

**Thinking the future with citizens: a participatory foresight  
approach for assessing beef consumption patterns in the  
future**

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**Industrial Engineering and Management**

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## **Declaration**

I declare that this document is an original work of my own authorship and that it fulfils all the requirements of the Code of Conduct and Good Practices of the Universidade de Lisboa.

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## **Abstract**

Beef has long been present in human diets. However, the rising contradictory information about the effects of its consumption, alongside the pandemic situation and the current war, is making the future of beef production more uncertain. Hence, this industry needs to take an active role in preparing and planning appropriate strategies to guarantee its businesses. Several forecasting studies have been developed on this topic, nevertheless, forecasts do not adequately explain the large variety of potential outcomes or begin to capture the range of uncertainty. Thus, it is necessary to understand potential futures and how they will impact different key factors, improving the ability to handle upcoming challenges. Accordingly, a foresight participatory scenario planning (PSP) approach, with large citizen involvement, is developed. Primarily, a review of existent studies is conducted to understand how PSP methodologies have been developed. Thereafter, a PSP methodology is developed and applied to identify key drivers of change and generate two contrasting scenarios for beef consumption in the Portuguese population until 2050. Sixty drivers are identified as most relevant/impacting in influencing the future of beef consumption and are used to build two opposite scenarios: “Beef deal” (describing a future with high, yet plausible, consumption) and “No deal” (describing a future with low, yet plausible, consumption). The work is developed in collaboration with FeedInov CoLAB, allowing contact with field experts, reaching a larger audience, and having an impact on the industry. The scenarios are expected to be used to inform the industry and aid in decision-making processes.

**Keywords:** Foresight, Participatory scenario planning, Cattle meat consumption, Portuguese population, Citizen involvement

## Resumo

A carne de bovino está há muito presente na dieta humana. Contudo, a crescente informação contraditória sobre os efeitos do seu consumo, juntamente com a pandemia e a guerra, torna o futuro da produção da carne de bovino mais incerto. Assim, é necessário, esta indústria, preparar e planear estratégias adequadas para garantir os seus negócios. Vários estudos de previsão foram desenvolvidos neste contexto, porém, previsões não explicam adequadamente a elevada variedade de potenciais futuros, nem captam toda a incerteza. Consequentemente é necessário obter uma maior compreensão sobre potenciais futuros e como estes impactam diferentes fatores-chave, melhorando a capacidade de lidar com desafios futuros. Para isto é desenvolvida uma abordagem prospetiva de planeamento participativo de cenários (PSP), com elevado envolvimento de cidadãos. Primeiramente é realizada uma revisão de estudos existentes, para compreender o desenvolvimento de diferentes metodologias PSP. Posteriormente é desenvolvida e aplicada uma metodologia PSP para identificar os principais fatores de mudança e gerar dois cenários contrastantes para o consumo da carne de bovino na população portuguesa, até 2050. Sessenta fatores são identificados como mais relevantes/impactantes para influenciar o futuro do consumo da carne de bovino e utilizados para construir dois cenários opostos e plausíveis: "Beef deal" (descrevendo um futuro com consumo elevado) e "No deal" (descrevendo um futuro com baixo consumo). O trabalho é desenvolvido em colaboração com o FeedInov CoLAB, permitindo contactar peritos na área, atingir maior participação e impacto na indústria. Espera-se que os cenários sejam usados para informar a indústria e ajudar na tomada de decisão.

**Palavras-chave:** Prospetiva, Planeamento participativo de cenários, Consumo de carne de bovino, População portuguesa, Participação dos cidadãos

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## List of abbreviations

<b>BAU</b>	Business-as-usual
<b>CoLAB</b>	Collaborative laboratory
<b>GEM</b>	Group Elicitation Method
<b>PhD</b>	Doctorate
<b>PSP</b>	Participatory scenario planning
<b>WEF</b>	World Economic Forum
<b>WWF</b>	World Wide Fund for Nature

# 1 Introduction

This chapter provides a brief introduction to the work developed in this dissertation. It starts by giving an overview of the problem and the study's motivation (section 1.1); then, the objectives of the dissertation are set (section 1.2), and the dissertation's structure is presented (section 1.3).

## 1.1 Problem contextualisation and motivation

Food is a basic human need. It is on the basis of human development, shaping its existence whether physically or mentally. Since the beginning of human existence, food consumption patterns have changed and evolved following the evolution of our species. As stated by Mann (2018) four million years ago, our bipedal ancestors witnessed a transition in their food habits, introducing animal-source foods into their former frugivorous diet. This has marked the introduction of meat consumption in human diets. Such consumption has been increasing over time with an emphasis from the 1980s (González et al., 2020).

Meat consumption is a controversial topic. On one hand, meat consumption, especially red meat, significantly adds to essential nutrients intake (McAfee et al., 2010) and it is considered to be an excellent source of high-quality protein (Wyness, 2016). Thus, contributing to healthier lifestyles since these two factors are essential to optimal health (Wyness, 2016). However, there is growing evidence stating that the consumption of meat causes significant problems related to resource use and has a negative environmental impact. Also, it is associated with critical health diseases (Ferreira et al., 2021). With so much information available to the public, consumers' consumption patterns are being shaped. Associated with this, there is an increasing uncertainty regarding consumers' preferences and willingness to substitute meat for lab-grown or plant-based meat. Hence, the meat industry is under severe strain.

Moreover, the recent pandemic situation and the ongoing war in Ukraine add to this uncertainty. Consumers' eating habits have been affected by disrupted food supply chains, as well as the increasing media attention to food safety issues caused by the COVID-19 pandemic (Attwood & Hajat, 2020). Also, the Ukrainian conflict threatens the world food supply. The Ukrainian-Russian region plays an important role not just as an exporter of core commodities such as wheat, but also as one of the world's leading suppliers of fertilizer (Fusaro & Rahilly, 2022). Thus, contributing to inflation and food availability.

With the raising uncertainty in today's world regarding what the future may hold in the food industry and in particular the meat industry, there is a need for this industry to be able to take an active role, in preparing and planning appropriate strategies, having in mind what can possibly happen. Several forecasting studies have been developed to cover predictions on future meat consumption. Examples of these studies include the development of models to forecast meat consumption in Australia (Wong et al., 2015) or specifically red meat in Turkey (Özen, 2019), as well as forecasting meat consumption at the table cut level in Mexico (A. Lopez & E. Malaga, 2009). This technique is used to predict what will happen based on past and present events, enabling organizations to plan their future steps and build

budgets that will ideally handle any uncertainties that may arise (Corporate Finance Institute, 2022). Nevertheless, forecasting methods usually produce a single prediction about the future and do not take into consideration disruptive events (Tietje, 2005), also, by grounding these predictions on past and present occurrences they tend not to consider significant trends until it becomes too late (Stokke et al., 1990). Therefore, forecasts do not adequately explain the large variety of potential outcomes or even begin to capture the range of uncertainty, leading to the need of having a deeper grasp of potential futures and how different key decision factors will be impacted by those futures (Stokke et al., 1990), in order to improve the ability to handle upcoming challenges and the decision-making process (European Foresight Platform, n.d.).

The field of foresight, and in particular, scenario planning provides the necessary tools to achieve these goals (Alvarenga et al., 2019). Scenario planning is a systematic approach to thinking about and considering “dynamic, complex and uncertain futures” as well as preparing for a variety of outcomes by planning adequate strategies (Reed et al., 2013). In addition, it enables the construction of numerous alternative futures, holistically aiding the future planning process, and improving the effectiveness of decision-making and the capability to deal with complex and uncertain environments (Amer et al., 2013; Reed et al., 2013). As noted by Reed et al. (2013) “By telling stories about what the future might hold, it is possible to build up plausible scenarios that we can prepare for”.

Considering several feasible scenarios, enables the food industry to take a proactive stand and foresee potential strategies to prepare for what may come (Alvarenga et al., 2019). The need to explore the implications of drastic changes in consumption patterns, such as meat consumption, through foresight studies, arises. By developing scenarios, the food industry, and specifically the cattle meat industry, is capable of identifying options on how unfavourable developments might be prevented and is capable of guaranteeing that food systems are able to meet changes in demand (Haen & Réquillart, 2014).

Nonetheless, for the scenarios to be relevant, consistent, and useful, the whole process to develop them should follow a participatory approach, involving “the people whose futures are being discussed” (Reed et al., 2013). For this, broad citizen involvement in the study is crucial. By taking into account various stakeholders’ perspectives, it is possible to have a better reflection on the problem, enable an interactive foundation required for creating collaborative thinking and provide a learning environment for all participants (Patel et al., 2007). However, involving participants in the scenario development process has some challenges associated (Tompkins et al., 2008; Carlsen et al., 2013).

All in all, the cattle meat industry is facing severe uncertainty regarding consumers’ eating habits. With this, the need to understand what may occur to cattle meat consumption, in the Portuguese population, in the future, is essential so the industry is informed on possible future evolutions to be able to take action. To meet this need, participatory scenario planning offers a suitable tool. Very few studies on scenario planning in the literature have been dedicated to the food industry. Of the identified ones, none address cattle meat consumption specifically. The topics addressed are food sustainability, food security and the development of the palm oil sector. Moreover, none of the studies relates to the Portuguese market, increasing the need to develop these types of studies for Portugal, on a national level since consumption patterns are locally specific (Haen & Réquillart, 2014).

## **1.2 Objectives and contribution**

This dissertation's main objective is to develop and apply a participatory scenario planning methodology to explore how the future may unfold concerning consumers' preferences and willingness to change cattle meat consumption patterns, in Portugal.

To achieve this main objective, three specific objectives are set:

1. Identify studies that apply scenario planning methodologies involving participation in complex environments, to have an overview of what has been made and how it has been made in the literature.
2. Identify the factors that are expected to influence cattle meat consumption in the Portuguese population in the future, by the population itself, with large citizen involvement.
3. Finally, build the scenarios. These describe alternative possible developments for the future, according to two extreme contrasting points of view, employing the Extreme-World method.

Hence, an assessment of consumer trends for 28 years, concerning cattle meat consumption is done. The second objective of identifying the main factors that are expected to influence cattle meat consumption in the Portuguese population is a crucial step to build the scenarios.

The methodology applied follows the work already conducted by Alvarenga et al. (2019) in "Scenarios for population health inequalities in 2030 in Europe: the EURO-HEALTHY project experience" where scenarios to assess the future of population health inequalities across European regions were constructed. Some adaptations to the social component of this methodology are made since the work developed hereinafter explores a large participatory concept and thus, it must fit the large citizen participation.

All the work presented herein is developed in collaboration with FeedInov collaborative laboratory (FeedInov CoLAB), which is an interface entity that powers industry-driven research to offer solutions to current and future challenges in the livestock sector by establishing a link between academics and this sector. By doing so, it is possible to deal with a real-life case involving major experts and decision-makers.

The study contributes to the literature on citizen participation in scenario building due to the innovation of the adapted methodology developed, for FeedInov CoLAB by means of the outcomes of the research and to the cattle meat industry in itself, by providing information, enabling adequate strategic planning and preparedness for the possible future developments, when living uncertain times.

## **1.3 Dissertation structure**

The dissertation's structure is presented in Figure 1. It is divided into seven chapters, and each has a brief description of what is addressed in it.

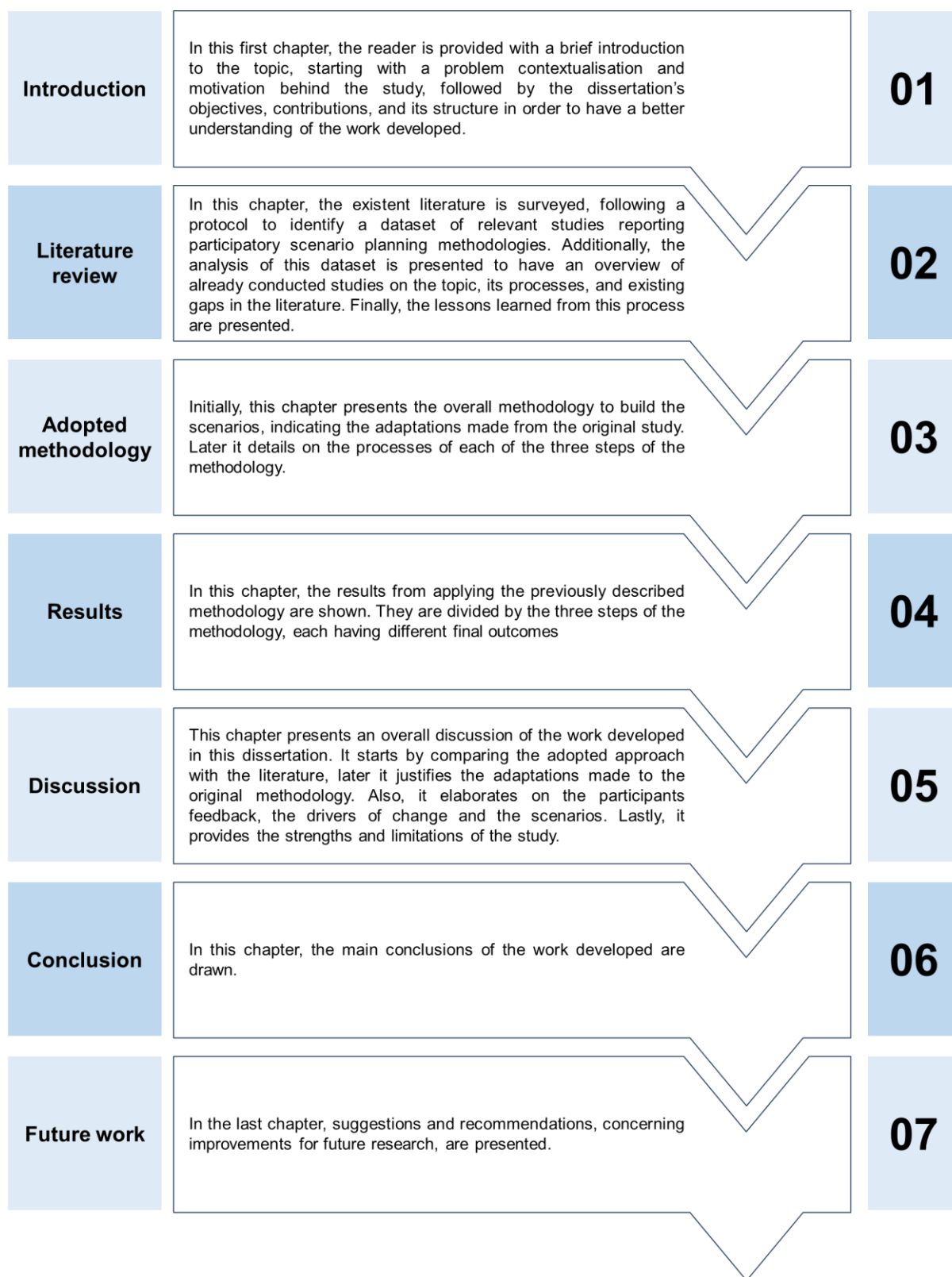


Figure 1 - Dissertation's structure

## 2 Literature review

In this chapter, a systematic review of the existing literature on participatory scenario planning methodologies is performed, providing an overview of what has already been done in this field of study, insights into the entire processes of building the scenarios and the gaps present in the literature. The review focuses on scenarios being developed for highly complex environments that consequently deal with a high number of uncertainties. The aim is to understand how the incorporation of many uncertainties in the scenario development process has been managed, and how methods, in these complex contexts, have been developed in the literature. Section 2.1 begins to describe the protocol followed, the inclusion and exclusion criteria for the dataset of relevant scientific articles, as well as the research questions addressed to the articles. Later in section 2.2, the results (final dataset) are analysed and critically evaluated to provide a clear picture of the state of knowledge on the topic. Section 2.3 presents the main gaps in the literature and at the end of the chapter, section 2.4, the lessons learned, from all the case studies analysed, are described, and a comparison of the methodology developed in this dissertation is drawn upon them.

### 2.1 Dataset and research questions

The systematic research to generate the final set of relevant articles on PSP methodologies is structured following the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement. As portrayed in Figure 2 the research is divided into four stages: two comprising the search on databases with specific terms, one including relevant articles cited in studies that were excluded in the previous stage and finally, one covering the scenario planning references from a previously identified article on the topic “An Approach to Multi-Criteria Decision Problems Under Severe Uncertainty” by Comes et al. (2013). Prior to the systematic research, this article was found to be an interesting insight for the study, as it links two approaches to decision-making in complex contexts, one of which is scenario planning. Since the article had not been included in the research through the previous stages, either from the direct search on the databases or by being mentioned in included articles, this fourth stage was seen as a crucial step to include key publications regarding PSP methodologies involving a high number of uncertainties.

In the first stage, the first step involves identifying potentially relevant articles for the review. For this, three databases were selected and used, namely, Socups, ScienceDirect and Web of Science. The search was performed in April 2022 in this exact respective order of databases. From an initial random search on Google scholar regarding PSP studies, it was possible to identify a pattern in some common terms which were useful to implement in the research. These terms were then used as search words in the three databases: “Scenario planning”, “Scenario building”, “Participatory”, “Method” and “Stakeholder”. Scenario planning was used together with scenario building using an OR operator, meaning the results must include one term or another, the remaining words were used with an AND operator, meaning the results had to include all the terms. The words were applied to title, abstract and



keyword (Scopus), respectively title, abstract and author specified keyword (ScienceDirect) and respectively topic (Web of Science).

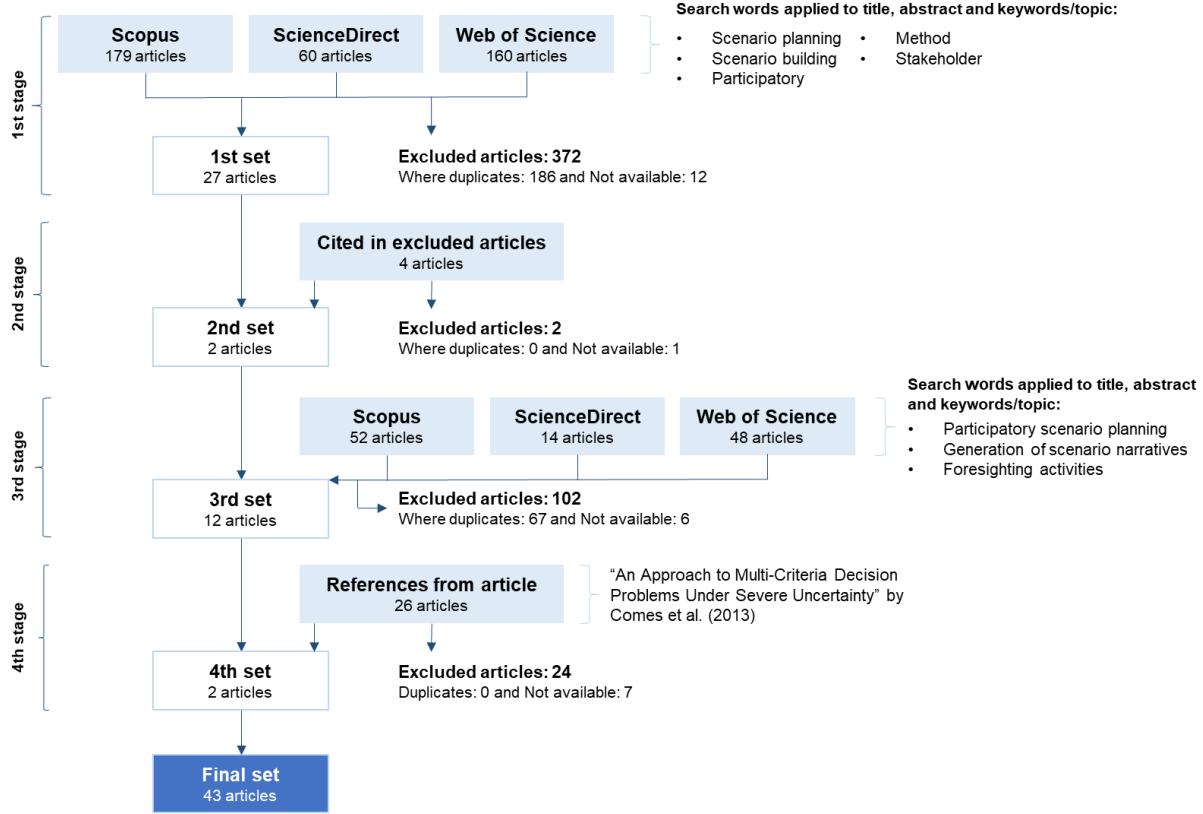


Figure 2 - PRISMA scheme for final dataset generation of relevant scientific articles

Having in mind that the PSP method developed hereinafter is done in a highly complex context, it would be useful to use the term wicked as a search word simultaneously. However, this reduced the results drastically to approximately fifteen articles. Nevertheless, the research considered the wicked context of the articles in the inclusion/exclusion criteria.

