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Deliverable 5.3-Part II:
Report on results of Socio-Economic Assessment

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0. General Remarks

Deliverable 5.3 (D5.3) is dedicated to presenting the results and relevant underlying inventory data and assumptions of the environmental (LCA) and socio-economic (sLCA) impact assessment of P2F food prototyps as compared to existing food alternatives. For reasons of practicability D5.3 consists of two separate reports:

- D5.3 part I: Report on results of the Life Cycle Impact Assessment by ifeu
- D5.3 part II: Report on results of Socio-Economic Assessment by UPM

Due to the iterative character of LCA in general and the innovative nature of P2F prototypes (implying continued changes in product compositions) it was quite challenging to keep both LCA and sLCA modelling updated according to the latest findings in WP 1-3. Several meetings and phone conferences between ifeu and UPM took place in order to ensure alignment of both work streams as much as possible. While minor deviations were unavoidable an overall consistency has eventually been achieved. The food products covered in both assessments are:

- Fibre-like vegetable meat alternative versus chicken breast meat
- Spread-like meat alternative versus pig meat based Liverwurst
- Lentil protein based milk alternative versus cow milk
- Plant protein rich pasta versus traditional pasta
- Plant protein rich bread versus traditional bread

On request of the EU reviewers and in order to have a larger picture of the potential environmental advantages of meat substitution it was decided to include a comparison of a beef meet burger versus a vegetable burger in the LCA. However, given the timing of this decision and the WP5 design as such it was not possible to include this additional comparison into the socio-economic assessment.

As already mentioned in Deliverable 5.2 (p.52-55 and figure 11) it should be taken into consideration that in this project LCA and sLCA while examining the same products necessarily have different life cycle boundaries. The drivers of the differences between the environmental profiles of the examined food products are found in the upstream supply chain up to the point where the food products are ready for retail. Process steps from there on can be considered to be quite similar and are therefore not further considered in the comparative environmental assessment.

The situation is different for the socio-economic assessment. Here the impact of innovative food solutions on the consumer is crucial for the potential success of P2F prototoypes on the market. Hence the consumption phase forms part of the socio-economic assessment. In this way it also provides a link to the market analysis carried-out in WP4.

The following chapters provide the documentation of Deliverable 5.3 part II.

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1. Introduction

This document presents the methodology and results of the Socioeconomic Life Cycle Assessment (S-LCA), performed for the following ten products: (1) P2F fibre-like vegetable meat alterative; (2) Traditional chicken meat; (3) P2F VMA-spread type LEBERWURST; (4) Traditional spread type LEBERWURST variant 1; (5) P2F prototype fresh vegan pasta; (6) Traditional fresh egg pasta; (7) P2F prototype vegan milk; (8) Traditional dairy milk; (9) P2F prototype bread; (10) Traditional wheat bread. These products have also been analysed in the LCA. They include traditional animal-based products and innovative plant-based protein rich food products, i.e. prototypes that are being developed by the SMEs in the context of P2F.

The present document focuses on results. Full details about the S-LCA methodology can be found in Deliverable 5.2 "*Report on the methodology applied in this project for Life Cycle and Socio-Economic Assessment*". The results obtained from the S-LCA will be used, in a future stage, in combination to LCA to carry out an Integrated Sustainability Assessment (D5.4) and to support the development and implementation of the WP4 multi-criteria assessment toolkit (D4.3).

The present document is divided in four chapters besides this introduction. In the first chapter, the methodological aspects of S-LCA are briefly reviewed and the main results obtained are presented. The goal and scope are resumed, the latest including the predefinition of the geographical and system boundaries and the functional units, as well as the list of indicators preselected in D5.2. Also, the inventory analysis is presented, in which the final selection of indicators and its justification is shown, along with their source and the data bases that have been used. After that, the impact assessment is described and divided into the definition of the evaluation scale method and the actual assessment of products where results are presented. The second chapter includes the comparison of results between innovative P2F products and traditional products. The third chapter refers to the discussion of results, where limits of the analysis are exposed. And finally, chapter four sets forth the main conclusions of the study.

2. Socio-economic life cycle assessment: methodology and results

This chapter is a summary of the S-LCA methodological aspects established in D5.2. Additionally, it includes the results of its application on Protein2Food innovative products and on the traditional products they aim to replace. First, the goal of this deliverable is presented, as well as the selected products that are being compared. Second, the scope of the analysis is discussed. As part of the scope, system boundaries are resumed, including the selection of lifecycle stages and stakeholder categories and subcategories, and functional units are defined. Third, the preselection of socio economic indicators chosen in D.5.2 is shown. Then, the inventory analysis is explained, where information is given about the data bases that have been used, the final selection of indicators (system refinement) and its justification. Finally, the methodology is implemented, and results are shown for each functional unit. Results are shown in the form of tables were final assessments can be seen. The results are discussed to highlight hotspots and positive aspects along the life cycle of these products and to analyse which stakeholder are the most negatively and positively affected in each case.

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2.1. Goal

The objective of a S-LCA is to provide a set of quantitative and qualitative decision variables that will help guide decision-making processes. Following Tamborra (2002), the ultimate goal of a S-LCA is to analyse the positive and negative socio-economic impacts associated to a given development, policy or product.

The particular aim of this study is to analyse the socio-economic aspects related to the life cycle of ten selected products and to compare results obtained from innovative plant-based products with those obtained from traditional animal-based products.
The ten selected products are grouped in five categories that correspond to the five comparisons that are being done in this assessment. These are the following:

- Category 1: Fibre-like meat
  Product 1 (P2F fibre-like vegetable meat alterative) compared to Product 2 (Traditional chicken meat)

- Category 2: Spread-like meat
  Product 3 (P2F VMA-spread type LEBERWURST) compared to Product 4 (Traditional spread type LEBERWURST variant 1)

- Category 3: Pasta
  Product 5 (P2F prototype fresh vegan pasta) compared to Product 6 (Traditional fresh egg pasta)

- Category 4: Milk
  Product 7 (P2F prototype vegan milk) compared to Product 8 (Traditional dairy milk)

- Category 5: Bread
  Product 9 (P2F prototype bread) compared to Product 10 (Traditional wheat bread)

The specific objectives of the study are:

(1) To identify potential positive and negative socio-economic impacts along the life cycle of innovative PROTEIN2FOOD plant-protein products in Europe, as well as of the traditional animal products they aim to replace.
(2) To compare traditional and innovative products' performances in relation to different socio-economic issues, with the aim of identifying differences and trade-offs between the different products' life cycles studied.
(3) To obtain valuable socio-economic information and an increased understanding of each product system.

The trade-offs analysed in S-LCA will aid in the decision-making process, but they are relative to socio-economic issues only. With just S-LCA, we cannot categorically declare that some alternatives are superior to others. To do so, a more integrated assessment (which includes S-LCA and LCA) is needed (Sala et al. 2015). Thus, this study focuses on highlighting trade-offs between alternatives and in gaining understanding of under

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what circumstances and regarding which issues one of the alternatives is preferable (UNEP-SETAC, 2009).

2.2. Scope

Defining the scope of the study is one of the most critical steps towards performing a S-LCA, since it encompasses many key decisions that need to be taken towards correctly orientating the assessment and fulfilling its specific objectives. In this study, the scope includes the definition of the geographical boundaries, life cycle stages and stakeholder categories and subcategories (system boundaries) and functional units.

2.2.1. Geographical boundaries

The geographical boundary that has been established for this study is the European Union (EU). The EU refers to the 28 member-states: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherland, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom. Nonetheless, it is important to notice that results will not be shown individually by country but as an average value for the whole European Union. The average value for the whole EU-28 has been gathered when available. When not, the average has been calculated using data from the 28 member-states (see Annex I and II).

2.2.2. System boundaries

As stated in D5.2, system boundaries refer both to life cycle stages and stakeholder categories and subcategories.

Life cycle stages

The life cycle stages encompass, in the first place, a *production stage*, that is related to crop and animal production at farm level; in second place a *processing and retail stage* representing the food transformation industry; and a third and final *consumption stage*.

- **Production:** including the primary production of crops for human consumption, and the production of feed crops and cattle farming in those products with animal proteins.

- **Processing & Retail:** from the moment the raw material (with an animal or vegetable origin) is sold by the primary producers and until the product is purchased by the final consumer. It therefore includes the processes performed by the food industry (such as food storage, protein extraction, design, food processing, packaging, etc.) and by distribution enterprises (product distribution and sale).

- **Consumption:** from the moment the product is purchased until it is used or consumed by the final client.

It should be stressed that the consumption stage is included in S-LCA, but not in the LCA. The consumer is one of the five stakeholder categories suggested by the S-LCA Guidelines (UNEP-SETAC, 2009) and it is regularly used in a large amount of S-LCAs

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(Sala et al. 2015). This is why consumer and the consumption stage have been included in the present study.

It is also important to emphasize that unlike the LCA, in S-LCA only final products are considered, discarding other inputs that have been included in the LCA as fuel and/or energy consumption, fertilizers, pesticides, irrigation water and others. This does not in any way affect the interpretation of results, as social hotspots depend on company or sector behaviour more than on background flows (Martínez-Blanco et al. 2014). Furthermore, it is not always possible, necessary or relevant to assess in detail all of the inputs and stages throughout the life cycle of a product when performing a S-LCA, especially due to practical constraints such as data limitations and budget restrictions (Couture 2012; Revére et al. 2015).

Stakeholder categories and subcategories

Regarding the stakeholder categories, they have been chosen taken into account the life cycle of products and its relevance for different social agents. S-LCA guidelines (UNEP-SETAC, 2009) propose five stakeholder categories (*workers, consumers, society, value chain actors* and *local community),* and open the possibility to include more categories, or exclude existing ones. In the present S-LCA, *local community* is excluded as it is considered implicitly integrated in the other categories (*society* and *workers* categories*).*

Subsequently, stakeholder categories are divided in stakeholder subcategories. The subcategories are *agricultural workers* and *processing and retail workers* for *workers* category, *farmers* as *value chain actor,* and *consumers* and *society* for *consumers* and *society* categories respectively.

Stakeholder categories and subcategories are shown in Table 1.

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Table 1. Stakeholder categories and subcategories

SH Category	SH Subcategory	Definition
Workers	Agricultural Worker	This category refers to employees within the production sector, who work in farms or holdings but do not own those agricultural businesses.
	Processing & Retail Worker	This category refers to employees working within the processing and retail sectors
Value Chain Actors	Farmer	This category refers to agricultural producers of proteins (mainly family-owned farms) who own businesses and whose economic situation and well-being depend on the profitability and performance of what they produce
Consumer	Consumer	This category refers to the persons that will buy these protein products for personal use
Society	Society	This category refers to the aggregate of people, institutions and interest groups who share customs, laws and acknowledged social values

Source: IFEU (2017)

With this system boundary, the whole life cycle of food products is assessed, including production, processing and consumption stages, which matches the S-LCA´s idea of assessing the whole production chain "from cradle to grave" from a holistic perspective (Jørgensen 2013).

2.2.3. Functional units

When implementing a S-LCA, it is necessary to establish a functional unit so that products can be comparable (Lehmann et al. 2013). Usually, establishing a functional unit is easier to do in LCA than in S-LCA, as social issues are hardly attributable to a functional unit (Iofrida et al., 2018; Martínez-Blanco et al., 2014; Benoit et al., 2010).

In the present study, functional units correspond to 100 grams of product. A total of ten products have been analysed (see section 2.1), thus, ten functional units have been identified. These are presented as follows:

- Functional unit 1= 100 grams of Product 1 'P2F fibre-like vegetable meat alternative'

Table 2. Functional Unit 1: P2F fibre-like vegetable meat alternative

Ingredients	Grams
Water	60
Lentil or lupin protein isolate	30
Amaranth or buckwheat flour	10

Source: Based on IFEU (2016)

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- Functional Unit 2= 100 grams of Product 2 ‘Traditional chicken meat’

Table 3. Functional Unit 2: Traditional chicken meat

Ingredients	Grams
Chicken meat	100

Source: Based on IFEU (2016)

- Functional Unit 3= 100 grams of Product 3 ‘P2F VMA-Spread type Leberwurst’

Table 4. Functional Unit 3: P2F VMA-Spread type Leberwurst

Ingredients	Grams
Water	52
Legume/pseudocereal flour	18
Canola oil	15
Lupin	6
Other ingredients	9

Source: Based on IFEU (2016)

- Functional unit 4= 100 grams of Product 4 ‘Traditional spread type Leberwurst variant 1’

Table 5. Functional Unit 4: Traditional spread type Leberwurst variant 1

Ingredients	Grams
Pork meat + Bacon	49
Pig liver	38
Other ingredients	13

Source: Based on IFEU (2016)

- Functional unit 5= 100 grams of Product 5 ‘P2F prototype fresh vegan pasta’

Table 6. Functional Unit 5: P2F prototype fresh vegan pasta

Ingredients	Grams
Water	23
Wheat flour	59
Buckwheat flour	12
Faba bean flour	4
Lupin protein isolate	2

Source: Based on IFEU (2016)

- Functional unit 6= 100 grams of Product 6 ‘Traditional fresh egg pasta’

Table 7. Functional Unit 6: Traditional fresh egg pasta

Ingredients	Grams
Water	42
Semolina	42
Egg	12
Canola oil	4

Source: Based on IFEU (2016)

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- Functional unit 7= 100 grams of Product 7 ‘P2F prototype vegan milk’

Table 8. Functional Unit 7: P2F prototype vegan milk

Ingredients	Grams
Water	Confidential
Legume isolate	Confidential
Oil	Confidential
Sugar	Confidential

Source: Based on IFEU (2016)

- Functional unit 8= 100 grams of Product 8 ‘Traditional dairy milk’

Table 9. Functional Unit 8: Traditional dairy milk

Ingredients	Grams
Raw dairy milk	100

Source: Based on IFEU (2016)

- Functional unit 9= 100 grams of Product 9 ‘P2F prototype bread’

Table 10. Functional Unit 9: P2Fprototype bread

Ingredients	Grams
Wheat (wholemeal flour)	49
Water	39.5
Lupine Protein Isolate	4.5
Amaranth/ Buckwheat/ Faba bean flour	4.5
Yeast	1
Sunflower oil	1
Salt	0.5

Source: Based on IFEU (2016)

- Functional unit 10= 100 grams of Product 10 ‘Traditional wheat bread’

Table 11. Functional Unit 10: Traditional wheat bread

Ingredients	Grams
Wheat flour	58
Water	39.5
Yeast	1
Sunflower oil	1
Salt	0.5

Source: Based on IFEU (2016)

The selection of products and their composition have been provided by IFEU team based on D5.1 (Andreas et al., 2016) and on data from WP3 (food processing) lead by University College Cork (UCC, 2016). Some of these products are still under development which means that composition can still change during the progress of Protein2Food project.

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2.3. Selection of impact subcategories and socio-economic indicators

The preselection of indicators has already been carried out in Deliverable 5.2 (from page 59 to page 61) and done following the methodologies proposed by Dreyer et al. (2006) and Kruse et al. (2009), were bottom-up and top-down approaches are combined. The top-down approach refers to general indicators that reflect international standards (Kruse et al. 2009). In the present study, the internationally known Social Hotspot Data Base has been used to fulfil the top-down approach. The bottom-up approach consists in selecting site-specific indicators suited to a company or sector, usually chosen after conducting a survey, a stakeholder consultation or other methods to detect company or sector particularities. In the present study, different stakeholders such as producers, transformation companies and consumers, were asked about their major concerns during the stakeholder consultation of the second annual meeting of Protein2Food held in Caserta, Italy 2016 (Varela-Ortega et al., 2017). From this consultation, along with other studies, a series of indicators ad hoc have been chosen, fulfilling the bottom-up approach (Dreyer et al. 2006; Lemeilleur and Vagneron 2010). This combined approach also matches the idea that general indicators must be complemented with more specific indicators (Sala et al. 2015).

All preselected indicators (general and tailored indicators) have been chosen after examining their suitability towards the achievement of the S-LCA goals and also after having conducted a preliminary scan on data availability. Three main data sources were used for this: The Social Hotspot Data Base, the stakeholder international consultation carried out during the second annual meeting of Protein2Food in Caserta, Italy (Varela-Ortega et al., 2017), and literature review.

Once preselected and following do Carmo et al. (2016), indicators have been grouped into impact subcategories. Preselected indicators have been grouped in thirteen impact subcategories (fair salary, hours of work, equal opportunities/discrimination, health and safety, contribution to farm income, economic security, management attributes, contribution to economic development, contribution to food security, commitment to sustainability issues, choice, product features relevant for consumers, contribution to protein affordability). These impact subcategories represent the main socio-economic impacts of protein products from both vegetable and animal origins. These impact subcategories are also related to stakeholder subcategories.

The preselected indicators and their related impact and stakeholder subcategories in each of the life cycle stages are shown below in Table 12 (production stage), Table 13 (processing and retail stage) and Table 14 (consumption stage).

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Table 12. Preselected list of indicators relating to the production stage

Production stage		
Stakeholder subcategory	**Impact Subcategory**	**Indicator**
Agricultural Workers	Fair Salary	Risk of Sector Average Wage being lower than country's non-poverty guideline
		Risk of Sector Average Wage being lower than country's minimum wage
	Hours of Work	Risk of Excessive working time by sector
	Equal Opportunities/ Discrimination	Risk of Gender Equality by Sector based on representation in the workforce
	Health and Safety	Risk of Fatal Injury by Sector
		Risk of non-fatal Injury by Sector
Farmers	Contribution to Farm Income	Profitability
		Production Efficiency
		CAP Support
	Economic Security	Yield Variability
		Production Price Variability
	Management Attributes	Main Cultivation/ breeding attributes and difficulties
Society	Contribution to Economic Development	Relevance of the considered sector for the economy
	Contribution to Protein Security	Protein production
	Commitment to Sustainability Issues	Contribution to the Sustainable Production of Proteins - Input use and efficiency

Source: IFEU (2017)

Table 13. Preselected list of indicators relating to the Processing and Retail stage

Processing and Retail Stage		
Stakeholder subcategory	**Impact Subcategory**	**Indicator**
Processing and Retail Workers	Fair Salary	Risk of Sector Average Wage being lower than country's non poverty guideline
		Risk of Sector Average Wage being lower than country's minimum wage
	Hours of Work	Risk of Excessive working time by sector
	Equal Opportunities/ Discrimination	Risk of Gender Equality by Sector based on representation in the workforce (female representation in the workforce by sector)
	Health and Safety	Risk of Fatal Injury by Sector (fatal injury rate by sector per 100,000)
		Risk of non-fatal Injury by Sector (non-fatal injury rate by sector per 100,000)
Society	Contribution to Economic Development	Relevance of the considered sector for the economy

Source: IFEU (2017)

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Table 14. Preselected list of indicators relating to the Consumption stage

Consumption Stage		
Stakeholder subcategory	**Impact Subcategory**	**Indicator**
Consumers	Health and Safety	Level of contribution to consumer health or safety
	Choice	Accessibility
		Product Affordability (price competitiveness)
	Product Features Relevant for Consumers	Organoleptic properties
		Nutritional Value (and functional benefits)
		Ease of Preparation
		Protein Content
Society	Contribution to Protein Security	Protein affordability

Source: IFEU (2017)

As it can be seen in Tables 12, 13, and 14, different impact subcategories may be present depending on the life cycle stage (UNEP-SETAC, 2009). Also, *contribution to protein security* impact subcategory is assessed with different indicators in *production* and *consumption* stages due to the fact that in the *production stage* the important aspect is the production of protein by hectare, while protein affordability is the expected output for the *consumption stage*.

2.4. Inventory Analysis

The inventory analysis phase is where data is collected to support the socio-economic analysis. This phase is composed in first place of the data collection, where details are exposed about the databases and other sources that have been used, and in second place, the system refinement, where the final selection of indicators is done and the elimination or addition of indicators with respect to the preselected list is justified.

Data collection

The main source of information used to fill up the general indicators is the 'Social Hotspot Database', often abbreviated as SHDB. The SHDB provides data and tools for improving visibility of social hotspots in product supply chains and allows practitioners to implement generic analyses. More information can be found at the SHDB website https://www.socialhotspot.org/about-shdb.html.

The SHDB not only provides a list of indicators regarding social concerns, it also provides raw data so that practitioners can adapt it to their model. In this study, data for each indicator has been downloaded individually by country and sector and then an average value has been calculated for the whole EU by sector.

Regarding tailored indicators, a variety of data sources has been used. The Farm Accountancy Data Network provided data concerning average European farm economy (outputs, inputs, taxes and others) as a European average. Data concerning CAP voluntary coupled support was taken from the European Regulation on direct payments (EU Regulation 1307/2013 on direct payments, 2013), and EU Commission Document on the decision taken by member states (EU document, 2014). FAOStat has provided data to calculate yield and production price variability (calculated with data from 2003 to 2016)

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for specific agricultural products. FAO Balance Sheets and Protein2Food's D5.1 were used to calculate animal protein yield. And, the French Agency for Food, Environmental Health and Safety and for Protein Content, specifically its French Food Composition Table tool, was used for food composition data, not only protein content but also vitamin content, fibre content, saturated fat, and others. More information on data source can be found in annexes I and II.

The main difference between the databases used in the analysis is that data from the SHDB is available by country, which means that an average value had to be calculated for the S-LCA, while for tailored indicators, all data bases offered European-28 average values except for price variability from FAOStat. More detailed information concerning which database has been used to calculate which indicator is shown in the next sub-section "system refinement".

System refinement

Some of the preselected indicators had to be omitted, due to a lack of data availability, source reliability and logistical reasons such as the difficulty of conducting sector specific research for 28 European countries. In contrast, other indicators have been included after discussing their suitability with IFEU's team and other P2F participants. The revision of indicators is common to S-LCAs and forms part of the 'system refinement' phase (Benoît et al., 2009).

In the *production stage*, for *agricultural workers* stakeholder, two indicators have been added as they were available in the SHDB and were appropriate for the present study. These indicators are *risk of unemployment* and *risk that a country does not provide adequate labour laws by sector*. Regarding *farmers* stakeholder the indicator *production efficiency* has been replaced by *net margin* due to of the lack of data for the first mentioned indicator and the reliability of the Farm Accountancy Data Network for the second. The difference between profitability and net margin is that profitability refers to the money earned by the farmer for each euro spend on operating expenses (feed, fertilizers and other variable inputs) (output/input ratio), while net margin refers to the total money earned by the farmer subtracting operating expenses (total output - total input). In both cases, CAP subsidies are not included. Profitability gets measured as a percentage, while net margin gets measured in euros. Increased net margin does not always lead to increased profitability. Thus, companies often use the term profitability, on top of net margin, to make themselves in a better position to control costs and make effective sales plans to increase revenue.

Regarding *society* stakeholder in *production stage*, *relevance of the considered sector for the economy* has been eliminated due to a lack of reliable data and *Contribution to the Sustainable Production of Proteins* has been eliminated as this indicator has already been assessed in the environmental life cycle assessment. Regarding *contribution to protein security*, animal protein yield per hectare has been calculated considering the area harvested for animal feed (Obtained from Table 40 within PROTEIN2FOOD's D5.1, based on IFEU's Food-Flow Model's Calculations) and the total amount of animal-origin food supply (Obtained from Table 34 within PROTEIN2FOOD's D5.1, elaborated with data from the FAO Food Balance Sheets (2011)). This allows us to obtain an average yield of meat per hectare, which is used to calculate the average protein yield per hectare.

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In the *processing and retail stage*, two indicators, *risk of unemployment* and *risk that a country does not provide adequate labour laws by sector* have been added to *processing and retail workers* stakeholder as they were available in the SHDB and were appropriate for the present study. In the same stage, the indicator *relevance of the considered sector for the economy* has been eliminated due to a lack of reliable data.

The *consumption stage* is the one which has suffered more changes as all of the indicators regarding consumer stakeholder have been removed and replaced by four indicators related to its nutritional value. The indicator *Level of contribution to consumers' health or safety* has been removed because it was chosen before establishing that the functional unit would be composed. Furthermore, the indicator *nutritional value* has been divided into four nutritional components that reflect consumers' concerns (Drichoutis et al. 2006). These indicators are *saturated fat content*, *fibre content*, *vitamins content*, *cholesterol content*, and *protein content*. Finally, indicators *accessibility*, *product affordability*, *ease of preparation* and *organoleptic properties* have been eliminated because there is no information concerning those attributes. We are studying innovative products and they have not been commercialised yet. With respect to *contribution to protein affordability*, it is important to highlight that prices of innovative products have not been established yet. Thus, similar products available in the market have been used to estimate prices of vegetable-protein rich products, as well as of traditional products. Protein content in the final product had to be decided between IFEU and UPM teams based on information from deliverables D3.1 (UCC, 2016) and D3.2 (IVV 2018) as innovative products are still under development and could change since the start of this deliverable (see annexes I and II).

