodders through cover crops Switching to fattening of terminal crossbred calves • Using fast rotational grazing • And by-products Local pulps and by-products in a single silo • Use of sugarbeet pulp Grass growing/fattening: • Fast rotational grazing Integrated crop-livestock system • Production of fodders through cover crops Use of algae in the ration
	BE-Dairy	Use of sexed semen in dairy herds. Crossbreeding is used to produce Holstein x BBB males

To develop those scenarios, we set up hypotheses based on literature, experts' knowledge and results of focus groups. The following paragraphs present these hypothesises. The economic results and sustainability analysis will be developed in further deliverables (D3.4 and D4.4).

4.1 Scenarios based on “crossbreeding”

Several scenarios use crossbreeding to reduce feed-food competition. However, this scenario takes different forms depending on the regions and case studies to which it applies.

4.1.1 Implementation in German case-studies

4.1.1.1 Crossbreeding Holstein x Belgian Blue

While crossbreeding is a breeding practice that has been well established, German farmers have continuously reduced the number of crossbred inseminations in the past decades. Often, the risk of dystocia (delayed or difficult parturition) is associated with crossbreeding, leading to the decline of the breeding technique. However, by making use of the heterosis effect, crossbred animals often express the desired traits of both parent lines. E.g. crossing a line expressing particular health with a line that expresses particular feed conversion rates ideally leads to a crossbred animal expressing both traits.

In the “cross-breeding” scenarios of the Germany case study farms “GE-Bav-F” and “GE-LS-F”, a crossing between the breeds “Holstein” and “Belgian Blue” is assumed. While Fleckvieh is the predominant breed in both case study farms, crosses between Holstein and Belgian Blue become more available. Also, the market for purebred Fleckvieh is diminishing, as producers are going out of business. The Belgian Blue animals are also known for their exceptionally high meat proportion, and higher feed conversion rates compared to Holstein cattle.

For this scenario, it was assumed that crossbred bulls are raised up to 750kg live weight, with an average weight gain of 1200 g/day and a dressing percentage of 58%. While their selling prices are assumed to be the same as for the purebred animals, their buying prices are assumed to be 10% less than the purebred ones, due to reduced transport costs (crosses are produced on dairy farms, which are available throughout the entire country opposed to purebred Fleckvieh producers which are mostly located in southern Germany).

4.1.1.2 Combination of crossbreeding and sexing

This scenario is only carried out in the “GE-NRW-DF“ case study farm, as it is the only case study farm in Germany that produces its own calves.

Prices for calves were undergoing high volatility in the recent past, but have stayed at relatively low levels since last fall. A German magazine even titled “Calves cheaper than canaries”, bringing the topic which has caused dairy farmers headaches to a wider audience (SPIEGEL, 2019)[1].

Given the situation, dairy farmers may either try to increase the value of their calves by crossing their milk breeds (mostly Holstein) with a meat breed (e.g. Belgian Blue) in order to produce crossbred animals, or by using sexed semen in order to reduce the number of male calves born.

While both of these options seem viable, they also introduce further uncertainties: Among others, crossbreeding increases the risk of dystocia, and sexed semen is both more expensive and (often) less fertile

[1] https://www.spiegel.de/wirtschaft/unternehmen/deutschland-kaelber-kosten-inzwischen-unter-neun-euro-a-1295665.html

than regular semen. Assessing whether any of these options could be profitable for a farm is therefore not straightforward.

This scenario evaluates the effects of different levels of sexed semen and / or crossbreeding use on the case study farm. For the scenario, a price premium per sexed semen dose of 15 Euro was assumed. For the crossbred calves, an average price of 150 Euro per animal was defined. Selling of excess heifers was allowed, for a heifer price of 1800 Euro per heifer.

4.1.2 Implementation in French case-studies: crossbreeding with Angus

The aim of crossbreeding with an early maturing breed adapted to grazing (Angus) is to produce animals that are better adapted to grazing systems and require small quantities of concentrates to finish animals before 2 years old. This can reduce feed/food competition. This innovation is mainly based on data from a project currently underway at INRAE: SALAMIX (Grassland ALTERNATIVE Rearing Systems: Adapting Genetic Type and MIXing Species to Enhance Sustainability), in which three organic grassland farming systems are compared with the aim of producing grass-fed meat. This scenario aims at assessing the economic, social and environmental impacts of the implementation of this innovation on a commercial farm. The data used are grouped in Table 2.

Table 2: Assumptions used to simulate Angus-Cross breeding

Variables	Data		Interviewed experts
Meat price / kg of carcass	Males 3.75€- Females 3.78€ **or** + 0.40€ if better valorization		Christophe Troquier (INRAE)
Carcass yield	55% **or** 57.5% according to the basic breed considered		Bernard Sepchat (INRAE)
Growth curve	Males	Females	Karine Vazeille (INRAE)
	From 503 to 521 kg to 430 days	From 510 to 532 kg to 470 days	Bernard Sepchat (INRAE)
Calving period	Grouped (during the winter)		Bernard Sepchat (INRAE)

For this innovation, two scenarios are tested on all the case-studies (Table 3). All scenarios outside the reference scenario require cross-bred animals with Angus sold at around 500 kg live weight (all sexes) at about 14 months of age. The second scenario is identical to the first, but it is assumed that the better quality of the meat results in a better economic value estimated at +0.40€/kg of carcass. In our scenarios, all the case studies will have grouped calving in the winter in order to be synchronized as much as possible with grass growth.

Table 3: Scenarios for Angus-Cross breeding

Scenarios / Modified Variables	Reference : *variable herd*	SCENARIO 1 : *Meat price equal to the CS*	SCENARIO 2 : *Meat price increased*
Breed	=Case-Study (CS)	Crossbred with Angus	Crossbred with Angus
Calving period	=CS	Grouped (during the winter)	Grouped (during the winter)
Meat price / kg of carcass	=CS	Males 3.75€ Females 3.78€	+ 0.40€

Weight of animals sold according to their age	=CS	~ 500 kg at ~ 14 months	~ 500 kg at ~ 14 months

4.1.3 Implementation in Italian case-studies: terminal crossbreeding using sexed semen

Due to the limited population of beef cows, Italian beef producers import live calves from France (80%) and from other EU countries such as Ireland, Austria, Poland, Romania, Germany (20%). On the other hand, there are several dairy farms that have good reproductive performances and are interested to valorise male calves. These farms are usually very dairy-specialised and cannot grow bulls. For these farms crossbreeding between Holstein cows and beef bulls is potentially profitable, because Holstein 50 kg-weight males are forwarded to veal production, with a very little return. At the opposite, crossed calves can be moved to specialized farms producing beef bulls, with a higher return. These dairy farms use sexed semen for both dairy and beef production. In the first case, female-sexed semen of top ranked Holstein sires is used for the best cows; in the second one, the male-sexed semen from beef breeds is used for low-producing cows. Currently, the most common breed is Belgian Blue among dairy farmers. Beef producers also benefit from crossbreeding, as it is a good alternative to importing calves.

From an environmental perspective, even if calves emit less methane, crossbreeding is potentially beneficial because transports of animals are reduced and, more important, veal production is quite all based on milk or reconstructed milk, that is in complete competition with human feeding. The availability of calves born in Italy reduces the need to import a large number of animals from abroad, namely France, alleviating the consumption of fossil fuels for transports. Reconstructed milk for veal feeding is largely based on vegetable meals as soybean meal, that is also a human food.

Some fatteners object that this system needs firms specialized in weaning crossed calves and this puts some problems of organization and market.

4.1.4 Implementation in Irish case-studies: crossbreeding (dairy) on pasture

Since the abolition of milk quotas in Ireland in 2015 the Irish national dairy herd has expanded rapidly by approximately 40% to over 1.4 million cows. The continued rise of the national dairy herd has seen an increasing supply each year of calves available for finishing on beef farms. A large proportion of beef farmers have either switched from suckling into purchasing dairy bred calves or expanded their current dairy calf to beef enterprise by buying extra calves to supplement their stock numbers.

The Teagasc Green Acres Calf to Beef programme is industry-funded and was set up with the motivation of increasing gross output of beef farmers operating a calf to beef system and reducing their reliance on direct payments. The programme is currently in its second phase in Ireland and it is the primary knowledge transfer route for Teagasc to disseminate all relevant information on sustainable dairy calf to beef systems to farmers. This occurs through the use of 14 demonstration farms, specialised calf to beef group meetings (held on the demo farms), media articles, social media platforms, technical notes, farmer fact sheets, open days / on-farm events. Of the 14 demonstration farms, four are located in the Border, Midland and Western (BMW) region and three in the South East.

During phase 1 of the Green Acres program (2014-2017) the average stocking rate for participatory farms rose from 1.8 LU/ ha in 2014 to 2.5 LU/ ha in 2017. Subsequently farmers output per ha increased by 71% from 759 kg/ha to 1296 kg/ha. As a result of operating more intensive farming system the average total variable costs on participant farms also rose from €946/ha to €1366/ha. The average gross margin on participating farms rose from €513/ha to €1058/ha, a 106% increase. Gross margin for each farm excludes all fixed costs on the farm and subsidies associated with the farm. The calf to beef system on participating farms left an average net margin of €475/ha in 2017, a significant increase from -€40/ha average figure in 2014.

A key motivation for this programme is to increase the quantity of beef generated from grazing systems with low inputs of cereal-based concentrate feeds. This objective has been met with a substantial increase in beef carcass production on predominately grass-based diets. Concomitantly, farm incomes have been greatly increased indicating that this approach is financially viable for participating farmers.

4.1.5 Implementation in Belgian case-studies: terminal crossbreeding using sexed semen

In Wallonia, terminal crossbreeding is already practiced and the majority of farmers sell their male calves in the Netherlands to produces white veal (SPW, 2019).

This scenario aims at computing two farming systems to study a new production path. We consider here that dairy farms sell their crossbred male calves to a specialized farm, located in grasslands area, for the growing and fattening phases. The structure of the specialized farm is taken from BE-CC2. Therefore, this implies a complete re-design of BE-CC2 original farming system.