The results from the three databases were limited to review and research articles and short communication papers, all written in English or Portuguese which are the two spoken languages of the researcher. Regarding the review articles the aim was to possibly identify relevant publications on PSP methodologies through them since they outline the current state of knowledge on a subject. From the research articles and short communications, the aim was to identify PSP methodologies in themselves since they provide relevant material on the research done. Thus, these types of articles were found to be relevant to the mentioned objectives. There were no limitations on the subject area or the year of publication. After this step, a total of 399 articles were identified.

For the articles to be relevant to this study they must have the same scope as the one developed in this dissertation, hence they must illustrate at least one scenario planning method with a participatory component in a complex context, not using mathematical models. An approach to defining what can be considered a complex environment was followed, based on what is noted by (Amer et al., 2013), in this way the exclusion criterion, for not being a complex problem, resorts to constructing the scenarios with

less than 5 uncertainties. Based on this it was possible to reach a list of exclusion criteria shown in Table 1.

*Table 1 - Exclusion criteria with corresponding definition and number of excluded articles during the four stages of the systematic search*

<b>Exclusion criterion</b>	<b>Description</b>	<b># of excluded articles</b>
Duplicates	<i>Articles already included from other databases</i>	253
No method but application	<i>Article does not describe the methodology but has information on the application of the scenarios</i>	55
Not complex	<i>Construction of scenarios with less than 5 uncertainties</i>	43
No method and no application	<i>Article does not describe the methodology neither the application of the scenarios</i>	40
Use of mathematical models	<i>Construction of scenarios through mathematical models</i>	33
Not a foresight method	<i>Article does not refer to a foresight method</i>	32
Not available	<i>Articles can not be accessed</i>	26
Complexity unknown	<i>Does not state the number of uncertainties used to construct scenarios neither states that it is a wicked problem</i>	13
No participation	<i>Scenario planning process done without a participatory component</i>	4
Other foresight method	<i>Article does not refer to scenario planning</i>	1
<b>Total</b>		<b>500</b>

After excluding duplicates and articles that could not be retrieved, the remaining 201 articles were assessed manually, and the exclusion criteria were applied. In this stage, 27 articles were found to be relevant and further included in the dataset and 174 were excluded. These excluded articles were tagged with the respective criterion that led to the exclusion.

Four excluded articles in the first stage referred to scenario planning but did not present any methodology, however, they quoted four other articles where the methodology was detailed. These three articles were included in the second stage and were analysed by applying the exclusion criteria. From this step, two more articles were added to the dataset.

At this point, only 29 articles were added to the dataset of relevant articles, which leads to think that the first stage of the systematic search was too restrictive. Therefore, the third stage aimed at including more relevant articles and followed the same approach as the one from the first stage. The databases used were the same and the search order was as well. This step was done in June 2022 and applied “Participatory scenario planning”, “Generation of scenario narratives” and “Foresighting activities” as search words resorting to the OR operator to make the research wider. Once again, the words were applied to title, abstract and keyword (Scopus), respectively title, abstract and author specified keyword (ScienceDirect) and respectively topic (Web of Science).

The results were limited to the same aspects as the ones from the first stage and at the end, a total of 114 articles were identified. After excluding duplicates and articles that could not be retrieved, the remaining articles (41) were assessed manually, and the exclusion criteria were applied. 29 articles included at least one exclusion criterion, and each article was tagged with the respective reason for exclusion. The resulting 12 relevant articles from this stage were added to the dataset.

With the aim of including key publications in the field looking into complexity and uncertainty, a fourth and last stage of the systematic search was carried out. This stage had as input an article combining scenario planning and Multi-Criteria decision analysis: “An Approach to Multi-Criteria Decision Problems Under Severe Uncertainty” by (Comes et al., 2013). By analysing this article, it was possible to retrieve articles linked to scenario planning. At this stage, only journal articles were identified. To the final dataset, two more relevant articles were added after excluding those who did not gather all the conditions to be included. A final set of 43 relevant articles (see Articles included in the systematic literature review), fulfilling all the conditions to be included, was achieved after applying the described protocol.

For systematically analysing this final set of articles, to be able to have a deeper understanding of what has been done in the past regarding PSP methodologies developed in complex contexts and potentially identifying some existing gaps in the literature, a set of research questions was elaborated. The aim is to understand why, how, and where PSP processes have been applied, the specific methods and tools used for the construction of scenarios and the details regarding the final outcomes of the projects. The purpose, therefore, is to answer the following research questions, shown in Table 2, addressed in the articles from the final dataset.

*Table 2 - Research questions and corresponding dimension of analysis*

<b>Research questions</b>	<b>Dimension</b>
In which year was the study published?	Bibliographic information
In which journal is the study published?	
What is the purpose for creating the scenarios?	Case study information
What is the field of study addressed?	
Where is the study developed?	
What is the foresight period of the study?	
How many variables/uncertainties are considered for the construction of the scenarios?	
How many final scenarios are constructed?	
What is the scenario perspective (normative or descriptive)?	Methodological concept
Which school of thought serves as the basis for building the scenarios, or name of the method implemented?	
What is the general framework used?	
Which auxiliary methods are implemented to assist the scenario planning process?	
What are the criteria used to identify and select participants?	Participatory concept
How many participants are involved?	
What is the background of the participants?	
What are the methods used for the participatory component of the overall process?	
What is the level of the scenario construction process that the participatory methods were used?	
Which material is given as input, to the participants, for the development of scenarios?	
Do the participants work with scientific evidence?	
What is the role of the facilitating team?	
How much time does the process last?	Evaluation
Are the scenarios displayed in the article?	
Are the scenarios quantitative or qualitative?	
What are the total costs of the project?	
What is the feedback from the participants regarding the methodology applied?	
Which are the lessons learned and challenges throughout the scenario construction process?	
What is the expected use of scenarios?	
What are the recommendations given for the scenario construction process or use of scenarios?	
How many times is the article cited in the literature?	
Which other methods are developed simultaneously in the article?	

Moving forward to the analysis, the documentation of the articles regarding the research questions is organized into six dimensions, also presented in Table 2: bibliographic information, case study information, methodological concept, participatory concept, evaluation, and supplementary information. A new taxonomy was created where the data is collected in the form of a table, presented in <https://docs.google.com/spreadsheets/d/e/2PACX1vSip8LewdPfoDcX3nVulx5HTWxi254JmSrBuxfChje6QiUOPZE2kLIKQy01TggQ/pubhtml> (PSP documentation taxonomy) containing all the information described above plus information on the authors, title, and keywords of the article, also four topics from this table can be seen in Table A.44 (Appendix A). The topics included in the table are inspired by the work already developed by Raford, 2015 and Amer et al., 2013, the first one from taxonomy used when analysing an online foresight platform, and the later from a comparison of different scenario techniques. From the 43 relevant articles identified, the documentation taxonomy includes 49 case studies due to specific articles containing more than one case study.

**2.2 Results**

**2.2.1 Study Sample**

All the articles gathered from the systematic research, are from this century, covering a period of seventeen years, from 2006 until 2022, even though there was no restriction on the year of publication. There is at least one publication per year, except for the years 2009 and 2010 which did not retrieve any article. From 2011 on, the number of articles published increased in general, but it is not possible to observe a trend in the raising quantity, since the number of publications swing. 2013 accounts for the highest number of articles (seven) and more recently, 2021 accounts for the second highest number of articles (six) as shown in Figure 3. Also, almost half of the case studies, 40%, are from 2018 on, showing that the sample of documents is recent.

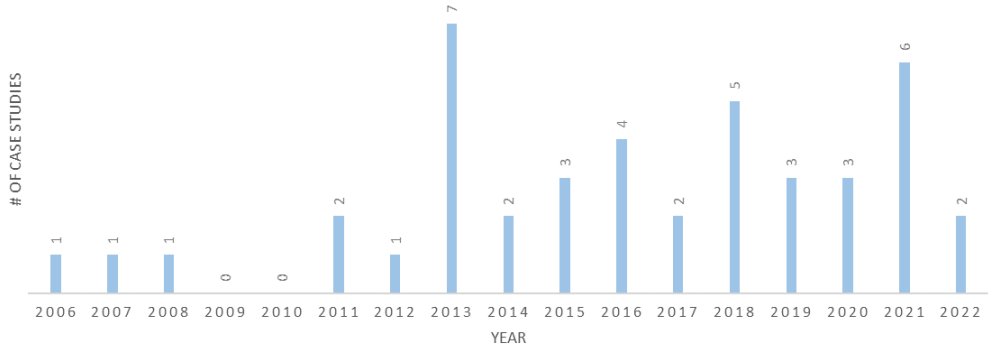


Figure 3 - Publications in dataset by year

Regarding the origin of the case studies, as observed in Figure 4, there is a strong publication activity of articles from Europe, accounting for 48%, followed by Africa (29%). The remaining continents, namely North America, Asia and South America together account for only 23% of the publications. The case studies cover 32 different countries, ten of them being subject of study more than once, and one of the case studies does not specify the country but does state that it is done in Europe. The countries with

more publications are France and Sweden, with both four articles, followed by Ireland and Tanzania with both three articles. Ethiopia, Finland, Mexico, South Africa, Spain, and the UK each have two publications. The remaining countries: Argentina, Brazil, Cameroon, Colombia, Costa Rica, Germany, Greece, Italy, Kenya, Madagascar, Morocco, Mozambique, Pakistan, Portugal, Romania, Scotland, Suriname, Tokyo, Trinidad & Tobago, USA, Vietnam, and Zimbabwe only have one publication each.

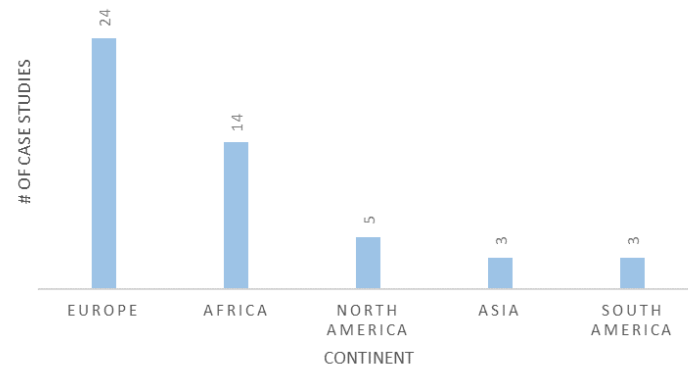


Figure 4 - Publications in dataset by origin

The number of journals in which the articles are published is quite considerable given the sample of articles included. In total, 30 journals were identified and only seven had more than one publication. There are two leading journals, with both 4 articles published: Ecology & Society, and Sustainability followed by Environmental Science & Policy with 3 publications. The remaining four journals that have more than one publication are Environmental Management, Journal of Cleaner Production, Journal of the Operational Research Society and Regional Environmental Change, each with two publications. Data concerning the journals where the articles are published can be seen in the PSP documentation taxonomy and in Appendix A.

### 2.2.2 Case studies' characteristics and methodology

Defining the objective for building scenarios is a priority step in the process, making clear, from the beginning, the purpose for constructing them. None of the articles failed at this stage. All the case studies plainly described the reasons for developing the scenarios.

The case studies address 17 different fields of study, as presented below in Table 3. The most approached topic is Climate change (ten case studies), followed by water management with 6 case studies and farming with 5. These areas reflect recent issues of today's society, showing scenario planning is being used as a tool to fight and improve important matters. The food industry, which is the general scope of the study developed hereinafter, has very few studies approaching the topic, only 3 case studies. Six of the presented topics are approached three times, the other six topics are approached only one time, and two topics are only two times. The topics that are only approached once are Economy, Landscape governance, Product development, Protected areas management, Rural, Development planning and Water-energy nexus.

Table 3 - Field of studies addressed and corresponding number of case studies

Field of study	# of case studies
Climate change	10
Water management	6
Farming	5
Ecosystems management	3
Food industry	3
Forest management	3
Health	3
Land use and land cover	3
Sustainability	3
Natural resource management	2
Urban planning	2
Economy	1
Landscape governance	1
Product development	1
Protected areas management	1
Rural Development planning	1
Water-energy nexus	1
<b>Total</b>	<b>49</b>

Foresight period can be described as the time span between the actual development of the scenarios and the targeted year for these scenarios. Some case studies do not mention explicitly this information, they only mention the target year. A fair few of them (36) had to be calculated through this target year and the year of publication, possibly leading to a small deviation from the real foresight period, or the target year and the beginning year of the process. Two studies perform the construction of scenarios for more than one target year. So instead of having 49 foresight periods gathered it is possible to collect information for 51 on this subject. Four of them do not retrieve any information about the time horizon of the scenario planning process. The foresight periods observed range from 5 to 75 years, with an emphasis on 20 years (20% of the case studies). From Figure 5 it is possible to observe that most of the studies have a foresight period between 5 and 25 years and very few operate for more than 35 years. Between 26 and 35, despite seeing a clear reduction in the number of studies it is still a significant value.

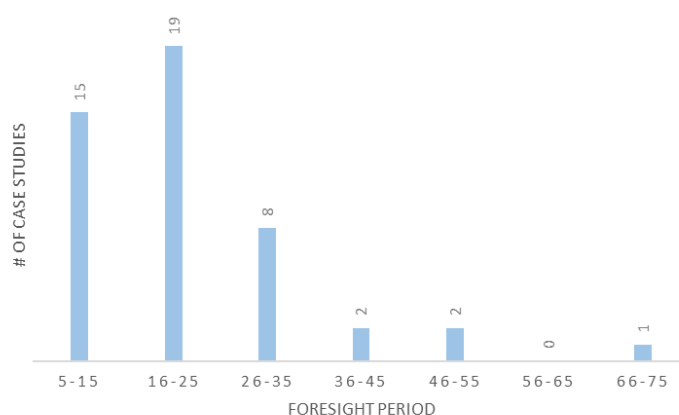


Figure 5 - Case studies' foresight period

Regarding the number of uncertainties used for building the scenarios, six case studies do not specify how many, but state that the construction is done in a complex environment. The range of uncertainties goes from 5 to 57. Fourteen studies make use of five variables and seven studies use six. As the number of uncertainties increases, it is noticeable that the quantity of case studies published reduces, as presented in Figure 6. Few studies are using great quantities of variables in the process, most of them use between five and ten. From ten uncertainties on, the number of studies decreases. Also, throughout the years it is possible to observe (Table 4) an increasing number of uncertainties used.

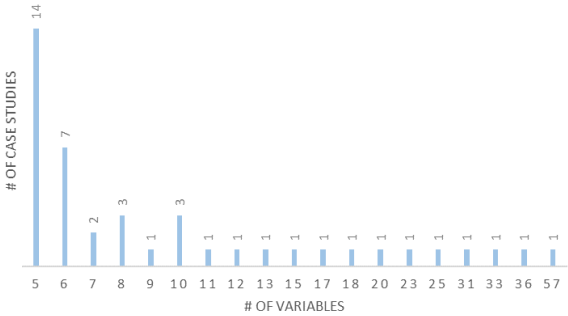


Table 4 - Case studies' number of uncertainties throughout the years

# of variables/Year	2006-'09	2010-'13	2014-'17	2018 on
5-10	2	8	7	13
11-20	-	2	2	3
21-30	-	1	-	1
31-40	-	-	1	2
41-50	-	-	-	-
More than 50	-	-	1	-

Figure 6 - Number of uncertainties used to build the scenarios and corresponding number of case studies

Amer et al. (2013) state that in the scenario planning literature, there is no specific answer to the question of how many future scenarios are best, but one must bear in mind that it is essential to create a manageable amount of scenarios. From the sample gathered, there are studies building only one scenario as well as 234 scenarios. As shown in Figure 7, more than half, build between three and five scenarios (70%), which most researchers, from a study carried out by Amer et al. (2013), consider an adequate number. 39 of the articles display the scenario narratives, either if it is just one of them (2) or as bullet points (3), while ten do not present them.

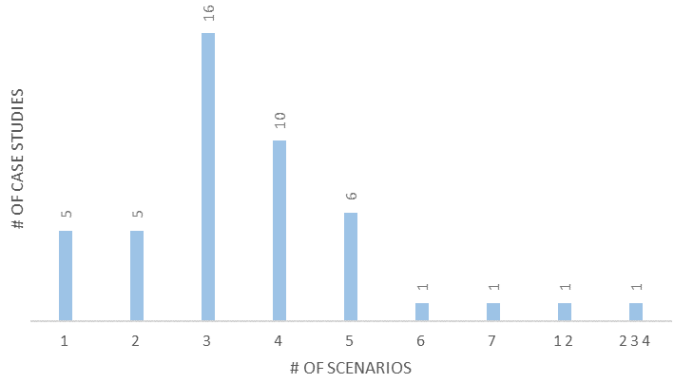


Figure 7 - Number of scenarios built in the case studies

With respect to the perspective of the scenarios, they can be classified into descriptive or normative. Descriptive scenarios are “extrapolative in nature” and represent a set of potential future events, on the other hand, normative scenarios are goal-oriented in order to reach desired objectives (Amer et al., 2013). Having this in mind, some case studies develop only descriptive scenarios (32), others only

normative scenarios (10) and some develop both (6). The majority develops the first ones which have the same approach as the one used in this dissertation.

There are three main schools of techniques for generating scenarios: the Intuitive logics school, which has many variations to its model (Amer et al., 2013), the Probabilistic modified trends (PMT) school and the French school – La prospective. In general, the studies do not refer to the school of thought in which the methodology is based, but they state the name of the methodology itself. Nevertheless, eleven studies do not indicate the school of thought neither the name of the methodology. The only school of thought mentioned is the intuitive logics and one of its variations called Intuitive logic approach' of the Shell/GBN (Global Business Network) scenario planning school, which is mentioned in three case studies that are part of the same article (Carlsen et al., 2013). Concerning the name of the methods, they all go around scenario planning, with some having slight variations. The most common one is participatory scenario planning, for the ones adopting a descriptive perspective, as expected, and backcasting for the ones adopting a normative perspective. The remaining ones are scenario planning, formative scenario analysis, general morphological analysis, multi-method scenario approach, multi-scale participatory scenario planning, participatory prospective analysis, participatory storytelling approach, scenario-based planning method, scenario workshop method, socio-technical approach for scenario building and finally transition scenario building, starting with the most frequent ones to the least frequent.

From all the case studies it was possible to gather information on the general framework used for building the scenarios. Several have a detailed explanation of the various steps of the methodology (38) while others do not present such complete descriptions (11), having just the general stages without mentioning the steps, making it impossible to reproduce the procedure in any other context. From the ones having this type of information, it is possible to observe some common and recurrent steps in the construction methodology, starting by choosing the focal question to which the scenarios are going to answer, the identification of relevant stakeholders to be involved in the process since it is a participatory study, followed by the identification of driving forces influencing the system and later selecting the most critical ones to serve as the basis for the next step, after there is the development of narratives and finally their validation. All this process refers to the descriptive perspective of scenarios. Beside the steps previously described, several other steps performed in the studies are worth mentioning such as the establishment of interdependencies between the drivers of change or their validation before selecting the crucial ones, the creation of states for the drivers, as well as structures for the development of the narratives and the revision of the final narratives, checking for their consistency. Still, in this perspective, there is also one study by Palacios-Agundez et al. (2013) which builds regional scenarios by downscaling from already constructed global scenarios. For the normative approach, the common steps for scenario building that were observed can be summed up to the identification of stakeholders as well, followed by understanding the problem at hand, after identifying aspects influencing the system (driving forces), creation of a vision or more and developing narratives of how the vision/s can be achieved. Concerning the studies where a descriptive and normative approach is taken into consideration, three of them do not have sufficient information to reach a general framework (Corrigan & Nieuwenhuis, 2019).