Tables 15, 16, and 17 display the final selection of indicators for the S-LCA of protein products, with their specific units of measurement and their source.

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Table 15. Final list of indicators relating to the production stage

Production Stage						
SH	**Impact subcategory**	**Indicator**	**Unit of measure**	**Source**	**Description**	**Justification/comments**
Agricultural workers	Fair Salary	Risk of Average Wage being lower than non-poverty line	Average Wage (AW): €/hour; Non-poverty Guideline (NPL): €/hour	S-LCA Methodological Sheets/ SHDB	This indicator aims to represent the risk of having wages below a country's non-poverty guideline. It compares the sector average wage in the country (AW) with the country's non-poverty guideline (NPL).	A European average wage for the sector and a European average non-poverty guideline have been calculated in order to obtain an EU average risk.
		Risk of Average Wage being lower than minimum wage	Average Wage (AW): €/hour; Non-poverty Guideline (MW): €/hour	S-LCA Methodological Sheets/ SHDB	This indicator aims to represent the risk of having wages below a country's minimum wage. It compares the sector's average wage in the country (AW) with the country's minimum wage (MW).	A European average wage on the sector and a European average minimum wage have been calculated in order to obtain an EU average risk.
	Hours of Work	Risk of Excessive Working time	Percentage of workers working more than 48h	S-LCA Methodological Sheets/ SHDB	This indicator represents the risk of the sector workers being working for an excessive number of hours per week (>48h and >60h)	A European average value has been calculated with the individual data of EU member states.
	Equal Opportunities/ Discrimination	Risk of Gender Equality	Percentage of women working in the sector (%)	S-LCA Methodological Sheets/ SHDB	This indicator has been developed as a proxy of gender equality in the sector	A European average value has been calculated with the individual data of EU member states.
	Health and Safety	Risk of Fatal Injuries	Number of cases per 100,000 workers	S-LCA Methodological Sheets/ SHDB	This indicator measures the risk that a worker of the sector has of suffering a fatal injury	A European average value has been calculated with the individual data of EU member states.
		Risk of Non-fatal Injuries	Number of cases per 100,000 workers	S-LCA Methodological Sheets/ SHDB	This indicator measures the risk that a worker of the sector has of suffering a non-fatal injury	A European average value has been calculated with the individual data of EU member states.
	Unemployment	Risk of unemployment	Unemployment percentage at sector level	S-LCA Methodological Sheets/ SHDB	This indicator measures the risk that a worker of the sector has of being unemployed	A European average value has been calculated with the individual data of EU member states.
	Labour Laws	Risk that a country does not provide adequate labour laws by sector	Number of labour laws by sector	S-LCA Methodological Sheets/ SHDB	This indicator measures the risk that a worker of the sector has of not being protected by labour laws	A European average value has been calculated with the individual data of EU member states.

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Farmers	Contribution to Farm Income	Profitability	Farm's Output / Input ratio (%)	Farm Accountancy Data Network	This indicator represents the profitability of each option, measured using the output/input Ratio. This ratio measures the amount of profit earned from the sale of a product or service, allowing to compare products in relative terms.	This ratio has been calculated by dividing output by inputs of each product for the average European farm. This indicator was chosen during the International SH Consultation. 2nd Annual Meeting Protein2Food (2017)
		Net Margin	000' euros-average farm	Farm Accountancy Data Network	This indicator represents the net margin of each option. This measures the amount of profit earned from the sale of a product or service in an average European farm, allowing to compare products in absolute terms.	The net margin is obtained by subtracting total inputs to total outputs for the average European farm. This indicator was chosen during the International SH Consultation. 2nd Annual Meeting Protein2Food (2017)
		CAP Voluntary coupled Support	Share of Total EU Budget of Voluntary Coupled Support destined to each type of product (%)	European Regulation 1307/2013, and European Commission (2015)	This indicator represents the support that crops, or animal products are currently receiving from the Common Agricultural Policy.	This support has been estimated attending to: a) Share of EU coupled payments; b) Ecological Focus Areas Regulation This indicator was chosen during the International SH Consultation. 2nd Annual Meeting Protein2Food (2017)
	Economic Security	Yield Variability	Coefficient of Variation	FAOSTAT average yields (2003-2016)	This indicator represents the variability in the yields of crops and animal products by using a coefficient of variation. This indicator will measure the yield-related risk that a farmer takes when cultivating/producing a crop or animal product. A higher variability will imply a higher risk	Yield variability has been estimated by calculating the coefficient of variation (standard deviation divided by each option's average) of EU average yields through the period 2003-2016. (Kathage et al. 2015)
		Production Price Variability	Coefficient of Variation	FAOSTAT European producer prices (2003-2016)	This indicator represents the variability in the production prices of crops and animal products. This indicator measures the price-related risk that a farmer takes when cultivating/producing a crop or animal product. A higher variability will imply a higher risk	Production price variability has been estimated by calculating the coefficient of variation (standard deviation divided by each option's average) of EU average production prices through the period 2003-2016. This indicator was chosen during the International SH Consultation. 2nd Annual Meeting Protein2Food (2017)
Society	Contribution to Food Security	Contribution to Protein Security	Kg of protein/hectare	FAO Balance Sheets, P2F D5.1, and French agency ANSES	This indicator estimates how much protein per hectare can be produced using each option. This indicator represents the efficiency (in terms of land use) of these crops or animal products in producing proteins.	Protein production per hectare has been estimated using product yields per hectare and their protein content. Yields per hectare of animal products have been calculated using data from the FAO Balance Sheets and IFEU's flow model calculations within D5.1. This indicator was chosen during the International SH Consultation. 2nd Annual Meeting Protein2Food (2017)

Source: Own elaboration

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

Table 16. Final list of indicators relating to the processing and retail stage

Processing and Retail Stage						
SH	**Impact subcategory**	**Indicator**	**Unit of measure**	**Source**	**Description**	**Justification/commentary**
Processing and retail workers	Fair Salary	Risk of Average Wage being lower than non-poverty line	Average Wage (AW): €/hour; Non-poverty Guideline (NPL): €/hour	S-LCA Methodological Sheets/ Social Hotspot Database	This indicator aims to represent the risk of having wages below a country's non-poverty guideline. It compares the sector average wage in the country (AW) with the country's non-poverty guideline (NPL).	A European average wage for the sector and a European average non-poverty guideline have been calculated in order to obtain an EU average risk.
		Risk of Average Wage being lower than minimum wage	Average Wage (AW): €/hour; Non-poverty Guideline (MW): €/hour	S-LCA Methodological Sheets/ Social Hotspot Database	This indicator aims to represent the risk of having wages below a country's minimum wage. It compares the sector's average wage in the country (AW) with the country's minimum wage (MW).	A European average wage on the sector and a European average minimum wage have been calculated in order to obtain an EU average risk.
	Hours of Work	Risk of Excessive Working time	Percentage of workers working more than 48h	S-LCA Methodological Sheets/ Social Hotspot Database	This indicator represents the risk of the sector workers being working for an excessive number of hours per week (>48h)	A European average value has been calculated with the individual data of EU member states.
	Equal Opportunities/ Discrimination	Risk of Gender Equality	Percentage of women working in the sector (%)	S-LCA Methodological Sheets/ Social Hotspot Database	This indicator has been developed as a proxy of gender equality in the sector	A European average value has been calculated with the individual data of EU member states.
	Health and Safety	Risk of Fatal Injuries	Number of cases per 100,000 workers	S-LCA Methodological Sheets/ Social Hotspot Database	This indicator measures the risk that a worker of the sector has of suffering a fatal injury	A European average value has been calculated with the individual data of EU member states.
		Risk of Non-fatal Injuries	Number of cases per 100,000 workers	S-LCA Methodological Sheets/ Social Hotspot Database	This indicator measures the risk that a worker of the sector has of suffering a non-fatal injury	A European average value has been calculated with the individual data of EU member states.
	Unemployment	Risk of unemployment	Unemployment percentage at sector level	S-LCA Methodological Sheets/ Social Hotspot Database	This indicator measures the risk that a worker of the sector has of being unemployed	A European average value has been calculated with the individual data of EU member states.
	Labour Laws	Risk that a country does not provide adequate labour laws by sector	Number of labour laws by sector	S-LCA Methodological Sheets/ Social Hotspot Database	This indicator measures the risk that a worker of the sector has of not being protected by labour laws	A European average value has been calculated with the individual data of EU member states.

Source: Own elaboration

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Table 17. Final list of indicators relating to the consumption stage

Consumption Stage						
SH	**Impact subcategory**	**Indicator**	**Unit of measure**	**Source**	**Description**	**Justification/comentary**
Consumer	Product Features Relevant for Consumers	Saturated Fat Content	grams/100 grams of product	'French agency for food, environmental health and safety and for protein content'	These indicators provide a glimpse of each product's nutritional value, by attending to their performance with regard to 3 criteria mentioned in PROTEIN2FOOD's DOW: saturated fat, fibre and minerals. Besides, a fourth criterion has also been included: level of cholesterol.	These indicators combine two positive components (fibre and vitamins) with two negative components (Cholesterol and saturated fats). (Drichoutis et al. 2006)
		Fibre Content	grams/100 grams of product			
		Vitamin Content	grams/100 grams of product			
		Cholesterol Content	grams/100 grams of product			
		Protein Content	grams /100grams of product	Based on data from D3.2 (IVV, 2018) and D3.1 (UCC, 2016), and from ANSES (ANSES 2018) composition table.	This indicator represents the protein content of the final product.	This indicator aims at comparing protein content of different products.
Society	Contribution to Food Security	Protein Affordability	€/kg of protein	Product prices have been taken from D3.1 (UCC, 2016) and from Rewe (Rewe, 2018). Protein content has been taken from D3.2 (IVV, 2018) and D3.1 (UCC, 2016), and from ANSES (ANSES 2018) composition table.	This indicator represents the price of protein of the final product based on the price of similar products in the market.	This indicator has been calculated by dividing product prices from D3.1. and Rewe (2018) by protein content data from D3.1 (UCC, 2016) and D3.2 (IVV, 2018). This indicator was chosen during the International SH Consultation. 2nd Annual Meeting Protein2Food (2017)

Source: Own elaboration

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2.5. Impact Assessment

First, an evaluation scale has been predefined so that the assessment can be done in a more feasible way. Second, Protein2food prototypes and traditional products are assessed using the proposed methodology, and results are shown for each product.

2.5.1. Evaluation scale

Each indicator must be assessed so that comparisons between products can be easily done. Nonetheless, there is no international consensus on an evaluation scale and characterisation method (Aparcana et al., 2013). For example, SAM (Subcategory Assessment Method) takes into account the country's context, where the company develops its activity, giving a better score to those who are located in countries with less guarantees (Ramirez et al., 2016). Another example is the semi-quantitative method used by Spillemaeckers et al. (2001) were indicators are assessed as 1 in cases where social criteria reaches a certain threshold and 0 when they do not.

In the present study, following the UNEP-SETAC recommendations (UNEP-SETAC, 2009) and the SHDB evaluation scale model (Benoit et al., 2013), an evaluation scale has been designed with 4 assessment categories: *Good performance (green), Medium performance (yellow), Upgradeable performance (orange)* and *Bad performance (red). Good and Medium performance* is assessed when the value of a particular indicator for a product is over the reference value. Upgradeable performance is when the value of the product is under the reference value but, because it is not very low, it still has the potential to upgrade to medium or good performance. Bad performance on the contrary denotes values that are way under the average value, and that need to be addressed as hotspots. The colour scheme makes the evaluation scale simple and easy to understand (Franze et al. 2011). The evaluation scale chosen for each indicator can be seen below in Table 18.

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Table 18. Evaluation scales by indicator

Average Wage being lower than non-poverty line (Weighting;1;2;3;4)		
NPL<AW	Good Performance	A score is given to each country: (bad=1; upgradeable=2; medium=3; good=4) then the average is calculated for each sector resulting in a score from 1 to 4 (1<bad<1.75; 1.75<upgradeable<2.5; 2.5<Medium<3.25; 3.25<good<4)
NPL>AW by <25%	Medium Performance	
NPL>AW by 25-50%	Upgradeable Performance	
NPL>AW by >50%	Bad Performance	
Average Wage being lower than minimum wage (Weighting;1;2;3;4)		
MW<AW by >25%	Good Performance	A score is given to each country: (bad=1; upgradeable=2; medium=3; good=4) then the average is calculated for each sector resulting in a score from 1 to 4 (1<bad<1.75; 1.75<upgradeable<2.5; 2.5<Medium<3.25; 3.25<good<4)
MW<AW	Medium Performance	
MW>AW by 0-25%	Upgradeable Performance	
MW>AW by >25%	Bad Performance	
Excessive Working time (% of people working more than 48h/w)		
<10%	Good Performance	Limits established in the Social Hotspot Data Base
<25%	Medium Performance	
<50%	Upgradeable Performance	
>50%	Bad Performance	
Gender Equality (% of women)		
>33%	Good Performance	Limits established in the Social Hotspot Data Base
>20%	Medium Performance	
>10%	Upgradeable Performance	
<10%	Bad Performance	
Fatal Injuries (Fatal/100,000)		
<1	Good Performance	Limits established in the Social Hotspot Data Base
>1	Medium Performance	
<5	Upgradeable Performance	
>10	Bad Performance	
Non-fatal Injuries (non-fatal/100,000)		
<100	Good Performance	Limits established in the Social Hotspot Data Base
>100	Medium Performance	
>500	Upgradeable Performance	
>2000	Bad Performance	
Unemployment (%)		
<0.1%	Good Performance	Limits established in the Social Hotspot Data Base
<0.5%	Medium Performance	
<1%	Upgradeable Performance	
>1%	Bad Performance	
Labour laws by sector		
>1	Good Performance	A score is given to each country: (upgradeable=1; medium=2; good=3) then the average is calculated for each sector resulting in a score from 1 to 3 (1<upgradeable<1.67; 1.67<medium<2.33; 2.33<good<4)
1	Medium Performance	
0	Upgradeable Performance	
Profitability (Output/Input)		
>110%	Good Performance	Limits have been established to balance ingredients along the four assessment categories
>105%	Medium Performance	
>100%	Upgradeable Performance	
<100%	Bad Performance	
Net Margin (000' euros-average farm)		
>10	Good Performance	Limits have been established to balance ingredients along the four assessment categories
>5	Medium Performance	
>0	Upgradeable Performance	
<0	Bad Performance	

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CAP Voluntary coupled Support (%)		
>20%	Good Performance	Limits have been established using CAP voluntary coupled support percentages to balance ingredients along the four assessment categories.
>10%	Medium Performance	
>1%	Upgradeable Performance	
<1%	Bad Performance	
Yield Variability (%)		
<7.98%	Good Performance	25% deviation model has been used
<10.64%	Medium Performance	
<13.30%	Upgradeable Performance	
>13.30%	Bad Performance	
Production Price Variability (%)		
<19.14%	Good Performance	25% deviation model has been used
<25.52%	Medium Performance	
<31.90%	Upgradeable Performance	
>31.90%	Bad Performance	
Contribution to Protein Security (Kg protein/ha)		
>452.84	Good Performance	30% deviation model has been used
>348.33	Medium Performance	
>243.83	Upgradeable Performance	
<243.83	Bad Performance	
Saturated Fat Content (g/100g)		
<1.12	Good Performance	25% deviation model has been used
<1.49	Medium Performance	
<1.86	Upgradeable Performance	
>1.86	Bad Performance	
Fiber Content (g/100g)		
>5.76	Good Performance	25% deviation model has been used
>4.61	Medium Performance	
>3.45	Upgradeable Performance	
<3.45	Bad Performance	
Vitamins Content (B1-6 + C + E) (mg/100g)		
>13.82	Good Performance	25% deviation model has been used
>11.05	Medium Performance	
>8.29	Upgradeable Performance	
<8.29	Bad Performance	
Cholesterol Content (mg/100g)		
<23.30	Good Performance	25% deviation model has been used
<31.06	Medium Performance	
<38.83	Upgradeable Performance	
>38.83	Bad Performance	
Protein Content (g/100g)		
>13	Good Performance	Limits have been established to balance ingredients along the four assessment categories
<13	Medium Performance	
<9	Upgradeable Performance	
<5	Bad Performance	
Protein Affordability (€/Kg of protein)		
<44.18	Good Performance	25% deviation model has been used
<58.90	Medium Performance	
<73.64	Upgradeable Performance	
>73.64	Bad Performance	

Source: Own elaboration

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It should be stressed that the evaluation scale proposed by the SHDB has only changed in its denomination but not in its values (the original assessment categories of the SHDB are low risk, medium risk, high risk and very high risk). This is done to simplify the assessment and make it less confusing, not only by homogenising the assessment but also by eliminating the word 'risk' of the evaluation scale. 'Risk', defined as a function of probability and impact, is not considered in the study.

The evaluation scale for tailored indicators had to be made from scratch. Therefore, a preliminary evaluation scale model has been chosen for all tailored indicators. This model consisted in calculating the average values of indicators with all the ingredients that make up all the functional units and adding, up and down, a 25% or a 30% deviation from that average value. With this, three limits are established for each indicator, which allows us to cluster the assessment into the four assessment categories aforementioned. When an ingredient is assessed, for example, as having a good performance, it doesn´t necessarily mean that this ingredient or product is good in relation to the indicator, but that the ingredient or product is better than other one having, for example, a medium performance. For this, it is important that in all indicators, ingredients are balanced between good, medium, upgradeable and bad performance. Therefore, when adding a 25% or 30% deviation from the average was not adequate in that sense, as it was the case for *profitability, net margin*, *CAP voluntary coupled support,* and *protein content* indicators, limits have been established to balance ingredients along the four assessment categories.

2.5.2. Impact assessment of selected products

The assessment phase is where the S-LCA methodology is applied and, consequently, where results are shown for each product. To do so, assessment is done at an indicator level instead of at an impact subcategory or impact category level, which would give a few assessment scores and would pose the problem of weighting indicators, leading to more subjective results.

Thus, in the present study, a value is given to each indicator for each ingredient. Then, those values are weighted in function of its percentage in the product and summed to calculate the *total* (the final value of the indicator for the product being assessed). Finally, the assessment is done using the evaluation scales aforementioned. The reader should bear in mind that this work does not pretend to elucidate whether a product is better than another one, but to understand what the most important differences between food alternatives are, and in which point of the life cycles are these differences located.

It should be clarified that:

- It was not possible to assess the ingredient '*salt*' as there were no reliable data. Therefore, this ingredient has been eliminated, bearing in mind that socio-economic impacts do not depend on the weight of the product, but on the proportion of ingredients in it.
- *Water* is not included in the production stage because it is considered irrigation water and, hence, a background flow in the considered stage.

The display of results is shown in the next five sub-sections, corresponding each of them to the five pre-established comparisons (product categories). Indicators' results are

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exposed, as well as the final weighted result and its assessment with the colour evaluation scale.

2.5.2.1. Fibre-like meat category

Table 19 shows the results from products (1) Fibre-like vegetable meat alternative (VMA-fibre) and (2) Traditional meat alternative.

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Table 19. Assessment results. Fibre-like vegetable meat alternative (VMA-fibre) and Traditional meat alternative

Stage	Stakeholder	Indicator	Fibre-like vegetable meat alternative (VMA-fibre)					Traditional meat alternative	
			Lupin protein isolate	Buckwheat flour	Water	Total	Assessment	Chicken	Assessment
			30	10	60	100		100	
Production	Agricultural workers	AW < NPL (Semi-quantitative score 1;2;3;4)	2.64	2.64		2.64	Medium	2.60	Medium
		AW < MW (Semi-quantitative score 1;2;3;4)	2.71	2.71		2.71	Medium	2.75	Medium
		Excessive Working time (% of people working more than 48 h/w)	9.64%	9.64%		9.64%	Good	9.64%	Good
		Gender Equality (% of women in the workforce)	33.11%	33.11%		33.11%	Good	33.11%	Good
		Fatal Injuries (per 100,000 workers)	12.14	12.14		12.14	Bad	12.14	Bad
		Non-fatal Injuries (per 100,000 workers)	2720.87	2720.87		2720.87	Bad	2720.87	Bad
		Unemployment (% by sector)	0.13%	0.13%		0.13%	Medium	0.13%	Medium
		Labour laws by sector (semi-quantitative 1;2;3)	2.86	2.86		2.86	Good	2.86	Good
	Farmer	Profitability (Output/Input)	106%	108%		106%	Medium	111%	Good
		Net Margin (000' euros per average farm)	3.82	5.10		4.14	Upgradeable	32.10	Good
		CAP Voluntary coupled Support (% of total coupled support)	10.88%	0.00%		8.16%	Upgradeable	0.00%	Bad
		Yield Variability (% of variability)	11.18%	13.00%		11.64%	Upgradeable	3.02%	Good
		Production Price Variability (% of variability)	23.07%	30.73%		24.98%	Medium	17.38%	Good
	Soc.	Contribution to Protein Security (Kg protein/ha)	511.51	207.04		435.39	Medium	403.86	Medium
Processing and Retail	Workers	AW < NPL (Semi-quantitative score 1;2;3;4)	3.28	3.28	3.54	3.44	Good	3.08	Medium
		AW < MW (Semi-quantitative score 1;2;3;4)	3.04	3.04	3.14	3.10	Medium	3.00	Medium
		Excessive Working time (% of people working more than 48 h/w)	9.64%	9.64%	9.64%	9.64%	Good	9.64%	Good
		Gender Equality (% of women in the workforce)	27.06%	27.06%	27.06%	27.06%	Medium	27.06%	Medium
		Fatal Injuries (per 100,000 workers)	3.37	3.37	3.88	3.67	Medium	3.37	Medium
		Non-fatal Injuries (per 100,000 workers)	2990.30	2990.30	1693.96	2212.50	Bad	2990.30	Bad
		Unemployment (% by sector)	0.87%	0.87%	0.09%	0.40%	Medium	0.87%	Upgradeable
		Labour laws by sector (semi-quantitative 1;2;3)	1.86	1.86	1.36	1.56	Upgradeable	1.86	Medium
Consumption	Consumer	Saturated Fat Content (g/100g)	0.00	0.33	0.00	0.03	Good	0.55	Good
		Fibre Content (g/100g)	0.00	4.20	0.00	0.42	Bad	0.00	Bad
		Vitamins Content (mg/100g)	0.00	7.96	0.00	0.80	Bad	13.29	Medium
		Cholesterol Content (g/100g)	0.00	0.00	0.00	0.00	Good	70.40	Bad
		Protein Content (g/100g)	30				Good	21.4	Good
	Soc.	Protein Affordability (€/Kg of protein)	55.37				Medium	46.73	Medium

Note: Average Wage being lower than Non-Poverty Line (AW<NPL); Average Wage being lower than country's Minimum Wage (AW<MW)

Source: Own elaboration

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Fibre-like vegetable meat alternative (VMA-fibre)

In the production stage, agricultural workers have a mixed picture with three indicators showing good performance (*"gender equality"; "Excessive working time"; "Labour laws")*, other three showing medium performance (*"Average wage being lower than poverty line"; "average wage being lower than country minimum wage"; "Unemployment")* and two showing bad performance *("Fatal injuries"; "non-fatal")* injuries. No indicator shows upgradeable performance for agricultural workers. Farmers subcategory shows a slightly worse picture with three indicators with upgradeable performance *("Net margin"; "CAP voluntary coupled support"; "Yield variability")*, only two with a medium performance (*"Profitability"; "Production price variability")*, and any with a bad neither a good performance. The indicator "*contribution de protein security"* in *Society* shows a medium performance.

In the processing and retail stage, workers show a different picture than workers in the production stage, with only one indicator showing a bad performance *("Non-fatal injuries")*, two showing a good performance *("Average wage being lower than non-poverty line"; "Excessive working time")*, four showing a medium performance *("Average wage being lower than country's minimum wage"; "Gender equality "; "Fatal injuries"; "Unemployment")* and one showing an upgradeable performance *("Labour laws by sector")*.

Finally, in the consumption stage, consumers show a mixed picture, with two indicators showing a bad performance *("Fibre content"; "Vitamin content")* and other three showing a good performance *("Saturated fat content"; "Cholesterol content*"; *"Protein content"*). The indicator "*protein affordability"* in the stakeholder society in the consumption stage shows a medium performance.

In summary, it can be noticed that fatal and non-fatal injuries in agricultural workers, non-fatal injuries in processing workers, and fibre and vitamin content in consumers can be considered as hotspots in the life cycle of Fibre-like vegetable meat alternative production, as they all show bad performance. Also, in farmers' stakeholder, three indicators show upgradeable performance and two show medium performance, which makes it the stakeholder with the worse assessment profile. This is due to the fact that the main ingredients of this product are lupin and buckwheat flower, which despite having both medium performance with respect to *profitability*, have upgradeable performance with respect to *net margin*. Regarding variability, it should be noticed that buckwheat and lupin have upgradeable *yield variability* (13% and 11% respectively), which also can be a possible reason for increased *price variability*. Only few countries in Europe produce buckwheat (ten countries) and lupin (twelve countries). Low levels of production can contribute to high prices and increased volatility.