At the dairy farm level, the main changes are the extra cost for the sexed semen (35 € for BB male and 40€ for Holstein female) and the calves prices (Cross-bred: 200 € vs Holstein: 50 €). An analysis (Pahmeyer and Britz, 2020) takes into account several sexed semen accuracy [75%->100% (Seidel, 2014)] and the additional insemination effort [0->1.15 (Butler et al., 2014)]; we will use those data.

The main hypothesis behind this innovation is the performances of such cross-bred young bulls. Based on the literature, in particular (Keane, 2010; Keane and Moloney, 2010; Robaye et al., 2012), we assume that this farmer buys about 1 month old cross-bred calves weighting 70 kg at a price of 200 € and sell them as fattened animals with the following characteristics (Table 4):

Table 4 – Characteristics of the crossbred bulls

	Hypothesis
Cull age	590 days
Live weight	600 kg
Carcass weight	330 kg (55% of dressing percentage)
EUROP- Score	U-R
Fat score	3
Price	3.40 € / kg carcass

Prices are taken from official tables based on EUROP and Fat scores[2].

[2] https://agriculture.wallonie.be/prix-du-marche-des-produits-agricoles

In this scenario, the fast rotational grazing, as described in section 4.3.4, is also implemented, as well as the possibility to complement animal on pasture. In particular, the possibility to use sugar beet pulps was considered.

Furthermore, the innovative practice “use of sexed semen in dairy herds” is implemented in the BE-D case-study. Crossbreeding with beef breeds is used to obtain males. Terminal crossbreeding receives the support of the Walloon value chain actors.

4.2 Scenarios based on the use of “Algae as an alternative feed”

Among possibilities for alternative feed products, several scenarios focus on the use of algae as an alternative feed product.

In feed industry, algae are considered an interesting alternative of soybean meal because they present a very high concentration in protein, which can be up to 60% on dry matter for *Chlorella pyrenoidosa, Aphanizomemenon flos-aquae, Chlorella vulgaris* or *Arthrospira maxima*. From an environmental perspective, algae can be grown using the sunlight energy, without requiring organic nutrients. Therefore, Algae are an interesting option for reducing the environmental footprint of the feed. In addition, they do not need land, so that they are not in competition with other food or feeds.

The target species are poultry, but algae could also be an alternative feed resource for ruminants. According to Lamminen et al. (2019), these vegetal, which are booming, are currently used for the production of biofuels, in cosmetics or human food and more marginally in animal feed. Algae are able to use aqueous nutrient streams for their growth. They reproduce quickly and are the only ones among all the biomass available for feeding ruminants to be able to provide biomass throughout the year.

Chemical composition varies considerably between algae species, but protein content is generally high (e.g. 51-58% on DM in *Clorella vulgaris* or 60-71% on DM in *Arthrospira maxima*), that makes them comparable to other protein feeds, as soybean. Considering their protein concentration and the very high biological value, 1 kg of dry microalgae can substitute more than 1 kg of soybean meal. The level of inclusion in the diet depends on algae species and treatment. Most algae contain also a great percentage of lipids (e.g. *Schizochytrium s.p.* with 50-77% of lipids on DM) that must be extracted before algae being fed to ruminants (Kovač et al., 2013; Lum et al., 2013).

For Gaëlle Maxin (INRAE) Chlorella is a protein-rich species, less used than Spirulina in human food, and is therefore a relevant alternative to the use, for example, of soybean meal in animal feed, which is not sustainable. The data used for FarmDyn are grouped in Table 5.

Table 5: Assumptions used to simulate the use of Chlorella (DM: Dry Matter, CP: Crude Protein, NDF: Neutral Detergent Fiber, PIA: Proteine in intestine from Feed, MAMIC: “Matière azotée microbienne”, UFL: energy “Unité fourragère Lait”, ME: metabolisable energy, RPB: Rumen Proitein Balance

Variables	Data		Bibliographic sources and experts interviewed
Chosen specie	*Chlorella vulgaris*		Gaëlle Maxin (INRAE)
Feed values	- DM : 94.8 % soit 948 g/kg	- UFL : 0.88 UF/kg DM	Gaëlle Maxin (INRAE) Pierre Nozière (INRAE) (Lamminen et al., 2019)
	- CP : 586 g/kg DM	- Crude Fiber : 30 g/kg DM	
	- NDF : 15.1 g/kg MS	- ME : 4180 kcal /kg DM	
	- Crude Fat : *123 g/kg DM*	- Starch + Sugar : *54 g/kg DM*	

	- PIA + MAMIC : 748.69 *g/kg DM*	- RPB : 302.6 *g/kg DM*	
Quantity incorporated	10 % maximum for fattening and finishing animals		Gaëlle Maxin (INRAE)
Hypoythesis on input price	600 € / kg dry		Gaëlle Maxin (INRAE)

Nevertheless, utilization of microalgae in animal nutrition cannot be considered a mature innovation so far. There are many reasons: large scale field trials are still missing; prices remain exceptionally high; lack of a clear legal definition of the possibility to use microalgae in feed industry, because they are still considered as novel feeds so that they require a specific authorization.

The use of Chlorella was tested in all case studies situated in Germany and Italy, and also in one Belgian case-study (BE-BF).

In France, a scenario was tested on the case studies that feed soybean to their animals. In this scenario, the model was allowed to choose the amount of chlorella to be inserted in the ration while still setting a maximum of 10% (threshold of potential toxicity/performance reduction). We have carried out several simulations with different purchase prices of this input, which can vary from 0 to 600 euros per ton. It will thus be possible to see from which price the insertion of the algae will be interesting. The data required for implementation in FarmDyn are grouped in Table 6.

Table 6: Scenarios for use of chlorella

Scenarios / Modified Variables	REFERENCE : *variable herd*	Scenario 1 to 5 : *cost and quantity variable + herd size variable*
Quantity incorporated	0	0 to 10 %
Price (€/T FM)	-	1 – 150 – 300 – 450 – 600
Available feed products	=CS	Reference diet + Chlorella

4.3 Scenario based on “cattle fattening on pasture” through fast rotational grazing

Several scenarios use fast rotational grazing to achieve the goal of “cattle fattening on pasture”. However, this scenario takes different forms depending on the regions and case studies to which it applies.

4.3.1 Implementation in German case-studies

Due to the endowments of the farms, the fast rotational grazing scenario is only evaluated in the “GE-NRW-DF“ case study. By splitting the grassland into multiple sub-parcels, animals make the best use out of the available fodder. Also, grass growth is supported and higher grass yield with a better quality can be expected.

Due to the insensitivity of the German milk production sector, characterised with high rates of concentrates and fewer access to pastures for the animals, fast rotational grazing is a production technique more often utilized by organic farms.

For the fast rotational grazing scenario in the “GE-NRW-DF“ case study, it was assumed that dry matter yield would increase by 10% compared to the default grassland yield (compare deliverable 2.2). Due to the additional workload from the fencing needed for the fast rotational grazing, also a workload increase of 10% was assumed in this scenario.

4.3.2 Implementation in French case-studies

The objective of this innovation is to better valorise the pasture in order to reduce feed/food competition. According to Luc Delaby (INRAE), rotational grazing favours quality grass and reduces animal refusals. It consists in increasing the number of plots (via their partitioning) and stocking rate to make it possible to respect the grass's stage of development. The data used are grouped in Table 7.

Table 7: Assumptions used to simulate Dynamic rotational grazing

Variables	Data	Bibliographic sources and experts interviewed
Use rate increased on the only grazed pastures	+ 10%	Luc Delaby (INRA)
Grass quality	Spring grass quality	Luc Delaby (INRA)
Work time (h) : **Creation of the grazing plan** **Preparing the plots (fencing, waterers ….)** **Animal surveillance (frequency of animal movements in the different plots)**	+10% added on pasture management	Nathalie Hostiou (INRA)
Materials investments (€) : **- fences** **- waterers** **- paths**	37.5 € /ha	(Delaby, 2017) (Seuret et al., 2012) Sylvain Chaneac (Agricultural Director EPLEFPA of Terres de l'Yonne)

For this innovation, three scenarios are tested on all the case studies. In the following scenarios, all areas of grassland managed only as pasture are now managed as fast rotational grazing. A higher rate of use of these pasture (+10%) was assumed according to Luc Delaby. Additional investments were considered (+37.5€ /ha) for the installation of fences, watering troughs and paths. In the first scenario, only the impact of fast rotational grazing on the utilization rate as considered. The second scenario assume the rotational grazing increased both grass quality and grass quantity. Eventually the third scenario combined the rotational grazing with the Angus cross in their respective best-case scenario - (i.e. +0.40€ /kg carcass, better grass quality and utilization rate). All farm case studies performed group calvings in winter so that they can be synchronized with grass growth as much as possible (Table 8).

Table 8: Scenarios for dynamic rotational grazing and Angus-Cross breeding associated with rotational grazing

Scenarios / Modified Variables	Reference : *variable herd*	Scenario 1 : *better use rate*	Scenario 2 : *better use rate and grass quality*	Scenario 3 : *innovation crossed with the one on Angus*
Calving period	=CS	Grouped (during the winter)	Grouped (during the winter)	Grouped (during the winter)
Surfaces in FRG (%)	0	100% of only grazed pastures (gra1)	100% gra1	100% gra1
Grassland use rate	=CS	+10% on gra1	+10% on gra1	+10% on gra1
Grass quality	=CS	=CS	improved	improved
Breed and Meat price / kg of carcass	=CS	=CS	=CS	Crossbred with Angus (+0,40€)

4.3.3. Implementation in Italian case-studies

Grass fattening rose interest among farmers, even if they are not very familiar with this system, because this is a new product, which meets the interest of consumers. Looking at some examples, one system suitable for the Padania Valley was assumed. The system should be based on grass pasture, composed by a mix *of Lolium spp* and *Phleum spp*., and on fast rotational grazing. The goal is to have a pasture with a good and steady quality, easy to be integrated. The grazing period is from March to June and from September to November for a total of 210 days. Animals stay on one paddock for 3-4 days and they return on after 30 days.

Animals go on pasture from 300 kg of live body weight to slaughter, at approximately 600 kg of body weight. In the example studied animals were Angus crossed with Holstein, that is considered the best animal type for this system. The scenario was designed for an average daily gain of about 1 kg.