Two, by Boden et al. (2015) and Rouillard et al. (2022), only detail the descriptive approach and it is in line with the framework presented. The remaining one chooses a target scenario, from the four developed, and creates the narrative to reach that goal (Palacios-Agundez et al., 2013).

In addition to the scenario development methods, some case studies make use of other methods to assist the process, defined here as auxiliary methods. The most common ones are software, all different depending on the task performed, they go from analysing each stakeholder's perception of the problem (Düspohl & Döll, 2016), to analysing impact and consistency matrixes developed by the team (Withycombe Keeler et al., 2015), turning qualitative scenarios into quantitative ones (Terrapon-Pfaff et al., 2020), performing system analysis (Kuzdas & Wiek, 2014), recording data from interviews (Brown et al., 2016), and finally documenting workshop sessions (Ritchey, 2006). The world café methodology is the second tool which the studies resort to more, and it is used as an effective social technology tool for getting people to have important dialogues (Palacios-Agundez et al., 2013). These methods are followed by causal loop diagrams, usually involved in identifying the drivers of change and the interrelations between them (Jiren et al., 2020; Alizadeh et al., 2022) and the use of a GIS tool which is a geographic information system mapping to create and present maps. The remaining auxiliary methods are a cartographic approach to visualise the visions and the emerging scenario (Pollastri et al., 2018), cluster analysis to analyse numerical data (Varho & Tapio, 2013), comparative analysis (Musse et al., 2018), controllability and cross-impact analysis to analyse the data (Tassew et al., 2019), excel to access interdependence and influence between variables (Djouma et al., 2018), the inVEST tool to generate the scenarios (Best et al., 2021), morphological analysis to select uncertainties and develop narratives (Ram et al., 2011), snowball sampling to identify relevant stakeholders to include in the study (Malinga et al., 2013), Lego seriously play toolkit to help participants express their opinion on the same theme and the fault tree analysis to identify the problems of a system and reach the causes of it (Mitake et al., 2020), trend and uncertainty analysis to identify the most important driving forces (Podolak et al., 2017), Extreme-World method and Group Elicitation method to set boundaries to construct the scenarios and identify the drivers of change, respectively, and finally ZADA method to help participants express their perceptions about a specific theme (Bergez et al., 2011). Essentially the auxiliary methods are used to aid the stakeholders' process of expressing their opinions and to identify drivers of change. Also, some methods are used simultaneously in the same study. Despite having useful functions in the whole process, 22 studies do not use any kind of auxiliary method.

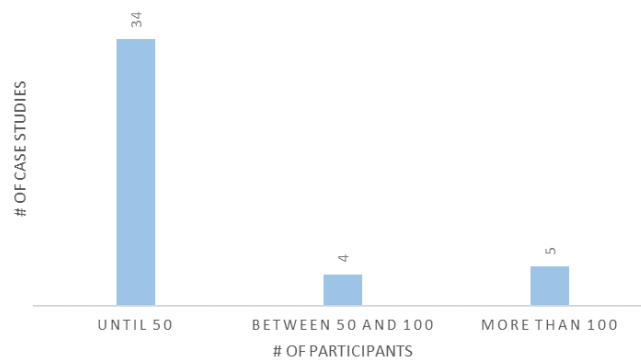
### **2.2.3 Participatory Dimension**

One of the main characteristics of the work developed hereinafter is the participation in the scenario planning process. A crucial requirement to include the articles in the systematic search is having the participatory component of the scenario development, thus all the studies included are participatory.

Information on the number of participants for the whole process was mostly easy to capture from the case studies gathered. Thirty-eight of these studies have straightforward evidence of the total number of participants or have just the number involved in each stage of the process and refer to which are the ones common in various steps, so they are not accounted for, twice. Few case studies, namely five, do not have this information so precisely stated. Two have a range of participatory members of between 8

and 12, and between 8 and 24 (Graveline et al., 2014; Pollastri et al., 2018) so the number of participants collected is 12 and 24, respectively. Two more, only detail how many participants are involved in just one step of the process but state that there are more involved. The first one only mentions 199 besides the remaining participants also included (Ojoyi et al., 2017) and the second 100 (James et al., 2013). Lastly, there is one case study mentioning every participatory step and the corresponding number of participants (Kuzdas & Wiek, 2014), where it is possible to understand that there are common participants in the different steps but not how many, so, in this case, the number of participants collected is 51 (number of participants that are not showed twice) but one must bear in mind this number may have a small variation of plus 14 participants. Only six studies do not have any information on the quantity but do state they are participatory.

As shown in Figure 8, most of the case studies use 50 participants or less, accounting for 80% when excluding the ones not retrieving any information. There are only five studies involving more than 100 participants in the process, which indicates there is a gap in the literature when it comes to having a significant sample of exercises involving high participation. Regarding these five case studies, they all are relatively recent, with three, each from 2013, 2015 and 2018 respectively and two from 2017.



*Figure 8 - Number of participants involved in the case studies*

When it comes to selecting the participants, information on the methods and criteria used to do so was not possible to collect on 21 case studies. The remaining have information regarding at least one of these aspects. The methods used for selecting the participants are shown in Table 5 and could only be retrieved from eight studies. Stakeholder analysis is a tool that allows to generate of knowledge about actors, in order to understand their interests and assess the influence they have on decision-making processes (Varvasovszky, 2000) and it is stated in three different case studies. the purposive sampling technique allows the identification of certain participants who fulfil some purposes (Etikan, 2016a) concerning sex, age, wealth status, years of settlement and experience working in the sector (Tassew et al., 2019). The criterion sampling approach to select the important stakeholders is based on the “existing relationships, recommendations from respected key informants, fit with desired characteristics, and ability to influence solution adoption” (Podolak et al., 2017). Snowball sampling, as mentioned earlier in the auxiliary methods, makes use of social networks, starting by identifying a group of relevant stakeholders and from these group’s contacts getting more (Etikan, 2016b). One study identified the participants from already established contacts (Brown et al., 2016) and finally, the expertise matrix is

implemented to attain complete coverage in terms of age, gender, organization, education, and expertise of actors (Varho & Tapio, 2013).

*Table 5 - Methods used for the selection of participants and corresponding number of case studies*

<u>Method for participants' selection</u>	<u># of case studies</u>
Stakeholder analysis	3
Purposive sampling technique	2
Criterion sampling approach	1
Snowball sampling	1
Previous contacts	1
Expertise matrix	1
<b>Total</b>	<b>8</b>

Where it is not possible to retrieve the method used for identifying participants, it is possible to gather information on the criteria considered for this process. Despite this, the criteria applied only meet the features looked up in the participants, in the methods described ahead. Some requirements for the inclusion of the participants are more related to demographic aspects, as mentioned, such as age, gender, origin (if migrant or native) and ethnicity, with the objective to balance these aspects in the study performed by Chirozva et al. (2013). Participants' ability to write and read, and their level of education are significant features as well (Rakotomahazo et al., 2021; Chirozva et al., 2013). The ability to speak in public is an important point, once being part of these participatory processes, entails dealing and debating with a group of, probably, unknown people, and one cannot be reluctant to speak up. Also, professional status is considered a relevant aspect, by looking into actors working in the sector of interest (Djouma et al., 2018). Besides professional status, knowledge and linkage to the sector are also pertinent (Mitake et al., 2020; Corrigan & Nieuwenhuis, 2019; Hossard et al., 2013; Rakotomahazo et al., 2021; Freeth & Drimie, 2016). For some, the final panel of participants must cover different areas, instead of being restricted to actors of the sector at hand (Proswitz et al., 2021; Graveline et al., 2014; Düsphohl & Döll, 2016). The need for the participants to have influential power is also observed (Hossard et al., 2013; Rakotomahazo et al., 2021; Rouillard et al., 2022; Campos et al., 2016). For Alvarenga et al., 2019 the requirement is involving participants from the public and private sectors and society in general and for Palacios-Agundez et al., 2013 the criteria sums up to involving policy makers, citizens, experts, and business representatives.

As for the nature of the scenario team, five case studies have no information regarding this topic and there is a massive amount of data collected from the remaining, as presented in the PSP documentation taxonomy and Appendix A, where the background of the participants is organized by field of study of the different case studies. There is evidence from nine studies revealing that some members of the panel of participants are experts, and there is a trend of great presence of key stakeholders from the public sector as well as members from the private sector. Besides this, only five case studies comprise participants described as overall citizens within the territory of study (Nanninga et al., 2012; Hatzilacou et al., 2007; Jiren et al., 2020; Brown et al., 2016) and two comprise the society in general (Rouillard et al., 2022; Alvarenga et al., 2019).

In order to include, interact and empower dialogue with and between the participants in the scenario planning process, it is necessary to choose the most appropriate and useful tools, so the participants' knowledge and information are collected effectively and efficiently, enabling them to get the most out of them. In every case study, there is information regarding this topic. From the 49 studies identified, information on 100 tools was gathered, where in total, eight different participatory methods are used and usually, in each of the scenario processes, a combination of more than one participatory tool is applied. The categorisation of the identified participatory methods is based on the categorisation performed by Popper (2008). Although focus groups, meetings, informal interactions, and seminars are not identified by the author, their specification in this analysis was considered essential. Focus groups, despite being similar to workshops, are not the same, and have a particular objective and organisation. Regarding the seminars, when analysing the activities performed in this method (Campos et al., 2016) and comparing it to the descriptions of the participatory methods provided by Popper (2008), seminars could be classified as workshops. However, in the case study, there is a separation of these terms, and both methods are used and described. The case study performing informal interactions (Podolak et al., 2017) does not give any information about the method other than distinguishing it from others that are used in combination, namely, interviews, focus groups and workshops. Therefore, it cannot be classified as any other participatory method. Concerning the meetings, from the description of the method presented in one of the case studies (Düspohl & Döll, 2016) it is not possible to identify it as one of the methods described in Popper (2008). Also, in this case, meetings are used in combination with workshops and interviews. In the remaining three case studies (Jurgilevich et al., 2021; Djouma et al., 2018; Kuzdas & Wiek, 2014), the meetings fit the definition of workshops. However, in all of the studies, these two methods are distinguished. All of them use meetings combined with workshops. For these reasons, it is appropriate to include in the analysis the three participatory methods, in a separate way.

Workshops and interviews are the most used participatory methods, employed in 46 and 24 case studies, respectively as shown in Figure 9. Informal interactions and seminars are the least used methods, and the use of surveys/questionnaires is also significant.

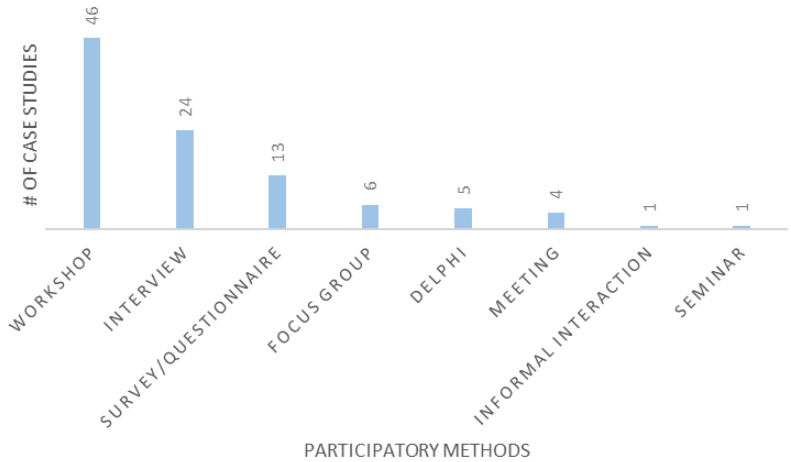


Figure 9 - Participatory methods used and corresponding number of case studies

Concerning the Delphi methods applied, they are used in forms of discussion (Musse et al., 2018; Varho & Tapio, 2013), analysis (Soria-Lara & Banister, 2018), and questionnaires (James et al., 2013; Alvarenga et al., 2019). Also, four case studies state that some of the participatory methods are performed in an online model, such as the questionnaires and surveys (Jurgilevich et al., 2021; Sisto et al., 2018), and the Delphi approach (James et al., 2013; Alvarenga et al., 2019) where only one of them is from 2013 and the remaining are from 2018 on.

Throughout the years it is possible to observe, from Table 6, workshops have always been the most used participatory methods followed by interviews. Also, until 2017 there is a gradual increase in the number of different participatory tools that were used, with 2018 having only one less tool used.

*Table 6 - Participatory methods used by year*

<b>Method/Year</b>	<b>2006-'09</b>	<b>2010-'13</b>	<b>2014-'17</b>	<b>2018 on</b>	<b>Total</b>
Workshop	3	11	12	20	46
Interview	1	6	8	9	24
Survey/Questionnaire	-	4	2	7	13
Focus group	-	3	1	2	6
Delphi	-	2		3	5
Meeting	-	-	2	2	4
Informal interaction	-	-	1		1
Seminar	-	-	1		1
Number of different methos applied	2	5	7	6	8

As for the methods used to deal with the participants, the case studies that involve more than 100 participants (Table 7), workshops, once again, and surveys and questionnaires are the most used ones, followed by interviews. In these studies, there is no evidence of the use of meetings and seminars. Two case studies (James et al., 2013; Sisto et al., 2018) make use of surveys in an online form which facilitates the process of interacting with so many actors.

*Table 7 - Participatory methods used in case studies involving more than 100 participants*

<b>Participatory methods</b>	<b># of case studies</b>
Survey/Questionnaire	4
Workshop	4
Interview	2
Focus group	1
Informal interaction	1
Delphi	1
<b>Total</b>	<b>13</b>

As said, most of the participatory tools employed are used in combination, that is to say, one participatory scenario planning method does not make use of one participatory tool exclusively but makes use of more than one each for a different stage of the process. Most of the studies use 2 participatory methods simultaneously as shown in Table 8, and only 15 make use of only 1 participatory tool.

Table 8 - Number of participatory methods used simultaneously and corresponding number of case studies

# of participatory methods used simultaneously	# of case studies
1	15
2	20
3	11
4	3
<b>Total</b>	<b>49</b>

To further identify how these methods are used together, a two-by-two combination analysis was carried out, as presented in Table 9. The most frequent combination of tools is workshops and interviews which are used 22 times simultaneously. Also, the use of workshops alone is frequent (13 studies). When resorting to online forms of the participatory process they are usually combined with workshops as well.

Table 9 - Combination of methods used and corresponding frequency of occurrence

Participatory methods	Workshop	Interview	Survey/Questionnaire	Focus group	Delphi	Meeting	Informal interaction	Seminar
Workshop	13							
Interview	22	1						
Survey/Questionnaire	10	3	1					
Focus group	6	5		-				
Delphi	4	3	2		-			
Meeting	4	2	1			-		
Informal interaction	1	1		1			-	
Seminar	1							-

Regarding the purpose of these abovementioned participatory methods, only three case studies do not describe the stage of the scenario construction process, for which any of the tools were used (Ritchey, 2006; Alizadeh et al., 2022; Chirozva et al., 2013), and several case studies, some only using workshops, do not give any details in which stages some of the tools are used. These stages can be summed up into overall steps in which the participatory tools are used, namely twelve. Two of these steps are exclusive for the scenario development of normative scenarios, in particular, the collection of data to create alternatives and the creation of visions.

As shown in Table 10, for identifying, validating and ranking the drivers of change, and building and evaluating/validating the scenarios, the workshops are the most used tool. To have a general discussion on the topic of study the most used method is interviews. Surveys and questionnaires are mainly used for gathering data for the creation of alternatives.

Table 10 - Participatory methods used in each stage and its frequency

Stages/Method	Workshop	Interview	Survey/Questionnaire	Focus group	Delphi	Meeting	Informal interaction	Seminar
Inform about the process						1		
Discuss overall knowledge on the topic	4	7	2	2		1		1
Identify drivers of change	14	4	2	1	1	2		
Validate drivers of change	3		1			1		
Rank drivers of change	11	1	2					
Generate scenario structures	1							
Validate scenario structures	1							
Build the scenarios	29			1				
Evaluate and validate scenarios	13	3	1		1	1		
Gather data for creation of alternatives	1	2	4					
Develop desired vision	1	1	2		1			
Get feedback from participants			2					

In some cases, the participants are given some kind of material or information on the topic, as an important input for the scenario development process, which can be considered scientific or non-scientific evidence. Of the nineteen case studies, where the participants are faced with available material input, in only five, the participants work with scientific evidence, and four of them detail the specific scientific material. Reliable databases such as the Food and agriculture organization of the united nations (<https://www.fao.org/home/en>) and Agreste (<https://agreste.agriculture.gouv.fr/agreste-web/>), and scientific studies are a few examples of the scientific data presented to the participants. In a nutshell, in more than half of the case studies participants do not have any material as an input to build scenarios (30), and from the ones that have (19) only five work with scientific evidence. Thus, in the majority of the studies (40), the participants do not work with scientific evidence.

As mentioned before, involving participants in the scenario planning process has its challenges (Tompkins et al., 2008; Carlsen et al., 2013). Trying to make the interaction with and between them, a guided, structured, and easy-going exercise, so it runs smooth, is a crucial task. To do so, it is convenient to have a facilitating member or team who, in general, has the role to manage the people involved in the process. Understanding the difficulty to manage the participants goes through understanding the people doing that and their job. Little information could be retrieved from the case studies regarding this matter, only seventeen studies have details on this. The mentioned tasks of the facilitating team are, in general, organizing and managing, but they go through identifying stakeholders and building common knowledge on the topic at hand (Hossard et al., 2013), informing stakeholders about the strategy development and helping them throughout the process (Düspohl & Döll, 2016), encourage participants to work together (Campos et al., 2016), give additional information when needed (Palacios-Agundez et al., 2013), make interviews (Freeth & Drimie, 2016), perform real-time translations in the participatory episodes (Malinga et al., 2013), record stakeholders ideas (Ritchey, 2006) and some even have the role to construct the scenarios (Bergez et al., 2011).

## 2.2.4 Case studies' outcomes and additional methods

Several case studies mention the participatory scenario planning processes as time-consuming exercises. Just under half of the studies, only 18, give information on the actual time spent, from the beginning of the process until the end, while five studies only bring up the time employed during the participatory stages.

For the ones referring to the time consumed in the participatory processes, they all resorted to workshops. One has four sessions of four hours each so in total twelve hours spent in the workshops (Hossard et al., 2013), three studies, one with two and one with three full working days for the workshops (Hatzilacou et al., 2007; Fofiu & Dobus, 2015; Ritchey, 2006) and one has three workshops of full working days for four days, so in total twelve days (Djouma et al., 2018).

Regarding the studies mentioning the time spent for the whole scenario process, as shown in Figure 10, none took less than six months to complete it, and more than half took one year or more, which confirms what is stated before concerning the time-consuming aspect of these kinds of exercises. The longest time observed to conclude the process is ten years (Tassew et al., 2019) and the shortest is exactly six months (Enfors et al., 2008).

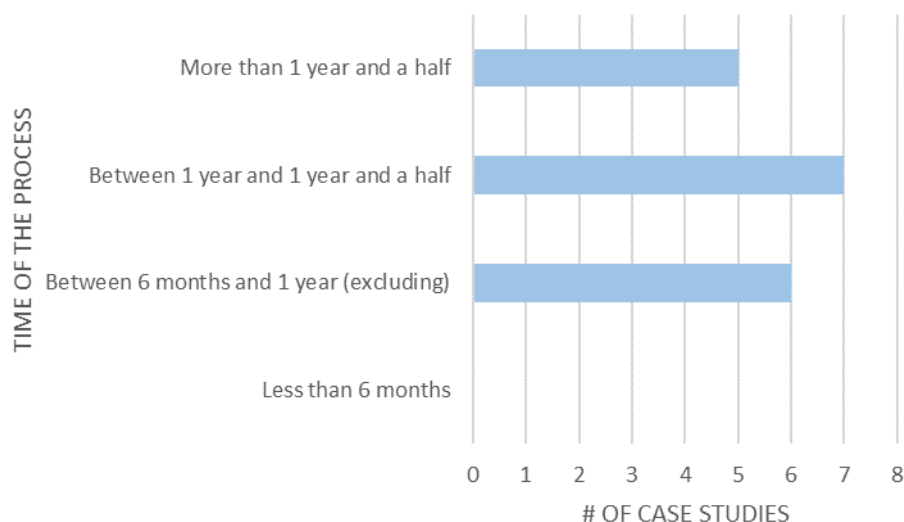


Figure 10 - Total time of the scenario planning process and corresponding number of case studies

As an outcome of the scenario planning process, the constructed scenarios can be classified into qualitative or quantitative. They can be fully qualitative storylines, or they can contain any type of quantitative data in them (Reed et al., 2013). However, some studies make a combination of both by first constructing entirely qualitative scenarios and then translating them into quantitative ones. As presented in Table 11, almost every case study develops qualitative scenarios with some exceptions. One study develops entirely quantitative scenarios and seven build first qualitative storylines to then turn them into quantitative ones. Only one case study has no information regarding this topic.