Traditional meat alternative

As seen in Table 17, in the production stage, agricultural workers stakeholder has three indicators showing good performance (*"gender equality"; "Excessive working time"; "Labour laws")*, other three showing medium performance (*"Average wage being lower than poverty line"; "average wage being lower than country minimum wage";*

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"Unemployment") and two showing bad performance *("Fatal injuries"; "non-fatal")*. No indicator shows upgradeable performance in this stakeholder. In the same stage (production stage), farmers subcategory has four indicators with good performance *("Profitability"; "Net margin"; "Yield variability"; "Production price variability")*, only one with a bad performance *("CAP voluntary coupled support")*, and any with a medium or an upgradeable performance. The indicator *"Contribution to protein security"* in society in the production stage shows a medium performance.

In the processing and retail stage, workers only have one indicator showing a bad performance *("Non-fatal injuries")*, one showing a good performance *("Excessive working time")*, five showing a medium performance (*"Average wage being lower than poverty line"; "average wage being lower than country minimum wage"; "Gender equality "; "Fatal injuries"; "Labour laws")* and one showing an upgradeable performance *("Unemployment")*.

In the consumption stage, consumers stakeholder has two indicators with good performance ("*saturated fat content*" and *"protein content"*), another one with medium performance ("fibre content") and other two with bad performance ("*cholesterol content*" and "*vitamin content*"). Society stakeholder has its only indicator ("*protein affordability*") showing a medium performance.

To conclude, it can be noticed that consumers and processing and retail workers show the worse assessment profiles and that stakeholders belonging to the production stage (production workers, farmers and society) have the best assessment profile. This is due to the fact that chicken has a high *profitability* and a good performance regarding *net margin*. Moreover, chicken is produced in all European countries and has a low *yield variability*, which possibly makes this product have a low *price variability*.

2.5.2.2. Spread-like meat category

Table 20 shows the results from products (3) P2F VMA-spread type LEBERWURST (liver pâté) and (4) Traditional spread type LEBERWURST variant .

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Table 20. Assessment results. P2F VMA-spread type LEBERWURST (liver pâté) and Traditional spread type LEBRWURST variant 1

Stage	Stakeholder	Indicator	P2F VMA-spread type LEBERWURST (liver pâté)							Traditional spread type LEBERWURST variant 1				
			Legume/pseudocereal flour	Canola oil	Lupin protein isolate	Other ingredients	Water	Total	Assessment	Pork meat + Bacon	Pig liver	Other Ingredients	Total	Assessment
			18	15	6	9	52	100		49	38	13	100	
Production	Agricultural workers	AW < NPL (Semi-quantitative score 1;2;3;4)	2.64	2.64	2.64	2.87		2.68	Medium	2.60	2.60	3.12	2.65	Medium
		AW < MW (Semi-quantitative score 1;2;3;4)	2.71	2.71	2.71	2.89		2.75	Medium	2.75	2.75	2.96	2.77	Medium
		Excessive Working time (% of people working more than 48 h/w)	9.64%	9.64%	9.64%	9.64%		9.64%	Good	9.64%	9.64%	9.64%	9.64%	Good
		Gender Equality (% of women in the workforce)	33.10%	33.11%	33.10%	31.77%		32.85%	Medium	33.11%	33.11%	27.06%	32.48%	Medium
		Fatal Injuries (per 100,000 workers)	12.14	12.14	12.14	10.23		11.78	Bad	12.14	12.14	3.37	11.24	Bad
		Non-fatal Injuries (per 100,000 workers)	2720.87	2720.87	2720.87	2767.29		2729.57	Bad	2720.87	2720.87	2990.30	2748.65	Bad
		Unemployment (% by sector)	0.13	0.13	0.13	0.29		0.16	Medium	0.13	0.13	0.87	0.21	Medium
		Labour laws by sector (semi-quantitative 1;2;3)	2.86	2.86	2.86	2.64		2.82	Good	2.86	2.86	1.86	2.75	Good
	Farmer	Profitability (Output/Input)	108%	106%	106%	117%		109%	Medium	111%				Good
		Net Margin (000' euros per average farm)	5.10	3.82	3.82	20.41		7.41	Medium	32.10				Good
		CAP Voluntary coupled Support (% of total coupled support)	0.00%	0.02%	10.88%	0.47%		1.46%	Upgradeable	0%				Bad
		Yield Variability (% of variability)	13.00%	8.35%	11.18%	13.21%		11.36%	Upgradeable	1.28%				Good
		Production Price Variability (% of variability)	30.73%	29.83%	23.07%	20.91%		27.65%	Upgradeable	17%				Good
	Soc.	Contribution to Protein Security (Kg protein/ha)	207.04	589.80	511.51	160.58		356.00	Medium	353.68				Medium
Processing and Retail	Workers	AW < NPL (Semi-quantitative score 1;2;3;4)	3.28	3.64	3.28	3.28	3.54	3.47	Good	3.08	3.08	3.64	3.14	Medium
		AW < MW (Semi-quantitative score 1;2;3;4)	3.04	3.15	3.04	3.04	3.14	3.11	Medium	3.00	3.00	3.15	3.02	Medium
		Excessive Working time (% of people working more than 48 h/w)	9.64%	9.64%	9.64%	10%	9.64%	9.64%	Good	9.64%	9.64%	9.64%	9.64%	Good
		Gender Equality (% of women in the workforce)	27.06%	27%	27.06%	27%	27.06%	27.06%	Medium	27.06%	27.06%	27.06%	27.06%	Medium
		Fatal Injuries (per 100,000 workers)	3.37	3.37	3.37	3.37	3.88	3.63	Medium	3.37	3.37	3.37	3.37	Medium
		Non-fatal Injuries (per 100,000 workers)	2990.30	2990.30	2990.30	2990.30	1693.96	2316.20	Bad	2990.30	2990.30	2990.30	2990.30	Bad
		Unemployment (% by sector)	0.87	0.87	0.87	0.87	0.09	0.46	Medium	0.87	0.87	0.87	0.87	Upgradeable
		Labour laws by sector (semi-quantitative 1;2;3)	1.86	1.86	1.86	1.86	1.36	1.60	Upgradeable	1.86	1.86	1.86	1.86	Medium
Consumption	Consumer	Saturated Fat Content (g/100g)	0.33	7.26	0.00	0.27	0.00	1.17	Medium	5.10				Bad
		Fibre Content (g/100g)	4.20	0.00	0.00	7.48	0.00	1.43	Bad	0.00				Bad
		Vitamins Content (mg/100g)	7.96	27.70	0.00	40.74	0.00	9.25	Upgradeable	8.39				Upgradeable
		Cholesterol Content (g/100g)	0.00	0.00	0.00	0.15	0.00	0.01	Good	77.80				Bad
		Protein Content (g/100g)	12.5						Medium	15				Good
	Soc.	Protein Affordability (€/Kg of protein)	127.36						Bad	66.33				Upgradeable

Note: Average Wage being lower than Non-Poverty Line (AW<NPL); Average Wage being lower than country's Minimum Wage (AW<MW)
Source: Own elaboration

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

P2F VMA-spread type LEBERWURST (liver pâté)

In this case, the agricultural workers in the production stage shows a varied picture, as it has two indicators with a good performance *("Excessive working time"; "Labour laws")*, other two with a bad performance *("Fatal injuries"; "Non-fatal injuries")*, and four with a medium performance (*"Average wage being lower than poverty line"; "average wage being lower than country minimum wage"; "Gender equality "; "Unemployment").* Moreover, farmers stakeholder has two indicators with medium performance *("Profitability"; "Net margin")* and three with upgradeable performance *("CAP voluntary coupled support"; "Yield variability"; "Production price variability")*. Society stakeholder has one indicator showing medium performance *("Contribution to protein security")*.

In the processing and retail stage, workers have a better performance than production stage workers. This stakeholder has four indicators with medium performance (*"Average wage being lower than country minimum wage"; "Gender equality "; "Fatal injuries"*; *"Unemployment")*, two with good performance (*"Average wage being lower than poverty line"; "Excessive working time")*, one with bad performance *("Non-fatal injuries")* and another one with an upgradeable performance *("Labour laws")*.

In the consumption stage, consumers' stakeholder has two indicators with medium performance *("Saturated fat content"* and *"protein content")*, one with good performance (*Cholesterol content")*, one with bad performance *("Fibre content")* and one with an upgradeable performance *("Vitamin content")*. Stakeholder society in the consumption stage has one indicator *("Protein affordability")* with bad performance.

To sum up, farmers are the stakeholder with the worst assessment profile. In this case, *profitability* is assessed as having medium performance, but despite the fact that this product is composed by the same main ingredients than *Fibre-like vegetable meat*, for which *net margin* is assessed as having upgradeable performance, *net margin* is assessed as having medium performance. This is due to the fact that the ingredient "other ingredients" has better performance concerning *profitability* and *net margin*, and hence makes the average go up. Other ingredients include horticultural products that are mostly grown in an intensive production system and often have a higher *net margin* and *profitability*. Furthermore, fatal and non-fatal injuries in the production stage, non-fatal injuries in the processing stage, and fibre content in the consumption stage, show a bad performance and therefore can be considered as hotspots for this product.

Traditional spread type LEBERWURST variant 1

In the production stage, agricultural workers show two indicators with good performance *("Excessive working time"; "Labour laws")*, two with bad performance *("Fatal injuries"; "Non-fatal injuries"),* and four with medium performance (*"Average wage being lower than poverty line"; "average wage being lower than country minimum wage"; "Gender equality "; "Unemployment")*. In the same stage, farmers stakeholder shows four indicators with a good performance *("Profitability"; "Net margin"; "Yield variability"; "Production price variability")* and one indicator with a bad performance ("CAP voluntary coupled support").

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In the processing and retail stage, workers stakeholder has five indicators with a medium performance (*"Average wage being lower than poverty line"; "Average wage being lower than country minimum wage"; "Gender equality "; "Fatal injuries"; "Labour laws")*, one with a good performance ("*Excessive working time")*, one with a bad performance ("*Non-fatal injuries")*, and one with an upgradeable performance *("Unemployment")*.

In the consumption stage, consumers' stakeholder has one indicator with good performance *("protein content"),* three indicators with a bad performance *("Saturated fat content"; "Fibre content"; "Cholesterol content")*, and one with an upgradeable performance *("Vitamin content")*. Society stakeholder in the consumption stage has one indicator with upgradeable performance ("*Protein affordability")*.

In summary, consumer is the stakeholder with the worse assessment profile, and farmers is the one with better performance. As it happens with chicken farms, pig farms have a high *profitability* and a good performance regarding *net margin*. Moreover, pigs are produced in all European countries and has a low *yield variability* and a low *price variability*. Fatal and non-fatal injuries, as well as cap support for farmers, and saturated fat, fibre and cholesterol content for consumers show bad performance and, therefore, can be considered as hotspots.

2.5.2.3. Pasta category

Table 21 shows the results from products (5) P2F prototype fresh vegan pasta and (6) Traditional fresh egg pasta.

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Table 21. Assessment results. P2F prototype fresh vegan pasta and Traditional fresh egg pasta

Stage	Stakeholder	Indicator	P2F prototype fresh vegan pasta							Traditional fresh egg pasta					
			Wheat flour	Buckwheat flour	Fababean flour	Lupin protein isolate	Water	Total	Assessment	Semolina	Egg	Canola oil	Water	Total	Assessment
			59	12	4	2	23	100		42	12	4	42	100	
Production	Agricultural workers	AW < NPL (Semi-quantitative score 1;2;3;4)	2.64	2.64	2.64	2.64		2.64	Medium	2.64	2.60	2.64		2.63	Medium
		AW < MW (Semi-quantitative score 1;2;3;4)	2.77	2.71	2.71	2.71		2.76	Medium	2.71	2.75	2.71		2.72	Medium
		Excessive Working time (% of people working more than 48 h/w)	9.64%	9.64%	9.64%	9.64%		9.64%	Good	9.64%	9.64%	9.64%		9.64%	Good
		Gender Equality (% of women in the workforce)	33.11%	33.11%	33.11%	33.11%		33.11%	Good	33.11%	33.11%	33.11%		33.11%	Good
		Fatal Injuries (per 100,000 workers)	12.14	12.14	12.14	12.14		12.14	Bad	12.14	12.14	12.14		12.14	Bad
		Non-fatal Injuries (per 100,000 workers)	2720.87	2720.87	2720.87	2720.87		2720.87	Bad	2720.87	2720.87	2720.87		2720.87	Bad
		Unemployment (% by sector)	0.15	0.13	0.13	0.13		0.14	Medium	0.13	0.13	0.13		0.13	Medium
		Labour laws by sector (semi-quantitative 1;2;3)	2.86	2.86	2.86	2.86		2.86	Good	2.86	2.86	2.86		2.86	Good
	Farmer	Profitability (Output/Input)	102%	108%	106%	106%		104%	Upgradeable	114%	111%	106%		113%	Good
		Net Margin (000' euros per average farm)	2.04	5.10	3.82	3.82		2.65	Upgradeable	3.30	32.10	3.82		9.29	Medium
		CAP Voluntary coupled Support (% of total coupled support)	2.11%	0.00%	10.88%	10.88%		2.46%	Upgradeable	2.11%	0.00%	0.02%		1.53%	Upgradeable
		Yield Variability (% of variability)	7.30%	13.00%	11.08%	11.18%		8.48%	Medium	32.93%	2.26%	8.35%		24.89%	Bad
		Production Price Variability (% of variability)	29.29%	30.73%	21.40%	23.07%		28.95%	Upgradeable	29.98%	20.87%	29.83%		28.09%	Upgradeable
	Soc.	Contribution to Protein Security (Kg protein/ha)	614.90	207.04	799.33	511.51		558.24	Good	359.59	250.71	589.80		301.07	Medium
Processing and Retail	Workers	AW < NPL (Semi-quantitative score 1;2;3;4)	3.28	3.28	3.28	3.28	3.54	3.34	Good	3.28	3.28	3.64	3.54	3.40	Good
		AW < MW (Semi-quantitative score 1;2;3;4)	3.04	3.04	3.04	3.04	3.14	3.06	Medium	3.04	3.04	3.15	3.14	3.09	Medium
		Excessive Working time (% of people working more than 48 h/w)	9.64%	9.64%	9.64%	9.64%	9.64%	9.64%	Good	9.64%	9.64%	9.64%	9.64%	9.64%	Good
		Gender Equality (% of women in the workforce)	27.06%	27.06%	27.06%	27.06%	27.06%	27.06%	Medium	27.06%	27.06%	27.06%	27.06%	27.06%	Medium
		Fatal Injuries (per 100,000 workers)	3.37	3.37	3.37	3.37	3.88	3.49	Medium	3.37	3.37	3.37	3.88	3.58	Medium
		Non-fatal Injuries (per 100,000 workers)	2990.30	2990.30	2990.30	2990.30	1693.96	2692.14	Bad	2990.30	2990.30	2990.30	1693.96	2445.84	Bad
		Unemployment (% by sector)	0.87	0.87	0.87	0.87	0.09	0.69	Upgradeable	0.87	0.87	0.87	0.09	0.54	Upgradeable
		Labour laws by sector (semi-quantitative 1;2;3)	1.86	1.86	1.86	1.86	1.36	1.74	Medium	1.86	1.86	1.86	1.36	1.65	Upgradeable
Consumption	Consumer	Saturated Fat Content (g/100g)	0.60	0.33	0.01	0.00	0.00	0.39	Good	0.21	2.64	7.26	0.00	0.70	Good
		Fibre Content (g/100g)	1.70	4.20	5.80	0.00	0.00	1.74	Bad	3.37	0.00	0.00	0.00	1.42	Bad
		Vitamins Content (mg/100g)	7.76	7.96	1.76	0.00	0.00	5.60	Bad	3.21	3.72	27.70	0.00	2.90	Bad
		Cholesterol Content (g/100g)	0.00	0.00	0.00	0.00	0.00	0.00	Good	0.00	398.00	0.00	0.00	47.76	Bad
		Protein Content (g/100g)	13.9						Good	7.8					Upgradeable
	Soc.	Protein Affordability (€/Kg of protein)	83.45						Bad	47.76					Medium

Note: Average Wage being lower than Non-Poverty Line (AW<NPL); Average Wage being lower than country's Minimum Wage (AW<MW)

Source: Own elaboration

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

P2F prototype fresh vegan pasta

In the production stage, agricultural workers stakeholder has three indicators with good performance ("Excessive working time"; "Gender equality "; "Labour laws") other three with medium performance (*"Average wage being lower than poverty line"; "Average wage being lower than country minimum wage"; "Unemployment")*, and two with bad performance *("Fatal injuries"; "Non-fatal injuries")*. Farmers stakeholder show four indicators with upgradeable performance *("Profitability"; "Net margin"; "CAP voluntary coupled support"; "Production price variability")* and one with medium performance *("Yield variability")*, while society show one indicator with good performance *("Contribution to protein security")*.

In the processing stage, workers have a worse performance profile than production stage workers, with four indicators with medium performance (*"Average wage being lower than country minimum wage"; "Gender equality "; "Fatal injuries"; "Labour laws")*, one with bad performance ("Non-fatal injuries"), one with upgradeable performance ("*Unemployment")* and only one with good performance ("*Excessive working time")*.

In the consumption stage, consumers stakeholder has three indicators with a good performance *("Saturated fat content"; "Cholesterol content"; "protein content")* and two indicators with a bad performance *("Vitamin content"; "Fibre content").* Society stakeholder in the same stage has one indicator showing a bad performance *("Protein affordability").*

To sum up, farmers stakeholder is the one with the worse performance. This is due to the fact that the main ingredient in this case is wheat, which is mostly grown in extensive production systems that are usually less *profitable* than other systems. Moreover, *price variability* of this ingredient is high despite having a low *yield variability*, due to different complex and sensitive facts such as changes in the stocks, the production of biofuels, energy prices interaction, climate change impacts, etc. Again, fatal and non-fatal injuries, and fibre and vitamin content indicators can be considered as hotspots in this life cycle.

Traditional fresh egg pasta

Agricultural workers in the production stage present three indicators with medium performance (*"Average wage being lower than poverty line"; "Average wage being lower than country minimum wage"; "Unemployment")*, other three indicators with good performance ("Excessive working time"; "Gender equality "; "Labour laws"), and two with bad performance *("Fatal injuries"; "Non-fatal injuries")*. Farmers stakeholder in the same stage, has two indicators with upgradeable performance *("CAP voluntary coupled support"; "Production price variability"*), one with good performance *("Profitability")*, one with medium performance *("Net margin")* and one with bad performance *("Yield variability")*. Society stakeholder presents one indicator with medium performance ("*Contribution to protein security")*.

In the processing stage, workers present three indicators with a medium performance (*"Average wage being lower than country minimum wage"; "Gender equality "; "Fatal injuries")*, two with a good performance (*"Average wage being lower than poverty line"; "Excessive working time")*, other two with upgradable performance *("Unemployment"; "Labour laws")*, and one with bad performance *("Non-fatal injuries")*.

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Finally, in the consumption stage, consumers stakeholder has three indicators with bad performance *("Cholesterol content"; "Vitamin content"; "Fibre content")*, one with ugradeable performance *("protein content"),* and one with good performance (*"Saturated fat content")*. Society stakeholder presents one indicator with medium performance *("Protein affordability")*.

In summary, consumer stakeholder can be considered as the one with the worse assessment profile, followed closely by farmers stakeholder. In this case, *profitability* (good performance) is highly influenced by ingredients semolina (durum wheat) and egg, which both have good performance regarding *profitability*. However, *net margin* is highly influenced by ingredient egg despite not being the main ingredient, because it has a very high *net margin* in comparison to other ingredients. Yield and price variability assessment are conditioned by semolina, which has a high *yield variability* and a high *price variability*, making the product have bad and upgradeable performance for yield and price variability respectively. Non-fatal injuries, yield variability and fibre, vitamins and cholesterol content can be considered as hotspots.

2.5.2.4. Milk category

The table below correspond to the products (7) P2F prototype vegan milk and (8) Traditional dairy milk

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

Table 22. Assessment results. P2F prototype vegan milk and Traditional dairy milk

Stage	Stakeholder	Indicator	P2F prototype vegan milk						Traditional dairy milk	
			Lentil	oil	Sugar	Water	Total	Assessment	Milk	Assessment
			Confidential	Confidential	Confidential	Confidential	100		100	
Production	Agricultural workers	AW < NPL (Semi-quantitative score 1;2;3;4)	2.64	2.64	2.58		2.63	Medium	2.67	Medium
		AW < MW (Semi-quantitative score 1;2;3;4)	2.71	2.71	2.67		2.70	Medium	2.78	Medium
		Excessive Working time (% of people working more than 48 h/w)	9.64%	9.64%	9.64%		9.64%	Good	9.64%	Good
		Gender Equality (% of women in the workforce)	33.10%	33.11%	33.11%		33.11%	Good	33.11%	Good
		Fatal Injuries (per 100,000 workers)	12.14	12.14	12.14		12.14	Bad	12.14	Bad
		Non-fatal Injuries (per 100,000 workers)	2720.87	2720.87	2720.87		2720.87	Bad	2720.87	Bad
		Unemployment (% by sector)	0.13	0.13	0.13		0.13	Medium	0.13	Medium
		Labour laws by sector (semi-quantitative 1;2;3)	2.86	2.86	2.86		2.86	Good	2.86	Good
	Farmer	Profitability (Output/Input)	106%	106%	108%		106%	Medium	115%	Good
		Net Margin (000' euros per average farm)	3.82	3.82	5.10		4.08	Upgradeable	13.90	Good
		CAP Voluntary coupled Support (% of total coupled support)	10.88%	0.02%	4.00%		5.22%	Upgradeable	20.09%	Good
		Yield Variability (% of variability)	5.57%	10.95%	11.27%		8.84%	Medium	6.56%	Good
		Production Price Variability (% of variability)	29.85%	28.80%	18.26%		27.09%	Upgradeable	27.99%	Upgradeable
	Soc.	Contribution to Protein Security (Kg protein/ha)	228.27	388.76	4553.02		1166.57	Good	176.17	Bad
Processing and Retail	Workers	AW < NPL (Semi-quantitative score 1;2;3;4)	3.28	3.64	3.50	3.54	3.54	Good	3.68	Good
		AW < MW (Semi-quantitative score 1;2;3;4)	3.04	3.15	3.19	3.14	3.14	Medium	3.21	Medium
		Excessive Working time (% of people working more than 48 h/w)	9.64%	9.64%	9.64%	9.64%	9.64%	Good	9.64%	Good
		Gender Equality (% of women in the workforce)	27.06%	27.06%	27.34%	27.06%	27.07%	Medium	27.06%	Medium
		Fatal Injuries (per 100,000 workers)	3.37	3.37	3.37	3.88	3.83	Medium	3.37	Medium
		Non-fatal Injuries (per 100,000 workers)	2990.30	2990.30	2990.30	1693.96	1802.85	Upgradeable	2990.30	Bad
		Unemployment (% by sector)	0.87	0.87	0.87	0.09	0.15	Medium	0.87	Upgradeable
		Labour laws by sector (semi-quantitative 1;2;3)	1.86	1.86	1.86	1.36	1.40	Upgradeable	1.86	Medium
Consumption	Consumer	Saturated Fat Content (g/100g)	0.00	10.90	0.00	0.00	0.36	Good	2.16	Bad
		Fibre Content (g/100g)	0.00	0.00	0.00	0.00	0.00	Bad	0.00	Bad
		Vitamins Content (mg/100g)	0.00	58.30	0.00	0.00	1.92	Bad	0.04	Bad
		Cholesterol Content (g/100g)	0.00	0.00	0.00	0.00	0.00	Good	14.00	Good
		Protein Content (g/100g)	3.3					Bad	3.32	Bad
	Soc.	Protein Affordability (€/Kg of protein)	68.18					Upgradeable	31.63	Good

Note: Average Wage being lower than Non-Poverty Line (AW<NPL); Average Wage being lower than country's Minimum Wage (AW<MW)

Source: Own elaboration

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P2F prototype vegan milk

In the production stage of vegan milk, agricultural workers present three indicators with good performance *("Excessive working time"; "Gender equality "; "Labour laws"),* other three with medium performance (*"Average wage being lower than poverty line"; "Average wage being lower than country minimum wage"; "Unemployment")*, and two with bad performance *("Fatal injuries"; "Non-fatal injuries")*. Farmers stakeholder presents three indicators with upgradeable performance *("Net margin"; "CAP voluntary coupled support"; "Production price variability"*) and two with medium performance ("Profitability"; "Yield variability"). Society stakeholder has one indicator showing good performance *("Contribution to protein security").*

In the processing and retail stage, workers present four indicators with medium performance (*"Average wage being lower than country minimum wage"; "Gender equality "; "Fatal injuries"; "Unemployment")*, two with good performance (*"Average wage being lower than poverty line"; "Excessive working time")* and other two with upgradeable performance *("Non-fatal injuries"; "Labour laws*").