The estimate production for grass mixture is 10 T of DM/ha. The chemical composition on dry matter is :

- Crude protein 10%;
- NDF 45-60;
- ADF 25-35;
- Feed value=0,75 UF/kg/DM.

During the pasture the animal are fed 2-3 kg/day of a protein supplement.

When the animals are not on pasture, they receive corn or sorghum silage, protein supplement (legume seeds or pellets) and hay and/or straw. The diet and protein supplement are decided by economic optimization and farm uses land.

4.3.3 Implementation in Irish case-studies

In Ireland fast rotational grazing is becoming widely practised throughout the country and was heavily advocated in the joint industry funded Teagasc-Irish Farmers Journal BETTER Beef Farm programme. This programme was set up to counteract poor economic performance on Irish beef farms by increasing the ratio of beef output to fertiliser and purchased feed inputs. The program ran from 2009-2019 and had three different phases, each consisting of demonstration farms located throughout the country. Farmers were challenged to implement fast rotational grazing to grow and utilize more grass, as every extra tonne of grass utilised on a dry stock farm was shown to be a key driver of farm profitability.

For the phase 2 participants, average gross margin on their farms increased from €675 ha^{-1} in 2012 to €1,029 ha^{-1} in 2015. At a production systems level, gross margins were: €715 ha^{-1} for weanling producers (compared to €363 ha^{-1} nationally); €785 ha^{-1} for store traders (compared to €572 ha^{-1} nationally); and €1,241 ha^{-1} for suckler to finishing (compared to €532 ha^{-1} nationally). Within the finishing systems, farms incorporating under 16- month bulls performed best at a gross margin of €1,464 ha^{-1} in 2015, followed by suckler to under 20-month bulls at €1,220 ha^{-1}. Suckler to steer finishing systems achieved a gross margin of €1,083 ha^{-1}.

4.3.4 Implementation in Belgian case-studies

In Wallonia, grass fattening receives the preferences of breeders related to all case-studies as well as from value chain actors too, even if a lot of barriers were identified (see deliverable 4.2 for more details). The innovations implemented to achieve this goal vary according to the case-studies, as well as the category of livestock targeted.

This scenario applied in the BE-BF case study relies on the technique of fast rotational grazing. The categories of animal targeted are the young bulls, but all the animals might have access to the pastures. The economic optimisation "decides" the allocated surface to this technique and which animal have access to it.

It is assumed in this scenario that the yields are increased from 8 to 8.8 ton of Dry matter per year, keeping the same distribution over the months. The quality is also increased especially during summer and autumn, since the grazed grass constantly is in the early stage of development (20 to 30 days between pasture periods).

The default quality values for Rye-Grass – white clover permanent grasslands, are Early, Middle and Late grass and represent pasture qualities at different stages of development. While, in the case studies, the grazed grass quality changed from early in spring to Middle and Late during summer and autumn, the implementation of the fast rotational grazing consists in having Early grazing quality during the entire grazing period.

Table 9 – Default quality value for Rye-grass/white clover permanent grasslands according to their development stage

Quality label	Dry Matter	Crude protein	Usable raw protein	Metabolisable energy
Early	150	215	152	11
Middle	180	172	137	11
Late	200	150	130	9

In BE-CC1 and BE-CC2 case-studies, grass fattening concerns cull cows, but the entire herd can have access to fast rotational grazing. In addition to fast rotational grazing, the insertion of white clover in pasture is implemented as default in the model.

4.4 Scenario based on "Integrated crop-livestock systems"

Originally, this innovation had to be considered on a territorial scale (i.e. exchanges between farms). As modelling is limited to the farm scale, the scenarios presented below implement this innovation on the same farm (synergy between crop and livestock speculation within the same farm).

4.4.1 Implementation in German case-studies

With the advent of the so called "Greening" directive of the European Union's Common Agricultural Policy (CAP) in 2016, mandatory ecological focus areas were introduced. When cultivating more than 30 ha of arable land, and a share of grassland below 75%, every farm needs to devote 5% of its arable land to ecological focus areas. While farmers are given a set of options to cope with the legislation, the cultivation of catch crops has become the dominant strategy to create the required ecological focus area in the German case study regions defined in the SustainBeef project.

As part of the Greening legislation, harvesting the catch crops is allowed after the minimum standing period of five months.

In this scenario, the effects of harvesting the catch crop, and making use of it as an alternative feed source are evaluated. For this scenario, it is assumed that ryegrass is cultivated as a catch crop. An expected yield of 3.06 tDM/ha is assumed, with feeding values of the ryegrass depicted in the following Table 10.

Due to their farm structure, the scenario is implemented for the case study farms “GE-Bav-F” and “GE-LS-F”.

Table 10: Ryegrass catch crop feeding values

DM (g/kg FM)	Raw fiber (g/kg DM)	Raw protein (g/kg DM)	Usable raw protein (g/kg DM)	Ruminal nitrogen balance (g/kg DM)	Net energy for lactation (g/kg DM)	Metabolisable Energy (g/kg DM)
170	235	165	140	4	6.33	10.0511,11

4.4.2 Implementation in Belgian case-studies

In Wallonia, the innovation implemented to achieve this goal is to produce fodders through catch crops. The pedo-climatic conditions of Wallonia being too rainy, this practice is however limited to the production of conserved fodders, the risk of trampling in case of grazing being too high. This practice is implemented in the case-study BE-BF, the only case study that has a significant cash crops surface in its UAA. In addition, it should allow fields that were used to produce animal feed to be reallocated to food production. The scenario is based on the same hypothesis than the German case-studies: An expected yield of 3.05 tDM/ha and feeding values from Table 10.

The catch crops are here sown in the summer, after harvesting a cereal for example (Herremans et al., 2018). Catch crops are then harvested in the Winter, at an early stage, giving them good nutritional values and protein content. Scenario “Better Genomic Selection of Animals”. The Sustainable Nitrogen Management Programme requires farmers to include at least two regrowing species in their catch crop mix if it is harvested before mid-November. The fodder is conserved as silage.

4.4.3 Implementation in Irish case-studies

This scenario represents an industry wide policy measure that has been implemented to encourage beef cow farmers to improve breeding decisions with the overall objective of reducing the greenhouse gas emissions intensity of beef cattle production. Policy makers in Ireland have for some time recognized the potential associated with improving the genetic make-up of the suckler herd. The Beef Data and Genomics Programme (BDGP) was approved by the European Commission as part of Ireland’s 2014-2020 Rural Development Programme. This scheme was launched in 2015 and will run until 2020 with a total funding of €300 million. It aims to improve the genetic merit of the Irish suckler herd whilst simultaneously reducing the greenhouse gas emissions being emitted from Irish beef herds. By improving the national beef herd genetics, it has enhanced carbon efficiency while delivering a positive economic benefit for the beef farmer. Under the scheme, the genetic merit of the national beef herd is currently being assessed through the collection of data and genotypes of nominated animals which will allow for the application of genomic selection within the beef herd. Farmers are paid ~€90 per cow per year to complete key actions that are set out in the scheme. An estimated 2.5 million animals will be genotyped during period of scheme. Ultimately building Ireland towards DNA based calf registration.

5 The validation of the scenarios by the stakeholders of the beef sector

The scenarios defined by the members of the consortium have been then validated and fine-tuned with the stakeholders of the beef sector through restitution workshops in Wallonia and in France (see the appendix 4, § 7.4 for the details). The objectives of these restitution workshops were:

- Fine-tuning / validating the case-studies: discussing and validating the hypotheses underlying the case-studies and their modelling;
- 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 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.

5.1 Belgium

5.1.1 Description of the participants

The CRA-W organised one restitution workshop in Ciney (Walloon Livestock Association), in March 2020. All the people previously involved in the project (through the interviews or the focus groups) were invited. However, only seven of them participated to the restitution workshop (see Table 11). The announce of restrictive measures linked to covid-19 epidemic partly explains this low participation rate[3].

Table 11 - List of people invited and present

Type	Invited	Present
Breeder	11	2
Expert in the field of fodders	2	1 (only AM)
Expert in the field of herd management	1	0
Expert in the field of animal feeding	1	0
Expert in beef production (representative of a consultative organ)	2	1 (AM only)
Value chain: veterinarian	1	1
Value chain: feed manufacturer	2	0
Value chain: cattle trader	1	0
Value chain: transformation (long supply chain)	1	0
Value chain: transformation (short supply chain)	2	2 (1 of whom only AM)

Farm advisor	4	0
Total	28	7

5.1.2 Discussion and validation of the case-studies

We presented three farms, each representative of one of the Walloon case studies, namely: the extensive suckling system (BE-CC1), the intensive suckling system (BE-CC2) and the breeder-fattener system (BE-BF)[4].

The presentation of BE-CC1 farm provoked many reactions and debates. Some data in particular (the crop rotation, the yields, the age at first calving, the interval between calvings, the weight of the animals sold) seemed unusual to some participants, when they seemed plausible to others. The participants stressed that the data require verification *in situ*, or at least with the advisor responsible for supervising the farm to validate the case study and its assumptions.

The presentation of the data of the farms representative of the two other case-studies provoked fewer reactions. Anyhow, the participants regularly highlighted the need of a verification *in situ*.

Since then, the data provider validated the data and the assumptions.

5.1.3 Discussion and validation of the assessment of the feed-food competition

The presentation of the state of the feed-food competition in each of the case studies and the comparison between all the case studies defined in the frame of the project provoked many reactions. These reactions focused on the indicators used to estimate the feed-food competition (1), the comparison of the different systems (2), and the state of the feed-food competition in beef farming systems compared to other livestock systems (pig, ovine, poultry, …), or even pets (3).

Remark: If all the participants correctly estimated the net protein efficiency of the extensive suckling farm (see Appendix 1, sequence 2), they all overestimated this indicator concerning the intensive suckling farm (considered as a net producer of protein or a transformer while it is a consumer). Some participants also overestimated the net protein efficiency of the breeding-fattening farm (considered as a transformer while it is a consumer) while other correctly estimated it.