*Table 11 - Scenario classification and corresponding number of case studies*

<b>Scenario classification</b>	<b># of case studies</b>
Qualitative	40
Qualitative translated into quantitative	7
Quantitative	1
Information not stated	1
<b>Total</b>	<b>49</b>

These scenarios are built to be used for a certain purpose. However, 31 case studies do not state the expected use of the scenarios. Apart from these, the most common purpose for the use of scenarios is policy-making (6) followed by decision-making (5). The remaining five studies have the objective described but cannot be defined as either policy or decision-making. Three studies make use of the scenarios for strategy building, one, in the context of climate change has the objective to inform adaptation plans (Carlsen et al., 2013) and lastly one in the context of the cattle and sheep industry has the purpose to test models, to propose strategies and to assess risks (Boden et al., 2015).

As stated by Amer et al. (2013), the scenario planning exercise usually has costs associated, ranging from minimal to very high costs depending on various factors, such as the number of uncertainties used as a basis for the construction of the scenarios or the number of scenarios constructed. Just one study refers to this matter and yet it does not detail the actual costs of the process.

At the end of the course of action of the scenario planning process, some case studies comprise a step which consists of assessing the feedback from the participants' team on the methodology applied, in order to have insights into what may have gone better or worse. Namely twenty-one studies collected this feedback and evaluated them. Most of the case studies gathered positive feedback regarding the methodology applied, specifically twelve (Table 12).

*Table 12 - Type of feedback and corresponding number of case studies*

<b>Type of feedback</b>	<b># of case studies</b>
Positive	15
Negative	5
Positive and negative	1
<b>Total</b>	<b>21</b>

Mainly, the positive feedback gathered concerns the usefulness of the approach adopted which suits well the purpose of the study, also, participants appreciated the transparency of the process (Corrigan & Nieuwenhuis, 2019), the interaction with the other participants and as well as the ability to express their opinions (Djouma et al., 2018) and finally the way the information was shown to them (Musse et al., 2018). Regarding the negative feedback, which is related to the little time given to the participants and the difficulty to imagine a world 20 years later (Carlsen et al., 2013), the questionnaires being too demanding and exhaustive (Jurgilevich et al., 2021), the inappropriate involvement of the participants in the process (James et al., 2013; Campos et al., 2016) and at last, the inappropriate methods used, for the participants to express their opinions (Düspohl & Döll, 2016).

As an evaluation exercise, the authors pointed out several challenges and lessons learned during the entire scenario planning process. Starting with the challenges, some common aspects can be detected

from the case studies, such as the participants' little time available, when compared to the time required, once the scenario exercises are considered time-consuming. Also, managing the participants, so they are involved, share their knowledge, and run a pleasant discussion panel, is identified as a challenge. For the lessons learned, a strong argument pointed out is the involvement of participants in the process and the corresponding nature of the team, with authors defending that by building scenarios in a participatory context, where the background of the participants is diversified, there were heterogeneous perspectives enabling a more comprehensive process, a build-up of relevant knowledge and it also allowed the integration of every significant detail essential to the study. At heart, the authors learned from the experience that participation in the scenario planning process is key. Other two common lessons learned are the importance to align every participant's interest from the beginning, so they all work towards the same objectives and that, applying multimethod (auxiliary methods) in the studies, enables to reduce the weaknesses of the methods used.

In addition, sixteen studies give recommendations for the methodology applied and for the use of the scenarios. In line with what was said regarding the lessons learned it is obvious that one common recommendation given is to guide every participant with the same objectives, from the beginning of the process. Besides this recommendation, the remaining are very specific to each study and can be looked up in the PSP documentation taxonomy and Appendix A in the recommendations section. Four studies make recommendations on the use of scenarios. Some defend that the scenarios can be used for adaptation planning (Jurgilevich et al., 2021), as input for the analysis of impacts (Proswitz et al., 2021), for possibly policy-making (Alvarenga et al., 2019), and lastly, one supports the use of the scenarios in other sectors, rather than the one of the study (Graveline et al., 2014).

Apart from the scenario planning methodology in each study, several studies, namely 22, develop other methods in combination. The most developed one is backcasting, in studies where there is the construction of, first, descriptive scenarios and then, normative ones. For this last stage backcasting is implemented. Also, Multi-criteria Decision Analysis is very common to be used in combination with scenario planning, sometimes applied to the constructed scenarios themselves.

Regarding the usefulness of these articles, an analysis of the citations of each one was made in order to check if the article has substantial relevance in the literature. More than half of the articles have been cited fifteen times or less, as seen in Figure 11, and few, only four, have been cited more than 105 times in the literature.

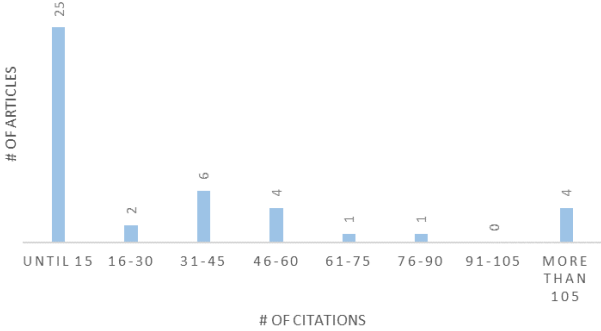


Figure 11 - Number of studies in which each article is cited and corresponding number of articles

## 2.3 Final remarks

As it was observed from the analysis conducted before in this chapter, not all 43 articles, included in the systematic search, document every detail of the PSP documentation taxonomy. In order to identify possible gaps in the literature either concerning lack of information about the general processes or lack of necessary data to replicate the methodologies, an analysis of the documented details of each method is presented in Figure 12.

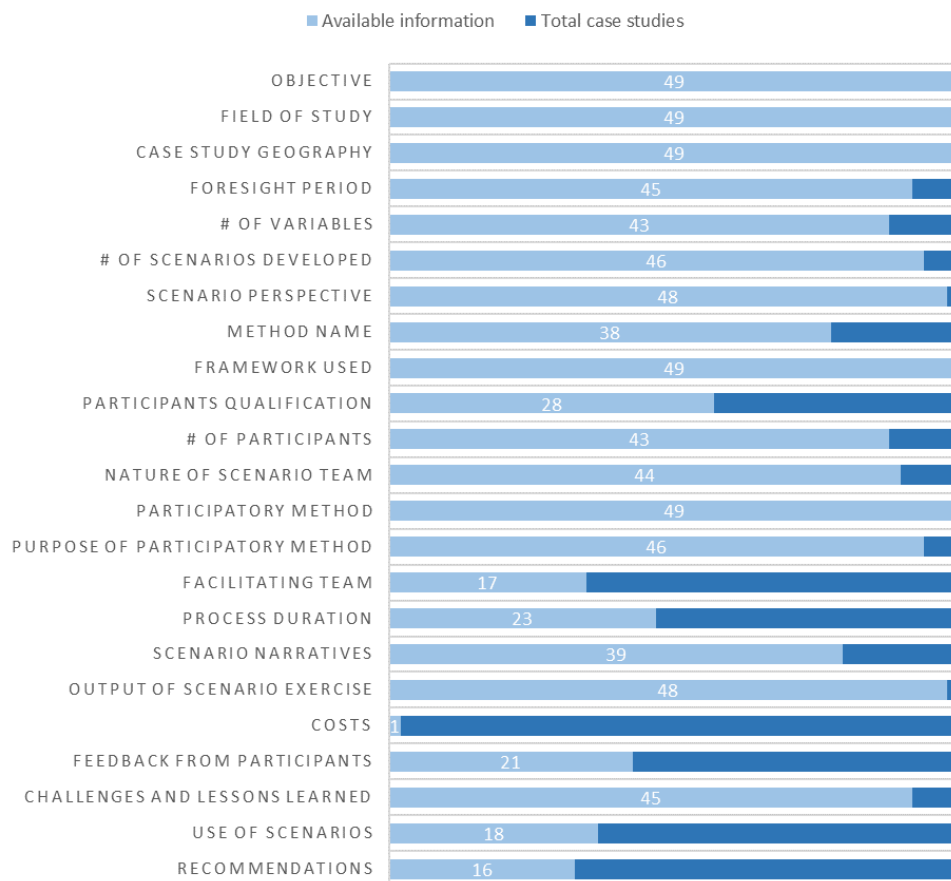


Figure 12 - Documented information per method

Information on the auxiliary methods, scientific evidence, material input and additional methods are not portrayed in Figure 12 because the methods can be developed regardless of having these aspects.

From among the 49 case studies, every type of information is available at least in one case study. Details on the costs of the process are the least mentioned feature, followed by the recommendations on the methodology or use of scenarios, and the role of the facilitating team. While the first two aspects mentioned do not interfere with the replication of the methodologies the last one may hinder the replication, since the facilitating team plays a crucial part in the process. In general, the information retrieved from the 49 case studies is a good basis for the replication of the methodologies, and to understand what has been done in the literature regarding participatory scenario planning in complex contexts.

In Portugal, there is an extremely small amount of participatory scenario planning studies developed, when considering the sample of articles retrieved from the systematic search, and very few studies involving a large number of participants (with more than 50), but recently there has been an increase in this quantity. Regarding the number of uncertainties used to build the scenarios, there has also been an increase throughout the years.

## **2.4 Lessons learned**

It is important to highlight that from all the identified studies, only a few focus on including participants described as overall citizens in the scenario building process, and more importantly reaching a high number of participants.

From the analysed literature, it is possible to observe that it is of great importance that the objective for the construction of scenarios is clear and presented. So, in this dissertation, the reader is provided with an explanatory and concise definition of the objectives for the construction of scenarios. With the objective clearly defined and presented, the identification of the topic at hand will be straightforward. Few studies identified in the literature directly indicate the foresight period, only having the target year for the scenarios. Here, there is an effort to correctly present this information, showing both the target year and the foresight period. Also, few studies do not have any information regarding the number of uncertainties or information concerning the context for building the scenarios. However, to understand if the scenarios are built in a complex context, it is relevant to have the number of uncertainties described in the study, which happens in this dissertation. Some case studies do not have any indication of the number of scenarios constructed nor show the narratives that are generated. Therefore, in case studies that do not specify the outcome of the scenarios, by not having the narratives, it becomes harder to understand if they are qualitative or quantitative. Hereinafter the number of scenarios constructed as well as the narratives are present, making it possible to understand if they are qualitative or quantitative.

Like many case studies from the literature, the name of the method adopted is described, and from this and the methodology in itself, it is possible to understand the perspective of the scenarios, as in most of the case studies. Regarding the framework for the development of the scenarios, every case study identified presents the methodology either detailed or not. The methodology developed herein follows the overall framework identified from the literature with some additional steps and it is explained in detail like the majority.

Just over half of the studies have a description of the participants' qualifications to take part in the scenario building process. But in this dissertation, this parameter is clearly explained. Also, the number of participants involved, and their background is described, as it is not in all case studies. Following the literature, the participatory methods adopted are clearly indicated and the process is explained, detailing in which step which method is used. Regarding the facilitation team, there is very little information on the case studies, being the parameter that least allows for replication in future studies. As mentioned before, the facilitation team has a crucial role in the scenario development process, and in the methodology described ahead, the role of the facilitator is understandably explained.

Feedback from participants, expected use of scenarios and recommendations either for the use of scenarios or the methodology, are not very commonly observed in the literature. Although the replication of the methodologies can be done while not having this information, these parameters give useful insights for the future use of the methods. In this dissertation, all these aspects are mentioned. Also, challenges and lessons learned from the process, are a common concept approached in almost every study and this dissertation is no exception.

### 3 Adapted methodology

This chapter presents the fully detailed participatory scenario planning methodology adopted to construct the scenarios.

This research aims to develop a set of relevant and plausible scenarios regarding what the future may hold, in terms of cattle meat consumption, in the Portuguese population, in order to inform our experts, FeedInov CoLAB, and further, to inform potential decision-makers, so they are prepared for what may lay ahead. In this context, the chosen foresight period is 28 years; thus, the year 2050 is the desired future.

When the food industry, particularly the cattle meat industry, is facing immense uncertainty about how the future may unfold, this study and its results are of extreme importance for decision-making contexts, enabling the consideration of uncertainty in these activities.

The construction of the scenarios is an exercise involving participation, as the name implies (participatory scenario planning), and it is made with help from a large number of citizens, and experts from FeedInov CoLAB. Regarding the citizens, the aim is to tackle the population in general, with an emphasis on people from a young age group, who are going to be living in the future we are considering (2050).

The methodology presented hereinafter is developed in collaboration with FeedInov CoLAB and is based on a previous PSP study: “Scenarios for population health inequalities in 2030 in Europe: the EURO-HEALTHY project experience” by Alvarenga et al. (2019) which developed a scenario planning methodology and constructed future scenarios to assess population health inequalities in Europe. Several adaptations to this methodology are made to better suit FeedInov requirements, the time constraints faced, and the type of participants involved in each stage.

Aligned with what was developed by Alvarenga et al. (2019), the Extreme-World method (Goodwin & Wright, 2004, chapter 15, p.380) is employed in the scenario planning process, considering this a “practical and transparent” approach to set reasonable boundaries to how the future of the cattle meat consumption may evolve. This method comprises the establishment of two extreme points of view, as boundary conditions to construct two contrasting scenarios through a three-stage process following a socio-technical approach, as seen in Figure 13. Only adaptations to the social component of the methodology are made, while the technical component remains the same. These modifications to the social component are made to better suit a large citizen involvement when opting for a questionnaire instead of a Web-Delphi process. Adding to this, the last two stages (stage two and stage three) were originally done in two separate workshops (Alvarenga et al., 2019), but herein, due to time constraints, they are done in only one workshop.

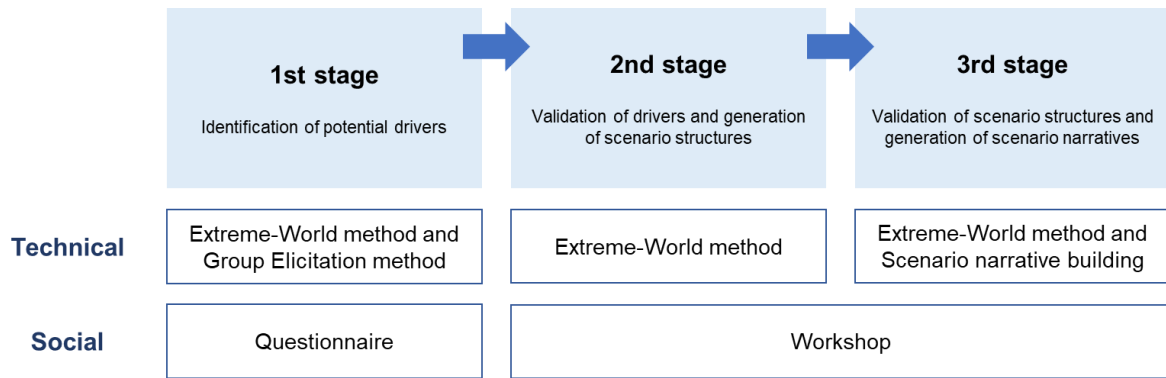


Figure 13 - Three-stage process for scenario building

For the first stage - Identification of potential drivers - the objective is to determine key factors, which are expected to influence the evolution of cattle meat consumption, in the Portuguese population, until 2050. These key factors in the scenario context are named drivers of change. For this, instead of using a Web-Delphi process, the collection of drivers is done via a regular questionnaire, in the Jotform platform (<https://eu.jotform.com/>) enabling to perform logical condition questions. The decision to use this platform for the questionnaire instead of the Web-Delphi process lies on the type and number of participants involved, since the aim is to target as many general citizens as possible, and not focus on targeting a panel of experts, the questionnaire must be the most user-friendly as possible. Also, it cannot imply the need for substantial engagement from the participants, possibly leading to a reduction in the number of answers or hampering the process. The questionnaire has no limitations on the number of responses aiming to power a broad number of participants into the process of identifying the key factors affecting the evolution of cattle meat consumption, by embracing a diversity of perspectives on the topic.

From the responses given by the participants, the divers of change are generated taking into consideration the same adapted criteria, from the Group Elicitation Method (GEM) (Boy, 1997), as the one from Alvarenga et al. (2019). Originally this method allows to gather knowledge from users, and enables the creation of a final list of elaborate concepts, from a starting point of a variety of viewpoints, which are reformulated through the implementation of different types of operations taking into account four criteria: simplicity, interest, robustness and corroboration (Boy, 1997). In our case, these criteria are adapted (as presented in First stage: Identification of drivers of change) and used to make an individual analysis of the results from the questionnaire, to finally, reach a list of drivers of change. Also, from this stage, information on the drivers of change' hypothesis of evolution is also gathered, the drivers' configurations.

Before going to the next stage, a final step is performed: organizing the identified drivers of change into the six DESTEP categories (Demographic, Economic, Social-cultural, Technological, Ecological, Political-Legal). In this step, the DESTEP framework is used instead of the PESTLE framework, used by Alvarenga et al. (2019). The DESTEP framework is a common tool for identifying trends and selecting the main driving forces (Hilderink et al., 2021), and despite being similar to PESTLE, it is more focused on demographics (Lüclidity, n.d.).

Regarding the second stage – Validation of drivers and generation of scenario structures – the final aim is to design the scenario structures. These are created according to two contrasting points of view, following the Extreme-World method. A group of experts, in a workshop, validate the drivers of change identified in the previous stage, and its hypothesis for evolution, and further arrange them into the two contrasting scenario structures. One, with all the configurations leading to a high consumption of cattle meat, in the Portuguese population, and the other one, with the configurations leading to a low consumption of cattle meat.

The third, and last stage - Validation of scenario structures and generation of scenario narratives – is done in the same workshop as the one from the previous stage. The objective is to validate and adjust the two scenario structures, generated in the last stage, and later use these structures as foundations to develop scenario narratives. The narratives make it possible to communicate and understand the scenarios better.

The following sections present the detailed methodology of each stage of the three-stage approach to construct the scenarios.

### **3.1 First stage: Identification of drivers of change**

The identification of the drivers of change, that are expected to influence the evolution of cattle meat consumption in the Portuguese population until 2050, is done via a publicly available questionnaire.

For this purpose, participants are not asked directly to identify the drivers of change. The approach must suit the type of participants included in the study, and as most of the participants are general citizens, one cannot ask technical questions to non-experts, it would be too demanding or even unfeasible for them to identify straightforwardly the drivers. Hence, participants should be given information relating to cattle meat consumption issues in order to trigger their reflection on the topic. To do so, they are presented with indicators along with their corresponding latest values for Portugal, which are related to cattle meat consumption. This way participants are faced with a set of indicators to which they can relate, making it easier for them to think about what can affect cattle meat consumption in the future, without being asked directly about it.

These indicators were obtained through the World Economic Forum (WEF) which is the International Organization for Public-Private Cooperation (<https://www.weforum.org/>). They aim to “empower global leaders to shape the future for the better” (World Economic Forum, 2019a) by integrating and aggregating the efforts of all stakeholders of global society, creating various initiatives and projects to extend their impact, following the stakeholder theory which states that an organization is responsible to all members of society. This is possible through participation in collaborative platforms, high-level personalized interaction, and integration into digital and knowledge networks (World Economic Forum, 2019a).

In the digital dimension, the organisation has a strategic intelligence platform where it develops the so-called transformation maps which “demonstrate the connections and relationships between economies, industries and global issues and provide access to insights from world-class experts.” (World Economic



Forum, n.d.-a). They cover 125 different areas and summarize the forum network’s collective intelligence. The development of the maps is made along with leading universities, think tanks and international organizations, also, it integrates research and analysis from the world’s best research institutes. The building process goes through the analysis of more than 1000 reports and articles per day, from more than 200 countries and 5 different languages and with the use of a machine learning capacity, the information is scanned, summarized, and classified (World Economic Forum, 2019b). A part of the transformation map used as a basis for the identification of the indicators is presented in Figure 14. As it is possible to observe, the map is divided into six areas of concern regarding the future of food. Also, associated with each area there is information on what it is about. By reading this information it was possible to identify several indicators related to each area. Thus, the identified indicators were organized as they are in the transformation map, divided by the six areas of concern.