Consumers in consumption stage present two indicators with good performance ("*Saturated fat content"; "Cholesterol content")* and three with bad performance *("Fibre content"; "Vitamin content"; "Protein content"))*. Society stakeholder in the same stage presents one indicator with upgradeable performance *("Protein affordability").*

In general, farmers have the worst assessing profile. This is due to the fact that main ingredients in this product have low profitability and a small net margin. Furthermore, the ingredient lentil is only produced in seven European countries, and not every year, which might contribute to increase in *price variability* despite having a low *yield variability*. Besides, vegetable milk has a good performance regarding *contribution to protein security* due to the high yield of sugar beet. Although sugar beet protein content is only 6.8 grams per 100g of sugar beet, its yield can go up to 80 tonnes per hectare, which means that the total amount of protein extracted per area is high, and therefore contributing to protein security. Finally, indicators fatal and non-fatal injuries in production stage and fibre and vitamins content in consumer stage can be considered as hotspots.

Traditional dairy milk

In the production stage of dairy milk, agricultural workers present three indicators with good performance *("Excessive working time"; "Gender equality "; "Labour laws")*, other three with medium performance (*"Average wage being lower than poverty line"; "Average wage being lower than country minimum wage"; "Unemployment")*, and two with bad performance *("Fatal injuries"; "Non-fatal injuries")*. Farmer stakeholder on the other hand present four indicators with good performance *("Profitability"; "Net margin"; "CAP voluntary coupled support"; "Yield variability")* and only one with upgradeable performance *("Production price variability").* Society stakeholder has only one indicator with bad performance *("Contribution to protein security").*

Processing and retail workers stakeholder present four indicators with medium performance (*"Average wage being lower than country minimum wage"; "Gender*

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equality "; "Fatal injuries"; "Labour laws"), two with good performance (*"Average wage being lower than poverty line"; "Excessive working time")*, one with bad *("Non-fatal injuries")* and one with upgradeable performance *(Unemployment").*

Consumer stakeholder has four indicators with bad performance ("*Saturated fat content"; "Fibre content"; "Vitamin content"; "Protein content")* and only one indicator with good performance (*"Cholesterol content")*, which makes it by far the stakeholder with the worse assessment profile. Society stakeholder in the consumption stage presents one indicator with good performance *("Protein affordability")*.

The analysis indicates here that farmers are the stakeholder with the best assessment profile. This is due to the importance of the dairy sector in Europe (milk is used for cheese, yogurt and other dairy product, as well as a preservative). This is reflected by the fact that *CAP voluntary coupled support* for milk production is high (20.09%). Furthermore, profitability and net margin show good results. *Price variability* is assessed as having upgradeable performance. Finally, fatal and non-fatal injuries, as well as saturated fat, fibre and vitamin content and protein affordability should be considered as hotspots in the life cycle of this product.

2.5.2.5. Bread category

Table 23 shows the results from the products (9) P2F prototype bread and (10) Traditional wheat bread.

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Table 23. Assessment results. P2F prototype bread and Traditional wheat bread

Stage	Stakeholder	Indicator	P2F prototype bread								Traditional wheat bread					
			Wheat (wholemeal flour)	Lentil or lupin protein isolate	Faba bean flour	Brewer`s yeast flakes	Sunflower oil	Water	Total	Assessment	Wheat	Brewer`s yeast flakes	Sunflower oil	Water	Total	Assessment
			49	4.5	4.5	1	1	39.5	99.5		58	1	1	39.5	99.5	
Production	Agricultural workers	AW < NPL (Semi-quantitative score 1;2;3;4)	2.64	2.64	2.64	3.68	2.64		2.65	Medium	2.64	3.68	2.64		2.65	Medium
		AW < MW (Semi-quantitative score 1;2;3;4)	2.77	2.71	2.71	3.54	2.71		2.77	Medium	2.77	3.54	2.71		2.78	Medium
		Excessive Working time (% of people working more than 48 h/w)	9.64%	9.64%	9.64%	9.64%	9.64%		9.64%	Good	9.64%	9.64%	9.64%		9.64%	Good
		Gender Equality (% of women in the workforce)	33.11%	33.10%	33.10%	27.06%	33.11%		33.00%	Medium	33.11%	27.06%	33.11%		33.00%	Medium
		Fatal Injuries (per 100,000 workers)	12.14	12.14	12.14	3.37	12.14		12.00	Bad	12.14	3.37	12.14		12.00	Bad
		Non-fatal Injuries (per 100,000 workers)	2720.87	2720.87	2720.87	2990.30	2720.87		2720.87	Bad	2047.83	2990.30	2720.87		2074.75	Bad
		Unemployment (% by sector)	0.15	0.13	0.13	0.87	0.13		0.16	Medium	0.15	0.87	0.13		0.16	Medium
		Labour laws by sector (semi-quantitative 1;2;3)	2.86	2.86	2.86	1.86	2.86		2.84	Good	2.86	1.86	2.86		2.84	Good
	Farmer	Profitability (Output/Input)	102%	106%	106%	112%	106%		103.16%	Upgradeable	102%	112%	106%		102.68%	Upgradeable
		Net Margin (000' euros per average farm)	2.04	3.82	3.82	4.33	3.82		2.37	Upgradeable	2.04	4.33	3.82		2.11	Upgradeable
		CAP Voluntary coupled Support (% of total coupled support)	2.11%	10.88%	10.88%	2.11%	0.02%		3.39%	Upgradeable	2.11%	2.11%	0.02%		2.07%	Upgradeable
		Yield Variability (% of variability)	7.30%	5.57%	11.08%	7.66%	10.95%		7.52%	Good	7.30%	7.66%	10.95%		7.37%	Good
		Production Price Variability (% of variability)	29.29%	29.85%	21.40%	28.68%	28.80%		28.73%	Upgradeable	29.29%	28.68%	28.80%		29.28%	Upgradeable
	Soc.	Contribution to Protein Security (Kg protein/ha)	614.90	228.27	799.33	597.70	388.76		595.68	Good	614.90	597.70	388.76		610.85	Good
Processing and Retail	Workers	AW < NPL (Semi-quantitative score 1;2;3;4)	3.28	3.28	3.28	3.28	3.64	3.54	3.39	Good	3.28	3.36	3.64	3.54	3.39	Good
		AW < MW (Semi-quantitative score 1;2;3;4)	3.04	3.04	3.04	3.04	3.15	3.14	3.08	Medium	3.04	3.04	3.15	3.14	3.08	Medium
		Excessive Working time (% of people working more than 48 h/w)	9.64%	9.64%	9.64%	9.64%	9.64%	9.64%	9.64%	Good	9.64%	9.64%	9.64%	9.64%	9.64%	Good
		Gender Equality (% of women in the workforce)	27.06%	27.06%	27.06%	27.06%	27.06%	27.06%	27.06%	Medium	27.06%	27.06%	27.06%	27.06%	27.06%	Medium
		Fatal Injuries (per 100,000 workers)	3.37	3.37	3.37	3.37	3.37	3.88	3.57	Medium	3.37	3.01	3.37	3.88	3.57	Medium
		Non-fatal Injuries (per 100,000 workers)	2990.30	2990.30	2990.30	2990.30	2990.30	1693.96	2475.67	Bad	2990.30	2990.30	2990.30	1693.96	2475.67	Bad
		Unemployment (% by sector)	0.87	0.87	0.87	0.87	0.87	0.09	0.56	Upgradeable	0.87	0.87	0.87	0.09	0.56	Upgradeable
		Labour laws by sector (semi-quantitative 1;2;3)	1.86	1.86	1.86	1.86	1.86	1.36	1.66	Upgradeable	1.86	1.86	1.86	1.36	1.66	Upgradeable
Consumption	Consumer	Saturated Fat Content (g/100g)	0.60	0.00	0.01	0.70	10.90	0.00	0.41	Good	0.60	0.70	10.90	0.00	0.47	Good
		Fibre Content (g/100g)	1.70	0.00	5.80	22.50	0.00	0.00	1.33	Bad	1.70	22.50	0.00	0.00	1.22	Bad
		Vitamins Content (mg/100g)	7.76	0.00	1.76	37.18	58.30	0.00	4.86	Bad	7.76	37.18	58.30	0.00	5.48	Bad
		Cholesterol Content (g/100g)	0.00	0.00	0.00	0.67	0.00	0.00	0.01	Good	0.00	0.67	0.00	0.00	0.01	Good
		Protein Content (g/100g)	12							Medium	8.22					Upgradeable
	Soc.	Protein Affordability (€/Kg of protein)	33.33							Good	28.95					Good

Note: Average Wage being lower than Non-Poverty Line (AW<NPL); Average Wage being lower than country's Minimum Wage (AW<MW)
Source: Own Elaboration

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P2F prototype bread

In the case of prototype bread, agricultural workers stakeholder in the production stage has four indicators with medium performance (*"average wage being lower than poverty line"; "average wage being lower than country minimum wage"; "Gender equality "; "unemployment")*, two indicators with good performance *("excessive working time"; "labour laws")* and two indicators with bad performance *("fatal injuries"; non-fatal injuries")*. Farmers stakeholder presents four indicators with upgradeable performance *("profitability"; "net margin"; "CAP voluntary coupled support"; "production price variability")*, and only one with good performance *("yield variability")*. Society stakeholder has one indicator assessed as good *("contribution to protein security").*

Workers stakeholder in processing and retail stage shows three indicators with medium performance (*"average wage being lower than country minimum wage"; "gender equality "; "fatal injuries")*, two with upgradeable performance *("unemployment"; "labour laws")*, two with good performance (*"average wage being lower than poverty line"; "excessive working time")* and one with bad performance *("non-fatal injuries")*.

Finally, consumers stakeholder presents two indicators with good performance ("*saturated fat content"; "cholesterol content)*, one with medium performance *("Protein content"*), and two with bad performance (*"fibre content"; "vitamin content")*. Society stakeholder has one indicator with good performance *("protein affordability").*

In summary, farmers' stakeholder is the subcategory with the worse assessment profile. Main ingredients (wheat, lentil, fababean and lentil or lupin) are usually grown in extensive production systems, which make them less *profitable* and with a smaller *net margin*. Furthermore, although *yield variability* is assessed as having good performance for those ingredients, *price variability* is assessed as having upgradeable performance. Finally, fatal and non-fatal injurie and fibre and vitamin content can be considered as hotspots for this particular product.

Traditional wheat bread

Agricultural workers stakeholder in the production stage has four indicators with medium performance (*"average wage being lower than poverty line"; "average wage being lower than country minimum wage"; "gender equality "; "unemployment")*, two indicators with good performance *("excessive working time"; "labour laws")* and two indicators with bad performance *("fatal injuries"; "non-fatal injuries")*. Farmers stakeholder presents four indicators with upgradeable performance *("profitability"; "net margin"; "CAP voluntary coupled support"; "production price variability"),* and only one with good performance *("yield variability")*. Society stakeholder has one indicator assessed as good *("contribution to protein security").*

Processing and retail workers stakeholder shows three indicators with medium performance (*"average wage being lower than country minimum wage"; "gender equality "; "Fatal injuries")*, two with upgradeable performance *("Unemployment"; "labour laws")*, two with good performance (*"average wage being lower than poverty line"; "excessive working time")* and one with bad performance *("non-fatal injuries")*.

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Consumers stakeholder presents three indicators with good performance ("s*aturated fat content"; "cholesterol content)*, one with upgradeable performance *("Protein content")* and two with bad performance (*"fibre content"; "vitamin content").* Society stakeholder has one indicator with good performance *("protein affordability")*.

To sum up, farmers' stakeholder is the subcategory with the worse assessment profile. The reasons behind this assessment are the same as the ones from P2F prototype bread, due to the fact that they are made with the same main ingredients (wheat, brewer yeast flakes, canola oil and water). This is to say that wheat shows small *profitability* and small *net margin*, and that prices are highly variable.

Fatal and non-fatal injuries as well as fibre and vitamin content can be considered as hotspots for traditional wheat bread.

3. Comparison of Results

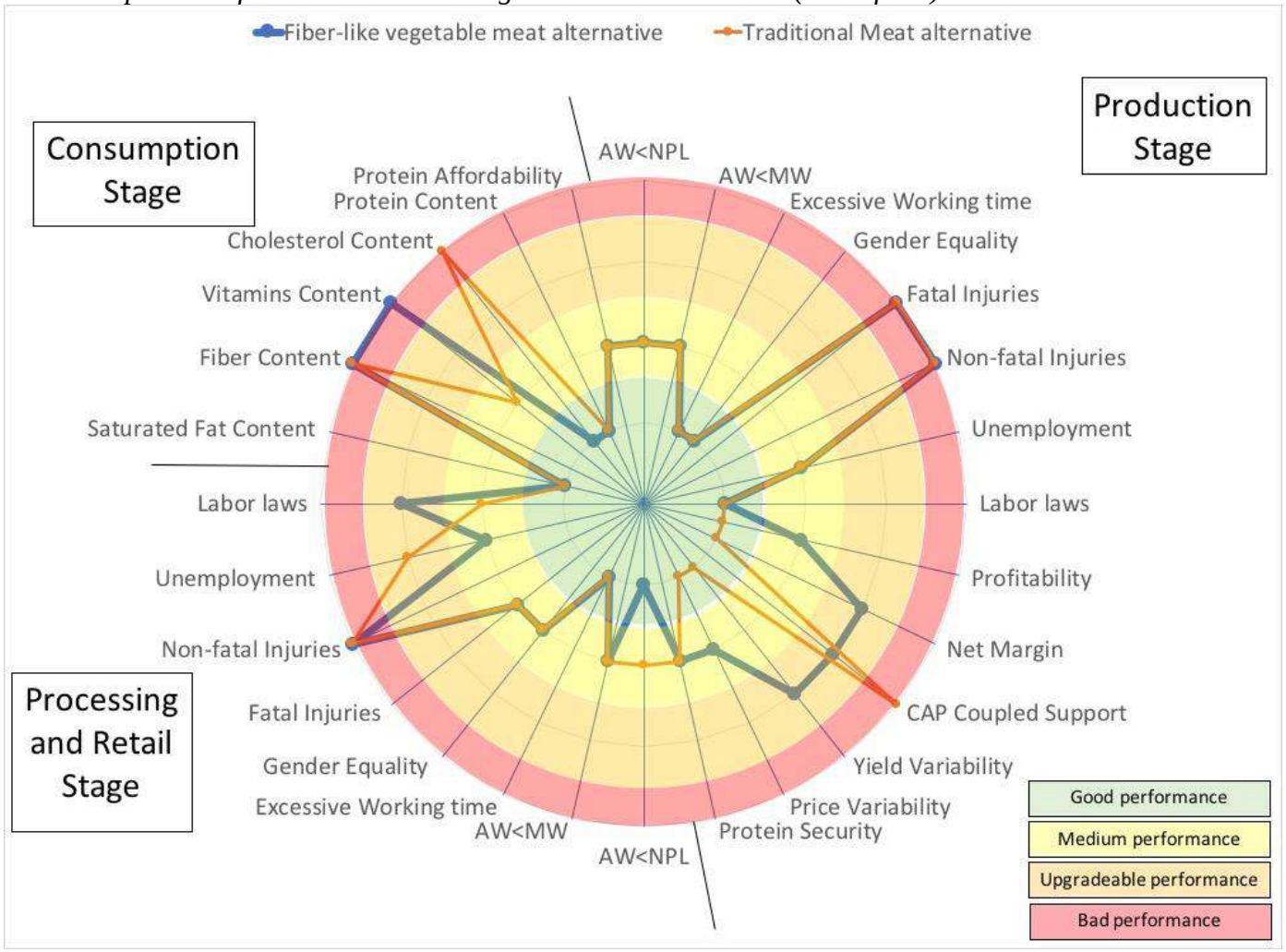
The aim of this section is to highlight differences between P2F prototypes and traditional products. For this, a radar (or spider web) diagram has been used, as this is one of the best ways to compare several features of different products. In the following subsection, products in each functional unit category are compared, and most significant points are highlighted.

3.1. Fibre-like meat category

Figure 1 below compares results obtained previously for the products (1) Fibre-like vegetable meat alternative (VMA-fibre) and (2) Traditional meat alternative.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

Figure 1. Comparison of results. Fibre-like vegetable meat alternative (VMA-fibre) and Traditional meat alternative



Note: Average Wage being lower than Non-Poverty Line (AW<NPL); Average Wage being lower than country's Minimum Wage (AW<MW)
Source: Own elaboration

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In the production stage, the indicators "*profitability*" and "*net margin*" have good performances for traditional meat while they have medium and upgradeable performances in the case of vegetable meat. As stated out earlier, this is due to the fact that chicken production is usually done under intensive production systems, which are more profitable and have higher net margins. "*Cap voluntary coupled support*" has a bad performance in traditional meat, with 0% of the voluntary coupled support designated to chicken meat production, and an upgradeable performance in vegetable meat, with 10.88% designated to legume production due to its strategic role in the 2015-2020 CAP as nitrogen fixers and protein crops. Also, "price variability" and "yield variabilities" have better performance for traditional meat, with good performances in both cases, versus vegetable meat with medium and upgradeable performance respectively. Regarding yield variability, animal production systems always have less yield variability than crop production because it does not depend on weather conditions such as drought, floods, cold or heat. Also, price variability is small in traditional meat production systems.

Processing and retail workers (indicators from *processing and retail stage*) show a similar pattern between products, with only three indicators showing differences: *"Average wage lower than non-poverty line"* has a medium performance in traditional meat and good performance in vegetable meat, while *"unemployment"* has upgradeable performance in traditional meat and medium performance in vegetable meat. *"Labour laws"* has medium performance in traditional meat and upgradeable performance in vegetable meat.

Finally, *consumption stage* presents also some differences. For instance, *"vitamin content"* has a medium performance in the case of traditional meat while it has bad performance in vegetable meat, mainly because buckwheat flour and lupin protein isolate are poor in vitamins. Although indicators *"protein content"* and *"protein affordability"* are assessed as having good and medium performance respectively for both products, there are some differences if we look at the data. P2F product has 30g of protein per 100g of product while traditional meat alternative has only 21.4g of protein per 100g of product. The price of protein however is 55.37 €/kg for vegetable protein rich products and 46.73 €/kg for traditional products.

In this case, it can be noticed that, on one hand, farmers stakeholder (indicators from *"Profitability"* to *"Price variability")* would be the most negatively affected by an alleged replacement of traditional meat with fibre-like vegetable meat. This happens mostly with respect to contribution to *farm income impact subcategory ("Profitability"; "Net margin"; CAP voluntary coupled support"*), as well as *contribution to economic security impact subcategory* ("*Yield variability"; "Price variability"*). The consumption stage (*"Saturated fat content"; "Fibre content"; "Vitamin content"; "Cholesterol content"; "Protein affordability"*) would be the most beneficiated, particularly regarding *"cholesterol content"* and *"protein content"*. Also, *processing and retail workers* (indicators from *processing and retail stage*) show a better general picture in vegetable meat than in traditional meat, regarding "*Average wage being lower than non-poverty line"* and *"under country's minimum wage"*, and "*unemployment"*, and a worse regarding *"labour laws"*.

3.2. Spread-like meat

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

Figure 2 below compares results obtained previously for the products (3) P2F VMA-spread type LEBERWURST (liver pâté) and (4) Traditional spread type LEBERWURST variant.

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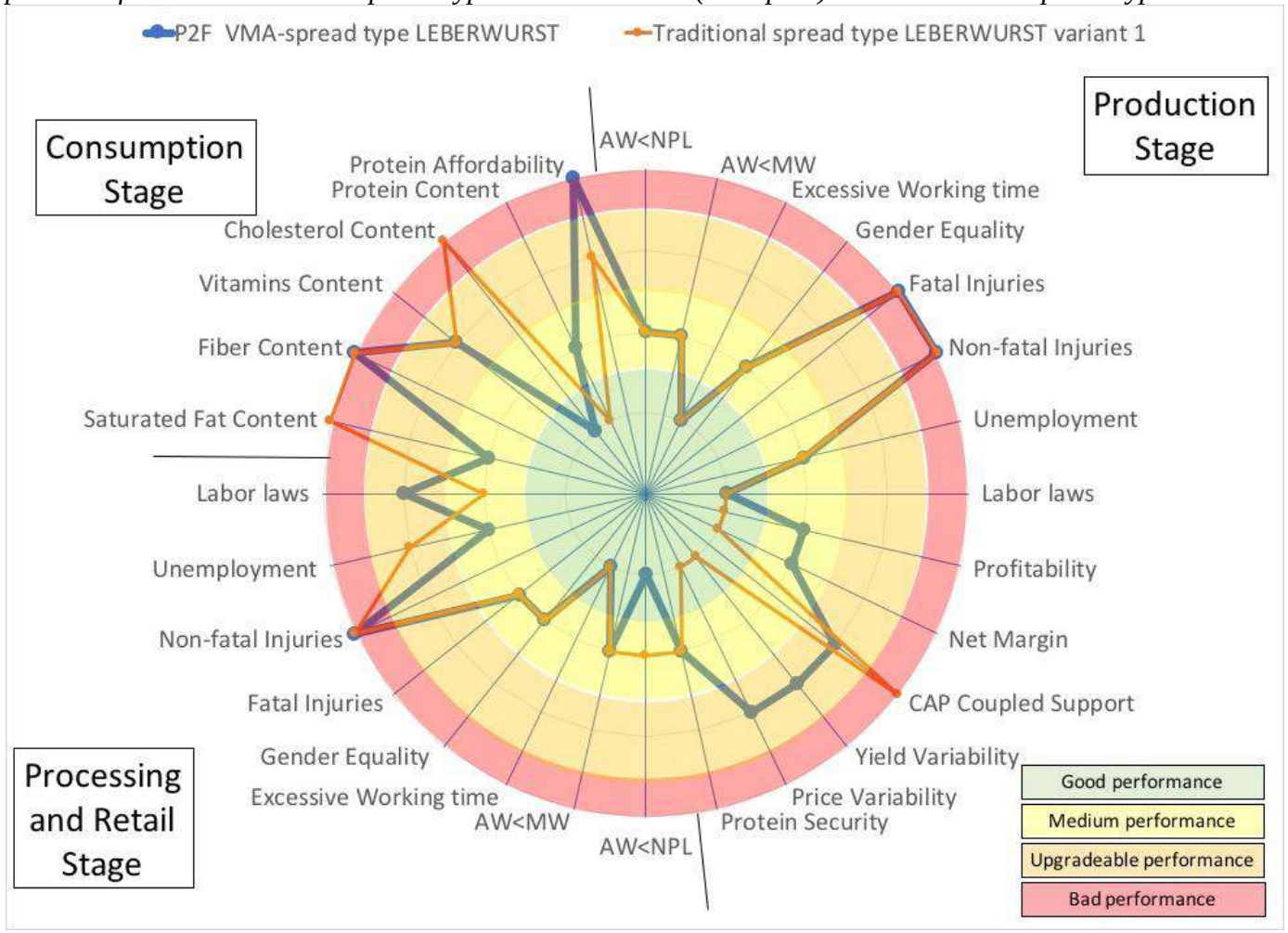
Figure 2. Comparison of results. P2F VMA-spread type LEBERWURST (liver pâté) and Traditional spread type LEBRWURST variant 1



Note: Average Wage being lower than Non-Poverty Line (AW<NPL); Average Wage being lower than country's Minimum Wage (AW<MW)
Source: Own elaboration

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Spread like meat has a similar assessment profile than fibre like meat as they both are comparing animal protein-based products. Here, the only differences in the production stage rely on famers stakeholder (indicators from "*Profitability*" to *"Price variability"*). In this case, *"profitability"* and *"net margin"* have good performances in traditional spread like meat, while they have medium performances in vegetable spread like meat. Pork production is usually more profitable and has higher net margins than vegetables, even though it does not have any CAP voluntary coupled support. *"Price variability"* and *"yield variability"* show good performances in traditional spread-like meat, and upgradeable performances in vegetable spread-like meat. Pork production yield does not depend on uncontrollable factors such as weather conditions and hence have less yield variability. Price variability is also small.

Processing and retail stage has similar differences than in fibre like meat as they both respond to similar sectors. *"Average wage lower than non-poverty line"* has a medium performance in traditional meat and good performance in vegetable meat, and *"unemployment"* has upgradeable performance in traditional spread-like meat and medium performance in vegetable spread-like meat. Again, size of companies in the sector is the reason driving these results. The bigger the company is, the more pressure they can exert to reduce salaries. On the contrary, indicator *"Labour laws"*, has medium performance in traditional spread-like meat and upgradeable performance in vegetable spread-like meat.