(1) Concerning the indicators used to estimate the feed-food competition, the participants pointed out the following remarks:
   a. The "net protein efficiency" indicator tends to favour the extensive suckling system. Some participants are afraid of the media and reductive use that could be made of this indicator. Indeed, this indicator seems to them the more "media-friendly", as it is easy to understand for the general public. They stressed the importance of not reducing the evaluation of the feed-food competition to this indicator alone, especially in the communication that will be made of the results. Some participants preferred the indicator "net edible protein/ha" to the "net protein efficiency".

[4] We did not present the fourth case-study, i.e. the dairy system (BE-D).

    b. The participants also highlighted that the assumption concerning the indicator “land used to produce meat”, stating that all the tillable land could be used for food production, needs to be nuanced. The participants evoked the soil and climate conditions as brake, but also the standards in force in the value chain (e.g. breadmaking cereals) preventing from producing cash crop on some “tillable” land.
    c. The sensitivity of all the indicators of feed-food competition to the change of value – even little change – of the variables (e.g. amount of grasslands, amount of by-product used, …) is a drawback. It complicates the delivery of "definitive" results.

(2) Concerning the comparison of the state of the feed-food competition in all the regions (and the related case-studies) involved, the participants pointed out the following remarks:
    a. The comparison of suckling with fattening systems makes no sense. All participants stressed the need to combine systems in order to make the comparison meaningful.
    b. For some participants, the indicator "land used to produce meat" is open to criticism if it is used to compare systems in different regions. Since its results are linked to yields (of areas and carcasses) and these yields are themselves highly variable according to the soil and climate conditions (e.g. the difference of yield between one ha of grassland in Wallonia or in Ireland) and the breeds (e.g. the difference of carcass yield between the Belgian Blue and other breeds), some participants think that this indicator is not ideal for comparison purposes.

(3) Finally, some participants argued to compare the state of the feed-food competition in beef farming systems with other livestock systems (pig, ovine, poultry…), in order to make these data more intelligible, to have a point of comparison.

5.1.4 Discussion and validation of the scenarios

The Walloon restitution workshop focused on two scenarios:

(1) Cattle fattening on pasture implemented in the BE-BF system
(2) Grass fattening of young males from terminal crossing (using sexed semen). This scenario implies a complete re-design of the BE-CC2 system towards a fattening system in combination with the dairy system (BE-D).

The discussions focused on several elements of the scenarios, that can either find an answer through modelling or require further research.

5.1.4.1 Scenario 1: Cattle fattening on pasture implemented in the breeder-fattener system (BE-BF)

5.1.4.1.1 Management of the herd

This scenario requires succeeding in managing young bulls in pasture. As already pointed out in the focus groups in 2018, the participants debated of using steers instead of bulls to facilitate the management of the herd. However, this possibility also raises a number of questions: when should castration be performed? What technique should be used? What about animal welfare? What about social acceptance? What is the impact on the meat produced (especially taste)? If these questions go beyond the frame of the modelling, they are essential for ensuring the realisation of the scenario and call therefore for future work.

5.1.4.1.2 Ration

This scenario implies the use of by-products of the agro-industries. In Wallonia, we chose to resort to beet pulps in the simulations (i.e. an inedible and local by-product). Some participants criticized this use for two main reasons, which are related.

(1) This represents a risk for the economic results of the scenario due to the fluctuation of the price and the availability of the by-products.
(2) This use may also (and consequently) conflict with the search for autonomy that is the driving force of some breeders.

These reasons were already pointed out during the focus group in 2018. More simulations are needed to investigate the impact of price fluctuation on the optimization.

According to experts consulted outside the workshops, this scenario should also limit the use of by-products to 30-40 % of the ration during the finishing phase (in particular to avoid acidosis[5]). For some participants, this means extend the slaughter age, as the breeding-growing phase will take more time, if we want to achieve the standards in force in the value chain concerning the carcass conformation and the fat scores. This extension of the slaughter age could be problematic in terms of valorisation. Further simulations will be tested with older slaughter ages and better carcass conformation and fat score. Depending on the results obtained, this could call for future work on the development of a specific valorisation (distinctive quality).

5.1.4.1.3 Structural conditions

This scenario, as it uses fast rotational grazing technique, also means to have plots in one block and near the farm, a structural brake already highlighted in the focus groups in 2018. If this element goes beyond the frame of the modelling, it is essential for ensuring the use of this grazing technique and calls for future work (study on the interest for a land consolidation).

5.1.4.1.4 Workload

This scenario is implemented in a mixed crop-livestock system, including beef and crops production. Some participants expressed their fear in terms of workload. They highlighted in particular the risk of work peaks overlapping between the beef farming and the crops systems, which could be unmanageable.

Concerning the herd management, the optimization leads to seasonal calvings. The calvings mainly occur between November and March, with a peak in March, which avoids overlaps between the beef and the crops productions in terms of work peaks.

This scenario also relies on fast rotational grazing, with supplementation in pasture. Some participants wondered aubout the workload involved in this practice. One participant pointed out that the dynamic rotational grazing do not lead to additional work, once the required equipment is in place. THowever, the plots must be in one block and near the farm, as already mentioned.

[5] Indeed, as this scenario resorts to the fast rotational grazing, the energy value of the grass is already high.

5.1.4.1.5 Breed

As this scenario relies on a case-study based on the Belgian Blue breed (as all the Walloon case-studies), some participants wondered whether this breed is the most suitable for a grass-based scenario, given the lower ingestion capacity of the Belgian Blue. It might be interesting to see if the simulation supports the results of experiments that have already been conducted on this subject. However, this work will not be done in the frame of SustainBeef.

5.1.4.1.6 Valorisation

Some participants remained sceptical about the possibility of a grass-based fattening, citing the lock-in of the value chain. This reinforces again the need to further investigate this aspect of the scenario.

Table 12 – Summary of the discussion and the proposals of fine-tuning on scenario 1 (cattle fattening on pasture implemented in the BE-BF case-study)

Controversial elements of the scenarios	Why?	Gap compared to the outputs of the optimization	Fine-tuning of the modelling	Future work
Management of young bulls in pasture	Technically complicated (risk of injuries, dangerosity, …)	This technical difficulty cannot be taken into account by the modelling		Simulations with steers instead of bulls Study the use of castration from a technical and societal point of view. Study the interest of a specific valorisation (distinctive quality)
Use of by-products	Economic risk due to price and availability fluctuation	Risk of lower than expected incomes	Sensitivity to by-products price fluctuation to determine the impact on the scenario	Study the availability of inedible by-products in the territory
	In conflict with search for autonomy in its autarky dimension			Study the dynamic between search of autonomy and search for low feed-food competition
Limit the use of by-products to 30-40% in the finishing phase	Difficulty (or even impossibility) to produce young animals as imposed by the current standards in force	Risk of valorisation's difficulties due to older than expected slaughter age	Simulations of older slaughter ages and better carcass conformation and fat score	Study the interest of a specific valorisation (distinctive quality)
Dynamic rotational grazing technique	Implies to have plots near the farm and in one block (or in several blocks if there are access paths)	Feasibility		Study the interest of a land consolidation

Belgian Blue Breed	Is the Belgian Blue a suitable breed for a grass-based scenario given its lower feed intake capacity?	Risk of lower than expected performances		Literature review and, if needed, simulations comparing the zootechnical performance achieved with the BB compared to other meat breeds
Dynamic rotational grazing with supplementation in pasture in a mixed livestock-cropping system	Fear of an unmanageable workload			

5.1.4.2 Scenario 2: Grass fattening of young males from terminal crossing (re-design of the BE-CC2 system and combination with the dairy system (BE-D))

5.1.4.2.1 Use of sexed semen

This scenario implies the use of sexed semen for terminal crossing in dairy farms. Some participants highlighted that this practice requires a good fertility of the herd. They also mentioned that, on average, 3 doses are needed for successful insemination (compared to 2 doses in non sexed insemination). Therefore, they wondered if the sale of the crossbred calves at better price covers the purchase cost of these doses. This element is taken into account in the modelling, relying on (Pahmeyer and Britz, 2020).

5.1.4.2.2 Purchase of the crossbred males and females

This scenario implies the purchase of the whole herd by the fattener. Some participants pointed out that this purchase could lead to health risk for the herd. One participant argued for the development of "trust chain" between dairy farmers and fatteners. This element goes beyond the frame of the modelling, but is essential for ensuring the feasibility of this scenario.

5.1.4.2.3 Re-design of the intensive suckling system (BE-CC2)

This scenario implies a complete re-design of the intensive suckling system (BE-CC2) towards a fattening system thanks to a combination with the dairy system (BE-D). Even though participants found the scenario relevant, they pointed out that this re-design could lead to a rejection of the scenario by the breeders, especially due to attachment to the Belgian Blue breed and to their cow-calf system. This element goes beyond the frame of the modelling, but is essential for ensuring the realisation of the scenario.

5.1.4.2.4 Management of the herd

As this scenario relies on the grass fattening of crossbred males, some participants highlighted the danger (for the farmer) linked to the management of these kinds of animals. This element goes beyond the frame of the modelling but calls for technical solution.

5.1.4.2.5 Use of by-products

As the scenario above, this scenario implies the use of by-products coming from the agro-industries. The participants highlighted the same issues than above, i.e. economic risk due to the price and availability fluctuation and conflict with search for autonomy. More simulations are needed to investigate the impact of price fluctuation on the results.

5.1.4.2.6 Sale of the crops production

The economic optimization of this scenario leads to the sale of the crops production and feed purchase. One participant disagreed with this output, because it increases the dependence of the farmers on the feed companies. Furthermore, selling their crops to the feed processor to buy it back later is actually not that profitable if you take into account the storing costs, real selling and buying prices. He argued rather for a "taking the control back of their system by the farmers" approach. This element of the scenario is again in conflict with the search for autonomy. Other participants reacted in pointing out the need for "neutral" advice, the current advice being too often given by salesmen/women in Wallonia. This last element could be an incentive measure to discuss with decision-makers.

5.1.4.2.7 Production of food on the tillable land

In this scenario, all the tillable land included in the UUA of the intensive suckling system (BE-CC2) are used for the production of food. As already mentioned above concerning the indicator of feed-food competition "land used to produce meat", some participants highlighted the need of nuance according to the soil and climate conditions and the standards in force in the value chain. Further work is needed to fine-tune the calculation of this indicator.