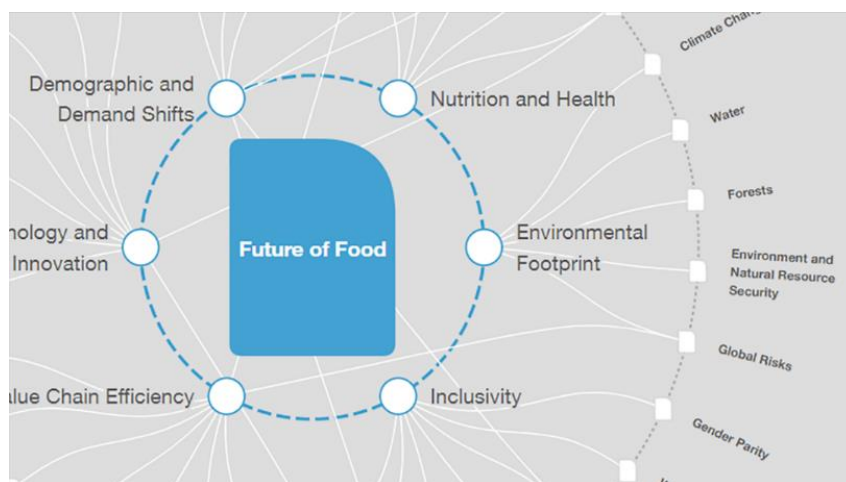


Figure 14– “Future of food” transition map (not complete) (World Economic Forum, n.d.-c)

The organization is currently the only one helping this purpose (World Economic Forum, n.d.-b), encouraging global and informed debate regarding global issues (World Economic Forum, 2019b).

By reason of the abovementioned characteristics, it is logical to underpin the areas of concern and indicators’ identification for the study, with the information provided in the “Future of Food” transformation map of the World Economic Forum (World Economic Forum, n.d.-c), thus ensuring a solid foundation and reliable source. Despite the topic being related to the future of food from a generic and global perspective, it is suitable for the specific case of cattle meat in Portugal (the subject of study) since it tackles dimensions that are similar in both cases.

With the objective of designing a suitable, user-friendly, and non-exhaustive questionnaire for the participants to answer, a first questionnaire is developed (see Appendix B), in the Google forms platform (<https://www.google.com/forms/about/>) to gather feedback, from a sample of participants (experts and non-experts), regarding the perceived complexity of the information that is going to be present in the second questionnaire (final questionnaire), as well as to understand if this information makes sense and if necessary, reduce the amount of information showed. Essentially, this first questionnaire is designed to identify which indicators are most relevant to be included in the second questionnaire.

In this step, participants are faced with the identified six different areas of concern regarding the future of food (Table 13). Each area is accompanied by its definition and several future-of-food determinants' indicators that can characterize it. For each area of concern, participants are asked to express their opinion on the indicators shown, in a five-level Likert scale ("Strongly Disagree (1)", "Disagree (2)", "Neither Agree nor Disagree (3)", "Agree (4)", "Strongly Agree (5)"), in order to determine if the indicators that characterize the corresponding area are clear and foster the reflection on the topic. A list of the six areas of concern and corresponding indicators used in this first questionnaire can be seen in Table C.45 (Appendix C). From the responses gathered it is possible to identify specific features that need to be changed for the second questionnaire.

By analysing the answers collected from the first questionnaire, some indicators are removed, and the construction of the final questionnaire is made. For the future-of-food determinants' indicators, from the first questionnaire to be excluded, the number of "Agree (4)" and "Strongly Agree (5)" answers given must be higher than the number of answers given on the remaining options.

A few rounds of testing are conducted in the second questionnaire to effectively check if it is well structured and easy to answer. From these test rounds and by having methodological discussions along with FeedInov CoLAB, adjustments to its composition and organization are made, such as, removing more indicators, or moving them to other areas of concern, changing the order of appearance of the areas, and changing the introductory paragraphs to make them simpler and straight to the point. The objective is to have approximately the same number of indicators by area of concern.

The second questionnaire encompasses open-ended questions aiming to generate ideas in order to identify possible causes for different possible evolutions of cattle meat consumption in Portugal (the drivers of change). The questionnaire can be seen in Appendix D: Questionnaire 2. In this step, the participants are faced with the set of future-of-food determinants' indicators clustered by the seven different main areas of concern (Table 13) regarding this topic, which were identified by the WEF and later adapted and validated by participants and by FeedInov CoLAB. With each indicator, comes its respective most recent performance value for Portugal. The list of indicators by area of concern, used in this step, can be checked in Table C.45 (Appendix C: Indicators by area of concern).

*Table 13 - Areas of concern presented in questionnaires 1 and 2*

<b>1st questionnaire's areas of concern</b> (by applied order)	<b>2nd questionnaire's areas of concern</b> (by applied order)
1. Demographic changes and demand shifts	1. Demographic changes and demand shifts
2. Environmental footprint	2. Environmental footprint
3. Inclusiveness in agriculture	3. Nutrition and health
4. Value chain efficiency	4. Consumer proximity to the agricultural sector
5. Nutrition and health	5. Technology and innovation
6. Food technology and innovation	6. Food chain efficiency
	7. Consumption patterns

Demographics are defined as the "statistical study of human populations and characteristics" such as population size, density, growth, and organizational groupings such as race, gender, or age. Hence, demographic shifts are observed changes occurring on this topic (Statista, n.d.). Concerning demand shifts, one must acknowledge that it defines the changes in consumer's preference to purchase a

particular product or service, regardless of its price (Liberto, 2020). Therefore, food demand is dramatically affected by demographic changes, and global urbanization also plays a key role in this aspect (World Economic Forum, n.d.-c). It is reasonable to consider the demographic and demand shifts when studying the future of cattle meat consumption since there is evidence that these are cross-linked subjects instigating the participants' reflection on the topic during the questionnaire. For this area, six different indicators are presented to the participants.

Environmental footprint is defined by the World Wide Fund for Nature (WWF) as the “ impact of human activities measured in terms of the area of biologically productive land and water required to produce the goods consumed and to assimilate the wastes generated” (World Wildlife Fund, n.d.) or, in other words, the amount of the environment needed to generate goods and services able to sustain a particular lifestyle. Food systems are a critical ingredient when it comes to the future of sustainability, and thus the future of the environmental footprint (Petrovic et al., 2015). The livestock sector has a significant environmental impact on air, water, and soil due to its use of natural resources such as land, water, and energy (Djekic, 2015). Therefore, measures of the environmental footprint are critical when dealing with the future of food, and five indicators are used for this area in the questionnaire.

Nutrition means eating a healthy and balanced diet (MedlinePlus, n.d.), in turn, according to the World Health Organization the definition of health goes beyond the absence of disease or infirmity to encompass a state of complete physical, mental and social well-being (World Health Organization, n.d.-a). Nutrition is an essential human need and a requirement to obtain and maintain a healthy life. It plays a crucial role in human development and health. Better nutrition is linked to better infant, child and maternal health, stronger immune systems, safer pregnancy and childbirth, lower risk of noncommunicable diseases and longer life expectancy. Adequate nutrition improves productivity and creates opportunities for people to progressively end poverty and hunger whereas malnutrition poses a serious health threat to humans (World Health Organization, n.d.-b). Nutrition and health are interconnected, hence, eating habits widely influence a person's lifestyle. When it comes to agriculture and food systems, businesses and governments increasingly focus on quality rather than quantity (World Economic Forum, n.d.-c). There is evidence that the long-term consumption of red and processed meat has strong effects on global health, sometimes being associated with numerous diseases, in both men and women (Battaglia Richi et al., 2015). Therefore, the topic of nutrition and health is a logical concerning area when it comes to the future of food and consequently the future habits of consuming cattle meat. For this area, four indicators are resented in the questionnaire.

Consumer proximity to the agriculture sector characterises the proximity that the consumer feels in relation to the agricultural sector, access to information on production practices, supply chains, and distribution circuits, among others. By having higher or lower proximity to this sector, food systems are affected and tend to change. In this way, when speaking about the future of food, consumer proximity to the agriculture sector plays an important role. Six indicators related to this area are shown to participants in the questionnaire.

Technology and innovation are related to the application of science in activities ranging from primary agricultural production (production practices, management, etc.), to selection, preservation, processing,

packaging, distribution, and the safe use of food. Researchers and technicians implement scientific disciplines, namely agronomy and zootechnics, engineering, chemistry, microbiology, and nutrition. The innovation dimension comprises the development of innovative production processes for application in food production and technology. According to the WEF (World Economic Forum, n.d.-c) “Technology innovation can help transform global food systems” and thus affect the cattle meat industry. For this area, only three indicators are presented to the participants.

Having in mind that value chains consist of the set of activities necessary to create a product or service, involving steps from conception to distribution and all aspects in between (Tardi, 2022), making it a crucial feature in any organization’s performance, it is logical that there is a need to analyze these value chains in order to make them more efficient. By efficiency, one must acknowledge that it describes the action of using the least number of inputs to obtain the greatest number of outputs (Banton, 2022). Hence, food chain efficiency can be characterized as a measure of all the activities comprised between the conception and distribution of a food product or service, which allows one to evaluate if these activities make the most optimum use of its resources. Therefore, implementing efficiency in the food chain allows a company to make its businesses more efficient, delivering a greater value for a lower cost. In this way, food chain efficiency impacts food systems. Again, in this area, only three indicators are shown to the participants in the questionnaire.

Consumption patterns are the process by which people look for, buy, and consume items in order to satisfy all of their requirements or wishes (IGI Global, n.d.). It is logical that consumption patterns are linked directly to cattle meat consumption in the population. Thus, having a straight-up area regarding the consumption patterns enables to identify the direct effects influencing cattle meat consumption. First, for this area of concern, a graphic with information on food consumption by sector in Portugal is shown to the participants (Figure 15), followed by three indicators related to the area.

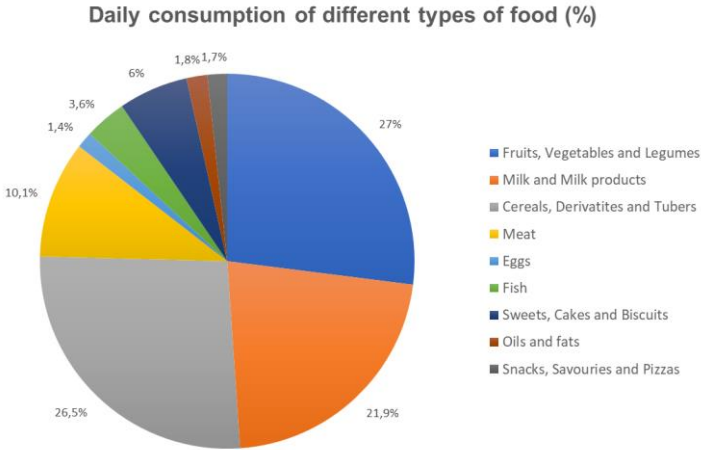


Figure 15 - Percentage of daily consumption of different types of food in the Portuguese population in 2017 (Lopes et al., 2017)

In a nutshell, in the questionnaire, each area of concern presented intends to allow the participants to reflect upon the topic, considering the most recent values of the respective indicators that characterize each of them, making it possible for them to structure their thoughts and fundament their answers. For

each area of concern, the following question is made: *Taking as an example the set of indicators presented above, please indicate which of the three statements you consider plausible (you can select more than one).* The available options presented, in check box form, are: *Until 2050, there will be (an increase/ a decrease/ no change) in the (area of concern) conditions in Portugal.* Also, an option of *Don't know/ Don't want to answer* is provided. On the first area of concern, *Demographic changes and demand shifts* the question is with regards only to the demand shifts, the demographic component is present to guide the participant on his/her possible answer. Later, on the *Consumption patterns'* area of concern, the question is made relative to the consumption of cattle meat, so the options are regarding the increase, decrease or no change in cattle meat consumption, until 2050.

Hence, participants are asked to choose a statement of increase, decrease and/or no change in the conditions presented, or choose a do not know/do not want to answer statement, and after, justify their answer, giving one or two reasons, through a pop-up text box, which appeared when clicking on the desired statement/s. If clicking on more than one statement, more than one text box appears. A representative example of the *Demographic changes and demand shifts* is presented in Figure 16. First, a small description of the area of concern is presented, followed by the final indicators, which also have a corresponding short description, and the latest value available for Portugal. Then the abovementioned question is made.

### 1. Demographic changes and demand shifts

This area of concern encompasses factors related to the demographic changes observed in the Portuguese population and its characteristics, as well as factors related to the acquisition of foodstuffs.

Indicator	Definition	Most recent value
Current population (n <sup>o</sup> of inhabitants)	Total number of people living in Portugal.	10 344 802 inhabitants
Residents in urban areas (%)	Percentage of the Portuguese population living in urban areas.	66%
Size of the middle class (%)	Percentage of the Portuguese population that fits the definition of middle class. Families with income between 75% and 200% of the national average income.	60%
Food demand (kg/day)	Food demand expressed as average consumption per inhabitant, for: Fruit, vegetables, pulses, cereals, derivatives, tubers, meat, fish, eggs, oils and fats.	1,1 Kg/day
Food production (tonnes)	Total primary and processed crops, and live animals.	11 970 972 tonnes
Household expenditure on food (%)	Percentage of household expenditure allocated to food compared to total household expenditure.	16,10%

Taking as example the set of indicators presented above, please indicate which of the three statements you consider plausible (you can select more than one):

- By 2050 there will be an increase in food demand in Portugal.
- By 2050 there will be a decrease in food demand in Portugal.
- By 2050 there will be no change in food demand in Portugal.
- Don't know/ Don't want to answer

Please give one or two reasons for the increase:

Type here...

Figure 16 - Demographic changes and demand shifts' question example (second questionnaire)

After collecting the answers given by the participants, it is possible to reach a list of drivers of change, through the application of the criteria defined by Alvarenga et al. (2019) which was based on the GEM (Boy, 1997). These criteria are: (i) address a specific issue, (ii) be nonredundant, (iii) be simple, and (iv) be understandable. This process involves, first, a rough collection of the reasons for the evolution of cattle meat consumption in Portugal, using the terms as described by the participants. As a second action, the identified terms that are similar and refer to the same reason are merged into only one. Later, all the terms gathered, are put in a simple and understandable way and ensured they address a specific topic. When in doubt in this process, FeedInov CoLAB is consulted to give their insight, after analysing the level of detail from scientific studies, that are similar to the one developed here, which can also have relevant information to clear these doubts. The aim of the scientific articles used for this stage is to analyse at which level of detail the drivers, that they use to build scenarios on the same topic, are described, investigating if they are more in a macro or micro level so that the drivers of change used here are in agreement with what has been done in comparative literature. In terms of the consultation with FeedInov CoLAB, the goal is to understand if the merge of some of the similar drivers can be done, or if they need, indeed, to be separate terms, also, to know if some drivers that are not clear must be included to later be validated in the workshop or amended right away since they are the experts.

As the last step in this stage, the drivers of change identified are organized into the six DESTEP categories (Demographic, Economic, Social-cultural, Technological, Ecological, Political-Legal), with their corresponding collected configurations, to be validated later.

### **3.2 Validation of drivers and generation of scenario structures**

The aim of this stage is to validate the drivers of change identified in the previous step, to align the possible evolutions for the drivers, also obtained from the first stage, as well as the construction of two contrasting scenario structures by organizing these drivers and corresponding configurations according to a scenario where there will be a high consumption of cattle meat, among the Portuguese population, in 2050, and the opposite scenario, where there will be a low consumption of cattle meat. These scenario structures will be later, in stage three, validated and will serve as the basis for the development of the scenario narratives.

For this purpose, a new participatory method is used, namely a workshop. This workshop is guided by a facilitator and involves a group of eight experts from FeedInov CoLAB, which also participated in the second questionnaire from the first stage. It has a duration of one working day, and it is done in FeedInov facilities, in Santarém. This same workshop encompasses the activities from this stage (stage two) and the following (stage three).

Before getting down to the work described ahead, an informal presentation of the facilitator to the participants is done, as well as an introduction of the work developed in this dissertation, and its final objectives: construction of scenario narratives, according to the Extreme-World method, to inform how the consumption of cattle meat may evolve in 2050, in the Portuguese population. Also, the overall methodology adopted for the construction of scenarios is shown. A short description of what was made

previously to this workshop, specifically in stage one, is shown in order for the participants to understand how everything was achieved, until this point, and detailed information on the processes necessary for reaching the purposes of the workshop is also shown, so the participants are aware of the activities and tasks they are going to be doing and to better contribute for the work. During this presentation, the definition of drivers of change and the definition of the configurations of the drivers are also explained to the participant.

### **3.2.1 Validation of drivers**

To initiate the validation of the drivers, the participants were presented with the list of drivers, organized by the six categories of the DESTEP framework, obtained from stage one. The lists are printed, and every two participants receive one. Through open discussions between the participants and led by the facilitator, the participants are asked to validate three parameters, driver by driver individually: The DESTEP category, the terms used to describe the drivers of change and the configurations.

- The DESTEP category parameter, to check if the driver is allocated to the category that they feel is most appropriate, and if not, allocate to the right one.
- The terms used to, first, identify any redundancy that may have remained after stage one, and to rename some drivers that may not have the appropriate terms describing them. This way some drivers are eliminated if redundant and renamed if the terms are not correct.
- The configurations (hypothesis for evolution), to generate configurations for the drivers that were not possible to obtain configurations for, during the second questionnaire, while having in mind the creation of the two contrasting scenarios, also, to validate the previously obtained configurations to check if they are extreme and yet plausible and if not, change to appropriate configurations.

To do so, the participants are faced with a set of drivers and categorization of the drivers regarding the DESTEP framework, from similar studies, so they are familiar with the terms and categorizations that are done in the literature. The modifications resulting from this step are noted, in real-time, by the participants on the printed lists of the drivers and on the computer by the facilitator.

### **3.2.2 Generation of scenario structures**

Having the list of the drivers allocated to the right DESTEP category, with the appropriate terms and left with no redundancies, and finally, with the correct and complete configurations, the ranking of the drivers of change is made. Each participant is asked to choose up to three drivers of change from each of the six DESTEP categories, regarding the perceived impact and relevance of the drivers. This means each participant chooses the eighteen drivers (three from each category) that they perceive as having the most impact and relevance to affect the evolution of cattle meat consumption by 2050. This way it is guaranteed that the drivers used for the construction of the scenarios are from every category. In this step, each category has a colour associated with it:

- Demographic – pink
- Economic – orange
- Social-cultural – yellow

- Technological – blue
- Ecological – green
- Political-Legal – coral

The participants write the chosen drivers of each category in a post-it of the corresponding colour (some write a single driver on each post-it) and then stick them into the corresponding category on a whiteboard which has six columns, each with a different category.

While the participants are on a short break, the drivers are then noted by the facilitator, on the computer, and a final list of drivers of change that are expected to affect the evolution of cattle meat consumption in the future is reached and will be used for the generation of the scenario structures. The final list of drivers of change is one last time checked for validation by all the participants to make sure there is not any important driver missing or any driver that can be omitted.

Having the final list of key drivers enabled them to organize the drivers' configurations according to the two extreme points of view, this is, for all the drivers from the final list of drivers the participants allocated the configurations leading to a high cattle meat consumption into one scenario structure, and all the configurations leading to a low cattle meat consumption into another scenario structure. This is done by projecting on the board the final list of drivers and their configurations, having two columns, each with a different extreme scenario, then the participants, through an open discussion, organized the configurations according to the two scenarios.

This resulted in two preliminary scenario structures, one for a high consumption and the other one, the opposite, for a low consumption. These scenario structures are then analysed for their consistency, this is, the logic in the scenario structures must guarantee that there are not any contradictions or internal inconsistency (Amer et al., 2013) and that some possible dependent drivers are eliminated.

At the end of this stage, the participants are faced with the two contrasting scenario structures built.