Finally, *"saturated fat"* and "*cholesterol content"* have medium and good performance respectively in vegetable spread like meat and bad performance in both cases in traditional spread like meat. These results are driven by pork compositions, which have high saturated fat and cholesterol content. "Protein content" and "protein affordability" show better performance in traditional products, with good and upgradeable performance respectively, than in P2F products, with medium and bad performance respectively. Also, it is important to highlight that vegetable spread type meat has the most expensive protein with a price of 127.36 €/kg.

In summary, it can be seen that the stakeholders most negatively affected by a decrease in animal protein consumption and an increase in vegetable protein consumption are *farmers* (indicators from *"profitability"* to *"price variability"),* with a similar pattern than in fibre like meat category. *Contribution to farm income impact subcategory ("Profitability"; "Net margin"; "CAP voluntary coupled support"),* as well as *contribution to economic security impact subcategory ("Yield variability"; "Price variability")* have a worse performance in the P2F VMA-spread type LEBERWURST than in the traditional LEBERWURST. On the contrary, *consumers* stakeholder has a better assessment profile in the vegetable made LEBEWURST than in the traditional LEBEWURST, mostly regarding *"saturated fat" and "cholesterol content"*. Also, *processing and retail workers* (indicators in *processing and retail stage*) show a better general picture in vegetable LEBERWURST than in traditional LEBERWURST, regarding *"average wage being lower than non-poverty line"* and *"being lower than country´s minimum wage"* and *"unemployment"*, but a worse picture regarding *"labour laws"*.

3.3. Pasta category

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

Figure 3 below compares results obtained previously for the products (5) P2F prototype fresh vegan pasta and (6) Traditional fresh egg pasta.

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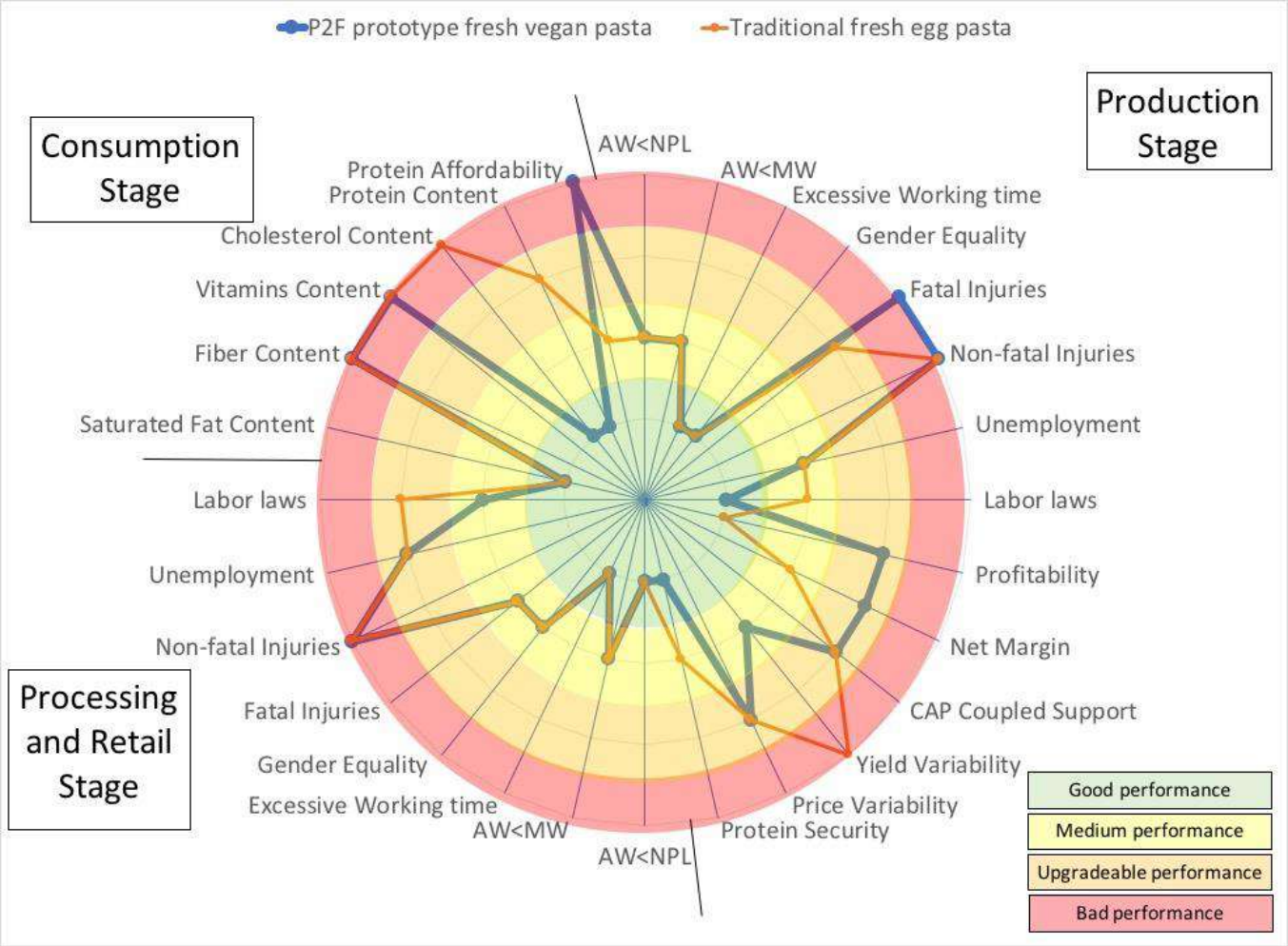
Figure 3. Comparison of results. P2F prototype fresh vegan pasta and Traditional fresh egg pasta



Note: Average Wage being lower than Non-Poverty Line (AW<NPL); Average Wage being lower than country's Minimum Wage (AW<MW)
Source: Own elaboration

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Pasta only involves egg as ingredient with an animal origin. Both prototype and traditional products are made with cereals and water as its main ingredients, which make them have a similar assessment profile along their life cycles.

For instance, during the *production stage*, only *farmers stakeholder* (Indicators from *"Profitability"* to *"Price variability")* has a different assessment: Regarding *"profitability"*, with good performance in traditional egg pasta due to the fact that the two main ingredients, durum wheat (semolina) and eggs, are assessed as having good profitability, and upgradeable performance in vegan pasta due to the fact that wheat is assessed as having upgradeable profitability. *"Net margin"* in traditional egg pasta is assessed as having medium performance because it is highly influenced by ingredient egg despite not being the main ingredient, because it has a very high net margin in comparison to other ingredients. *"Yield variability"* is assessed as having bad performance in traditional egg pasta and medium performance in vegan pasta. *Society stakeholder* in the *production stage ("protein security"),* has a medium performance in traditional egg pasta and good performance in vegan pasta. The difference here is driven by the producer price of egg proteins, which is more expensive than vegetable proteins.

In its next stage, *processing and retail workers* (all indicators from *processing and retail stage*) show a similar pattern in both products, with only one indicator making a difference, *"labour laws"*, with upgradeable performance in traditional egg pasta and medium performance in vegan pasta. In this case, the proportion of ingredient water is responsible for the difference. Sector water, which conforms 23% of vegan pasta and 42% of egg pasta, has worse performance concerning labour laws than other ingredients.

In the *consumption sector,"cholesterol content"* is assessed as having bad performance in traditional egg pasta and good performance in vegan pasta. It can be seen in Table 21 that eggs are responsible for the majority of cholesterol levels in traditional pasta. Vegetable protein rich pasta also has better performance regarding protein content with 13.9 g/100g versus 7.8g/100g in traditional egg pasta, but worse performance regarding protein affordability, with a price of 83.45 €/kg versus 47.76 €/kg in traditional egg pasta.

In this category, *farmers* (Indicators from *"profitability"* to price *"variability")* would be the stakeholders most negatively affected by an increase in fresh vegan pasta consumption and a decrease in traditional fresh egg pasta consumption, specifically due to *"profitability"* and *"net margin"*. The difference between egg pasta, fibre-like meat and spread like meat products is that, in egg pasta, the negative impacts on farmers (due to a decrease in animal protein consumption and an increase in vegetable protein consumption) are not so pronounced due to the fact that in this comparison, only eggs have an animal origin, and they only represent 12% of the total weight of traditional egg pasta. On the contrary, the stakeholders most beneficiated are *consumers ("Saturated fat"; "Fibre"; "Vitamins"; "Cholesterol"; "Protein content"),* with a clear reduction of *"cholesterol content"* and an increase in *"protein content"*. On the contrary, *society stakeholder* in the *consumption stage* would be negatively affected as price of protein would increase.

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3.4. Milk category

The figure below compares results obtained previously for the products (7) P2F prototype vegan milk and (7) Traditional dairy milk.

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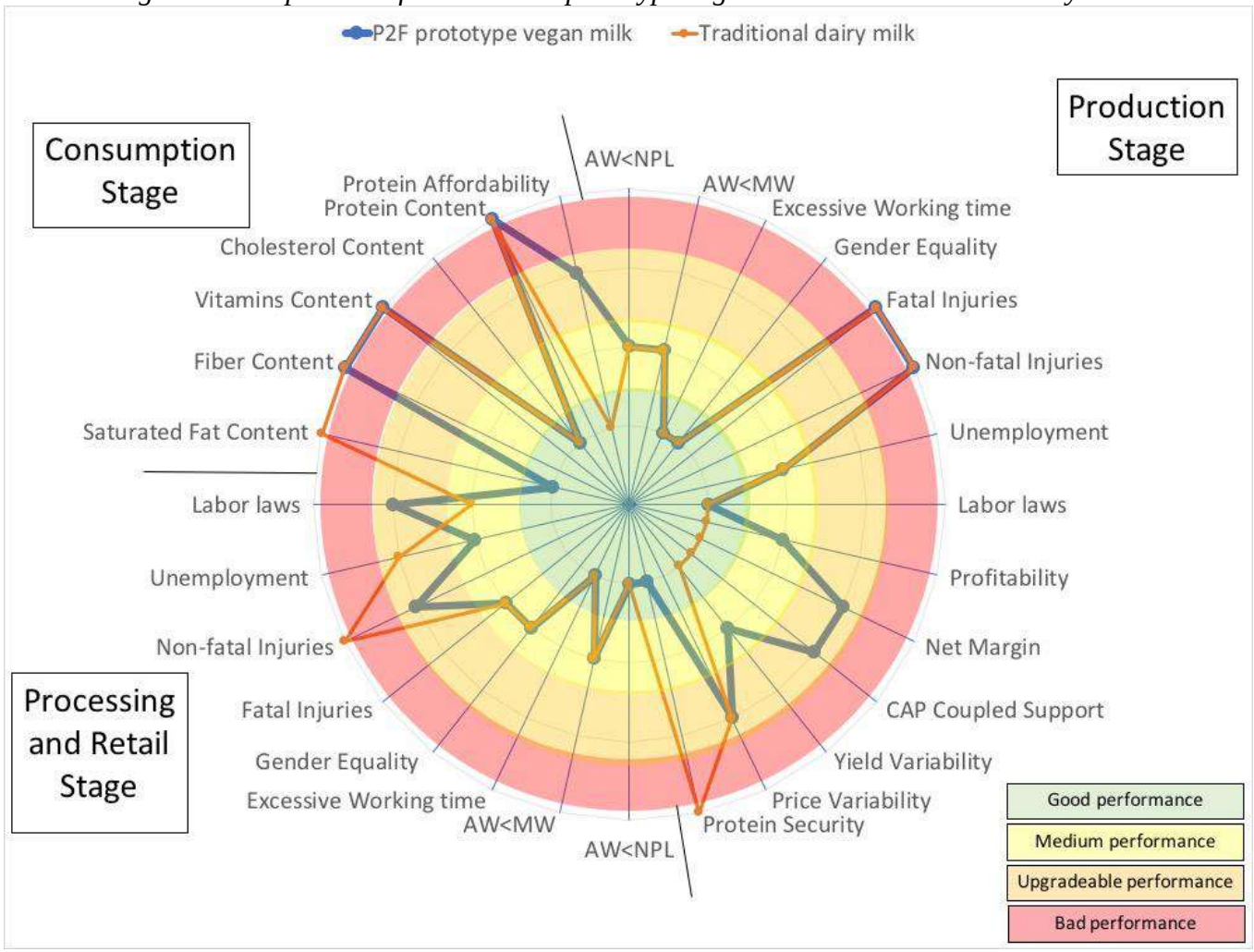
Figure 4. Comparison of results. P2F prototype vegan milk and Traditional dairy milk.



Note: Average Wage being lower than Non-Poverty Line (AW<NPL); Average Wage being lower than country's Minimum Wage (AW<MW)
Source: Own elaboration

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In this comparison, traditional dairy milk (entirely composed of animal origin ingredient) is compared to a vegetable-based milk. In the *production stage*, differences between products are concentrated in *farmers stakeholder* (indicators from *"profitability"* to *"price variability"),* with *"profitability", "net margin", "cap support"* and *"yield variability"* with a good performance for traditional dairy milk, and medium, upgradeable, upgradeable, and medium respectively for vegetable-based milk. Indeed, as stated out earlier in chapter 2, dairy milk shows good profitability and net margins, as well as low yield variability. Milk is an important sector for European countries, indicated by the amount of voluntary coupled support that it receives (more than 20% of the total amount of voluntary coupled support). On the contrary, *Society stakeholder ("protein security")* has a better performance in vegetable-based milk than in traditional milk with good and bad performance, respectively. The reason behind this assessment is that sugar beet has very high yields (up to 80 tonnes per hectare/year between 2003 and 2016), which translates into high protein yields, despite having a low protein content (6.8 grams per 100 grams of sugar beet).

In the *processing and retail stage*, differences between products can be appreciated for the indicators *"non-fatal injuries"*, with bad performance in traditional milk and upgradeable performance for vegetable milk, *"unemployment"* with upgradeable performance for traditional milk and medium performance for vegetable milk, and *"labour laws"* which has a medium performance in traditional milk and upgradeable performance in vegetable milk. These differences are due to the fact that sector corresponding to ingredient water, which is one of the main ingredients in P2F prototype vegan milk, has a low rate of *"non-fatal injuries*" (1693 non-fatal injuries in water sector versus 2990 non-fatal injuries in other food industry sectors). Also low level of unemployment (0.09 in water sector versus 0.87 in other food industry sectors), but less labour laws than the average (1.36 in water sector versus 1.86 in other food industry sectors).

In the *consumption stage*, clear differences between products can be observed for the indicators *"saturated fat content"* and *"protein affordability"*. Vegetable milk has better performance regarding *"saturated fat content"* with good performance versus bad performance in dairy milk, but worse performance regarding *"protein affordability",* with upgradeable performance versus good performance in dairy milk.

In summary, *farmers* (indicators from *"profitability"* to *"price variability")* are the stakeholder most negatively affected in the category. This due to a decrease in animal protein consumption and an increase in vegetable protein consumption, involvs not only *contribution to farm income impact subcategory ("Profitability"; "Net margin"; "CAP voluntary coupled support")* but also *economic security impact subcategory ("Yield variability"; "Price variability")* with an increase in *"yield variability".* On the contrary, stakeholders most beneficiated are *consumers ("saturated fat"; "fibre"; "vitamin"; "Cholesterol")* in the *consumption stage* and *society in the production stage* with a better performance of *"contribution to protein security".*

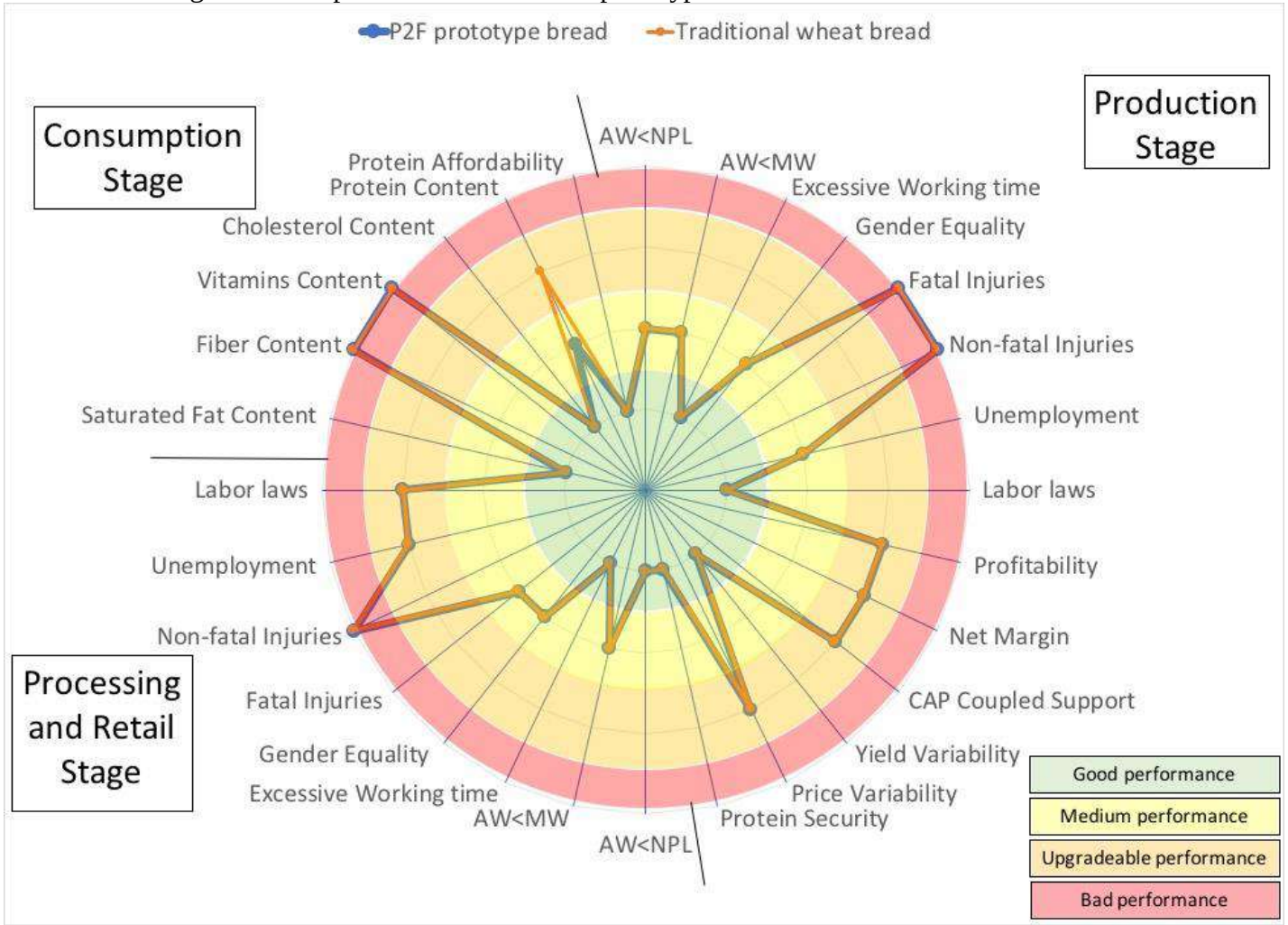
3.5. Bread category

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

Figure 5 below compares results obtained previously for the products (9) P2F prototype bread and (10) Traditional wheat bread.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

Figure 5. Comparison of results. P2F prototype bread and Traditional wheat bread



Note: Average Wage being lower than Non-Poverty Line (AW<NPL); Average Wage being lower than country's Minimum Wage (AW<MW)
Source: Own elaboration

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In this particular comparison there are no differences in the assessment profiles of both prototype and traditional products. To observe any difference, raw data from Table 23 can be used, although interpretation should be limited. For instance, there are 2175 "*non-fatal injuries*" in P2F prototype bread and 2074 "non-fatal injuries" in traditional wheat bread, being this the only remarkable difference for *production stage workers* stakeholder.

Other indicators showing slight differences are those belonging to *farmers* stakeholder. P2F prototype bread has a 103% profitability ratio, while traditional wheat bread has 102% profitability ratio. Also, net margin seems to be slightly better for P2F prototype bread farmers with 2.37 (000' euros per average farm) versus 2.11 (000' euros per average farm) in traditional wheat bread. P2F prototype bread has higher percentage of CAP voluntary coupled support with 3.39% than traditional wheat bread with 2.07%. With respect to price variability, P2F prototype bread has a better performance (less variability) with 28.73% than traditional wheat bread with 29.28%. Traditional wheat bread has better performance with respect to yield variability, with 7.37%, than prototype bread with 7.52%. P2F prototype bread contributes to protein security by producing 595.68 kg of protein per hectare while traditional wheat bread produces 610.85 kg of protein per hectare.

In the processing and retail stage, workers stakeholder shows no differences between the two mentioned products (P2F prototype and traditional wheat bread).

In the consumption stage, P2f prototype has less "*saturated fat"* (0.41 g/100g) than traditional wheat bread (0.47 g/100g). It has also more "*fibre"* (1.33 g/100g for P2F prototype and 1.22 g/100g for traditional wheat bread) but less "*vitamins"* (4.86 mg/100g for P2F prototype bread and 5.48 mg/100g for traditional wheat bread). There are no differences with respect to "*cholesterol content".* The only indicator with a different assessment is "protein content" with good performance (12g/100g) in P2F prototype bread and upgradeable performance (8.22g/100g) in traditional bread. Finally, in society stakeholder of the consumption stage, traditional wheat bread provides a cheaper protein (28.95 euros/kg of protein) than P2F prototype (33.33 euros/kg protein).

The only difference between these two products is that P2F prototype bread has two ingredients that are not present in the traditional bread. These ingredients are lentil or lupin protein isolate, and fababean flour. Hence, differences in the assessments of the products are due to those ingredients.

It should be noted that this is the only comparison where the traditional product has no animal origins ingredients, which can explain why there are no significant differences between products. This help to confirm, along with raw data, that it is animal origin ingredients which make major differences between products regarding socio-economic impacts.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

4. Discussion

In this section, all the methodological aspects of this analysis are discussed, along with the results of the assessment.

As stated out in section 2.1. (Goal), this analysis aims at comparing different vegetable and animal protein-rich products using Socioeconomic Life Cycle Assessment methodology proposed by UNEP-SETAC (UNEP-SETAC, 2009), but also to highlight any possible hotspot along the life cycle of those products. With this, the two possible objectives underlined by Jørgensen et al. (2008) (compare products and highlight hotspots) are met. In particular, the S-LCA performed in this study encompasses three stages of the life cycle product (production, processing and consumption), assesses ten different products, and compares them two by two in five categories: Fibre like meat, Spread-like meat, Pasta, Milk and Bread.

The first methodological point addressed in this analysis is the system boundaries, which can significantly influence results (Martínez-Blanco et al. 2010). Depending on the system boundaries, the analysis can focus on part of the life cycle of a product, like a particular company or a particular sector, or it can assess the whole life cycle of the product from "cradle to grave" (Benoit et al. 2010).

Couture (2012) analyses dairy farms across Canada and sets up a system boundary focused on production at a farm level and on upstream suppliers but does not assess processing nor consumption. In the analysis of a cocoa soap, Ramirez et al. (2016) include production at a farm level, processing and transportation but did not include consumption stage. Franze and Ciroth (2011) compare rose production in Ecuador and in the Netherlands taking into account production at a farm level and cutting and packaging, discarding background flows, retail and consumption stages. Martinez-Blanco et al. (2010) include the production, processing and consumption of fertilisers and compost, but also some of the background processes (i.e., those necessary to produce the desired product but that are not present in it; e.g., electricity, fuel, irrigation water consumption or machine replacements).

When undertaking a conjoint LCA and S-LCA, it is recommended in the UNEP-SETAC guidelines (UNEP-SETA, 2009) that S-LCA´s system boundaries should be as similar as possible as LCA´s system boundaries, without necessarily being exactly the same. In the present study, the system boundaries have been chosen in concordance with the LCA carried out in Protein2Food. As already shown in figure 11 of Deliverable 5.2 the LCA encompasses three stages: agricultural *production*, processing of crops into ingredients and *production of final food products ready for retail*, while in the S-LCA the processing stage includes both processing of crops and food production while adding *consumption as a third stage* (also see Martinez-Blanco et al 2010). In contrast to the LCA the sLCA is done without including any background flows or processes. The reason to include the consumption stage in the S-LCA is because consumer stakeholder is one of the five stakeholders proposed in the UNEP-SETAC guidelines and it is used in multiple S-LCAs (Sala et al. 2015). Nonetheless, the incorporation of the third stage (consumption stage) to the analysis had some contretemps, as it was difficult to decide what features were more relevant for consumer stakeholder, as most impact depend greatly on their own behaviour (Parent et al. 2013).