5.1.4.2.8 Valorisation

This scenario relies on a valorisation of the meat produced at a price of 3.40 euros/kg carcass, based on a "U" or "R" carcass conformation and a "3" fat score. The participants however highlighted the need to study the possibility of an integrated production chain (focus on minced meat) for ensuring the valorisation of the production. This element goes beyond the frame of the modelling, but is essential for ensuring the realisation of the scenario.

Table 13 - Summary of the discussion and the proposals of fine-tuning on scenario 2 (grass fattening of young males from terminal crossing (BE-D case-study + BE-CC2 re-designed in growing-fattening unit)

Controversial elements of the scenarios	Why?	Gap compared to the outputs of the optimization	Fine-tuning of the modelling	Future work
Use of sexed semen	On average, 3 doses are needed in order to succeed sexed insemination (compared to 2 doses in classic insemination): does the sale of the crossbred calves at better price cover the cost of sexed semen?	Risk of lower than expected incomes for the dairy farmers	This element is currently studied by the German team	
Crossbred males purchase	Health risk for the herd	This risk cannot be taken into account by the modelling		Study the possibility to develop a "trust chain" between dairy and meat farmers OR Model a scenario implying the fattening on the dairy farm using dual-purpose breed
Re-design of the system	"Cultural" brake due to the attachment of the breeders in BE-CC2 case-study to the Belgian Blue breed and to their cow-calf system	This risk cannot be taken into account by the modelling		Study the acceptance of the sector, in particular the breeders, for the proposed system
Crossbred males	Greater danger of the crossbred males (for the farmer) than the BB bulls	This element cannot be taken into account by the model		Simulations with steers instead of bulls
Use of by-products	As already highlighted in the scenario 1, this use could lead to an economic risk due to the price and availability fluctuation	Economic risk that could lead to lower than expected incomes	Simulations of price fluctuation sensitivity to determine the impact on the scenario	Study the availability of inedible by-products in the territory

	In conflict with the search for autonomy			Study the dynamic between search of autonomy and search for low feed-food competition
Sale of the crops production (and feed purchase)	In conflict with the search for autonomy			Need for neutral advice
Production of food on the tillable land	The assumption that all the tillable land can be used to produce food needs to be nuanced, depending of the soil and climate conditions and the standards in force in the value chain (e.g. feed grains versus bread-making cereals).	Overestimation of the feed-food competition through the indicator “land use”		Fine-tuning of the indicator “land use”
Valorisation of the production	As already pointed out for the scenario 1, the participants wonder if this kind of meat will be accepted by the value chain, given the standards in force.	Currently, the model considers a slaughter age equal to 19 month, with a carcass conformation equal to “U” or “R” and a fat score equal to “3”. This leads to a price of 3.40 euros/kg carcass.		Study the interest of a specific valorisation (integrated production chain focus on more minced meat)

5.1.5 Identification of the incentives measures supporting scenarios

The participants identified several incentives measures in order to support the scenarios. The Table 14 summarizes them.

Table 14 – Summary of the incentive measures identified by the participants

Elements of the scenarios	Incentives measures
Dynamic rotational grazing	As this practice requires plots in one block and near the farm, it calls for studying the interest of a land consolidation
Grass-based meat production	As the scenarios change completely the way the meat is produced, it calls for ensuring its valorisation and need therefore to study the interest of a specific valorisation (e.g. distinctive quality, integrated production chain)
Sale/purchase of the crossbred males	As the scenario 2 implies the purchase of the whole herd by the fattener, it calls for avoiding health risk, for example by developing "trust chain" between dairy farmers and fatteners
Use of by-products	As both scenarios rely on the use of by-products from the agro-industries, they call for studying the availability of inedible by-products on the territory

Besides, participants stressed that support to the sector must also take into account whether or not the innovation is a "niche innovation". If it is the case, incentives should not aim at generalizing a practice that is relevant solely if a small amount of farmers implement it. According to the participants, this aspect is sometimes overlooked by decision-makers. They also mentioned the general need for neutral advice (i.e. non commercial) for the guidance of the farmers in order to allow emergence of innovations. Finally, this restitution workshop also gave us ideas for future research.

5.2 France

5.2.1 Description of the participants

Due to the Covid-19 restriction, the restitution workshop was organized in June 2020 in the form of a 2.5 hours webinar using TEAMS and KLAXOON. This meeting was co-organized by IDELE and INRAE and the local extension services (Chambre d'Agriculture) were in charge of inviting the participants. All the people previously involved in the focus groups were invited as well as external persons. 22 persons participated this webinar plus the four organizers: 9 farmers, 6 extension services, 3 from the livestock Institute and 4 stakeholders (veterinary services, agricultural high school, Arvalis institute).

5.2.2 Discussion and validation of the case-studies

The different case studies were presented as showed, but not the model outputs because the meeting was very short and because the model results were not yet validated by the French team (problem of high level of concentrates).

5.2.3 Discussion and validation of the assessment of the feed-food competition

The following food security indicators were presented.

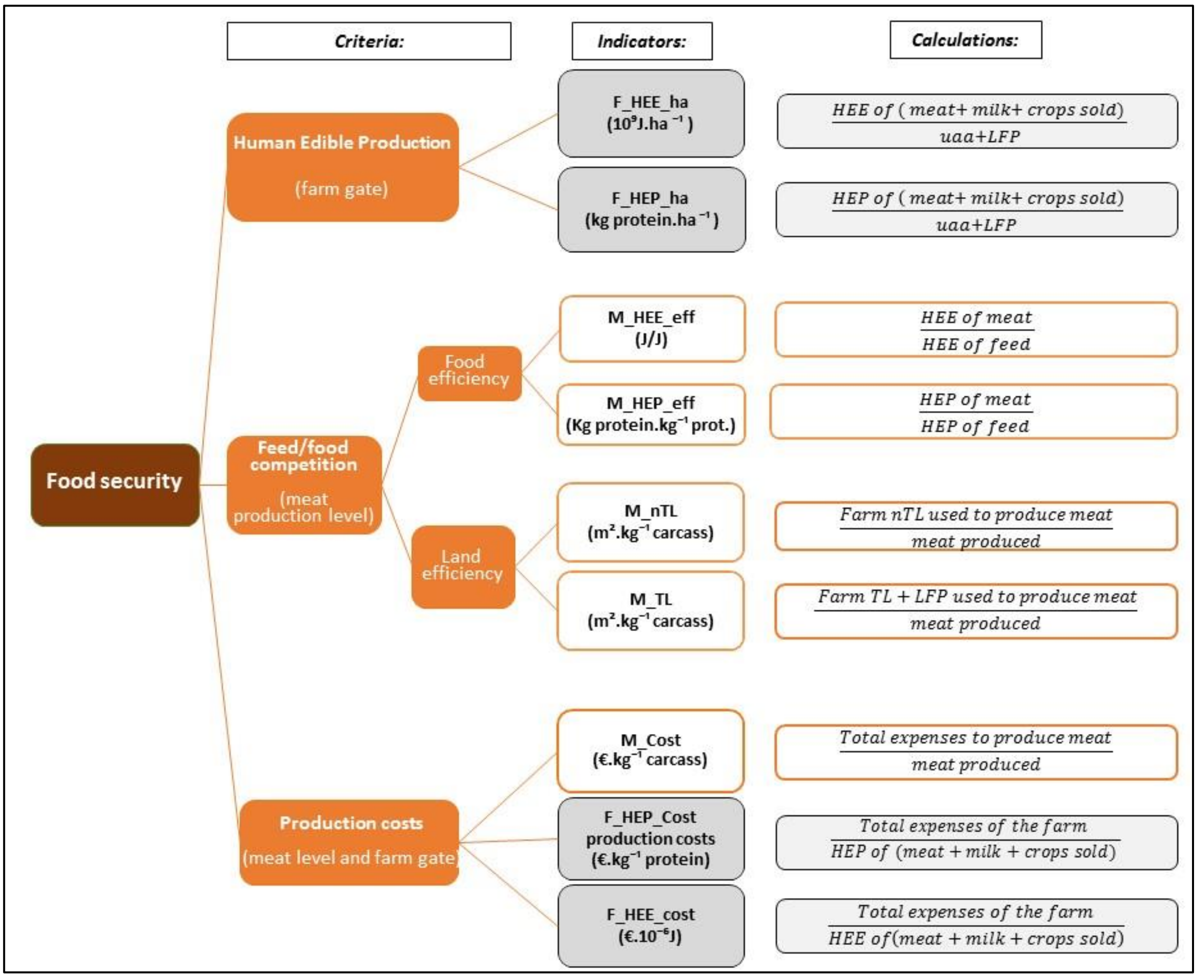

Figure 1: **Food security evaluation tree.**

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.

The reactions of the partners were:

- One participant ask why we chose carcass instead of live animals since in cow-calf systems they sell live weight. Nonethless they agree on this unit.
- What about the social acceptability ? →Food security is one component of social acceptability
- What about water consumption ? → not considered

- Is purchased protein accounted for? → yes
- The indicator of protein production per hectare is not very relevant to assess feed/food competition → feed / food competition is not the only criteria considered to assess food security

We also presented the main results for the different countries (based on description of the case studies not on simulation results. The results show that, at the farm level, systems producing both beef and milk or cereals have higher protein and energy production per hectare (up to 370 kg of protein and 60000 106J.ha-1) than specialized beef systems (up to 50 kg of protein and 1600 106J.ha-1) (Figure 2) and have lower protein and energy costs (approximately €6 kg-1 protein in mixed beef system and of €29 kg-1 of protein in a specialized cow-calf-fattener system).