### **3.3 Validation of scenario structures and generation of scenario narratives**

As mentioned before, the activities assigned for this third stage are performed in the same workshop as the one from the second stage, after achieving the two desired scenario structures.

#### **3.3.1 Validation of scenario structures**

In the continuation of the workshop, participants are asked to validate and adjust the two contrasting scenario structures, through an open discussion, considering four main scenario characteristics referred to by Amer et al. (2013):

- Plausibility – the scenarios must have a chance to occur
- Compatibility – the multiple combined variation of the scenario drivers must be compatible
- Meaningfulness - each scenario should provide distinct insights into the future that aid in decision making
- Representativeness – the scenarios must generate a new and unique viewpoint on the issues.



Ideally, a business-as-usual (BAU) scenario structure should be constructed, to serve as the basis for a reference scenario, but due to time constraints participants do not proceed to build this specific structure, and only the construction of two contrasting scenarios occurs. Also, future-oriented scientific evidence should be collected to improve each driver's configurations descriptions – i.e. high cattle meat consumption and low cattle meat consumption - as performed by (Alvarenga et al., 2019).

### **3.3.2 Generation of scenario narratives**

The final scenario structures developed, serve as backbones for the final step: the generation of the scenario narratives which are elaborated with help from the participants. Also, a name for each scenario is given by the participants in the workshop.

For this step, the participants are left with the scenario structures, to think about them and reflect, and have some more time to generate the narratives in a calmer environment. These narratives are then sent to the facilitator by email who is going to develop factsheets describing the main points of the two contrasting scenarios.

In the end, participants are asked, in an informal way, to give feedback on the process and on the methods used, since they have participated in the two participatory components: questionnaire and workshop.

The outcome from the whole methodology described above is a list of the key drivers of change that are expected to affect cattle meat consumption and two different narratives describing two possible evolutions for the future, in 2050, regarding the consumption of cattle meat, among the Portuguese population. One narrative describes a future where there is high consumption of cattle meat, and the other one describes a future where this consumption is low.

## 4 Results

This chapter presents the results from applying the methodology described in the previous chapter (adopted methodology). The chapter is divided into three sections. In section 4.1 an analysis of the responses given, and the type of participants involved in the study is made, as well as the presentation of the results from the first stage of the methodology, this is, the list of drivers of change organized by the six DESTEP categories, with their corresponding configurations, to later be validated. Section 4.2 presents the results from the first part of the workshop, regarding the second stage of the methodology, namely the results from the discussions to obtain the final list of drivers with the configurations arranged according to the two contrasting scenario structures. Finally, in section 4.3 the validated scenario structures are represented, as well as the narratives constructed based on these structures.

### 4.1 The first stage of the methodology

In the first questionnaire, it was possible to gather nine responses. After analysing the answers given in this questionnaire, following the criteria defined to remove the future-of-food determinants' indicators, ten indicators were excluded: one from the *Demographic changes and demand shifts* area, three from *Environmental footprint*, four from *Inclusiveness in agriculture*, one from *Value chain efficiency*, and finally one from *Nutrition and health*.

Later, as a result of the test round of the second questionnaire and the methodological discussions with FeedInov CoLAB, three areas' names were changed, to more appropriate terms, and one new area of concern was created: *Consumption patterns*. Also, the order of the areas of concern changed, once, after discussing with the laboratory, this order seemed the most appropriate one, in order to guide the participants through the questionnaire. Also, the new area of concern was strategically placed at the end of the questionnaire, so as not to influence the answers of the remaining areas, since this one is related to cattle meat consumption. Regarding the indicators, on *Demographic changes and demand shifts* a new indicator was included, which was previously from another area, on *Nutrition and health*, two more indicators were removed, on *Consumer proximity to the agricultural sector* (former *Inclusiveness in agriculture*) all the indicators were changed, on *Food chain efficiency* (former *Value chain efficiency*) seven indicators were removed, and one, from another area, included, lastly, on the new area of concern, *Consumption patterns*, two of the indicators were from the original information from the WEF and a new one was added. All these modifications can be seen in Table C.45 (Appendix C: Indicators by area of concern).

#### 4.1.1 Participants' characteristics

The second questionnaire was open for approximately two months, and with help from FeedInov CoLAB, it was possible to gather a substantial number of responses. A group of 141 participants from Portugal (mainland and islands) took part in this step. Their background covers a broad range of fields of study, such as health, agriculture and livestock, engineering, management, veterinary medicine, social sciences, communication, psychology and quality and food safety. More than half of the participants are

from the health sector, namely 61%, followed by the agriculture and livestock sector (25%) as Table 14 indicates.

Table 14 - Participants' background

<b>Participants' background</b>	<b># of participants</b>
Health	86
Agriculture and livestock	36
Engineering	6
Management	5
Veterinary medicine	4
Social sciences	1
Communication	1
Psychology	1
Quality and food safety	1
<b>Total</b>	<b>141</b>

Few participants only have a secondary education level (6). Mainly, they have a bachelor's degree (62) and a master's degree (36). Also, some participants have postgraduate degrees (11) and a Doctorate (PhD) (26).

Regarding the age distribution, the goal of including mostly people from a young age group was achieved. Participants are mainly between 21 and 49 years old as seen in Figure 17.

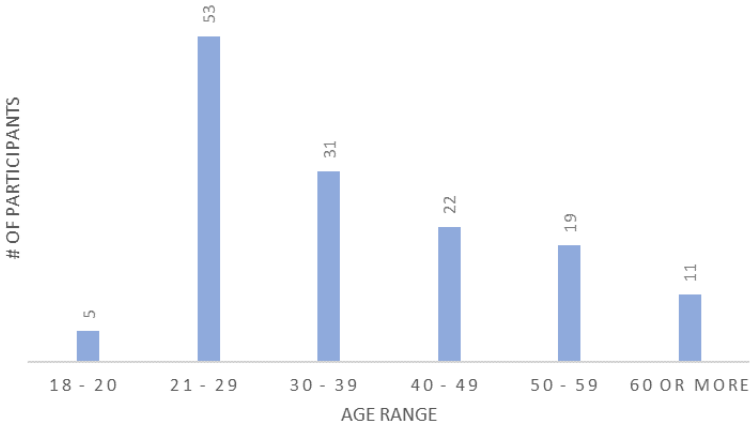


Figure 17 - Age distribution of participants

It was not possible to reach a balance in terms of the participant's gender, 80% are women, 19% are men and the remaining 1% preferred to keep this information confidential.

When it comes to geographical dispersion, it was possible to have good coverage of the entire country. Participants are from every autonomous region and district of Portugal, except two, namely Bragança and Guarda. Most of the participants are from the two big centres of Portugal, Lisbon, accounting for 47 and Porto, for 18, as presented in Table 15.

Table 15 - Participants' local of residence

<b>District/ Autonomous region</b>	<b># of participants</b>
Lisboa	47
Porto	18
Setúbal	12
Santarém	9
Leiria	8
Beja	6
Braga	6
Coimbra	6
Vila Real	5
Castelo Branco	3
Évora	3
Faro	3
Portalegre	3
Viana do Castelo	3
Aveiro	2
Viseu	2
Madeira	2
Açores	1
Did not mention	2
<b>Total</b>	<b>141</b>

#### 4.1.2 Type of responses

Focusing now on the analysis of the type of responses given by the participants. Although not all participants gave reasons or justifications, all chose a check box option (increase, decrease, no change, don't know/don't want to answer), indicating which statement or statements they agreed on. Several participants could not agree with only one statement, so they chose more than one option for each area of concern, in Table 16, this information is provided.

Table 16 - Number and percentage of participants choosing more than one statement per area of concern

<b>Area of concern</b>	<b># of participants choosing more than one statement</b>	<b>% of participants choosing more than one statement</b>
1. Demographic changes and demand shifts	3	19%
2. Environmental footprint	3	19%
3. Nutrition and health	5	31%
4. Consumer proximity to the agricultural sector	1	6%
5. Technology and innovation	1	6%
6. Food chain efficiency	1	6%
7. Consumption patterns	2	13%
<b>Total</b>	<b>16</b>	<b>100%</b>

Regarding the first area of concern, *Demographic changes and demand shifts*, the answers given were mainly expecting an increase in these conditions, approximately 60% (Table 17 and Table 18). Participants aged between 21 and 39 years old, chose more statements for an increase in food demand when compared to the remaining statements. When analysing the relation between the background of the participants and the type of answers given, only participants with a background in management have chosen more statements for the decrease in food demand until 2050 compared to the increase. Besides

management and psychology, all the remaining participants have a higher or equal (engineering) rate of responses on increase rather than on decrease or no change.

Table 17 - Number of responses given by type of answer considering age range (Demographic changes and demand shifts)

<b>Chosen statement/ Age range</b>	<b>18-20</b>	<b>21-29</b>	<b>30-39</b>	<b>40-49</b>	<b>50-59</b>	<b>60 or more</b>	<b>Total of responses</b>
Increase	5	32	23	8	8	5	81
Decrease		11	4	7	6	2	30
No change	1	6	4	6	2	3	22
Don't know/Don't want to answer		5	1	1	3	1	11
<b>Total of responses</b>	<b>5</b>	<b>53</b>	<b>31</b>	<b>22</b>	<b>19</b>	<b>11</b>	<b>144</b>

Table 18 - Number of responses given by type of answer considering participants' background (Demographic changes and demand shifts)

<b>Chosen statement/ Participants' background</b>	<b>Health</b>	<b>Agriculture and livestock</b>	<b>Engineering</b>	<b>Management</b>	<b>Veterinary medicine</b>	<b>Social sciences</b>	<b>Communication</b>	<b>Psychology</b>	<b>Quality and food safety</b>	<b>Total of responses</b>
Increase	53	20	3	1	2	1			1	81
Decrease	17	7	2	4						30
No change	12	7	1		1			1		22
Don't know/Don't want to answer	7	2			1		1			11
<b>Total of responses</b>	<b>86</b>	<b>36</b>	<b>6</b>	<b>5</b>	<b>5</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>144</b>

*Environmental footprint* has registered, as well, a strong incidence on responses stating the increase of the environmental impact until 2050, namely 72%. In young age groups, the number of answers stating an increase, when compared with the remaining types of answers, is far greater than in older age groups (Table 19). Again, participants with a background in management are the only ones having more statements on the decrease in environmental impacts (Table 20).

Table 19 - Number of responses given by type of answer considering age range (Environmental footprint)

<b>Chosen statement/ Age range</b>	<b>18-20</b>	<b>21-29</b>	<b>30-39</b>	<b>40-49</b>	<b>50-59</b>	<b>60 or more</b>	<b>Total of responses</b>
Increase	5	42	23	16	11	7	104
Decrease		7	8	1	5	3	24
No change		4		4	2	2	12
Don't know/Don't want to answer		2		1	1		4
<b>Total of responses</b>	<b>5</b>	<b>55</b>	<b>31</b>	<b>22</b>	<b>19</b>	<b>12</b>	<b>144</b>

Table 20 - Number of responses given by type of answer considering participants' background (Environmental footprint)

<b>Chosen statement/ Participants' background</b>	<b>Health</b>	<b>Agriculture and livestock</b>	<b>Engineering</b>	<b>Management</b>	<b>Veterinary medicine</b>	<b>Social sciences</b>	<b>Communication</b>	<b>Psychology</b>	<b>Quality and food safety</b>	<b>Total of responses</b>
Increase	72	18	5	2	4	1		1	1	104
Decrease	7	12	1	4						24
No change	6	6								12
Don't know/Don't want to answer	3						1			4
<b>Total of responses</b>	<b>88</b>	<b>36</b>	<b>6</b>	<b>6</b>	<b>4</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>144</b>

With regards to the area of concern of *Nutrition and Health*, the observed trend of increasing conditions did not last. More responses are stating a decrease in nutrition and health conditions until the year 2050 (42%) rather than an increase (39%) or no change (14%). Older participants have voted more for an increase in these conditions to the detriment of the decrease or no change (Table 21). Logically, participants with a background in health have expertise in this area, and half of these participants stated that the nutrition and health conditions of the population are going to face a decrease until 2050, while only approximately 32% stated an increase, and 13% stated the conditions are going to remain the same (Table 22).

Table 21 - Number of responses given by type of answer considering age range (Nutrition and health)

Chosen statement/ Age range	18-20	21-29	30-39	40-49	50-59	60 or more	Total of responses
Increase		20	11	9	12	5	57
Decrease	4	23	16	10	5	4	62
No change	1	10	3	1	2	3	20
Don't know/Don't want to answer		2	2	3			7
Total of responses	5	55	32	23	19	12	146

Table 22 - Number of responses given by type of answer considering participants' background (Nutrition and health)

Chosen statement/ Participants' background	Health	Agriculture and livestock	Engineering	Management	Veterinary medicine	Social sciences	Communication	Psychology	Quality and food safety	Total of responses
Increase	28	18	4	4	2			1		57
Decrease	44	12	1		2	1		1	1	62
No change	11	7	1	1						20
Don't know/Don't want to answer	4	2		1						7
Total of responses	87	39	6	6	4	1	1	1	1	146

Concerning the fourth area of concern, *Consumer proximity to the agricultural sector*, more participants were stating that the consumers are going to be closer to the agricultural sector, although the number of participants stating a decrease in the proximity is almost the same. Also, there was a substantial number of responses defending that the proximity of the consumer to the sector is going to remain the same until 2050 when comparing this type of response to other areas of concern. While more participants from younger generations affirmed less proximity of the consumers to the agricultural sector, participants aged 30 or more declared that this proximity is going to increase (Table 23). Participants with a background in Agriculture and livestock are more likely to understand this area and think about how it can evolve in the future. These types of participants stated more of a distant relationship between the consumer and the sector than closer proximity, still, the number of participants having a background on this topic, stating that there will be an increase in the proximity is not much lower (Table 24).

Table 23 - Number of responses given by type of answer considering age range (Consumer proximity to the agricultural sector)

Chosen statement/ Age range	18-20	21-29	30-39	40-49	50-59	60 or more	Total of responses
Increase	1	19	14	8	8	2	52
Decrease	3	23	6	6	6	6	50
No change	1	8	7	6	4	2	28
Don't know/Don't want to answer		4	4	2	1	1	12
Total of responses	5	54	31	22	19	11	142

Table 24 - Number of responses given by type of answer considering participants' background (Consumer proximity to the agricultural sector)

Chosen statement/ Participants' background	Health	Agriculture and livestock	Engineering	Management	Veterinary medicine	Social sciences	Communication	Psychology	Quality and food safety	Total of responses
Increase	34	15		1		1			1	52
Decrease	26	17	3		4					50
No change	17	3	3	4				1		28
Don't know/Don't want to answer	9	2						1		12
Total of responses	86	37	6	5	4	1	1	1	1	142

When it comes to *Technology and innovation*, despite the age range or the background of the participants there can be seen a trend: an increase in technological advance and innovation, 87% (Table 25 and Table 26).

Table 25 - Number of responses given by type of answer considering age range (Technology and innovation)

Chosen statement/ Age range	18-20	21-29	30-39	40-49	50-59	60 or more	Total of responses
Increase	5	45	29	20	15	10	124
Decrease		1				1	2
No change	1	4		1	1		7
Don't know/Don't want to answer		3	2	1	3		9
Total of responses	6	53	31	22	19	11	142

Table 26 - Number of responses given by type of answer considering participants' background (Technology and innovation)

Chosen statement/ Participants' background	Health	Agriculture and livestock	Engineering	Management	Veterinary medicine	Social sciences	Communication	Psychology	Quality and food safety	Total of responses
Increase	76	31	6	4	4	1		1	1	124
Decrease	2									2
No change	4	3								7
Don't know/Don't want to answer	5	2		1				1		9
Total of responses	87	36	6	5	4	1	1	1	1	142

Regarding the area of concern of *Food chain efficiency*, more responses were stating an expected increase in efficiency, namely 65%, while the number of responses stating a decrease or no change is nearly the same, 13% and 10% respectively. Also, the trend is steady regardless of the age of the participants (Table 27). When it comes to the background of the participants the trend is also the same, except for the participants from a veterinary medicine and psychology background (Table 28). In this

area, there is an increase in the number of participants stating they do not know how the food chain efficiency is going to evolve or they do not want to answer.

Table 27 - Number of responses given by type of answer considering age range (Food chain efficiency)

<b>Chosen statement/ Age range</b>	<b>18-20</b>	<b>21-29</b>	<b>30-39</b>	<b>40-49</b>	<b>50-59</b>	<b>60 or more</b>	<b>Total of responses</b>
Increase	3	29	21	18	13	9	93
Decrease	1	11	2	2	2		18
No change	1	6	3	1	2	1	14
Don't know/Don't want to answer		7	5	1	3	1	17
<b>Total of responses</b>	<b>5</b>	<b>53</b>	<b>31</b>	<b>22</b>	<b>20</b>	<b>11</b>	<b>142</b>

Table 28 - Number of responses given by type of answer considering participants' background (Food chain efficiency)

<b>Chosen statement/ Participants' background</b>	<b>Health</b>	<b>Agriculture and livestock</b>	<b>Engineering</b>	<b>Management</b>	<b>Veterinary medicine</b>	<b>Social sciences</b>	<b>Communication</b>	<b>Psychology</b>	<b>Quality and food safety</b>	<b>Total of responses</b>
Increase	53	28	4	4	2	1			1	93
Decrease	14	2	2							18
No change	8	4			1			1		14
Don't know/Don't want to answer	12	2		1	1		1			17
<b>Total of responses</b>	<b>87</b>	<b>36</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>142</b>

In the last area of concern, *Consumption patterns*, there were significantly more answers stating an expected reduction in cattle meat consumption, namely 70%. Only participants aged less than 20 stated more of an increase in cattle meat consumption when compared to a decrease or no change, while all the remaining participants chose a decrease (Table 29). When it comes to the background of the participants, there is a substantial difference between the decrease and increase in this area for the health, and agriculture and livestock participants. 70% of the health participants and 75% of the agriculture and livestock participants voted for a decrease (Table 30).

Table 29 - Number of responses given by type of answer considering age range (Consumption patterns)

<b>Chosen statement/ Age range</b>	<b>18-20</b>	<b>21-29</b>	<b>30-39</b>	<b>40-49</b>	<b>50-59</b>	<b>60 or more</b>	<b>Total of responses</b>
Increase	3	5	2		1	1	12
Decrease	2	42	21	17	12	6	100
No change	1	5	5	3	4	4	22
Don't know/Don't want to answer		1	4	2	2		9
<b>Total of responses</b>	<b>6</b>	<b>53</b>	<b>32</b>	<b>22</b>	<b>19</b>	<b>11</b>	<b>143</b>



Table 30 - Number of responses given by type of answer considering participants' background (Consumption patterns)

Chosen statement/ Participants' background	Agriculture and		Engineering	Management	Veterinary medicine	Social sciences	Communication	Psychology	Quality and food safety	Total of responses
	Health	livestock								
Increase	8	2	1		1					12
Decrease	61	27	3	4	2	1	1	1		100
No change	14	6	1						1	22
Don't know/Don't want to answer	5	1	1	1	1					9
Total of responses	88	36	6	5	4	1	1	1	1	143

Overall, in all the areas of concern, there were very few participants stating they did not know or did not want to answer, still, the area of concern where this type of answer was more common, was *Food chain efficiency*. The same with the responses stating no change in the conditions for the future. In every area the number of this type of answer is not significant, being 20 the maximum in *Consumer proximity to the agricultural sector*. The most chosen types of answers were an increase or decrease in the conditions. In all the areas, except for *Consumption patterns*, more answers were stating an increase in the conditions rather than a decrease, with a substantial difference in *Environmental footprint*, *Technology and innovation* (more increase than decrease) and *Consumption patterns* (more decrease in cattle meat consumption than increase). In some cases, it is possible to observe a relation between the type of answers given, and the age range of the participants or their background. In *Demographic changes and demand shifts*, *Environmental footprint*, *Nutrition and Health* and *Consumer proximity to the agricultural sector* these parameters clearly influenced the responses given. While on the remaining areas there is no direct evidence between the parameters and the answers. No trend of increase or decrease despite the age or the background can be seen.

As mentioned, although all participants filled out the check box answers not all justified them. There were found to be four different kinds of open-ended answers: answers giving reasons for the increase in the areas of concern's conditions, a decrease, no change, and justification for the Don't know/Don't want to answer responses. The total of these reasons/justifications, for all the areas of concern, was 567 and below (Table 31 and Table 32) they are broken down by area and type of answer and compared to the number of responses given on the check boxes.