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Stakeholder categories and subcategories are the next point that had to be addressed in the development of the S-LCA methodology. The link between sector's activity and impacts on stakeholders can be convoluted (Dreyer et al. 2006). This is why the UNEP-SETAC guidelines propose five stakeholder categories and opens the possibility to include or exclude categories with the condition that it is justified (Benoit et al. 2010). In the present study, four of the five proposed UNEP-SETAC stakeholder categories have been included (*Workers*, *Value chain actors*, *Consumers* and *Society*), discarding *Local community* because of a lack of data, and because it is implicitly assessed in consumption and society stakeholders. Moreover, categories have been divided into subcategories to meet the specific requirements of Protein2Food´s particular products. The subcategories are: agricultural workers and processing and retail workers subcategories for worker category; farmers subcategory for value chain actors category; consumers and society subcategories for consumer and society categories respectively.

Additionally, the election of a Functional Unit is one of the riskiest decisions to be taken in a S-LCA, as impacts on stakeholder depend on company decisions, sector´s specific laws or country development (Iofrida et al. 2018; Martínez-Blanco et al. 2014; Benoit et al. 2010), and not on mass flows as it clearly occurs in LCA. In the present study, ten functional units have been chosen, one per product. With this, both LCA and S-LCA in P2F refer to the same functional unit, making the analysis easier to understand.
To be more specific, the functional units are composed products (i.e., they correspond to 100 grams of a product), which include different ingredients (and therefore sectors). This makes this S-LCA unique. According to the literature, this is the first S-LCA were a composed functional unit is being assessed. It has obliged us to create a new methodology, where indicators are weighted for each ingredient in function of its proportion in the final product.

The inventory analysis and data collection can be the most arduous and time-consuming step in a S-LCA due to a lack of specific socio-economic database (Ciroth et al. 2011; Petti et al. 2018; Zanchi et al. 2018). In this case, a combined bottom-up and top-down approach has been applied (Dreyer et al. 2006; Kruse et al. 2009; Jørgensen et al. 2008). For this, two types of indicators have been included: A selection of general indicators, obtained from the SHDB and suited to assess any sector, and a set of tailored indicators, selected form different sources (literature review, stakeholder consultation, etc.) and suited to specifically assess food products. Data can be site specific or generic depending on the purpose of the analysis (Parent et al. 2010). In this case, due to the fact that this analysis includes 28 countries (each country with its own particularities regarding each sector), a site-specific data collection in the form of surveys and others was not feasible. The result is a set of 27 indicators (16 from the SHDB and 11 tailored indicators) distributed along the life cycle of protein-rich food products. A limitation encountered in the SHDB was that agricultural sectors´ and food industry sectors´ inventory data seem to have been extracted from four general sectors per country (crop production, animal production, crop transformation industry and meat transformation industry), which makes it difficult to distinguish between crop sectors such as pulses or cereals, or between animal production sectors such as pig production or chicken production. In line with Jørgensen et al. (2013) and Kathage et al. (2015), the main limitation found has been the long time spent in data gathering in order to ensure proper availability, quality, and comparability of the data. Also, the fact that some of the products have not been launched to market, making it an ex ante analysis (Demont et al. 2009). It is important to mention that we have assumed some uncertainty in the analysis.

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Results depend on the chosen indicators and these have been chosen primarily for availability of data. Having chosen other data or source of data would have led to different results. For instance, detailed and updated economic data of farm activities for the different sectors was hard to find, and we had to use the ones available in FADN, which has data from 2010 to 2014. Also, prices of products in the market have been taken partially from REWE supermarket (REWE, 2018), and can differ from other supermarket chains, or from other countries. Indicator contribution to protein security represents protein yield per hectare, which is hard to calculate for animal products. Total area for EU animal feed and total meat from animal origin had to be used to calculate animal protein yield per hectare, and this can differ between stabled animals or non-stabled animals. In spite of these data gathering problems, which are common to any S-LCA and environmental LCA, the study has been performed with reliable data, which makes it robust and trustworthy.

Impact assessment results are highly influenced by the evaluation scale (Parent et al. 2010) and can require different methods depending on the assessed indicator (Martínez-Blanco et al. 2014). Indeed, the majority of S-LCA´s evaluation scales (and so is the SHDB) are based on Performance Reference Points (PRP) (Parent et al. 2010), which are international consensus values that are used as reference points to evaluate the relative position of a particular indicator for a particular product.

The SHDB uses PRP to assess sectors in four different assessment categories which are low risk, medium risk, high risk and very high risk. The problem in this particular case (when comparing products in Europe) is that, taking into account that social and socio-economic aspects are relatively homogenised across European sectors, most indicators are characterised in the same assessment category, which makes it difficult to compare although they have different values. This kind of evaluation scales are more suited to highlight hotspots along the life cycle of a single product, that is to say if indicators along the life cycle of a product are under or above the PRP. In general, evaluation scales of SHDB indicators were not modified except for qualitative indicators *("average wage being lower than non-poverty line", "average wage being lower than country's minimum wage*" and "*labour laws"*) which cannot be summed to calculate the European average. These indicators have been translated into semi quantitative indicators as suggested by Paragahawewa et al. (2009) so that country results can be summed, although linking qualitative or semi-quantitative indicators to the functional unit can be challenging (Couture 2012).

Additionally, evaluation scales of tailored indicators have been designed to allow comparison between products. Evaluation scales were designed for each tailored indicator based on different PRP (average values of all ingredients for a particular indicator). In fact, the PRPs of tailored indicators have been calculated with the values of all the ingredients that make up all the analysed products. This enables us to assess products relative to the average value (of all the analysed products) instead of relative to international consensus values, avoiding the risk of having all ingredients in the same assessment category for a particular indicator. The result is a four-category assessment system: good, medium, upgradeable and bad performance categories.

The two stakeholders *'production workers'* and '*processing and retail workers'* are entirely assessed with the SHDB (eight indicators each), while *'famers', 'consumers'* and *'society'* stakeholders are assessed with tailored indicators.

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If we look into *production worker stakeholder*, an interesting fact is that for all the assessed products, fatal and non-fatal injuries indicators during the production (stage) at a farm level are all assessed as having bad performance, which can apparently conform one of the main hotspots. Looking deeper in the data (see *annex I* chapter *A.b Social Hotspot Data Base: Gender equality and fatal injuries*) we can see that some countries have a score way over the limit of bad assessment regarding fatal and non-fatal injuries during the production stage. These countries are Austria, Bulgaria, Croatia, Cyprus, Czech Republic, Italy, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia, and Sweden. Something similar happens with indicator *"non-fatal injuries"* during the processing stage. On the contrary, no country shows a bad assessment regarding fatal injuries in processing stage. Another interesting fact is that indicators *average wage being lower than non-poverty line* and *lower than countries' minimum wage* during the *production stage* are always assessed as having medium performance, which can be explained by the fact that all the countries included in the analysis have relatively high living standards as European members. The same reason can explain that indicators *excessive working time* and *labour laws* during the production stage have good performance and that *unemployment* has medium performance in all the products. *Gender equality* differs from good to medium performance without a clear pattern. All the aforementioned indicators have been gathered (along with the inventory data) from the SHDB and reflect impacts on workers stakeholder in the production stage.

When looking into the *processing and retail worker stakeholder (*for which indicators have also been gathered from de SHDB*)*, a similar pattern can be observed, although there are more differences between products. For instance, *average wage being lower than non-poverty line* and *lower than countries' minimum wage* during the *processing and retail stage* are always assessed as having good and medium performance respectively, except for *traditional meat alternative* and *traditional spread type leberwurst* where *average wage being lower than non-poverty line* is assessed as having medium performance. *Excessive working time* and *gender equality* have good and medium performance respectively for all the products. *Fatal injuries* indicator is assessed as having medium performance for all products, and *non-fatal injuries* as having bad performance except for vegetable milk where it is assessed has having upgradeable performance due to the high proportion of the ingredient water in the processing of this product. *Unemployment* and *labour laws* in the same stage range from medium to upgradeable depending on the product, without a clear pattern.

Farmer's stakeholder is assessed with five indicators related to farm income and economic security. Here, more differences can be observed between products. In effect, regarding farmer stakeholder, traditional products seem to have a better performance profile (or equal at most) than P2F prototypes. This is true for all farmer stakeholder indicators, except for CAP support in traditional meat and traditional spread type leberwurst (because pig and poultry productions are not supported with voluntary coupled payments) and for yield variability in pasta (because durum wheat variability is relatively high).

Society stakeholder in the production stage is assessed with only one indicator regarding *contribution to protein security*. This indicator is assessed as having good performance for all P2F prototypes except for vegetable fibre-like meat and vegetable spread-like meat where they have medium performance. On the contrary, the same indicator shows bad

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performance in traditional milk, medium performance in traditional pasta, fibre like meat and spread like meat and good performance in traditional bread, which indicates that P2F prototypes have better performance profile regarding Society stakeholder in the production stage.

Consumer stakeholder, which is assessed with five tailored indicators regarding nutritional values, shows a similar pattern between traditional products and P2F prototypes. P2F prototypes generally have good performance for saturated fat and cholesterol content and bad performance for fibre and vitamin content. This can be a bias of the selected indicators, as vegetable products may have other sterols such as phytosterol, or other vitamins such as vitamin A. Regarding protein content, all P2F innovative products show better performance (higher protein content), except for P2F spread like meat alternative that has less protein content than its traditional counterpart. And for vegetable milk, that has the same amount of protein than dairy milk. A possible limitation of this study regarding consumer stakeholder is that protein quality has not been analysed. Protein quality can differ greatly between products and limits the benefits of protein intake (e.g., quality can refer to aspects such as digestibility, amino acid profile, presence of antinutritional factors and others), which might affect consumers' acceptance. However, this study focuses on socio-economic impacts and thus, these type of considerations fall out of the scope of the analysis.

Finally, protein affordability, which has an impact on society at a consumption stage level, has a worse performance in P2F prototypes than in traditional products. This is due to the high cost of vegetable protein rich products in the market, which in some cases can have more than double of the price of its traditional counterpart, like vegetable milk and vegan pasta (see final product price in €/kg, table 61, *annex II* chapter *R. Protein affordability*). These prices can be driven by several factors such as fashion, low demand, and others. This can be considered as a hotspot in the life cycle of vegetable products as protein price indicates of a worse assessment than in traditional products.

5. Conclusions

Findings

The S-LCA has been conducted in parallel to the LCA, taking into consideration innovative protein-rich products and their traditional counterparts. Findings from this analysis show socio-economic differences among products and hotspots along the life cycle of products, which may contribute to achieve more effective policies. These findings can be interpreted under two perspectives: Total score across all indicators, and learnings regarding selected indicators.

Total score across all indicators

A total score of each product examined is shown in Annex III (see "total average" values in tables 63-67). The sum was done by product and stakeholder category on the assumption that all indicators weigh the same.

- This overall ranking should be interpreted carefully, considering that it only refers to socio-economic impacts and that indicators do not necessary have to have the same weigh and importance for society and the economy.

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- Given the fact that each indicator had been classified into four performance categories which then were assigned numerical scores from 1 to 4 it seems adequate to apply an estimated uncertainty range to the total score of at least 20%.
- On that basis, we would conclude that overall the P2F prototypes and their respective traditional alternatives achieve a comparable socio-economic overall performance. *"Fibre-like vegetable meat alternative"* has a slightly worse overall socio-economic performance than "*traditional meat alternative"*. It also happens with "*P2F VMA-spread type LEBERWURST*" with regard to its traditional counterpart, although the difference is very small. "*P2F prototype fresh vegan pasta*" has a better overall performance than "*Traditional fresh egg pasta*". This comparison has more different overall results between traditional and P2F prototype, although the difference is still relatively small. In the milk comparison, again the P2F prototype ("*P2F prototype vegan milk*") has a slightly worse socio-economic overall performance than *"traditional dairy milk"*. "*P2F prototype bread*" and "*traditional wheat bread*" is the only comparison where both traditional and P2F products have the same assessment profile (except for indicator protein content). It should be considered here that this product is the only comparison where traditional alternative has no animal-origin ingredients, and that P2F product only has 10% less wheat flour.

Learnings regarding selected indicators

When looking at the results at a more differentiated level, the analysis shows distinct socio-economic differences among products and hotspots along the life cycle of products, and thus helps identify areas where political interventions might be worth discussing and thereby may contribute to achieve more effective policies.

- Almost all pairs of comparisons of P2F prototypes and traditional counterparts show that without a supportive policy framework the economics of plant-based protein-rich food products will most likely have a difficult stand on the market especially due to the less favourable conditions for farmers (see results for "net margin" and "profitability" at production stage).
- On top of that, factors like yield variability being larger for plant-based meat and milk alternatives and, to a less extent, also price variability might increase the risk and/or decrease confidence in these product lines on both ends, the farmer and the consumer.

Outlook

A hypothetical shift in Europeans' consumption patterns from an animal-protein based diet to a vegetable-protein diet could thus be potentially accompanied by negative impacts as described in the previous paragraphs, while consumers could be positively affected regarding food nutritional attributes on the other hand. The latter has been shown using indicators such as "saturated fat content", "cholesterol content", "fibre content", "vitamin content", and "protein content" but needs further substantiation by results and information coming from work packages 2 and 3.

In total, the results from the sLCA should be interpreted carefully, considering that it only represents a part of the larger picture. Further issues, such as environmental and health aspects, should be also explored and incorporated into the overall assessment to eventually achieve a more integrated view of the pros and cons of innovative products.

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This is partly planned to be done in Deliverable 5.4, under the integrated sustainability assessment.

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ANNEX I. Data Collection

The goal of this section is to show the data used for calculations in the indicators taken as examples in ANNEX II. First, the Social Hotspot Data Base is presented with two examples, *gender equality* and *fatal injuries*. Then, data bases used for 'specific' indicators are shown. These data bases are the Farm Accountancy Data Network (FADN, 2018) with economic data that is used to calculate profitability and net margin; The document from the commission "CAP voluntary couple support: Decision notified to the commission by 4 August 2014" (EC, 2015) includes data on voluntary coupled support designated per country and sector, and is used to calculate CAP voluntary coupled support; the Food and Agriculture Organization Data Base (FAOStat, 2018) that includes data about yields and producer prices is used to calculate yield and price variabilities; the Deliverable 5.1. of Protein2Food "Report on the scenarios" (IFEU, 2016) contains data on EU meat supply and on the area harvested for EU meat supply, which was used to calculate animal protein yield in kilograms per hectare; the French Agency for Food, Environmental and Occupational Health and Safety (ANSES, 2018) includes a food composition table with data on saturated fat, fibre, vitamins and cholesterol content per ingredient.

A. Social Hotspot Data Base: Gender equality and fatal injuries

The social hotspot provides data for 52 sectors for the 28 EU member states. Data is shown individually by country. Data was downloaded, and an average was calculated for each sector.

a. Gender Equality

Gender equality is presented as the percentage of women in the work force in each sector. Below, table 24 shows data for all 28 countries.

b. Fatal injuries

Fatal injuries are presented as the number of fatal injuries per 100 000 workers in each sector. Table 25 below shows data for all 28 countries.

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Table 24. Percentage of women in the workforce in different sectors across Europe

Countries	Animal Products (%)	Beverages Tobacco (%)	Cattle (%)	Other Meat (%)	Other Grains (%)	Other Crops (%)	Dairy Products (%)	Other Food (%)	Cattle Meat (%)	Oil Seeds (%)	Raw Milk (%)	Vegetable Oils (%)	Veg Fruits (%)	Water (%)	Wheat (%)	Sugar Beat (%)	Sugar (%)
Austria	45.66	20.1	45.66	20.1	45.66	45.07	20.1	20.1	20.1	45.66	45.66	20.1	45.66	20.1	45.66	45.66	20.1
Belgium	26.03	19.22	26.03	19.22	26	26.03	19.22	19.22	19.22	26.03	26.03	19.22	26.03	19.22	26.03	26.03	19.22
Bulgaria	35.44	40.96	35.44	40.96	35.44	35.44	40.96	40.96	40.96	35.44	35.44	40.96	35.44	40.96	35.44	35.44	40.96
Croatia	47.74	31.25	47.74	31.25	47.74	47.74	31.25	31.25	31.25	47.74	47.74	31.25	47.74	31.25	47.74	47.74	31.3
Cyprus	35.53	22.17	35.53	22.17	35.53	35.53	22.17	22.17	22.17	35.53	35.53	22.17	35.53	22.17	35.53	35.53	22.17
Czechia	31.95	30.25	31.95	30.25	31.95	31.95	30.2	30.2	30.2	31.95	31.95	30.25	31.95	30.25	31.95	31.95	30.25
Denmark	25.56	25.32	25.56	25.32	25.56	25.56	25.32	25.32	25.32	25.56	25.56	25.32	25.56	25.32	25.56	25.56	25.32
Estonia	31.6	35.22	31.55	35.22	31.55	31.55	35.22	35.22	35.22	31.55	31.55	35.22	31.55	35.22	31.55	31.55	35.22
Finland	30.28	23.99	30.28	23.99	30.28	30.28	23.99	23.99	23.99	30.28	30.28	23.99	30.28	23.99	30.28	30.28	23.99
France	30.2	23.73	30.2	23.73	30.18	30.18	23.73	23.73	23.73	30.18	30.18	23.73	30.18	23.73	30.18	30.18	23.73
Germany	35.25	23.94	35.25	23.94	35.25	35.25	23.94	23.94	23.94	35.25	35.25	23.94	35.25	23.94	35.25	35.25	23.94
Greece	41.94	19.96	41.94	19.96	41.94	41.9	19.96	19.96	19.96	41.94	41.94	19.96	41.94	19.96	41.94	41.94	19.96
Hungary	24.61	33.67	24.61	33.67	24.61	24.61	33.67	33.67	33.67	24.61	24.61	33.67	24.61	33.67	24.61	24.61	33.67
Ireland	10.69	21.68	10.69	21.68	10.69	10.69	21.68	21.7	21.68	10.69	10.69	21.68	10.69	21.68	10.69	10.69	21.68
Italy	31.37	24.14	31.37	24.14	31.37	31.37	24.14	24.14	24.14	31.37	31.37	24.14	31.37	24.14	31.37	31.37	24.14
Latvia	42.12	33.99	42.12	33.99	42.12	42.12	33.99	33.99	33.99	42.12	42.12	33.99	42.12	33.99	42.12	42.12	33.99
Lithuania	41.09	38.53	41.09	38.53	41.09	41.09	38.53	38.5	38.53	41.09	41.09	38.53	41.09	38.53	41.09	41.09	38.53
Luxembourg	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Malta	3.85	21.46	3.85	21.46	3.85	3.85	21.46	21.46	21.46	3.85	3.85	21.46	3.85	21.46	3.85	3.85	21.46
Netherland	30.23	18.58	30.23	18.58	30.23	30.23	18.58	18.58	18.58	30.23	30.23	18.58	30.23	18.58	30.23	30.23	18.58
Poland	43.86	27.64	43.86	27.64	43.86	43.86	27.64	27.64	27.64	43.86	43.86	27.64	43.86	27.64	43.86	43.86	27.64
Portugal	50.55	29.78	50.55	29.78	50.55	50.55	29.78	29.78	29.78	50.55	50.55	29.78	50.55	29.78	50.55	50.55	29.78
Romania	49.36	37.35	49.36	37.35	49.36	49.36	37.35	37.35	37.35	49.36	49.36	37.35	49.36	37.35	49.36	49.36	37.35
Slovakia	27.34	31.42	27.34	31.42	27.34	27.34	31.42	31.42	31.42	27.34	27.34	31.42	27.34	31.42	27.34	27.34	31.42
Slovenia	47.06	35.03	47.06	35.03	47.06	47.06	35.03	35.03	35.03	47.06	47.06	35.03	47.06	35.03	47.06	47.06	35.03
Spain	26.04	17.19	26.04	17.19	26.04	26.04	17.19	17.19	17.19	26.04	26.04	17.19	26.04	17.19	26.04	26.04	17.19
Sweden	25.49	22.23	25.49	22.23	25.49	25.49	22.23	22.23	22.23	25.49	25.49	22.23	25.49	22.23	25.49	25.49	22.33
U.K	23.08	21.86	23.08	21.86	23.08	23.08	21.86	21.86	21.86	23.08	23.08	21.86	23.08	21.86	23.08	23.08	21.86
EU Average	33.11	27.06	33.11	27.06	33.10	33.08	27.06	27.06	27.06	33.11	33.11	27.06	33.11	27.06	33.11	33.11	27.07

Source: SHDB (2018)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

Table 25. Number of fatal injuries per 100 000 workers in different sectors across Europe

Countries	Animal Products	Beverages and Tobacco	Cattle	Other Meat	Other Grains	Other Crops	Dairy Products	Other Food	Cattle Meat	Oil Seeds	Raw Milk	Vegetable Oils	Veg Fruits	Water	Wheat	Sugar Beat	Sugar
Austria	32.00	3.20	32.00	3.20	32.00	32.00	3.20	3.20	3.20	32.00	32.00	3.20	32.00	0.00	32.00	32.00	3.20
Belgium	3.80	4.40	3.80	4.40	3.80	3.80	4.40	4.40	4.40	3.80	3.80	4.40	3.80	7.10	3.80	3.80	4.40
Bulgaria	13.20	5.30	13.20	5.30	13.20	13.20	5.30	5.30	5.30	13.20	13.20	5.30	13.20	27.80	13.20	13.20	5.30
Croatia	10.40	3.10	10.40	3.10	10.40	10.40	3.10	3.10	3.10	10.40	10.40	3.10	10.40	0.00	10.40	10.40	3.10
Cyprus	44.00	7.00	44.00	7.00	44.00	44.00	7.00	7.00	7.00	44.00	44.00	7.00	44.00	0.00	44.00	44.00	7.00
Czech Republic	10.50	3.80	10.50	3.80	10.50	10.50	3.80	3.80	3.80	10.50	10.50	3.80	10.50	2.00	10.50	10.50	3.80
Denmark	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Estonia	6.90	3.00	6.90	3.00	6.90	6.90	3.00	3.00	3.00	6.90	6.90	3.00	6.90	0.00	6.90	6.90	3.00
Finland	0.00	1.20	0.00	1.20	0.00	0.00	1.20	1.20	1.20	0.00	0.00	1.20	0.00	0.00	0.00	0.00	1.20
France	5.80	3.70	5.80	3.70	5.80	5.80	3.70	3.70	3.70	5.80	5.80	3.70	5.80	3.20	5.80	5.80	3.70
Germany	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Greece	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hungary	7.73	2.06	7.73	2.06	7.73	7.73	2.06	2.06	2.06	7.73	7.73	2.06	7.73	3.12	7.73	7.73	2.06
Ireland	7.80	0.11	7.78	0.11	7.78	7.78	0.11	0.11	0.11	7.80	7.78	0.11	7.80	0.11	7.80	7.80	0.11
Italy	11.00	3.00	11.00	3.00	11.00	11.00	3.00	3.00	3.00	11.00	11.00	3.00	11.00	3.00	11.00	11.00	3.00
Latvia	14.10	5.70	14.10	5.70	14.10	14.10	5.70	5.70	5.70	14.10	14.10	5.70	14.10	12.50	14.10	14.10	5.70
Lithuania	32.30	6.30	32.30	6.30	32.30	32.30	6.30	6.30	6.30	32.30	32.30	6.30	32.30	0.00	32.30	32.30	6.30
Luxembourg	0.00	2.90	0.00	2.90	0.00	0.00	2.90	2.90	2.90	0.00	0.00	2.90	0.00	0.00	0.00	0.00	2.90
Malta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Netherland	1.90	1.50	1.90	1.50	1.90	1.90	1.50	1.50	1.50	1.90	1.90	1.50	1.90	1.50	1.90	1.90	1.50
Poland	21.10	3.90	21.10	3.90	21.10	21.10	3.90	3.90	3.90	21.10	21.10	3.90	21.10	7.00	21.10	21.10	3.90
Portugal	2.70	5.10	2.70	5.10	2.70	2.70	5.10	5.10	5.10	2.70	2.70	5.10	2.70	3.00	2.70	2.70	5.10
Romania	14.00	5.00	14.00	5.00	14.00	14.00	5.00	5.00	5.00	14.00	14.00	5.00	14.00	8.00	14.00	14.00	5.00
Slovakia	26.00	3.00	26.00	3.00	26.00	26.00	3.00	3.00	3.00	26.00	26.00	3.00	26.00	7.00	26.00	26.00	3.00
Slovenia	15.50	4.30	15.50	4.30	15.50	15.50	4.30	4.30	4.30	15.50	15.50	4.30	15.50	0.00	15.50	15.50	4.30
Spain	3.30	3.70	3.30	3.70	3.30	3.30	3.70	3.70	3.70	3.30	3.30	3.70	3.30	6.30	3.30	3.30	3.70
Sweden	13.10	1.70	13.10	1.70	13.10	13.10	1.70	1.70	1.70	13.10	13.10	1.70	13.10	4.30	13.10	13.10	1.70
United Kingdom	6.40	1.30	6.40	1.30	6.40	6.40	1.30	1.30	1.30	6.40	6.40	1.30	6.40	1.00	6.40	6.40	1.30
UE average	12.14	3.37	12.14	3.37	12.14	12.14	3.37	3.37	3.37	12.14	12.14	3.37	12.14	3.88	12.14	12.14	3.37

Source: SHDB (2018)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

B. Farm Accountancy Data Network: Economic data

This data base provides economic information on average farms across Europe. Among others, it provides data for twelve sectors: Wheat, durum wheat, barley, grain maize, COP (cereals, oilseeds and protein crops), cattle, milk, field crops, horticulture, granivores, mixed farming, fruits. "Total output" and "total input" were used to calculate sectors' *profitability* and *net margin* indicators. COP sector is shown in table 26 as an example of the data available in the FADN.