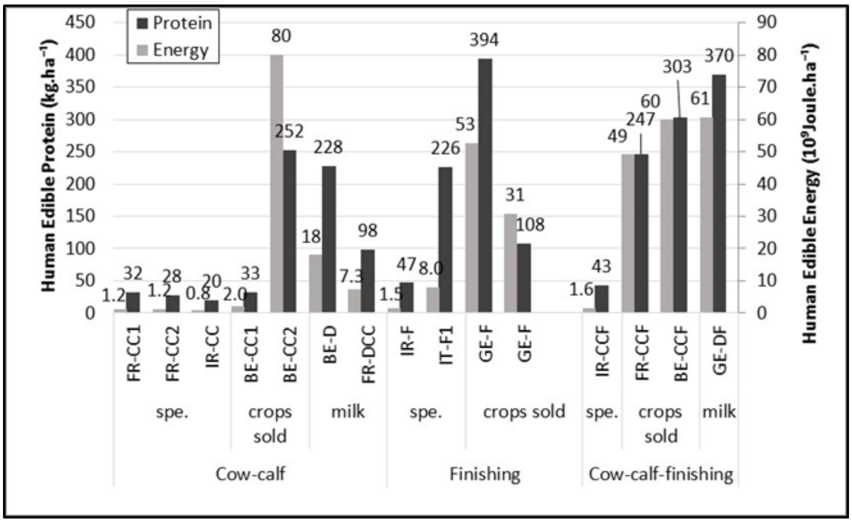

Figure 2: Net production of human edible protein *(F_HEP_ha)* and energy per hectare *(F_HEE_ha)* of utilised agricultural area at farm level. *(FR-CC1= FR-CANT-Lim, FR-CC2 = FR-CANT-CC)*

Beef systems are almost all energy consumers with net edible energy efficiencies between 0.1 and 0.2 except for systems exclusively based on grass which have a higher efficiency due to the low share of human edible energy in meat compared to that present in the feed consumed (Figure 3). Results are more variable concerning net edible protein efficiency. The cow-calf enterprises are mostly net producers of protein but, in order to produce human edible meat, these systems need to be combined with finishing systems that are mostly net consumers of protein. In most cases, cow-calf-finishing systems are net consumers of protein (between 0.6 and 0.7) but systems using very little concentrates or using co-products not edible by humans are net protein producers.

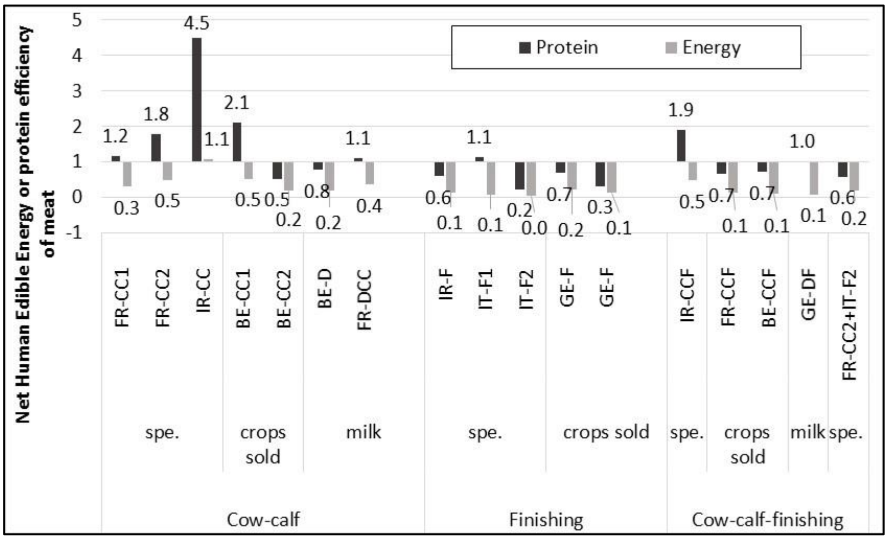

Figure 3: Net Human Edible Protein and Energy Efficiencies of meat production ***(M_HEP_eff and M_HEE_eff) (FR-CC1= FR-CANT-Lim, FR-CC2 = FR-CANT-CC)***

These grass-based systems use more land area per kilogram of carcass but a major part of this area is non-tilled land, thus these systems are not in direct competition with human food production (Table 15)

Table 15: Indicator of competition for Land used for meat production

	FR-CC1	FR-CC2	IR-CC	BE-CC1	BE-CC2	BE-D	FR-DCC	IR-F	IT-F1	IT-F2	GE-F1	GE-F2	IR-CCF	FR-CCF	BE-CCF	GE-DF	FR-CC2+IT-F2
M_nTL *($m^2.kg^{-1}$ carc)*	23	58	80	37	11	87	32	27	0	0	1	1	38	27	12	1	34
M_TL ($m^2.kg^{-1}$ carc)	29	2	1	21	8	5	3	7	7	16	4	15	2	9	9	9	7

Notes: TL and nTL: Tillable and non-Tillable Land in and out of farm; M_Cost meat production cost, F_HEP_cost and F_HEE_cost production costs of Human Edible Protein and Energy at farm gate. na: not available; (FR-CC1= FR-CANT-Lim, FR-CC2 = FR-CANT-CC)

The lowest meat production costs are the finishing systems producing the most live weight per livestock unit (LU) per year and dairy systems in lowland which share the costs between milk and meat (Figure 4).

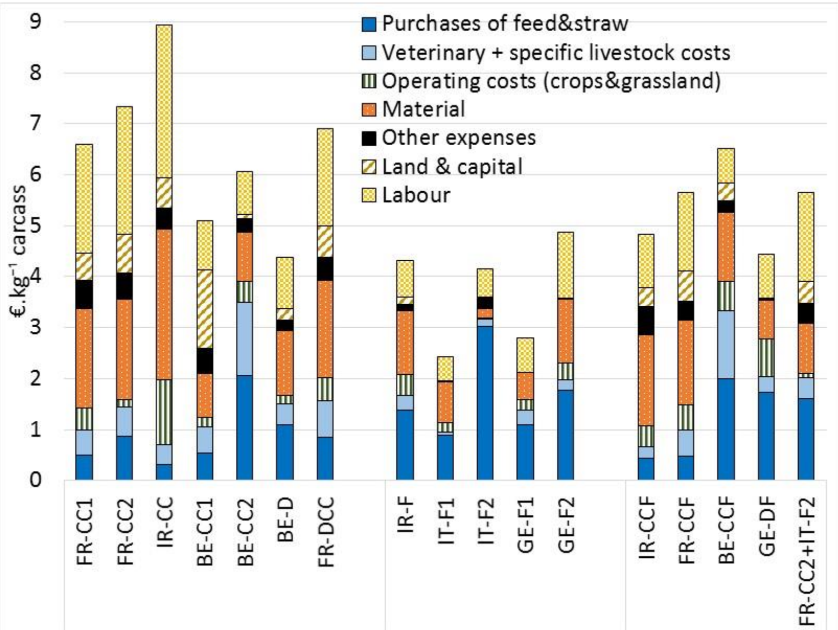

Figure 4: Beef production costs (€.kg^{-1} of meat carcass produced). ***FR-CC1= FR-CANT-Lim, FR-CC2 = FR-CANT-CC)***

5.2.4 Discussion and validation of the scenarios

Two scenarios were presented: (1) dynamic rotational grazing assuming both higher quality of grazed grass and higher quantity of grass and (2) cross-breeding with Angus assuming the same price for angus animals as for previous prices of the case studies. Since we noticed some inconsistencies in the results, the results were presented as preliminary. These scenarios were applied to all case studies.

5.2.4.1 Dynamic Rotational Grazing

The Table 16 was presented to the participants.

Table 16: Preliminary results for Dynamic Rotational Grazing

	Lim_CC	Cant_CC	Cant_DCC	Lor_CCF
Animal Production	↑ +13 LU	↑ +7 LU	= +0 LU	=+0 LU
Purchase of concentrate	↑ +10T	↑ +29 T	↓ -5T	↓ -3T
Crop Acreage	=	↓ harvested area	=	=
Δ Animal Sales	8.5 k€	6.4 k€		
Δ Crop Sales	0	0		0.9 k€
Δ Subsidies	1.1 k€	1.0 k€		
Δ inut purchase	3.6 k€	7.3 k€	- 0.4 k€	0.3 k€
Δ other variables costs	1.3 k€	0.2 k€	- 0.3 k€	- 1.2 k€
Δ depreciation	- 0.9 k€	0.4 k€	- 0.1 k€	0.2 k€
Δ Profit	+5.6 k€	- 0.5 k€	+0.8 k€	+1.6 k€
Δ Production efficiency of Human edible protein	**-5%**	**-20%**	**+5%**	**+5%**

Regarding the results proposed participants made the following remarks:

- They do not understand the variation of herd size
- The presentation of the results in % of variation is not sufficient. It may be necessary to clearly indicate the initial and final values. If a 100% grassland system needs to increase the amount of concentrates, that's understandable...whereas in other regions, there may be a real saving in concentrates...
- It was not clear whether the objective was to finish animals on grazed grass ? or on grass-based feed (hays is also possible)
- The assumption of spring grass all over the year appear too optimistic for one participant.
- Simple rotational grazing already makes it possible to increase the grazing performance compared to the usual continuous management usually done in suckler cow farms.
- Investment costs may have been underestimated in the simulations
- Relatively small impact of efficiency innovations on systems that are already very grassy systems
- Simulation results need to be more realistic and detailed

5.2.4.2 Angus Crossbreeding

The Table 17 was presented to the participants.

Table 17: Preliminary results for Angus Crossbreeding

	Lim_CC	Cant_CC	Cant_DCC	Lor_CCF
Animal Production	↑ +13 LU	↑ +7 LU	= +0 LU	=+0 LU
Purchase of concentrate	↑ +10T	↑ +29 T	↓ -5T	↓ -3T
Crop Acreage	=	↓ Surface fauchée	=	=
Δ Animal Sales	8.5 k€	6.4 k€		
Δ Crop Sales	0	0		0.9 k€

Δ Subsidies	1.1 k€	1.0 k€		
Δ input purchase	3.6 k€	7.3 k€	- 0.4 k€	0.3 k€
Δ other variables costs	1.3 k€	0.2 k€	- 0.3 k€	- 1.2 k€
Δ depreciation	- 0.9 k€	0.4 k€	- 0.1 k€	0.2 k€
Δ Profit	+5.6 k€	- 0.5 k€	+0.8 k€	+1.6 k€
Δ Production efficiency of Human edible protein	**-5%**	**-20%**	**+5%**	**+5%**

The main reactions of the participants were the following:

- In Cantal: they noticed that the more concentrate is purchased the highest profit !
- What is the impact of the variability of grassland production on the fattening performance ?
- Simulation results need to be more realistic and detailed

5.2.5 Negative and positive consequences of the innovations simulated identified by participants

Participants were asked to write post-it on the consequences of the innovation. Concerning the first scenario (Dynamic rotational grazing), they pointed out:

- Labour: Labour availability is often a constraint on farm; More work for little additional economic profit
- Plots: Water points are an important issue; Farm plots are often not adapted for rotational grazing
- Technical implementation: Need goods skill
- Animal Performance: Increase milk production (→ better growth of calves)
- Forage production: Improve the securing forage resources; make it possible to grow more cereals if herd size is kept constant
- Other: Improve carbon balance

Concerning the second scenario (crossbreeding with angus), they pointed out:

- Market and demand: It may be difficult to find some industrial buyers for this meat. Cross bred Angus meat pieces difficult to sell. The Payment criteria for meat doesn't correspond to meat quality
- Cross Breed problems: 1)The meat industry is very attached to pure breeds; 2) fewer pure-bred females will be available to improve the genetics
- Technical implementation: More technical references are required
- Pasture: If animals are finished on pasture, there would be a problem of congestion with all animals ready to be slaughtered at the same period
- Climate change: How reliable would be pasture production in the future?