The number of statements chosen by the participants, despite being similar throughout the different areas, are not all the same nor 141 as expected, since participants were choosing more than one statement, as mentioned.

In general, the number of responses (reasons/justifications) did not vary much from area to area, with *Environmental footprint* standing out, having 105 reasons and justifications gathered. Also, it is possible to identify a reduction in the number of responses as the questionnaire becomes closer to the end. The area of concern where there were the least justifications was the last one, *Consumption patterns* followed by *Technology and innovation*.

When comparing the reasons/justifications with the check box answers, in *Consumption patterns* the number of responses is substantially lower, around 40% of the participants did not justify their choices.

On the other hand, in *Environmental footprint*, 73% of the participants gave reasons for their choices. Overall, approximately 50% of the participants justified their answers.

Table 31 - Number of check box responses and number of reasons/justifications given by area of concern

Area of concern	# of Check box answers	# of Reasons/Justifications
1. Demographic changes and demand shifts	144	83
2. Environmental footprint	144	105
3. Nutrition and health	146	87
4. Consumer proximity to the agricultural sector	142	76
5. Technology and innovation	142	73
6. Food chain efficiency	142	74
7. Consumption patterns	143	69
<b>Total</b>	<b>1003</b>	<b>567</b>

The number of reasons/justifications given by the type of answer (increase, decrease, no change, don't know/don't want to answer), when compared to the number of statements (check boxes) chosen is around 50%. Hence, the trend, when looking into the type of answers given, remains. Justifications for a decrease are the most observed, and the least observed are the reasons for the don't know/don't want to answer.

Table 32 - Number of check box responses and number of reasons/ justifications given by type of answer

Area of concern	Increase		Decrease		No change		Don't know/Don't want to answer		Total # of Reasons/Justifications
	# of Check box answers	# of Reasons/Justifications	# of Check box answers	# of Reasons/Justifications	# of Check box answers	# of Reasons/Justifications	# of Check box answers	# of Reasons/Justifications	
Total	523	285	286	186	125	66	69	30	567
Justification rate		54%		65%		53%		43%	

Some answers given, either reasons or justifications did not allow the identification of any driver, either because the participants justified with the area of concern itself, mentioned they did not have enough knowledge to have a fixed opinion, or even because they did not give any reasons, despite having written their opinion.

From the total of 567 reasons and justifications collected, 478 responses led to the extraction of drivers. The number of responses gathered, and the number of responses that enabled the extraction of drivers are broken down by area of concern, in the table presented below (Table 33). For the responses enabling the extraction of drivers of change, the area of concern *Environmental footprint* stands out, being the one having the most responses that enable the extraction of drivers. Although, this number of responses is approximately the same across all areas. For *Technology and Innovation*, there is a substantial reduction between the number of responses and the ones enabling the extraction of drivers. As said, the last area of concern had the fewest responses, but the same did not happen in the responses enabling the extraction of drivers. The area of concern which led to the identification of the least drivers of change was *Technology and Innovation*.

Table 33 - Number of responses and number of responses enabling the extraction of drivers by area of concern

Area of concern	# of Reasons/ justifications	# of Reasons/ justifications enabling the extraction of drivers
1. Demographic changes and demand shifts	83	72
2. Environmental footprint	105	94
3. Nutrition and health	87	78
4. Consumer proximity to the agricultural sector	76	64
5. Technology and innovation	73	49
6. Food chain efficiency	74	62
7. Consumption patterns	69	59
<b>Total</b>	<b>567</b>	<b>478</b>

When analysing the number of responses enabling the extraction of drivers compared to the number of responses given, in Table 34, a very positive rate was seen except for the Don't know/Don't want to answer type of answer. Very few responses of Don't know/Don't want to answer were given and consequently, very few drivers of change were identified from them, only 10 responses justifying this type of answer, out of the 30 given enabled the identification of drivers. The type of answer that enabled the most extraction of drivers is the decrease, followed by the increase and no change, where this number is almost the same.

Table 34 - Number of reasons/justifications and number of reasons/justifications enabling the extraction of drivers given by type of answer

Area of concern	Increase		Decrease		No change		Don't know/Don't want to		Total # of Reasons/ Justifications enabling the extraction of drivers
	# of Reasons/ Justifications enabling the extraction of drivers	# of Reasons/ Justifications enabling the extraction of drivers	# of Reasons/ Justifications enabling the extraction of drivers	# of Reasons/ Justifications enabling the extraction of drivers	# of Reasons/ Justifications enabling the extraction of drivers	# of Reasons/ Justifications enabling the extraction of drivers	# of Reasons/ Justifications enabling the extraction of drivers		
Total	285	239	186	174	66	55	30	10	478
Justification enabling the extraction of drivers rate		84%		94%		83%		33%	

A combined display of the two abovementioned features is shown in Figure 18, where it is possible to observe the summary of the number of responses enabling the extraction of drivers, by area of concern and by type of answer. In all the areas of concern except *Consumption patterns*, *Consumer proximity to the agriculture sector* and *Nutrition and health*, the reasons and justifications enabling the extraction of drivers are prevalent when talking about an increase compared to the remaining type of answers. As expected, from what is mentioned above, very few drivers were obtained from the Don't know/Don't want to answer responses in every area of concern, having two areas, namely *Environmental footprint* and *Nutrition and Health* with not a single driver obtained from the responses. In the *consumption patterns* area, the same happened, but with the increase type of answer, it was not possible to obtain any driver of change from these. On the other hand, in *Technology and innovation*, not a single driver was obtained from the justification and reasons obtained from the decrease statement.

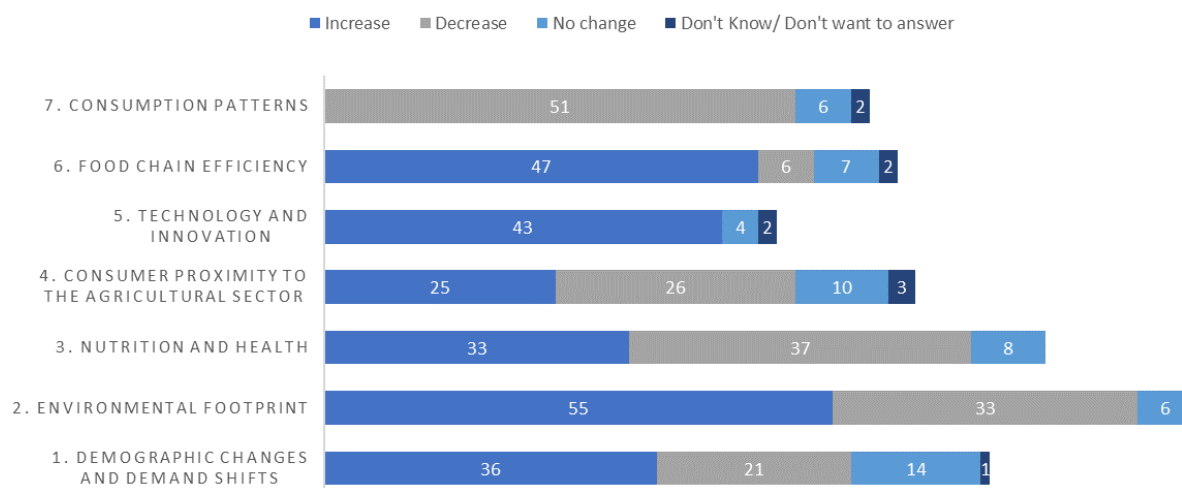


Figure 18 - Number of answers enabling the identification of drivers, by area of concern and type of answer

Most of the answers from which it was possible to identify drivers belong to participants aged between 20 and 49. This amount is in accordance with the age range of most of the total participants. Very few drivers are originated by participants who have no more than the level of education of compulsory schooling. Still in this context, participants with a bachelor's degree stand out, but compared to the total sample of participants, the ones with a postgraduate degree gave more useful responses. Participants with a background in health and agriculture and livestock are the ones enabling the most identification of drivers. The responses from all the participants with a background in management have allowed to obtain drivers. All this information is stated in Table 35 below.

Table 35 - Number of responses enabling the extraction of drivers by age range, educational level, and participants' background (Demographic changes and demands shifts)

Age range	# of responses enabling the extraction of drivers	# of participants	Level of education	# of responses enabling the extraction of drivers	# of participants
18 - 20	0	5	High school	1	6
21 - 29	25	53	Bachelor	30	62
30 - 39	17	31	Postgraduate	7	11
40 - 49	14	22	Master	20	36
50 - 59	10	19	PhD	14	26
60 or more	6	11	Total	72	141
Total	72	141			

Participants' background	# of responses enabling the extraction of drivers	# of participants
Health	40	86
Agriculture and livestock	23	36
Engineering	2	6
Management	5	5
Veterinary medicine	2	4
Social sciences	0	1
Communication	0	1
Psychology	0	1
Quality and food safety	0	1
Total	72	141

Regarding the area of concern of *Environmental impact* (Table 36), the abovementioned trend remains the same for all the parameters except for the age range. There is a significant increase in the number of responses enabling the extraction of drivers from participants aged between 21 and 29. Also, a significant increase can be seen in the participants with a background in health, having given more reasons and justifications from where it was possible to obtain drivers. Again, all the participants with a background in management gave reasons and justifications that enabled the extraction of drivers.

From this area of concern, it is noticeable that sometimes the number of responses enabling the extraction of drivers is superior to the actual number of participants. This is because there are participants that chose more than one statement and justified all the statements chosen, as mentioned ahead.

*Table 36 - Number of responses enabling the extraction of drivers by age range, educational level, and participants' background (Environmental footprint)*

Age range	# of responses enabling the extraction of drivers	# of participants	Level of education	# of responses enabling the extraction of drivers	# of participants
18 - 20	0	5	High school	2	6
21 - 29	37	53	Bachelor	43	62
30 - 39	18	31	Postgraduate	12	11
40 - 49	18	22	Master	20	36
50 - 59	15	19	PhD	17	26
60 or more	6	11	Total	94	141
Total	94	141			

Participants' background	# of responses enabling the extraction of drivers	# of participants
Health	54	86
Agriculture and livestock	28	36
Engineering	2	6
Management	7	5
Veterinary medicine	3	4
Social sciences	0	1
Communication	0	1
Psychology	0	1
Quality and food safety	0	1
Total	94	141

In *Nutrition and health*, the trend in the age range remains the same, also in the level of education of the participants. The number of participants, having a master's degree, giving reasons and justifications enabling the identification of drivers had a slight increase. Once again, all the participants from management enabled the identification of drivers in their responses. Also, one participant with a background in social sciences gave useful insights, which was not observed in the previous areas. In this area, it was expected a significant increase in the number of participants with a background in health to answer and give useful insights for the construction of the scenarios, once their area of expertise covers what is addressed in the area of concern, but this did not happen, the number of participants did not vary much from the remaining areas (Table 37).

Table 37 - Number of responses enabling the extraction of drivers by age range, educational level, and participants' background (Nutrition and health)

Age range	# of responses enabling the extraction of drivers	# of participants	Level of education	# of responses enabling the extraction of drivers	# of participants
18 - 20	0	5	High school	1	6
21 - 29	29	53	Bachelor	34	62
30 - 39	17	31	Postgraduate	8	11
40 - 49	15	22	Master	23	36
50 - 59	12	19	PhD	12	26
60 or more	5	11	Total	78	141
Total	78	141			

Participants' background	# of responses enabling the extraction of drivers	# of participants
Health	45	86
Agriculture and livestock	23	36
Engineering	2	6
Management	5	5
Veterinary medicine	2	4
Social sciences	1	1
Communication	0	1
Psychology	0	1
Quality and food safety	0	1
Total	78	141

Regarding the area of concern of *Consumer proximity to the agricultural sector* (Table 38), the number of participants aged 60 or more giving answers that enable the extraction of drivers is significantly reduced. The same can be seen from participants having a bachelor's degree. When it comes to the participants' background, in this area of concern, the same from the previous area was expected, but this time with the participants with a background in agriculture and livestock. It was expected for the number of responses enabling the identification of drivers, from participants with a background in this area, to be higher when compared to the remaining areas of concern, but, again, this did not happen, the number remained almost the same.

Table 38 - Number of responses enabling the extraction of drivers by age range, educational level, and participants' background (Consumer proximity to the agricultural sector)

Age range	# of responses enabling the extraction of drivers	# of participants	Level of education	# of responses enabling the extraction of drivers	# of participants
18 - 20	0	5	High school	1	6
21 - 29	27	53	Bachelor	27	62
30 - 39	13	31	Postgraduate	7	11
40 - 49	9	22	Master	17	36
50 - 59	12	19	PhD	12	26
60 or more	3	11	Total	64	141
Total	64	141			

Table 38 - Number of responses enabling the extraction of drivers by age range, educational level, and participants' background (Consumer proximity to the agricultural sector) continued

Participants' background	# of responses enabling the extraction of	
	drivers	# of participants
Health	34	86
Agriculture and livestock	22	36
Engineering	1	6
Management	4	5
Veterinary medicine	2	4
Social sciences	1	1
Communication	0	1
Psychology	0	1
Quality and food safety	0	1
<b>Total</b>	<b>64</b>	<b>141</b>

For *Technology and innovation* (Table 39), only one participant aged 60 or more, and a few participants aged between 21 and 29 gave an answer that enabled the identification of drivers. Also, a few postgraduate participants gave useful insights into the study. Responses enabling the extraction of drivers from the participants having no more than a high school education and a master's degree are very few. Again, hardly any engineer participant gave a justification allowing the extraction of drivers.

Table 39 - Number of responses enabling the extraction of drivers by age range, educational level, and participants' background (Technology and innovation)

Age range	# of responses enabling the extraction of		Level of education	# of responses enabling the extraction of	
	drivers	# of participants		drivers	# of participants
18 - 20	0	5	High school	1	6
21 - 29	19	53	Bachelor	22	62
30 - 39	9	31	Postgraduate	5	11
40 - 49	10	22	Master	11	36
50 - 59	10	19	PhD	10	26
60 or more	1	11	<b>Total</b>	<b>49</b>	<b>141</b>
<b>Total</b>	<b>49</b>	<b>141</b>			

Participants' background	# of responses enabling the extraction of	
	drivers	# of participants
Health	30	86
Agriculture and livestock	15	36
Engineering	1	6
Management	2	5
Veterinary medicine	1	4
Social sciences	0	1
Communication	0	1
Psychology	0	1
Quality and food safety	0	1
<b>Total</b>	<b>49</b>	<b>141</b>

Concerning the area of *Food chain efficiency*, participants aged between 21 and 29 are the ones that enabled the most identification of drivers, like in every area, but still, in this area, this amount is significantly low. Participants with a bachelor's and master's degree giving useful insights for the extraction of drivers are the lowest when compared to the participants that answered the questionnaire

having that level of education. Almost every participant with a background in management gave responses enabling the extraction of drivers (Table 40).

*Table 40 - Number of responses enabling the extraction of drivers by age range, educational level, and participants' background (Food chain efficiency)*

Age range	# of responses enabling the extraction of drivers	# of participants	Level of education	# of responses enabling the extraction of drivers	# of participants
18 - 20	0	5	High school	1	6
21 - 29	22	53	Bachelor	26	62
30 - 39	14	31	Postgraduate	7	11
40 - 49	11	22	Master	15	36
50 - 59	10	19	PhD	13	26
60 or more	5	11	Total	62	141
Total	62	141			

Participants' background	# of responses enabling the extraction of drivers	# of participants
Health	38	86
Agriculture and livestock	18	36
Engineering	1	6
Management	4	5
Veterinary medicine	1	4
Social sciences	0	1
Communication	0	1
Psychology	0	1
Quality and food safety	0	1
Total	62	141

Regarding the last area of concern, *Consumption patterns*, a trend in the responses enabling the identification of drivers regarding the participants' age remains as stated in Table 41. The same concerning the level of education of the participants, but in this area, more people having a bachelor's degree have justified the chosen options with useful insights. Again, almost every participant with a background in management enabled the extraction of drivers and the least participants allowing to identify drivers from their responses are the ones with a veterinary medicine background.

*Table 41 - Number of responses enabling the extraction of drivers by age range, educational level, and participants' background (Consumption patterns)*

Age range	# of responses enabling the extraction of drivers	# of participants	Level of education	# of responses enabling the extraction of drivers	# of participants
18 - 20	0	5	High school	1	6
21 - 29	19	53	Bachelor	30	62
30 - 39	13	31	Postgraduate	5	11
40 - 49	12	22	Master	11	36
50 - 59	10	19	PhD	12	26
60 or more	5	11	Total	59	141
Total	59	141			



Table 41 - Number of responses enabling the extraction of drivers by age range, educational level, and participants' background (Consumption patterns) continued

Participants' background	# of responses enabling the extraction of drivers	# of participants
Health	34	86
Agriculture and livestock	18	36
Engineering	2	6
Management	4	5
Veterinary medicine	1	4
Social sciences	0	1
Communication	0	1
Psychology	0	1
Quality and food safety	0	1
Total	59	141

All in all, regardless of age, level of education or background, there was not an outstanding variation in the number of responses enabling the extraction of drivers, throughout the seven areas of concern. In any area, not a single participant aged less than 20 gave justifications and reasons from which it was possible to extract drivers. In every area of concern, the participants that enabled the most identification of drivers are the ones aged between 21 and 29, which is expected, since they are the majority of the respondents. In *Technology and innovation*, participants over 60 years old had the lowest number of responses allowing the extraction of drivers. In addition, in the big picture, all participants that answered the second questionnaire, which have a background in management, gave useful insights for the study. Participants with a background in communication, psychology and quality and food safety did not give any response enabling the extraction of drivers in any area of concern, and participants with a background in social sciences only gave useful insights in two areas: *Nutrition and health*, and *Consumer proximity to the agricultural sector*.

### 4.1.3 Drivers of change

Each participant's reasons and justifications mentioned ahead, sometimes enabled the extraction of more than one driver. This is, the responses given by the participants, could lead to the identification of one driver or, often, more than one driver.

Applying the GEM to the responses given by the participants, in order to reach a list of drivers that address a specific issue, are simple, non-redundant and understandable, was not a direct exercise, and some doubts regarding the similarity of the drivers have arisen. To possibly eliminate these doubts an analysis of four similar studies was made, to understand at which level of detail the drivers were specified in them. From these studies, it was possible to realise that the drivers are described on a macro level. Later, this was communicated to FeedInov CoLAB, to check if the merge of the drivers could be done. As a result, some drivers were immediately merged into only one, and some were agreed to leave exactly how they were, to later be validated in the workshop with the participants. In this step, there were doubts about 59 drivers where 42 were merged into only 18, and 17 drivers were kept the same.

Regularly, different participants mentioned the same driver. It was observed that, in the beginning, a lot of different drivers were identified, but as the number of participants increased fewer new drivers

appeared, this shows that, even if the participation is infinite, the number of different drivers identified reaches a saturation point.