Table 26. Economic situation of European average COP farm

FADN variable	**Unit**	**2010**	**2011**	**2012**	**2013**	**2014**
Total output	**EUR'000**	**66.7**	**76.9**	**77.2**	**66.6**	**67.7**
Output crops	EUR'000	58.7	67.4	68.4	57.5	58.9
Output livestock	EUR'000	3.2	4	3.9	3.9	1.9
Other output	EUR'000	4.8	5.5	5.0	5.3	6.9
Total input	**EUR'000**	**63.1**	**68.7**	**67.8**	**66.5**	**69.9**
Intermediate consumption	EUR'000	40.4	45.1	45.2	44.1	46.1
Depreciation	EUR'000	11.0	11.1	10.5	10.9	11.3
External factors	EUR'000	11.8	12.5	12.0	11.5	12.5

Source: FADN (2018)

The correspondence between FADN's sectors and ingredients used in P2F products are shown below in table 27.

Table 27. Correspondence between FADN sectors and P2F products

FADNA sectors	Wheat	Durum Wheat	Barley	COP	Milk	Field Crops	Horticulture	Granivores
P2F ingredients	Wheat	Durum Wheat	yeast flakes	Faba bean	Milk	Sugar beet	Chives	Chicken meat
				Lupin		Buckwheat		Egg
				Lentil				Pork meat and fat
				Sunflower oil				
				Canola oil				

Source: Own elaboration

C. DG Agriculture and Rural Development: CAP voluntary couple support.

The document, from DG Agriculture and Rural Development, "CAP voluntary couple support: Decision notified to the commission by 4 August 2014" (EC, 2015) provides information on the specific amount of CAP voluntary coupled support designated to each sector in each country. This is used to assess the indicator CAP support. Table 28 shows the total amount designated per sector and its percentage over the total.

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Table 28. Voluntary coupled support notified to the commission by 1 august 2014

Sector	CAP Voluntary coupled Support (Millions of €)	Percentage (%) over total CAP Voluntary coupled Support
Beef and veal	1706	41.35%
Cereals	87	2.11%
Flax	1	0.02%
Fruit and Vegetables	204	4.94%
Grain legumes	6	0.15%
Hemp	2	0.05%
Hops	5	0.12%
Milk and milk products	829	20.09%
Nuts	14	0.34%
Oilseeds	1	0.02%
Olive oil	70	1.70%
Protein crops	443	10.74%
Rice	57	1.38%
Seeds	5	0.12%
Sheepmeat and goatmeat	503	12.19%
Silkworm	1	0.02%
Starch potato	18	0.44%
Sugar beet	174	4.22%
Total	4126	100.00%

Source: EC (2018)

D. FAOStat: Yields and producer prices

FAOStat provides reliable data on different agricultural aspects. For this study, yield and producers' price were used to calculate yield variability and producers price variability.

a. Yield

In the case of yield, data in the database is shown as an average value for the whole European Union. Annual yields per sector in the EU can be seen below in table 29.

b. Producer price

In the case of producers' price, FAOStat only provides data per individual country. Chicken meat is used as an example of data collected. It can be seen in table 30.

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Table 29. EU average yield from 2003 to 2016

Year	Lentil Yield (kg/ha)	Lupin (kg/ha)	Fababean (kg/ha)	Buckwheat (kg/ha)	Wheat (kg/ha)	Barley (kg/ha)	Durum Wheat (kg/ha)	Sugar Beet (kg/ha)	Sunflower (kg/ha)	Canola (kg/ha)	Chives (kg/ha) (spices)	Chicken Meat (in carcass weight) (g/animal)	Pork (in carcass weight) (kg/animal)	Milk Yield (kg/animal)	Egg (g/animal)
2003	839.70	1324.10	2709.70	1694.60	4581.20	3962.40	1313.33	52757.50	1500.60	2657.00	1416.80	1478.90	87.90	5625.90	14159.60
2004	856.30	1346.30	3157.30	1860.40	5612.60	4684.40	2160.00	59394.50	1842.70	3390.70	1210.00	1494.40	87.60	5664.60	14241.00
2005	901.50	1286.50	2591.70	1547.50	5115.30	3963.00	1810.00	60088.00	1671.30	3208.00	1196.00	1498.70	88.10	5846.50	13356.00
2006	921.40	1170.10	2743.40	1000.40	5081.60	4071.20	2130.00	59034.80	1742.50	2980.30	1401.10	1497.30	87.30	5902.20	14108.60
2007	962.20	1269.40	3091.50	1682.50	4843.30	4230.80	1667.50	62976.10	1480.30	2819.40	1189.20	1509.00	87.90	5927.50	13907.60
2008	889.90	1264.10	3469.50	1425.00	5659.60	4528.30	2250.00	66268.00	1906.40	3087.90	1288.00	1462.70	88.70	5982.90	14137.20
2009	809.00	1401.30	3841.80	1549.70	5397.20	4474.90	2335.00	71513.00	1805.20	3300.20	1298.40	1509.70	88.70	6063.90	14278.50
2010	969.20	1501.90	3005.90	1606.90	5261.40	4340.30	3335.83	65376.30	1863.30	2906.30	1312.20	1537.10	89.50	6180.90	13642.80
2011	862.70	1374.60	3179.80	1540.00	5343.80	4346.60	3174.17	75988.70	1960.00	2850.10	1313.60	1548.70	89.30	6429.10	13904.80
2012	833.40	1509.50	3283.70	1643.30	5178.60	4395.70	3189.29	69049.70	1660.30	3103.20	1258.50	1579.30	90.00	6452.20	13453.30
2013	955.30	1581.90	3069.60	1822.70	5578.70	4834.60	3652.14	69183.10	1999.10	3126.70	1188.10	1567.50	89.80	6520.40	13695.90
2014	921.60	1746.10	3206.20	1697.50	5884.40	4891.30	3880.71	79887.70	2173.90	3617.90	1397.10	1590.50	89.30	6741.70	14000.70
2015	881.70	1403.40	2763.60	1662.90	6028.10	5066.90	3942.14	71813.20	1889.30	3374.60	1815.10	1583.00	90.80	6847.10	14395.00
2016	906.40	1602.90	2762.50	1736.50	5292.00	4655.90	3885.00	74056.70	2057.50	3036.80	1788.40	1607.40	90.80	6701.50	14148.50

Source: FAOStat (2018)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

Table 30. Chicken meat producer price across 28 EU member states from 2003 to 2016 (USD/tonne)

Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Austria	901.80	995.80	1001.10	1009.90	1118.20	1313.90	1272.50	1213.20	1298.40	1187.20	1430.00	1428.90	1194.50	1191.30
Bulgaria	1030.20	1078.00	1110.50	1000.50	1265.20	1532.40	1323.00	1224.50	1337.80	1295.00	1550.00	1362.10	1143.50	1069.00
Croatia	1233.40	1357.20	1348.10	1361.80	1372.00	1529.90	1383.40	1316.80	1412.80	1337.00	1379.50	1304.20	1076.20	1064.50
Czechia	742.80	858.50	884.20	850.40	1033.60	1336.70	1083.70	1066.90	1249.50	1179.10	1264.20	1149.40	964.80	960.30
France		1132.00	1119.10	1104.80	1381.00	1665.50	1433.50	1370.10	1626.80	1533.20	1704.60	1584.50	1282.90	1266.80
Germany	883.10	948.40	869.90	989.00	1208.20	1446.80	1416.80	1437.80	1679.30	1189.80	1285.30	1211.30	981.50	941.30
Greece	1295.00	1495.60	1504.50	1581.40	1948.00	2197.20	2055.30	1980.90	2084.50	1983.80	2053.10	2009.40	1609.90	1567.50
Hungary	757.40	892.30	843.10	799.60	1063.40	1348.70	1063.70	1027.50	1241.50	1204.50	1305.00	1372.40	1091.80	891.20
Italy	1121.60	1196.30	1107.30	1243.30	1649.80	1679.60	1530.50	1390.50	1848.00	1800.10	1980.60	1968.10	1588.70	1496.50
Portugal	940.00	1001.20	948.00	1112.00	792.30	798.60	761.40	572.70	731.60	695.10	634.50	709.40	529.80	234.50
Romania	1696.40	1005.10	1221.80	1306.50	1525.70	1524.50	1213.40	1220.90	1381.00	1254.30	1505.40	1233.10	1001.10	1017.50
Slovakia	777.60	879.00	886.30	842.80	1091.90	1375.60	1101.20	1044.20	1267.50	1204.80	1325.80	1224.40	967.10	931.70
Slovenia	936.20	1093.50	1021.50	1034.10	1238.80	1586.40	1425.20	1356.20	1514.10	1408.90	1567.90	1467.10	1193.90	1169.20
Spain	943.50	1064.10	1106.80	1218.60	1489.00	1499.50	1397.40	1292.90	1603.00	1605.30	1603.80	1516.70	1227.70	1142.00
Belgium	837.40	910.10	966.30	879.00	1174.20	1302.70	1143.90	1141.90	1296.00	1189.70	1260.10	1218.60	996.40	953.60
Chiprus	1465.60	1716.80	1761.10	1795.90	2328.20	2790.50	2626.40	2580.40	2655.60	2459.70	2619.30	2593.20	2147.60	2130.20
Denmark	645.10	724.40	712.00	634.00	779.30	1166.80	966.60	982.40	1213.70	1178.50	1299.00	1182.50	935.20	923.80
Estonia	927.60	1139.40	1104.70	1125.80	1568.90	1789.60	1421.00	1209.10	1338.80	1268.50	1457.90	1415.30	1275.40	1284.60
Finland	1089.60	1063.30	1025.50	1170.20	1428.20	1291.90	1192.00	1369.20	1342.80	1509.40	1451.40	1130.70	1092.00	
Ireland	864.50	1018.20	997.40	963.40	1071.70	1248.00	1193.20	1144.70	1295.00	1234.40				
Leetonia	864.40	918.10	1237.80	1306.20	1786.70	1971.70	1703.10	1449.70	1604.10	1494.00	1690.60	1738.00	1305.40	1306.50
Lithuania	1104.30	1139.00	1282.60	970.60	1220.90	1432.40	1119.10	1072.50	1289.30	1215.90	1320.50	1212.90	1012.20	924.70
Luxembourg	2962.60	3259.40	5179.60	5445.70	6451.90	7053.10	4292.60	4092.50	4598.60	4818.20	5377.30	5403.80	4034.80	3791.90
Malta		957.50	932.70	946.00	1034.70	1186.50	1233.90	1180.10	1324.10	1229.30	1307.40	1245.50	1004.30	997.60
Netherlands	713.30	808.30	868.00	791.70	1075.90	1213.50	1085.40	1042.70	1222.50	1162.80	1223.20	1176.40	967.70	930.10
Poland	698.40	819.90	849.50	805.00	1144.50	1315.80	1083.30	1062.90	1251.50	1185.60	1224.80	1173.20	927.70	846.10
U.K.	813.10	926.40	895.80	898.60	1052.10	1218.60	1040.30	1104.30						
Sweden	837.20	918.50	867.10	866.10	1019.60	1371.50	1122.30	1191.80	1470.70	1411.10				

Source: FAOStat (2018)

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E. P2F Deliverable 5.1: Food supply and harvested area

Deliverable D5.1 "Report on scenarios" (IFEU, 2016) has been used to calculate animal protein yield per hectare to analyse its contribution to protein security. Specifically, table 34 from D5.1, food supply and calculated food intake (page 62), and table 40 from D5.1, area harvested for feed for EU food supply of animal origin (page 69) were used. Table 31 shows EU food supply, specifically meat supply. Table 32 shows the area harvested for feed for EU food supply of animal origin.

Table 31. EU food supply

Food Commodity	Food Supply [1000 t]
Meat	65,288
thereof: PorkMeat	28,523
thereof: Poultry Meat	16,116
thereof: Beef Meat	12,894
thereof: Mutton and Goat Meat	2,165
Dairy	126,107
Eggs	6,088

Source: IFEU (2016)

Table 32. Area harvested for feed for EU food supply of animal origin

Food Commodity	Harvested Area [1000 ha]
Meat (in total)	65,073
thereof: Pork Meat	17,984
thereof: Poultry Meat	7,981
thereof: BeefMeat	32,547
thereof: Mutton & Goat Meat	6,560
Dairy (in total)	21,475
Eggs (in total)	3,084

Source: IFEU (2016)

F. French agency "ANSES": Nutritional values

The composition table is used to determine the composition of the different ingredients used in P2F products. Specifically, four features that concerns consumers have been analysed, which are (a) saturated fat content, (b) fibre content, (c) vitamin content, (d) cholesterol content. Additionally, protein content has been gathered to calculate protein yields.

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a. Saturated fats

Table 33 below shows the amount of saturated fat per commodity.

Table 33. Saturated fat content

Commodity	Value (g/100g)
Lupin/Lentil protein isolate	0
Fababean	0.01
Buckwheat flour	0.33
Wheat	0.6
Durum Wheat (semolina)	0.21
Sunflower oil	10.9
Canola oil	7.26
Sugar	0
Chives	0.15
Brewer`s yeast flakes	0.7
Chicken, breast, without skin, cooked	0.55
Pork meat and fat	5.1
Milk (whole, Pasteurized)	2.16
Egg	2.64

Source: ANSES (2018)

b. Fibre

Table 34 below shows the amount of fibre per commodity.

Table 34. Fibre content

Commodity	Value (g/100g)
Lupin/Lentil protein isolate	0
Fababean	5.8
Buckwheat flour	4.2
Wheat	1.7
Durum Wheat (semolina)	3.37
Sunflower oil	0
Canola oil	0
Sugar	0
Chives	3.19
Brewer`s yeast flakes	22.5
Chicken, breast, without skin, cooked	0
Pork meat and fat	0
Milk (whole, Pasteurized)	0
Egg	0

Source: ANSES (2018)

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c. Vitamins

Table 35 below shows the amount of Vitamins B1-6, C and E per commodity.

Table 35. Vitamin content

Commodity	Value (g/100g)
Lupin/Lentil protein isolate	0
Fababean	1.764
Buckwheat flour	7.96
Wheat	7.76
Durum Wheat (semolina)	3.207
Sunflower oil	58.3
Canola oil	27.7
Sugar	0.019
Chives	41.755
Brewer`s yeast flakes	37.18
Chicken, breast, without skin, cooked	13.294
Pork meat and fat	8.39
Milk (whole, Pasteurized)	1.98
Egg	3.718

Source: ANSES (2018)

d. Cholesterol

Table 36 below shows the amount of cholesterol per commodity.

Table 36. Cholesterol content

Commodity	Value (g/100g)
Lupin/Lentil protein isolate	0
Fababean	0
Buckwheat flour	0
Wheat	0
Durum Wheat (semolina)	0
Sunflower oil	0
Canola oil	0
Sugar	0
Chives	0
Brewer`s yeast flakes	0.67
Chicken, breast, without skin, cooked	70.4
Pork meat and fat	77.8
Milk (whole, Pasteurized)	14
Egg	398

Source: ANSES (2018)

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e. Protein content

Table 37 below shows the amount of protein per commodity.

Table 37. Protein content

Commodity	Value (g/100g)
Lupin	36.2
Lentil	25.4
Fababean	26.1
Buckwheat flour	12.9
Wheat	11.5
Barley	13.4
Durum Wheat (semolina)	13
Sunflower seeds	21.3
Canola seeds	19
Sugar beet	6.8
Chives	2.62
Chicken, breast, without skin, cooked	21.4
Pork meat and fat	22.3
Milk (whole, Pasteurized)	3.32
Egg	12.7

Source: ANSES (2018)

G. P2F deliverable D3.1 and D3.2: Final product protein content

P2F Final product protein content is based on data presented in deliverables D3.1 "Evaluation of commercial reference plant-based protein-rich foods" (UCC, 2016) and D3.2 "Recipes and optimized processing conditions for meat alternatives" (IVV, 2018). Table 38 below shows final product's protein content.

Table 38. Final product protein content

Final Product	Value (g/100g)
P2F prototype VMA-fiber	30
Traditional chicken meat	21.4
P2F prototype VMA-spread type LEBERWURST (liver pâté)	12.5
Traditional spread type LEBERWURST variant 1	15
P2F prototype fresh vegan pasta	13.9
Traditional fresh egg pasta	7.8
P2F prototype vegan milk	3.3
Traditional Dairy milk	3.32
P2F prototype bread	12
Traditional Bread	8.22

Source: UCC (2016), IVV (2018), and ANSES (2018)

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H. P2F deliverable D3.1 and REWE: Final product price

Final product's price is based on deliverable D3.1 "Evaluation of commercial reference plant-based protein-rich foods" (UCC, 2016), and on REWE online supermarket web for Germany (REWE, 2018). Table 39 below shows prices for final products analysed in this S-LCA.

Table 39. Final product's price

Final product	Market denomination	Price (€/packet)	Weight (kg/packet)	Source
P2F prototype VMA-fibre	Rügenwalder Mühle Vegetarische Mühlen-Frikadellen 2x90g	2.99	0.18	rewe.de
Traditional chicken meat	Wilhelm Brandenburg Hähnchenbrustfilet ca. 340g, 2 Stück	3.4	0.34	rewe.de
P2F prototype VMA-spread type LEBERWURST (liver pâté)	Rügenwalder Mühle Vegetarische Pommersche Schnittlauch 125g	1.99	0.125	rewe.de
Traditional spread type LEBERWURST variant 1	Wilhelm Brandenburg Leberwurst im Glas 200g	1.99	0.2	rewe.de
P2F prototype fresh vegan pasta	Pasta Lang Lang-linsen-Nudel	2.9	0.25	D3.1
Traditional fresh egg pasta	REWE Beste Wahl Tagliatelle 400g	1.49	0.4	rewe.de
P2F prototype vegan milk	Provamel Soya Drink plus Calcium	2.25	1	D3.1
Traditional Dairy milk	Tuffi Frische Vollmilch 3.5% 1l	1.05	1	rewe.de
P2F prototype bread	Brotland eiweiss brot	2	0.5	D3.1
Traditional Bread	Harry Vollkorn-Toast 500g	1.19	0.5	rewe.de

Source: UCC (2016) and REWE (2018)

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ANNEX II. Data Processing: Examples for selected indicators

The goal of this Annex is to show the calculations made to get from raw data presented in Annex I 'Data collection', to the actual data used to assess the different indicators used in this S-LCA. To do so, an example is shown for each indicator. The indicators that are going to be addressed are two from the Social Hotspot Data Base, gender equality and fatal injuries, and height specific indicators: Profitability, net margin, CAP voluntary coupled support, yield variability, price variability, contribution to protein security, product features relevant for consumers and protein affordability.

I. Gender equality

The average percentage of women in the work force in the EU by sectors is calculated using table 24. It is then assessed using the same assessment limits than the SHDB and shown in table 40. Results are shown below in table 41.

Table 40. Assessment limits of indicator gender equality

Assessment Limits (% of women in the work force)	Performance	Description
>33%	Good	Limits established by the Social Hotspot Data Base
>20%	Medium	
>10%	Upgradeable	
<10%	Bad	

Table 41. EU average percentage of women in the work force by sectors and assessment

Gender Equality	Animal Products	Beverages and Tobacco Products	Cattle	Other Meat	Other Grains	Other Crops	Dairy Products	Other Food	Cattle Meat	Oil Seeds	Raw Milk	Vegetable Oils	Veg and Fruits	Water	Wheat	Sugar Beat	Sugar
% of women in the work force in the EU	33.11	27.06	33.11	27.06	33.10	33.08	27.06	27.06	27.06	33.11	33.11	27.06	33.11	27.06	33.11	33.11	27.34
Assessment	Good	Medium	Good	Medium	Good	Good	Medium	Medium	Medium	Good	Good	Medium	Good	Medium	Good	Good	Medium

Source: Own elaboration

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J. Fatal injuries

The average number of fatal injuries in different sectors across the EU is calculated using table 25. Then, the assessment is done using the same assessment limits than the SHDB and shown in table 42. Results are shown below in table 43.

Table 42. Assessment limits of indicator fatal injuries

Assessment Limits (nº of fatal injuries)	Performance	Description
<1	Good	Limits established by the Social Hotspot Data Base
>1	Medium	
<5	Upgradeable	
>10	Bad	

Table 43. EU average number of fatal injuries per 100 000 workers and assessment

Fatal Injuries	Animal Products	Beverages and Tobacco Products	Cattle	Other Meat	Other Grains	Other Crops	Dairy Products	Other Food	Cattle Meat	Oil Seeds	Raw Milk	Vegetable Oils	Veg and Fruits	Water	Wheat	Sugar Beat	Sugar
Fatal injuries per 100 000 workers in the EU	12.14	3.37	12.14	3.37	12.14	12.14	3.37	3.37	3.37	12.14	12.14	3.37	12.19	3.88	12.14	12.14	3.37
Assessment	Bad	Medium	Bad	Medium	Bad	Bad	Medium	Medium	Medium	Bad	Bad	Medium	Bad	Medium	Bad	Bad	Medium

Source: Own elaboration

K. Profitability

Profitability is calculated using data from the FADN data base. Specifically, the average total output and the average total input were calculated using data from 2010 to 2014. Then, profitability was calculated by using the output/input ratio. An example can be seen in table 45 that corresponds with the COP sector. After calculating the profitability, sectors are assessed using assessment limits shown in table 44.

Table 44. Assessment limits of indicator profitability

Assessment Limits (Profitability)	Performance	Description
>110%	Good	Limits have been established to balance ingredients along the four assessment categories
>105%	Medium	
>100%	Upgradeable	
<100%	Bad	

Source: Own elaboration

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

Table 45. Profitability calculation and assessment of COP sector

FADNA sectors	Average Total Outputs per farm in 000' euros between 2010 and 2014	Average Total Inputs per farm in 000' euros between 2010 and 2014	Profitability (output(€) /input(€)) (%)	Assessment
COP	71.02	67.20	105.68%	Medium

Source: Own elaboration

L. Net margin

Net margin is calculated using data from the FADN data base. Specifically, the average total output and the average total input were calculated using data from 2010 to 2014. Then, net margin is calculated by subtracting average total inputs to average total outputs. An example can be seen below in table 47 that corresponds with the COP sector. After calculating the net margin, sectors are assessed using assessment limits shown in table 46.

Table 46. Assessment limits of indicator net margin

Assessment Limits (Net Margin)	**Performance**	**Description**
>10	Good	Limits have been established to balance ingredients along the four assessment categories
>5	Medium	
>0	Upgradeable	
<0	Bad	

Source: Own elaboration

Table 47. Net margin calculation and assessment of COP sector

FADNA sectors	Average Total Outputs per farm in 000' euros between 2010 and 2014	Average Total Inputs per farm in 000' euros between 2010 and 2014	Net margin (output-input) (000' euros)	Assessment
COP	71.02	67.20	3.82	Upgradeable

Source: Own elaboration

M. CAP voluntary coupled support

Data to calculate the percentage of the total voluntary coupled support designated to each sector across the EU has been extracted from the document "Voluntary coupled support. Decision notified to the Commission by 1st august 2014" (EC, 2018). After the calculation, P2F ingredients were assigned to sectors. This can be seen in table 49. Finally, the assessment was done using the assessment limits shown in table 48.