5.3 Italy

5.3.1 Description of the participants

Because of the outbreak of the pandemic caused by Covid19 and the severe measures that the Italian government adopted to counter it, it was impossible to organize restitution workshops. For this reason, according with the management of the project, we interviewed some actors about the scenario "cattle feeding on pasture", that is a shared scenario among all the participants of the project (see appendix 5, §7.5 for the details).

The interviewed people were a manager of a large retail company, a meat trader, a breeder and a director of a farmer association.

5.3.2 Discussion and validation of the scenarios

5.3.2.1 Management of the herd

There are several systems where beef cattle are fed on grass. The scenario was considered in the interview of the farmers was tightly combined with cross-breeding between a dairy breed (Holstein) and a beef breed (Angus). The cross-breed males and females are let to graze during from sprint to autumn, on several small yards, where they remain for few days (fast rotation).

This scenario is not common in the Po Valley, where the soil fertility and land value are very high and there are also some environmental constrains, like scarcity of rains in summer. This represents the main problem in the management of the herd and probably is the main technical reason limiting the number of farms applying this system.

5.3.2.2 Ration

Animals are fed herb during the grazing periods, with no supplement. The farmer's evidence is in contrast with some other farmers applying the same rearing system, who use some supplements during grazing periods. This demonstrates that this system requires further researches to be applied in this environment.

5.3.2.3 Structural condition

The need to have an area large enough and close to the farm is a major constrain. Farmers stressed the fact that the farms are in urbanized areas characterized by village, industries and road limiting the extension of the fields and impeding the animal movement from one field to another.

5.3.2.4 Workload

The opinions about workload depend on the characteristics of the farms (other activities, composition of the family etc.). In the interview of the owner of a dairy farm with cross-bred animals on pasture is considered. The farmer's opinion is very favourable about workload; however, this cannot be enough to draw a conclusion and much more examples should be examined.

5.3.2.5 Breed

The scenario is influenced by the choice of the farmer also in this case. There are several breeds that could be used. The farmer who was interviewed choose Angus, but he also added that he is testing some other breeds. So far, there are very few data or experience to say which the best breed is in plain areas in Italy.

5.3.4.6. Valorization

Different opinion emerged from the interviews. On one side there are the opinions of farmers and meat trader, who consider that the main strategy to appreciate grass-beef is butcher's shop. On the other side, the large retail requires larger amounts of meat of constant quality.

Table 18 – Summary of the discussion and the proposals of fine-tuning

Controversial elements of the scenarios	Why?	Gap compared to the outputs of the optimization	Fine-tuning of the modelling	Future work
Use of supplement	Grass growth could not be enough	Risk to produce animals too old or to lean	Simulations of older slaughter ages and better carcass conformation and fat score	Studies on grass production, adapted to the environment of the northern plains in Italy
Breeds	There are other breeds that could be an alternative		Simulations with other live weight at slaughter	Comparisons of different pure or cross-breeds in this environment
Valorisation of the production	To have a large consumption of this meat larger amounts of steady quality are required			

5.3.3 Identification of the incentive measures supporting scenario

There are several suggestions resulting from the interviews. Some are technical:

- different breeds should be tested to identify which has the best performance for growth, adaptation and meat quality;
- to consolidate a pastures management that guarantees a constant growth and quality of grass.

Other measures concern the value chain and exploitation of the meat produced in such a way.

6 Conclusion

The main proposed scenario concerns on an association of two innovations: grass fattening and crossbreeding. Indeed each region propose this scenario but with some difference:

- In France, the scenario proposed is to improve grass valorisation by young bulls from crossbreeding of two different suckling races: one rustic race and a second one with high meat production.
- In the Belgium, Italy and Ireland, the crossbreeding concerns the dairy herd and the valorisation of grass by the young crossbred bull.

Excepted in Ireland, Algae was proposed as an alternative fodder, due to their high concentration of protein. The opportunity to test this innovation trough modelling looks promising but the lack of knowledge, price of production or legal definition are as many obstacles to its implementation.

Some scenarios were presented to actors of the value chains of Belgium, Italy and France through participatory approaches. Due the sanitary crises, the methodology need to be adapted: in Belgium and France it was during meetings (face-to-face versus virtual), and individual interviews in Italy. The participants underlines the interest of the modelling and propose remarks, barriers and levers to improve the presented scenarios. The main remarks concern technical aspects (is it feasible! – Is it neutral advising to help the implementation) and about the market and the commercialisation of news products.

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7 Appendixes

7.1 Appendix 1: The list of innovations

Table 19 – List of innovations identified to address feed-food competition and their characterization based on the Eco-Efficiency (E) – Substitution (S) – Re-design (R) framework (Hill and MacRae, 1995)

	Innovations	ESR characterization
1	Cattle fattening on pastures	R
2	Fast rotational grazing	E
3	Alfalfa and red clover as protein supplements in rations for young beef cattle	S
4	Hay dried in barn	
5	Production of fodders through cover crops	E
6-8	Use of by-products coming from the agri-food industry: • oil seed cakes • used dried stoned olive pomace • whey	S
9	Conservation of local pulps and by-products in a single silo	E
10	Use of insect meal as a source of protein in cattle diets	S
11	Use of algae as a substitute for corn or soymeal in the grower and finisher cattle diets	S
12	Crossbreeding (continental breed x breed with an early maturity, more adapted to be fattened under grazing) (e.g. Salers x Angus)	E, S
13	Spring calving for a better use of grass resources	R
14	Genomic selection: measuring and favouring the milk production of suckler cows	E, R
15	Genomic selection for food efficiency	E
16	Terminal crossbreeding with beef breed, on dairy herd, for commercial beef production	E, R
17	Precision livestock farming: connected plate pasture meters	E
18	Precision livestock farming: infrared analysis of fodder	E
19	Integrated crop-livestock systems	R
20	Agroforestry	S, R
21	Limiting meat production to non-competitive feed	R

7.2 Appendix 2: The relevance of the innovations according to the stakeholders

Table 20 – Results of the votes according to the relevance of the innovations per region involved

<table>
<tr><td rowspan="2"></td><td rowspan="2">Lorraine (FR.LOR-BF) (n=10)</td><td rowspan="2">Creuse (FR.LIM-CC) (n=9)</td><td rowspan="2">Cantal (FR.CANT-CC, FR.CANT-DCC) (n=9)</td><td rowspan="2">Veneto (IT.F-900 IT.F-226) (n=10)</td><td rowspan="2">Piemonte [6] (n=6)</td><td colspan="5">Wallonia</td></tr>
<tr><td>BE-CC1
BE-CC2
BE-BF
(n=15)</td><td colspan="4">Value chain actors
(n=7)</td></tr>
<tr><td>Cattle fattening on pasture</td><td>0</td><td>0</td><td>6</td><td>0</td><td>1</td><td>6</td><td colspan="4">4</td></tr>
<tr><td>Fast rotational grazing</td><td>0</td><td>1</td><td>6</td><td>0</td><td>0</td><td>5</td><td colspan="4">4</td></tr>
<tr><td>Genomic selection for food efficiency</td><td>*</td><td>7</td><td>6</td><td>2</td><td>0</td><td>*</td><td colspan="4">5</td></tr>
<tr><td>Use of by-products</td><td>0</td><td>1</td><td>2</td><td>1</td><td>1</td><td>3</td><td>Dregs:6</td><td>Whey: 2</td><td>Downgraded products:3</td><td>Water process: 1</td></tr>
<tr><td>Crossbreeding (meat breed x breed adapted to grazing) (e.g. Angus X Salers)</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>2</td><td colspan="4">4</td></tr>
</table>

[6] The participants of this focus group are not related to any case-study defined in WP2. They are breeders-fatteners.

	Lorraine (FR.LOR-BF) (n=10)	Creuse (FR.LIM-CC) (n=9)	Cantal (FR.CANT-CC, FR.CANT-DCC) (n=9)	Veneto (IT.F-900 IT.F-226) (n=10)	Piemonte [6] (n=6)	Wallonia	
						BE-CC1 BE-CC2 BE-BF (n=15)	Value chain actors (n=7)
Production of fodder through cover crops	*	*	*	2	1	7	*
Precision Livestock Farming	4	0	1	3	1	0	4
Terminal crossbreeding (beef breed on dairy herd)	*	*	*	0	1	1	5
Alfalfa and red clover as protein supplements in rations for young beef cattle	3	0	0	0	0	7	6
Genomic selection: favouring the milk production of suckler cows	4	0	0	1	0	1	6
New sources of proteins: Insects, Algae	1	0	0	3	0	2	Insects: 0 Algae: 3
Integrated crop-livestock systems	*	*	*	*	*	5	4
Spring calving	0	0	0	*	*	2	2
Agroforestry to produce fodder	0	1	0	0	0	1	2
Hay dried in barn	1	0	0	0	0	0	2

	Lorraine (FR.LOR-BF) (n=10)	Creuse (FR.LIM-CC) (n=9)	Cantal (FR.CANT-CC, FR.CANT-DCC) (n=9)	Veneto (IT.F-900 IT.F-226) (n=10)	Piemonte [6] (n=6)	Wallonia	
						BE-CC1 BE-CC2 BE-BF (n=15)	Value chain actors (n=7)
Preservation of the by-products in a single silo	*	*	*	0	0	1	1
Limiting meat production to non-competitive feed	*	*	*	0	0	0	0

*No data available, as these innovations have not been discussed in this group.