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Table 48. Assessment limits of indicator cap voluntary coupled support

Assessment Limits (CAP voluntary coupled Support)	Performance	Description
>20%	Good	Limits have been established using CAP voluntary coupled support percentages to balance ingredients along the four assessment categories.
>10%	Medium	
>1%	Upgradeable	
<1%	Bad	

Source: Own elaboration

Table 49. Cap voluntary coupled support by sectors and correspondence with ingredients used in P2F products

CAP sector	Cereals	Grain legumes	Protein Crops	Milk and milk products	Oil seeds	Sugar beet	No voluntary coupled support
Support	2%	0.15%	10.74%	20%	0.024%	4%	0.000%
P2F ingredients	Wheat	Lentil		Milk	Canola oil	Sugar beet	eggs
	Durum Wheat	Lupin			Sunflower oil		Chicken meat
	Brewer`s yeast flakes	Faba bean					Pork meat and fat
							Buckwheat flour
							Chives
Assessment	Upgradeable	Medium		Good	Bad	Upgradeable	Bad

Source: Own elaboration

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N. Yield variability

Yield variability has been calculated using data from FAOStat (table 29), specifically, using average EU yield data from 2003 to 2016. First the average yield per sector was calculated. Then, the standard deviation and the coefficient of variation were calculated. The coefficient of variation is a value of the yield variability. The results can be seen in table 51 shown below. Sectors were assessed using assessment limits shown in table 50.

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Table 50. Assessment limits of indicator yield variability

Assessment Limits (Yield variability)	Performance	Description
<7.98%	Good	25% deviation model has been used
<10.64%	Medium	
<13.30%	Upgradeable	
>13.30%	Bad	

Source: Own elaboration

Table 51. Yield variability for different sectors

	Lentil (kg/ha)	Lupin (kg/ha)	Fababean (kg/ha)	Buckwheat (kg/ha)	Wheat (kg/ha)	Barley (kg/ha)	Durum Wheat (kg/ha)	Sugar Beet (kg/ha)	Sunflower (kg/ha)	Canola (kg/ha)	Chives (kg/ha) (spices)	Chicken Meat (in carcass weight) (g/animal)	Pork (in carcass weight) (kg/animal)	Milk (kg/animal)	Egg (g/animal)
EU average yield between 2003 and 2016	893.59	1413.01	3062.59	1604.99	5346.99	4460.45	2766.08	66956.24	1825.17	3104.22	1362.32	1533.16	88.98	6206.17	13959.25
Standard Deviation	49.77	158.02	339.31	208.63	390.28	341.71	910.98	7546.97	199.78	259.26	201.67	46.30	1.14	406.87	315.97
Coefficient of variation	5.57%	11.18%	11.08%	13.00%	7.30%	7.66%	32.93%	11.27%	10.95%	8.35%	14.80%	3.02%	1.28%	6.56%	2.26%
Assessment	Good	Upgradeable	Upgradeable	Upgradeable	Good	Good	Bad	Upgradeable	Upgradeable	Medium	Bad	Good	Good	Good	Good

Source: Own elaboration

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O. Price variability

Price variability has been calculated using producer price data from FAOStat (table 30). The price is presented individually per country and sector (Chicken meat example in table 7), which means that the first calculation done was variability within countries during the period from 2003 to 2016. Then, the average variability across Europe was calculated. This was done for each sector. Sectors are shown below in table 53, along with calculated variability for each country and the average variability for the whole EU. Sectors were assessed using assessment limits shown in table 52.

Table 52. Assessment limits of the indicator price variability

Assessment Limits (Price variability)	Performance	Description
<19.14%	Good	25% deviation model has been used
<25.52%	Medium	
<31.90%	Upgradeable	
>31.90%	Bad	

Source: Own elaboration

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Table 53. Coefficient of variation for different sectors per country

Country	Lentil	Lupin	Faba beans	Buckwheat	Wheat	Barley	Durum wheat	Sugar beet	Sunflower	Canola	Chives	Chiken Meat	Pork	Milk	Eggs
Austria		13.71%	15.30%		34.17%	32.69%	29.52%	24.69%	34.29%	31.38%		13.72%	14.35%	16.49%	17.43%
Belgium					30.57%	31.70%		14.55%		17.37%		14.81%	12.92%	15.97%	31.54%
Bulgaria	26.93%		37.00%	28.43%	28.43%	30.48%	26.16%	19.48%	30.28%	36.75%	21.80%	14.17%	20.21%	24.90%	20.67%
Cyprus	15.26%		36.86%		39.39%	25.63%	33.38%					18.91%	16.86%	16.46%	21.56%
Croatia	69.34%			25.97%	25.57%	26.80%	27.57%	16.75%	32.42%	36.14%		9.39%	13.07%	16.20%	13.79%
Czechia			25.68%		31.01%	30.82%		13.42%	27.27%	30.76%		16.99%	14.30%	18.56%	20.57%
Denmark					30.38%	28.48%		10.15%		29.00%		23.93%	15.15%	14.43%	18.49%
Estonia					26.44%	27.35%				27.79%		16.52%	16.23%	21.86%	21.80%
Finland			21.96%	29.55%	29.98%	29.73%	48.16%	21.33%		29.60%		13.21%	16.50%	15.26%	22.80%
France		21.95%	9.44%		30.43%	31.85%		17.43%	29.82%	29.13%		15.12%	13.14%	13.36%	26.74%
Germany		6.90%	26.27%		26.19%	22.64%	22.58%	19.16%	27.85%		19.67%	21.41%	15.33%	17.59%	21.79%
Greece	18.71%	26.27%	20.68%	30.22%	30.22%	29.79%	28.49%	29.25%	34.93%	32.53%	19.55%	15.84%	16.35%	11.42%	16.71%
Hungary	38.11%	37.14%			30.26%	33.61%		11.86%	29.27%	28.87%		19.49%	15.43%	17.36%	19.26%
Ireland			20.04%		30.69%	18.71%	24.92%	5.44%		27.47%		12.85%	15.12%	19.09%	15.32%
Italy		20.05%		29.15%	31.43%	33.33%		7.19%	8.50%	26.50%		19.41%	21.96%	11.46%	19.41%
Latvia		21.70%		36.24%	31.68%	32.00%		18.40%		30.04%		22.13%	36.94%	24.59%	18.50%
Lithuania		31.77%	17.83%	37.81%	29.90%	32.16%		18.75%		30.56%		12.29%	15.90%	33.54%	22.04%
Luxemburg					26.51%	32.38%				29.70%		24.12%	42.70%	14.75%	14.60%
Malta			20.87%		17.68%	17.19%						12.94%	17.28%	17.92%	26.74%
Netherlands			9.00%		28.73%	31.28%		23.28%		31.49%		17.14%	13.56%	14.02%	22.74%
Poland		28.76%		32.67%	31.30%	30.66%		17.90%		31.05%		19.31%	19.39%	24.01%	20.69%
Portugal		8.27%	8.27%		30.04%	24.96%	26.57%	29.91%	35.89%			29.64%	16.28%	11.55%	23.53%
Romania					27.18%	27.71%		28.30%	30.48%	33.41%		16.46%	16.79%	31.42%	18.22%
Slovakia	17.13%	28.97%	19.09%	29.98%	29.98%	28.53%	35.40%	19.87%	28.95%	35.15%		18.01%	14.46%	19.84%	25.49%
Slovenia				27.28%	25.29%	26.93%		15.50%	23.66%	33.36%		16.85%	12.07%	13.63%	17.03%
Spain	23.51%	22.88%	25.29%		25.29%	23.37%	27.07%	20.57%	29.60%	19.63%	13.74%	16.70%	30.85%	15.23%	16.92%
Sweden					31.65%	31.75%		22.69%		28.84%		21.99%	13.76%	16.37%	33.24%
U.K.			28.77%		29.82%	30.57%		12.37%		29.44%		13.40%	10.87%	16.50%	16.80%
Average	**29.85%**	**22.36%**	**21.40%**	**30.73%**	**29.29%**	**28.68%**	**29.98%**	**18.26%**	**28.80%**	**29.83%**	**18.69%**	**17.38%**	**17.78%**	**17.99%**	**20.87%**
Assessment	Upgdbl	Medium	Medium	Upgdble	Upgdbl	Upgdbl	Upgdble	Good	Upgdbl	Upgdbl	Good	Good	Good	Upgdbl	Medium

Source: Own elaboration

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P. Contribution to protein security

Contribution to protein security refers to the protein yield. Protein per yield was calculated using average EU yields (in kg per hectare) from 2003 to 2016 (data from FAOStat, table 29) and the average protein composition (data from ANSES, table 37). Non the less, animal products in FAOStat are presented as weight per carcass, which cannot be used to calculate protein yield in kilograms per hectare. Thus, animal product yield in kilograms per hectare was calculated using tables 31 and 32, extracted from deliverable 5.1 "report on scenarios" (IFEU, 2018). Animal product yield can be seen below in table 54, and final protein yield for all the products can be seen in table 56. The assessment is done using assessment limits shown in table 55.

Table 54. Animal-products yield calculation

Commodity	EU Food Supply (thousands of tonnes)	Area harvested for Feeding EU Supply of Animal Origin (thousands of ha)	Yield (Kg/ha)
Dairy Products (Milk)	12,6107	21,475	5,872
Pork Meat	28,523	17,984	1,586
Eggs	6,088	3,084	1,974
Chicken	16,116	7,981	2,019

Source: Own elaboration

Table 55. Assessment limits of indicator contribution to protein security

Assessment Limits (Contribution to protein security)	Performance	Description
>452.84	Good	30% deviation model has been used
>348.33	Medium	
>243.83	Upgradeable	
<243.83	Bad	

Source: Own elaboration

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635727.

Table 56. Protein yield of different commodities

Commodity	Protein content (kg protein/ kg)	Yield (kg/ha)	Protein yield (Kg protein/ha)	Assessment
lupin	0.362	1413.01	511.51	Good
Lentil	0.254	898.68	228.27	Bad
Fababean	0.261	3062.59	799.33	Good
Buckwheat	0.129	1604.99	207.04	Bad
Wheat	0.115	5346.99	614.90	Good
Barley	0.134	4460.45	597.70	Good
Durum Wheat	0.13	2766.08	359.59	Medium
Sunflower seeds	0.213	1825.17	388.76	Medium
Canola Seeds	0.19	3104.22	589.80	Good
Sugar Beet	0.068	66956.23	4553.02	Good
Chives	0.0262	1362.32	35.69	Bad
Chicken	0.2	2019.29	403.86	Medium
Pork	0.223	1586.02	353.68	Medium
Milk	0.03	5872.27	176.17	Bad
Egg	0.127	1974.06	250.71	Upgradeable

Source: Own elaboration

Q. Product features relevant for consumers

Product features relevant for consumers consist in a series of five indicator assessing saturated fat content, fibre content, vitamin content, cholesterol content, and protein content. Products' compositions have been extracted from the French Food Composition Table Tool (ANSES, 2018) shown in tables 33 (saturated fat), 34 (fibre), 35 (vitamins) and 36 (cholesterol), and from Deliverables D3.1 (UCC,2016) and D3.2 (IVV, 2018) shown in table 38 (final product protein content). No calculation was done except for the average value of each feature. Saturated fat and protein content are shown below in table 58 and 60 as examples. Assessments were done using assessment limits shown in table 57 for saturated fat content and in table 59 for protein content. The three other features (fibre, vitamins and cholesterol content) were assessed in the same way, and assessment limits have all been calculated by adding up and down 25% of the average of each feature.

Table 57. Assessment limits of indicator saturated fat content

Assessment Limits (Saturated fat content)	Performance	Description
<1.12	Good	25% deviation model has been used
<1.49	Medium	
<1.86	Upgradeable	
>1.86	Bad	

Source: Own elaboration

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Table 58. Saturated fat content

Commodity	Value (g/100g)	Assessment
Lupin/Lentil protein isolate	0	Good
Fababean	0.01	Good
Buckwheat flour	0.33	Good
Wheat	0.6	Good
Durum Wheat (semolina)	0.21	Good
Sunflower oil	10.9	Bad
Canola oil	7.26	Bad
Sugar	0	Good
Chives	0.15	Good
Brewer`s yeast flakes	0.7	Good
Chicken, breast, without skin, cooked	0.55	Good
Pork meat and fat	5.1	Bad
Milk (whole, Pasteurized)	2.16	Bad
Egg	2.64	Bad

Source: Own elaboration

Table 59. Assessment limits of indicator protein content

Assessment Limits (Protein content)	Performance	Description
>13	Good	25% deviation model has been used
>9	Medium	
>5	Upgradeable	
<5	Bad	

Source: Own elaboration

Table 60. Protein content

Final product	Value (g/100g)	Assessment
P2F prototype VMA-fibre	30	Good
Traditional chicken meat	21.4	Good
P2F prototype VMA-spread type LEBERWURST (liver pâté)	12.5	Medium
Traditional spread type LEBERWURST variant 1	15	Good
P2F prototype fresh vegan pasta	13.9	Good
Traditional fresh egg pasta	7.8	Upgradeable
P2F prototype bread	12	Medium
Traditional Bread	8.22	Upgradeable
P2F prototype vegan milk	3.3	Bad
Traditional Dairy milk	3.32	Bad

Source: Own elaboration

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R. Protein Affordability

Protein affordability has been calculated based on protein content of P2F and traditional final products and on prices of similar products available on the market. Thus, tables 38 (final product protein content) and 39 (final product's price) were used to calculate the price of protein in euros per kilogram. Table 62 below shows protein prices provided by products analysed in this S-LCA. Assessment limits are shown in table 61.

Table 61. Assessment limits of indicator protein affordability

Assessment Limits (Protein affordability)	Performance	Description
<44.18	Good	25% deviation model has been used
<58.91	Medium	
<73.64	Upgradeable	
>73.64	Bad	

Source: Own elaboration

Table 62. Protein price of final products

Final product	Protein content (Kg protein/kg product)	Final product price (€/kg product)	Protein price (€/Kg protein)	Assessment
P2F prototype VMA-fibre	0.3	16.61	55.37	Medium
Traditional chicken meat	0.214	10	46.73	Medium
P2F prototype VMA-spread type LEBERWURST (liver pâté)	0.125	15.92	127.36	Bad
Traditional spread type LEBERWURST variant 1	0.15	9.95	66.33	Upgradeable
P2F prototype fresh vegan pasta	0.139	11.6	83.45	Bad
Traditional fresh egg pasta	0.078	3.725	47.76	Medium
P2F prototype vegan milk	0.033	2.25	68.18	Upgradeable
Traditional Dairy milk	0.0332	1.05	31.63	Good
P2F prototype bread	0.12	4	33.33	Good
Traditional Bread	0.0822	2.38	28.95	Good

Source: Own elaboration

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ANNEX III. Total score per product and stakeholder

Final scores for products and stakeholders can be seen below. Indicators have been weighted considering that they all weigh the same. A score was given to each assessment as follows: Good = 1; Medium = 2; Upgradeable = 3; Bad = 4. This means that higher the average score, the worse the assessment. It is done this way because S-LCA is intended to highlight possible hotspots along the life cycle of product. Results are shown below in tables 63 to 67 which correspond to *fibre like category*, *spread type category*, *pasta category*, *milk category*, *and bread category* respectively.

Table 63. Score per product and stakeholder. Fibre-like vegetable meat alternative (VMA-fibre) and Traditional meat alternative

Life cycle Stage	Stakeholder	Indicator	Fibre-like vegetable meat alternative			Traditional Meat alternative		
			Assessment	Score	Average	Assessment	Score	Average
Production	Agricultural workers	AW<NPL	Medium	2	2.125	Medium	2	2.125
		AW<MW	Medium	2		Medium	2	
		Excessive Working time	Good	1		Good	1	
		Gender Equality	Good	1		Good	1	
		Fatal Injuries	Bad	4		Bad	4	
		Non-fatal Injuries	Bad	4		Bad	4	
		Unemployment	Medium	2		Medium	2	
		Labour laws	Good	1		Good	1	
	Farmer	Profitability	Medium	2	2.6	Good	1	1.6
		Net Margin	Upgradeable	3		Good	1	
		CAP Voluntary coupled Support	Upgradeable	3		Bad	4	
		Yield Variability	Upgradeable	3		Good	1	
		Price Variability	Medium	2		Good	1	
	Soc.	Protein Security	Medium	2	2	Medium	2	2
Processing and Retail	Workers	AW<NPL	Good	1	2.125	Medium	2	2.25
		AW<MW	Medium	2		Medium	2	
		Excessive Working time	Good	1		Good	1	
		Gender Equality	Medium	2		Medium	2	
		Fatal Injuries	Medium	2		Medium	2	
		Non-fatal Injuries	Bad	4		Bad	4	
		Unemployment	Medium	2		Upgradeable	3	
		Labour laws	Upgradeable	3		Medium	2	
Consumption	Consumer	Saturated Fat Content	Good	1	2.2	Good	1	2.4
		Fiber Content	Bad	4		Bad	4	
		Vitamins Content	Bad	4		Medium	2	
		Cholesterol Content	Good	1		Bad	4	
		Protein Content	Good	1		Good	1	
	Soc.	Protein Affordability	Medium	2	2	Medium	2	2
		Total average		2.21		Total average	2.11	

Source: Own elaboration

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Table 64. Score per product and stakeholder. P2F VMA-spread type LEBERWURST (liver pâté) and Traditional spread type LEBRWURST variant 1

Life cycle Stage	Stakeholder	Indicator	P2F VMA-spread type LEBERWURST			Traditional spread type LEBERWURST variant 1		
			Assessment	Score	Average	Assessment	Score	Average
Production	Agricultural workers	AW<NPL	Medium	2	2.25	Medium	2	2.25
		AW<MW	Medium	2		Medium	2	
		Excessive Working time	Good	1		Good	1	
		Gender Equality	Medium	2		Medium	2	
		Fatal Injuries	Bad	4		Bad	4	
		Non-fatal Injuries	Bad	4		Bad	4	
		Unemployment	Medium	2		Medium	2	
		Labour laws	Good	1		Good	1	
	Farmer	Profitability	Medium	2	2.6	Good	1	1.6
		Net Margin	Medium	2		Good	1	
		CAP Voluntary coupled Support	Upgradeable	3		Bad	4	
		Yield Variability	Upgradeable	3		Good	1	
		Price Variability	Upgradeable	3		Good	1	
	Soc.	Protein Security	Medium	2	2	Medium	2	2
Processing and Retail	Workers	AW<NPL	Good	1	2.125	Medium	2	2.25
		AW<MW	Medium	2		Medium	2	
		Excessive Working time	Good	1		Good	1	
		Gender Equality	Medium	2		Medium	2	
		Fatal Injuries	Medium	2		Medium	2	
		Non-fatal Injuries	Bad	4		Bad	4	
		Unemployment	Medium	2		Upgradeable	3	
		Labour laws	Upgradeable	3		Medium	2	
Consumption	Consumer	Saturated Fat Content	Medium	2	2.4	Bad	4	3.2
		Fiber Content	Bad	4		Bad	4	
		Vitamins Content	Upgradeable	3		Upgradeable	3	
		Cholesterol Content	Good	1		Bad	4	
		Protein Content	Medium	2		Good	1	
	Soc.	Protein Affordability	Bad	4	4	Upgradeable	3	3
		Total average		2.36	Total average		2.32	

Source: Own elaboration

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Table 65. Score per product and stakeholder. P2F prototype fresh vegan pasta and Traditional fresh egg pasta

Life cycle Stage	Stakeholder	Indicator	P2F prototype fresh vegan pasta			Traditional fresh egg pasta		
			Assessment	Score	Average	Assessment	Score	Average
Production	Agricultural workers	AW<NPL	Medium	2	2.125	Medium	2	2.125
		AW<MW	Medium	2		Medium	2	
		Excessive Working time	Good	1		Good	1	
		Gender Equality	Good	1		Good	1	
		Fatal Injuries	Bad	4		Upgradeable	3	
		Non-fatal Injuries	Bad	4		Bad	4	
		Unemployment	Medium	2		Medium	2	
		Labour laws	Good	1		Medium	2	
	Farmer	Profitability	Upgradeable	3	2.8	Good	1	2.6
		Net Margin	Upgradeable	3		Medium	2	
		CAP Voluntary coupled Support	Upgradeable	3		Upgradeable	3	
		Yield Variability	Medium	2		Bad	4	
		Price Variability	Upgradeable	3		Upgradeable	3	
	Soc.	Protein Security	Good	1	1	Medium	2	2
Processing and Retail	Workers	AW<NPL	Good	1	2.125	Good	1	2.25
		AW<MW	Medium	2		Medium	2	
		Excessive Working time	Good	1		Good	1	
		Gender Equality	Medium	2		Medium	2	
		Fatal Injuries	Medium	2		Medium	2	
		Non-fatal Injuries	Bad	4		Bad	4	
		Unemployment	Upgradeable	3		Upgradeable	3	
		Labour laws	Medium	2		Upgradeable	3	
Consumption	Consumer	Saturated Fat Content	Good	1	2.2	Good	1	3.2
		Fiber Content	Bad	4		Bad	4	
		Vitamins Content	Bad	4		Bad	4	
		Cholesterol Content	Good	1		Bad	4	
		Protein Content	Good	1		Upgradeable	3	
	Soc.	Protein Affordability	Bad	4	4	Medium	2	2
		Total average		2.29	Total average		2.43	

Source: Own elaboration

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Table 66. Score per product and stakeholder. P2F prototype vegan milk and Traditional dairy milk

Life cycle Stage	Stakeholder	Indicator	P2F prototype vegan milk			Traditional dairy milk		
			Assessment	Score	Average	Assessment	Score	Average
Production	Agricultural workers	AW<NPL	Medium	2	2.125	Medium	2	2.125
		AW<MW	Medium	2		Medium	2	
		Excessive Working time	Good	1		Good	1	
		Gender Equality	Good	1		Good	1	
		Fatal Injuries	Bad	4		Bad	4	
		Non-fatal Injuries	Bad	4		Bad	4	
		Unemployment	Medium	2		Medium	2	
		Labour laws	Good	1		Good	1	
	Farmer	Profitability	Medium	2	2.6	Good	1	1.4
		Net Margin	Upgradeable	3		Good	1	
		CAP Voluntary coupled Support	Upgradeable	3		Good	1	
		Yield Variability	Medium	2		Good	1	
		Price Variability	Upgradeable	3		Upgradeable	3	
	Soc.	Protein Security	Good	1	1	Bad	4	4
Processing and Retail	Workers	AW<NPL	Good	1	2	Good	1	2.125
		AW<MW	Medium	2		Medium	2	
		Excessive Working time	Good	1		Good	1	
		Gender Equality	Medium	2		Medium	2	
		Fatal Injuries	Medium	2		Medium	2	
		Non-fatal Injuries	Upgradeable	3		Bad	4	
		Unemployment	Medium	2		Upgradeable	3	
		Labour laws	Upgradeable	3		Medium	2	
Consumption	Consumer	Saturated Fat Content	Good	1	2.8	Bad	4	3.4
		Fiber Content	Bad	4		Bad	4	
		Vitamins Content	Bad	4		Bad	4	
		Cholesterol Content	Good	1		Good	1	
		Protein Content	Bad	4		Bad	4	
	Soc.	Protein Affordability	Upgradeable	3	3	Good	1	1
		Total average		2.29	Total average		2.25	

Source: Own elaboration

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Table 67. Score per product and stakeholder. P2F prototype bread and Traditional wheat bread

Life cycle Stage	Stakeholder	Indicator	P2F prototype bread			Traditional wheat bread		
			Assessment	Score	Average	Assessment	Score	Average
Production	Agricultural workers	AW<NPL	Medium	2	2.25	Medium	2	2.25
		AW<MW	Medium	2		Medium	2	
		Excessive Working time	Good	1		Good	1	
		Gender Equality	Medium	2		Medium	2	
		Fatal Injuries	Bad	4		Bad	4	
		Non-fatal Injuries	Bad	4		Bad	4	
		Unemployment	Medium	2		Medium	2	
		Labour laws	Good	1		Good	1	
	Farmer	Profitability	Upgradeable	3	2.6	Upgradeable	3	2.6
		Net Margin	Upgradeable	3		Upgradeable	3	
		CAP Voluntary coupled Support	Upgradeable	3		Upgradeable	3	
		Yield Variability	Good	1		Good	1	
		Price Variability	Upgradeable	3		Upgradeable	3	
	Soc.	Protein Security	Good	1	1	Good	1	1
Processing and Retail	Workers	AW<NPL	Good	1	2.25	Good	1	2.25
		AW<MW	Medium	2		Medium	2	
		Excessive Working time	Good	1		Good	1	
		Gender Equality	Medium	2		Medium	2	
		Fatal Injuries	Medium	2		Medium	2	
		Non-fatal Injuries	Bad	4		Bad	4	
		Unemployment	Upgradeable	3		Upgradeable	3	
		Labour laws	Upgradeable	3		Upgradeable	3	
Consumption	Consumer	Saturated Fat Content	Good	1	2.4	Good	1	2.6
		Fiber Content	Bad	4		Bad	4	
		Vitamins Content	Bad	4		Bad	4	
		Cholesterol Content	Good	1		Good	1	
		Protein Content	Medium	2		Upgradeable	3	
	Soc.	Protein Affordability	Good	1	1	Good	1	1
		Total average		2.25		Total average	2.29	

Source: Own elaboration

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