7.3 Appendix 3: the modelling possibilities

Table 21 – List of innovations according to their modelling possibility

N°	Innovation	Modelling	Reason(s)
1	Cattle fattening on pastures	Doable	
2	Fast rotational grazing	Doable	
3	Alfalfa and red clover as protein supplements in rations for young beef cattle	Doable	
4	Hay dried in barn	Doable	
5	Production of fodders through cover crops	Doable	
6-8	Use of by-products	Doable	
9	Local pulps and by-products in a single silo	Doable under conditions	Need the feed values and the prices of all the feedstuffs used
10	Use of insects meal as source of protein in the grower and finisher cattle diets	Doable	
11	Use of algae as substitute for corn or soymeal in cattle diets	Doable	
12	Crossbreeding (meat breed x breed adapted to grazing) (Salers x Angus)	Doable	
13	Spring calving	Doable	
14	Genomic selection: measuring and favouring milk production of suckler cows	Not doable	Lack of data
15	Genomic selection for food efficiency	Not doable	Lack of data
16	Terminal crossbreeding (beef breed on dairy breed)	Doable	
17-18	Precision livestock feeding	Not doable	Technical reason (default setting): FarmDyn considers that the feeding is optimized by default
19	Integrated crop-livestock system	Not doable	This innovation occurs at territorial scale (not a farm scale innovation)
20	Agroforestry	Not doable	Agroforestry is not part of FarmDyn. The modelling of this innovation needs the development of additional modules, out of the scope of this project.
21	Limiting meat production to available non-competitive feed: principle of ecological leftovers applied to the Swedish context	Not doable	This innovation occurs at territorial scale (not a farm scale innovation)

7.4 Appendix 4: the running of the meeting used for the restitution workshop

Sequences	Time	Accumulated Time	Description	Techniques	Material
1. Introduction **10:00 to 10:25**	5’	5’	Welcome Consent for the recording Rules of the group : • There is no bad or good opinion : every opinions are welcome (no judgement) • Positive and constructive attitude • Mutual listening in a respectful way • Voluntary participation : no obligation of anything • Shared responsibility in the success of the meeting • Switch off or mute phone • Respect of the agenda to finish on time • … Anything else?	The rules of the group have to be written previously on a flipchart sheet visible for all at all times	Sound recorder Flipchart, marker
	5’	10’	Go round the table introducing yourselves (name and function)	Round table	Badges
	10’	20’	1/ Reminder of the project, its foundations, the feed-food competition, its indicators (net protein efficiency, net protein edible/ha, tillable and non-tillable land used to produce beef meat), quality of animal protein VS plant protein.		Slides show

	5’	25’	2/ Program and objectives of the meeting		Slides show
2. The state of the feed-food competition and the presentation of the case-studies **10:25 to 11:40**	75’	1h40	1/ Presentation of the case-studies (approach to designing them, description) (10’) and discussion based on the following question: *Do you have any comments on the modelling of this case-study? Do you agree with the hypotheses underlying this case-study modelling? Explain. (10’)* 2/ State of the FFC in each case-study (5’). Start with the following question: *In your opinion, what is the state of the FFC for this case-study?* Presentation of the net protein efficiency in each case-study. 3/ Comparison with the other regions involved in the project based on the net protein efficiency (cf. work of Anne Jarousse) (5’)	--> For the step 2/ (FFC): Use of coloured cards that participants will have to hold up: Green = “producer” (net protein efficiency > 1) Yellow = “transformer” (net protein efficiency = 1) Red = “consumer” (net protein efficiency < 1)	Slides show Coloured cards (1 set/participant), flipchart, marker, camera
3. Break **11:40 to 11:50**	10’	1h50			
4. The innovations modelled (part 1) **11:50 to 13:25**	15’	2h05	Introduction: reminder of the objectives of the modelling and its principles		Slides show
	20’	2h25	1/ Feedback on the focus groups organised last year: ranking of the innovations based on the votes of relevance, approach to choose the innovations modelled (10’)		Slides show

			2/ Reminder of the barriers and levers identified during the focus groups for the innovations presented below (10’)		
	60’	3h25	1/ Presentation of the first “scenario” (do not forget to make the link with the barriers mentioned during the focus groups if the simulation results provide information on this subject) (30’) 2/ Discussion of the first scenario focused on the following questions (30’): *Do you have any comments on the consequences (positive or negative) of the introduction of this (these) innovation(s) at the farm level? At the value chain scale?* *What incentives could support this scenario?*	During the presentation, the participants note the consequences they identify, their remarks Brainstorming	Slides show, blank sheets, pens Flipchart, markers or Mindmapping software
5. Lunch time **13:25 to 14:25**	60’	4h25			
6. The innovations modelled (part 2) **14:25 to 15:25**	60’	5h25	1/ Presentation of the second “scenario” (do not forget to make the link with the barriers mentioned during the focus groups if the simulation results provide information on this subject) (30’) 2/ Discussion of the second scenario focused on the following questions (30’): *Do you have any comments on the consequences (positive or negative) of the introduction of this*	During the presentation, the participants note the consequences they identify, their remarks Brainstorming	Slides show, blank sheets, pens Flipchart, markers or Mindmapping software

			(these) innovation(s) at the farm level? At the value chain scale? *What incentives could support this scenario?*		
7. Conclusion **15:25 to 15:40**	10'	5h35	*Question:* *At the end of the meeting:* *What surprised you?* *What interested you?* *What you didn't like?* *What follow-up do you expect?*	Individual and written evaluation	Appendix 1, pens
	5'	5h40	Information about the next steps: • Combination of breeder and fattener systems • Improvement of the modelling thanks to their comments • Integration of the incentives in the modelling (if possible) • Final conference in the Agricultural Fair of Libramont Acknowledgement		

7.5 Appendix 5: the interview's guides used for individual interviews in Italy

7.5.1 Interview's guide for breeders

Introduction: explain the project SustainBeef in few words. Explain that the project shows that grass-based systems are interesting in the perspective of the reduction of feed-food competition. However, in the agricultural region concerned, grass-based systems are not the norm, and the meat produced in such systems does not necessary fit with what the value chain expects.

Explain that the objective of the interview is to understand how their system work, the brakes they encounter, the levers they use to succeed to produce beef on pasture.

1/ Could you explain how did you choose to develop a grass-based system? How did this happen?

What are the reasons, the motivations? …

2/ How was the implementation of this system carried out?

a) *At the level of the farm:*
   - What are the changes made (herd, area, equipment, practices, skills, …)?
   - What are the key milestones?
   - Which brakes did you encountered?
   - Which levers help you to succeed?
   - Which impacts has this system on your previous system, your practices, the herd, the equipment, the area and its management, the workload, the economic performances, …?
   - …

b) *Downstream, at the level of the valorisation:*
   - What are the changes made (relation with the actors of the value chain, type of animal produced, …) ?
   - What are the key milestones?
   - Which brakes did you encountered?
   - Which levers help you to succeed?
   - …

3/ Could you describe your system. Currently, how does it work?

a) *At the level of the farm:*
   - Type of system (breeder-fattener, fattener, …)
   - Type of animals produced, breeds, slaughter age, …
   - Grassland and forage management (grazing technique, stocking rate, grassland composition, fertilization, forage production, preservation and distribution, …)
   - Diet in summer/in winter
   - Herd management (calving, husbandry, …)
   - …

b) *Downstream, at the level of the valorisation:*

- How is the valorisation organised? With who? For who?

4/ Are you currently experiencing any particular difficulties in maintaining or developing your system?

- Which ones? How do you deal with them? What solutions are you putting in place? What levers can you rely on?
- How do you envision the future of your system?
- …

5/ In conclusion, could you summarize what you consider to be the main key elements of your system now and in the future?

6/ Do you want to add something?

Conclusion: Explain what happens next. Thank the interviewee.

7.5.2 Interview's guide for value chain actors

Introduction: explain the project SustainBeef in few words. Explain that the project shows that grass-based systems are interesting in the perspective of the reduction of feed-food competition. However, in the agricultural region concerned, grass-based systems are not the norm, and the meat produced in such systems does not necessary fit with what the value chain expects.

Explain that the objective of the interview is to understand how the valorisation of the meat produced in such systems works, the brakes it encounters, the levers used to succeed to valorise meat coming from cattle breeded and fattened on pasture.

1/ Could you describe how does the valorisation of cattle coming from grass-based systems work?

a) *At the whole value chain level:*
   - How is the value chain organised?
   - How are the actors of each step (production, cattle trade, transformation, distribution, consumption) connected?
   - …

b) *At the transformation level:*
   - How is the transformation going?
   - What are the differences compared to the transformation of the meat produced in more "mainstream systems"? Which changes did you do?
   - …

c) *At the distribution level (retailers):*
   - How is the distribution going?
   - What are the differences compared to the distribution of "ordinary meat"? Which changes did you do?

- Is there a specific valorisation (label, distinctive quality, …)?
- Could you describe the type of consumers interesting by this kind of meat?
    - What do they expect?
    - Which “profiles” do they have?
    - …
- What is the image used to promote this meat? What elements (of the production, the transformation) are promoted?

2/ Could you explain how did the desire to promote this type of meat come about? How did it develop?

- What are the reasons, the motivations?
- Who are the actors involved in the development of this system? How are they connected?
- What brakes did you encountered in the development of the valorisation of such a meat?
- What levers did you use for supporting the development of the valorisation of such a meat?

3/ Could you describe the meat so produced?

- What impact has the method of production (i.e. based on grass) on the finished product?
- What differences are there in terms of:
    - carcass (conformation, fat score, ...)?
    - meat: organoleptic and nutritional properties, type of piece, price, …?
    - …

4/ In your opinion, is it possible to develop more this kind of production (in the region concerned)?

- Under what conditions?
- What would be the consequences if so?
- …

5/ Do you want to add something?

Conclusion: Explain what happens next. Thank the interviewee.