From the first area of concern, *Demographic changes and demand shifts*, it was possible to gather 129 drivers, from which, only 35 are different. Nineteen drivers were mentioned only once, and four drivers stood out:

1. Resident population – mentioned 38 times
2. Purchase power – mentioned 15 times
3. Ageing population – mentioned 10 times
4. Birth rate – mentioned 9 times

Regarding *Environmental footprint*, out of the 164 extracted drivers, only 56 are different. There were drivers only mentioned once, namely 29, and five drivers were mentioned a considerable number of times:

1. Resource availability – mentioned 13 times
2. Deforestation phenomena – mentioned 13 times
3. Use of chemicals – mentioned 12 times
4. Public awareness (on food, animal welfare, and sustainability) – mentioned 9 times
5. Government measures for sustainability – mentioned 9 times

On *Nutrition and health*, 142 drivers were extracted of which only 59 are different. This area was the one that retrieved the most variety of drivers. A significant number of drivers were identified only once, and five drivers stood out, being mentioned more than 6 times:

1. Purchase power – mentioned 14 times
2. Investment in preventive health – mentioned 8 times
3. Food education – mentioned 7 times
4. Concern about health – mentioned 7 times
5. Food security – mentioned 7 times

Concerning *Consumer proximity to the agriculture sector* area of concern, 102 drivers were identified from the responses given where only 49 are not the same. Thirty drivers were mentioned only once, and two drivers stood out:

1. Urbanisation – mentioned 12 times
2. Youth employment in the agricultural sector – mentioned 8 times

From *Technology and innovation*, only 66 drivers were gathered from the responses and 26 of them were repeated, leading to 40 different drivers. Of these 40 drivers, 28 were mentioned once, and only one driver was mentioned a significant number of times:

1. Government support and investment in technology and innovation – mentioned 15 times

With regard to *Food chain efficiency*, out of the 85 extracted drivers, only 27 were not the same. Few were mentioned only once, namely 15, and five drivers stood out, being mentioned more than 6 times:

1. Food waste – mentioned 16 times
2. Measures to increase value chain efficiency – mentioned 9 times
3. Public awareness (on food, animal welfare, and sustainability) – mentioned 7 times
4. Efforts to reduce food waste – mentioned 7 times
5. Purchase power – mentioned 7 times

The last area of concern, *Consumption patterns*, was the one that enabled the least extraction of drivers, with only 21 different drivers, out of the 92 gathered. Only ten drivers were mentioned only once, and four drivers were mentioned a considerable number of times:

1. Cattle meat price – mentioned 20 times
2. Public awareness (on food, animal welfare, and sustainability) – mentioned 15 times
3. Food pattern – mentioned 15 times
4. Connection of aggravated environmental impact to cattle meat production – mentioned 7 times

Although the area of concern that had the most responses enabling the extraction of drivers is *Environmental footprint*, this was not the area that retrieved the highest variety of drivers of change. The same is observed with the area that had the least responses enabling the extraction of drivers, *Technology and innovation*, which was not the area where there was the least variety of drivers.

A list with a total of 228 drivers of change was achieved, but after removing the duplicates, this is, the drivers that appear in two or more areas of concern, a final list (in this stage) was reached, with a total of 201 drivers of change. In Table E.46 (Appendix E), the list of 201 drivers of change is presented, each with its corresponding proposal for configuration/s and DESTEP category.

When analysing the drivers from all areas of concern together, five drivers stand out of the 201, being mentioned 20 or more times, they are:

1. Resident population – mentioned 48 times
2. Purchase power – mentioned 47 times
3. Public awareness (on food, animal welfare, and sustainability) – mentioned 36 times
4. Resource availability – mentioned 20 times
5. Cattle meat price – mentioned 20 times

The driver purchase power was the only driver identified in every concern area. The resident population was extracted from every area of concern except for *Consumer proximity to the agriculture* sector and *Food chain efficiency*. Public awareness (on food, animal welfare, and sustainability) also was identified from five areas of concern, except for *Nutrition and health* and *Technology and innovation*. Resource availability was extracted from every area except for *Demographic changes and demand shifts* and *Nutrition and health*. And finally, cattle meat price was only identified from the last area, *Consumption patterns*.

Of all the 201 drivers, 183 have their corresponding configurations (hypothesis of evolution), either just one configuration or more, and from the remaining 18 drivers, it was not possible to extract any information regarding their configuration.

## 4.2 The second stage of the methodology

As a result of the first step of the workshop, modifications to the final list of 201 drivers Table E.46 (Appendix E) were made. Several drivers were eliminated, some were renamed, and a few were assigned to another DESTEP category. Sixty-three drivers were eliminated because they did not meet all the criteria adapted from GEM. For the redundant drivers, two operations were made: eliminate the redundant drivers and create a new one which characterizes the eliminated ones, or from among the redundant drivers, one was chosen to represent the remaining. The other criterion that some drivers did not meet was to address a specific issue or sometimes just because the participants felt that the drivers did not fit the context, in this case, these drivers were eliminated.

The modifications made to the drivers due to redundancies are as follows:

- Emigration and Immigration → Migratory balance
- Size of middle class, Purchase power, Transition to upper class and Household income → Purchase power
- Working hours and Working conditions → Working conditions
- Benchmarking of the agricultural sector, Investment in marketing and communication in the food sector and Food marketing → Marketing and communication strategies in the agri-food sector
- Agricultural production and Food production → Agri-food production
- Financial capabilities of the agricultural sector and Profitability of the agricultural sector → Profitability of the agricultural sector
- Food consumption, Consumption of high-calorie-density food, Diet, Concern about food and Interest in healthy options → Nutritionally balanced diet
- Animal protein consumption and Consumption of animal-based food → Consumption of animal-based food
- Diversity of unprocessed food and Healthy food supply → Healthy food supply
- Efforts towards sustainability by the population, Priorities in terms of economic model: green-based vs fossil-fuel-based and Circular economy → Circular economy
- Veterinary graduates, Graduates in the agricultural area, Graduates in the agricultural sector, Attractiveness of the agricultural sector for young generations and Agricultural literacy → Graduates in agricultural sciences/ veterinary
- Nutritionists' workplaces, Quality of preventive healthcare, National healthcare service's response time, Political commitment to improving public healthcare and Access to healthcare → Access to healthcare
- Perception of the impact of food on health and Concern about health → Perception of the impact of food on health

- Hunger, Efforts to reduce global hunger and Food security → Food security
- Awareness-raising campaigns, Awareness-raising campaigns for sustainability and Public awareness (on food, animal welfare, and sustainability) → Public awareness (on food, animal welfare, and sustainability)
- Cultural traditions and social component of food → Social component of food
- Scientific studies in the field of nutrition and health, Scientific studies in the field of technology and innovation and R&D activities → R&D activities
- Motivation to innovate technology and Attractiveness of the technological and innovation sector → Attractiveness of the technological and innovation sector
- Connection of aggravated environmental impact to cattle meat production and Villainization of livestock farming → Villainization of livestock farming
- Environmental conservation, Emissions of pollutants into the ocean, Greenhouse gas emissions and Exposure to environmental toxics → Environmental conservation
- Concern about desertification in the agricultural sector and Producer renewal rate → Producer renewal rate
- Resource usage and Resource availability → Resource availability
- Importance given to health by government members, Policies to raise the population's awareness of healthy eating and Government actions and incentives for the adoption of a healthy lifestyle → Government actions and incentives for the adoption of a healthy lifestyle
- Effectiveness of government measures for sustainability and Government measures for sustainability → Effectiveness of government measures for sustainability
- Efforts to reduce food waste and Measures to tackle food waste → Measures to tackle food waste
- Access to education, Level of education, Environmental education, Food education and Health education → Environmental education, Food education and Health education

The drivers which were eliminated because they did not address a specific issue or did not fit in the context are the following: Competitive prices, Production process, Production, Mass production, Productivity, Demand-Supply ratio, Consumption capacity, Personal care, Scientific performance of young generations, Demystification of trends, Natural evolution, Professional experience of young people until their PhD, Facilitation, Public information, Medical experts practising, Urban-depressive population and Resource management.

From the remaining drivers, some modifications to their names were made, namely on 19, in order to apply the appropriate terms and make them perceptible. The modifications are:

- Food dependency on other countries → Food sovereignty
- Global market size → Global market
- Investment in preventive health → Investment in health
- Corporate profits → Corporate income
- Social component of food → Socio-cultural component of food

- Mental health problems → Mental health
- Food patterns → Diet
- Predictability of Agricultural and Livestock activity → Stability of the agricultural activity
- Producer renewal rate → Producer replacement rate
- Free time available → Time for meal preparation and cooking
- R&D activities → Level of development of R&D activities
- Political forces operating in the country → Radical groups against livestock production
- Community projects and support for technological development, at an academic and business level → Community support for technological development
- Agricultural and livestock production systems → Sustainability of agricultural and livestock production systems
- Climate change → Climate change adaptation
- Atmospheric phenomena → Extreme atmospheric phenomena
- Ecologic footprint of commerce → Ecologic footprint of the value chain
- Quantity of fires → Frequency and magnitude of fires
- Domestically produced foodstuffs → Origin of food products

Regarding the drivers of change that were allocated to other DESTEP categories where they fit better, according to the participants, two were from the Demographic category, two from the Economic, two from the Socio-cultural, two from the Technological and only one from the Ecological. None from the Political-Legal category was changed. In total, modifications to nine drivers were made:

- Poverty levels: Demographic → Economic
- Nutrition graduates: Demographic → Socio-cultural
- Organic crops: Economic → Ecological
- Food waste: Economic → Socio-cultural
- Energy consumption: Socio-cultural → Ecological
- Availability of livestock feed: Socio-cultural → Economic
- Project development/maintenance: Technological → Political-Legal
- Community support for technological development: Technological → Economic
- Use of additives: Ecological → Technological

Later, the participants completed the configurations for the drivers that had only one, or even no configuration associated, and adjusted these drivers' configurations when necessary. The aim was to have the configurations for each driver leading to the two opposite scenarios.

At the end of this step, the participants achieved a list of 138 drivers of change with their corresponding configurations. This list is presented in Table 42 where, of all the drivers of change presented, the drivers that were chosen by the participants to be included in the scenario structures, are represented in bold.

Table 42 - List of drivers validated and corresponding configurations, by DESTEP category

DESTEP	Driver	Conf. 1	Conf. 2
Demographic	<b>Ageing population</b>	Decrease	Increase
	<b>Birth rate</b>	Decrease	Increase
	<b>Coastal urbanisation</b>	Increase	decrease
	Death rate	Decrease	Increase
	Migratory balance	Positive	Negative
	<b>Resident population</b>	Increase	Decrease
	<b>Rural exodus</b>	Decrease	Increase
	<b>Urban exodus</b>	Decrease	Increase
	<b>Urbanisation</b>	Increase	Decrease
	<b>Young people living in rural areas</b>	Decrease	Increase
	<b>Young resident population</b>	Decrease	Increase
	Economic	Agri-food production	Efficient
Availability of livestock feed		Low	High
<b>Available manpower</b>		High	Little
Cattle meat price		Increase	Decrease
<b>Cattle meat production</b>		Decrease	Increase
<b>Circular economy</b>		Large-scale implementation	Implemented as it is nowadays
Community support for technological development		Existing	Non-existent
Corporate income		Decrease	Increase
Cost of energy		Increase	Decrease
<b>Country's economic situation</b>		Growing	Downturn
Demand for innovative products		Increase	Decrease
Demand for natural resources		Increase	Decrease
<b>Economic crisis</b>		Existing	Non-existent
Fast food price		Decrease	Increase
Food exports		Increase	Decrease
Food production for self-consumption		Non-existent	Existing
<b>Food sovereignty</b>		Low	High
<b>Fuel prices</b>		Increase	Decrease
Global market		Existing	Non-existent
Healthcare costs		Increase	Free
<b>Healthy food supply</b>		Increase	Decrease
Household expenditure on food		Prioritised	Non-prioritised
Imports		Increase	Decrease
Industrialisation		Growing	Stagnation
Innovative products		Increase	Stagnation
Investment in health		Higher	Lower
Local production		More valued	Less valued

Table 42 - List of drivers validated and corresponding configurations, by DESTEP category (continued)

DESTEP	Driver	Conf. 1	Conf. 2
Economic	<b>Marketing and communication strategies in the agri-food sector</b>	Increase	Decrease
	Poverty levels	High	Low
	Processed food supply	Increase	Decrease
	<b>Production costs</b>	High	Low
	Profitability of the agricultural sector	Low	High
	<b>Purchase power</b>	Decrease	Increase
	Waste generation	Increase	Decrease
	<b>Working conditions</b>	Favourable	Unfavourable
	Youth employment in the agricultural sector	Increase	Decrease
	Socio-cultural	Access to healthcare	Broad
Alternatives to animal protein		Existing	Non-existent
<b>Changes in dietary habits</b>		Non-existent	Existing
<b>Consumers requirements</b>		Greater	Fewer
Consumption of animal-based food		Decrease	Increase
Consumption of local food		High	Low
<b>Diet</b>		Inclusion of animal-based products	Exclusion of meat of animal-based products
Employability uncertainty		Existent	Non-existent
<b>Environmental education</b>		Addressed	Not addressed
Family bonds to the countryside		Existing	Non-existent
Farming practice		Increase	Decrease
Food- and environment-related diseases		Increase	Decrease
<b>Food education</b>		Addressed	Not addressed
Food purchasing mode: online vs. face-to-face		Online	Face-to-face
Food quality		Increase	Decrease
<b>Food security</b>		Guaranteed	Not guaranteed
Food shopping at supermarkets		Increase	Decrease
Food waste		Increase	Decrease
Graduates in agricultural sciences/ veterinary		Increase	Decrease
Graduates in technology and innovation		Increase	Decrease
Health education		Addressed	Not addressed
Interest in information		Existent	Non-existent
<b>Lifestyle</b>		Consumerist	Non-consumerist
Mental health		Better	Worse
Nutrition graduates		Increase	Decrease
<b>Nutritionally balanced diet</b>		Existing	Non-existent
Origin of food products		National	International
Pandemic situation	Existing	Non-existent	



Table 42 - List of drivers validated and corresponding configurations, by DESTEP category (continued)

DESTEP	Driver	Conf. 1	Conf. 2
Socio-cultural	Perception of the impact of food on health	High	Low
	Personal relation with body image	Relevant	Not relevant
	Producer replacement rate	Insufficient	Sufficient
	Protein consumption	Increase	Decrease
	<b>Public awareness (on food, animal welfare, and sustainability)</b>	Little	High
	Quality of life	Low	High
	Recognition of nutritional sciences	Higher	Lower
	<b>Social inequalities</b>	Increase	Decrease
	<b>Socio-cultural component of food</b>	Strong	Weak
	Sports practice	Increase	Decrease
	Stability of the agricultural activity	Existing	Non-existent
	Support and adherence to urban and community gardens	Increased adhesion	Reduced adhesion
	Time for meal preparation and cooking	Short	Long
	Touristic activity	High	Little
	<b>Understanding of the food production process, by the population</b>	Existing	Non-existent
	<b>Villainization of livestock farming</b>	Increase	Decrease
	War	Existent	Non-existent
Technological	<b>Artificial Intelligence (AI)</b>	Increase	Remains the same
	<b>Attractiveness of the technological and innovation sector</b>	Increase	Decrease
	<b>Automation of processes in the agricultural sector</b>	Increasing	Remains the same
	Implemented technology in healthcare services	High	low
	<b>Innovation and technology companies</b>	Increase	Decrease
	<b>Level of development of the R&amp;D activities</b>	High	Low
	<b>Recycling system management</b>	Efficient	Non-efficient
	<b>Self-sufficiency in production</b>	High	Low
	Size of the public transport network	Increase	Decrease
	<b>Sustainability of the agricultural and livestock production systems</b>	High	Low
	Use of additives	Increase	Decrease
Ecological	Areas devoted to organic farming	Increase	Decrease
	<b>By-products valorisation</b>	Increase	Remains the same
	<b>Climate change adaptation</b>	Efficient	Non-efficient
	<b>Climate emergency</b>	Existing	Non-existent
	Compensation for the consequences of anthropic activities	Existing	Non-existent
	Deforestation phenomena	Increase	Decrease

Table 42 - List of drivers validated and corresponding configurations, by DESTEP category (continued)

DESTEP	Driver	Conf. 1	Conf. 2
Ecological	Drought	Increase	Decrease
	<b>Ecologic footprint of the value chain</b>	High	Low
	Energy consumption	High	Low
	<b>Environmental conservation</b>	Increase	Decrease
	<b>Extreme atmospheric phenomena</b>	Increase	Decrease
	Frequency and magnitude of fires	Increase	Decrease
	Impact of war on the environment	Negative	
	Organic crops	More valued	Less valued
	<b>Resource availability</b>	Low	High
	Soil exploitation	Increase	Decrease
	<b>Use of antibiotics in agriculture and animal production</b>	Reduction	Remains the same
	Use of chemicals	Decrease	Increase
	Use of environmentally friendly transports	Remains the same	Increase
	Use of plastic and disposable products	Decrease	Increase
	<b>Use of renewable energy</b>	Increase	Remains the same
Political-Legal	Volcanic activity	Existing	Non-existent
	Actions to promote graduation in agriculture	Existing	Non-existent
	<b>Bureaucracies</b>	Impose barriers	Do not impose barriers
	<b>Carbon emission charges</b>	Existing	Non-existent
	Effectiveness of government measures for sustainability	Effective	Non-effective
	<b>Encouragement for the adoption of the Mediterranean diet</b>	Increase	Decrease
	<b>European guidelines to fight the environmental impact</b>	Remains the same	Increase
	<b>Government actions and incentives for the adoption of a healthy lifestyle</b>	Existing	Non-existent
	<b>Government support and investment in technology and innovation</b>	Existing	Non-existent
	<b>Measures to increase value chain efficiency</b>	Existing	Non-existent
	Measures to tackle food waste	Efficient	Non-efficient
	Project development/maintenance	High	Little
	<b>Radical groups against livestock production</b>	Very influential	Have little influence
	<b>Tax on processed food</b>	Existing	Non-existent

When having the list of drivers with all the modifications, each participant chose up to three drivers from each DESTEP category. Participants were choosing one, two or three drivers, based on their perception of the impact/relevance that each driver had in influencing cattle meat consumption in the Portuguese

one chose one driver and the remaining (3) chose three drivers. Regarding the Economic category, half of the participants chose three drivers, and the other half chose two. On the Socio-cultural dimension, only one participant chose two drivers, also, only one participant chose one driver, and the remaining chose three. Concerning Technology, five participants chose three drivers of change, two participants chose two drivers and only one chose one driver. In the Ecological category, all the participants chose three drivers of change. Regarding the last category, Political-Legal, six participants chose three drivers and only two chose two drivers. In general, participants were keener to choose three drivers, rather than two or just one. A picture of the participants ranking the drivers (on the left), and one with the participants placing the chosen drivers by category on the whiteboard (on the right), in the workshop, can be seen in Figure 19.



Figure 19 - Participants choosing the most relevant/impacting drivers of change (left) and participants placing the chosen drivers on the whiteboard (right) (Workshop)

From the first category, nine different drivers were identified, where the ageing population and rural exodus were the most mentioned, both being chosen by four participants. Economic has 12 drivers; the most mentioned was purchase power (5 participants). Regarding the Socio-cultural category, this was the category from which it was possible to gather more drivers (13), Socio-cultural component of food and Food education were the most chosen drivers. In contrast, the Technological category has the least drivers chosen. Level of development of the R&D activities and Attractiveness of the technological and innovation sector were the most mentioned drivers, from six participants and three, respectively. Ecological and Political-Legal both have nine drivers, in the first, By-products valorisation and Extreme atmospheric phenomena were the most mentioned, 5 times and four times respectively, and in the second, Government support and investment in technology and innovation, Bureaucracies, and European guidelines to fight the environmental impact were the most mentioned, five times the first driver and four times the last two drivers.

In total, 60 different drivers were chosen as most relevant/impacting, and these were the basis to generate the scenario structures. To do so, participants organized the drivers' configurations, only from the chosen ones, to allocate the configurations that lead to a high cattle meat consumption in one scenario structure, and all the configurations leading to a low cattle meat consumption into another scenario structure.

The 60 chosen drivers of change and corresponding configurations for each scenario structure are shown in Table 43. The drivers are organised by DESTEP category: Demographic (nine drivers), Economic (12 drivers), Socio-cultural (13 drivers), Technological (eight drivers), Ecological (nine drivers), Political-Legal (nine drivers).

Table 43 - The two scenario structures, composed by drivers and drivers' configurations

DESTEP	Driver	High cattle meat consumption	Low cattle meat consumption
Demographic	Ageing population	Decrease	Increase
	Rural exodos	Decrease	Increase
	Urban exodos	Increase	Decrease
	Coastal urbanisation	Decrease	Increase
	Young people living in rural areas	Increase	Decrease
	Resident population	Increase	Decrease
	Young resident population	Increase	Decrease
	Birth rate	Increase	Decrease
	urbanisation	Decrease	Increase
Economic	Working conditions	Favourable	Unfavourable
	Economic crisis	Non-existent	Existing
	Production costs	Low	High
	Circular economy	Large-scale implementation	Implemented as it is nowadays
	Country's economic situation	Growing	Downturn
	Marketing and communication strategies in the agri-food sector	Increase	Decrease
	Available manpower	High	Little
	Healthy food supply	Increase	Decrease
	Purchase power	Increase	Decrease
	Fuel prices	Decrease	Increase
	Cattle meat production	Increase	Decrease
	Food sovereignty	High	Low
Socio-cultural	Changes in dietary habits	Non-existent	Existing
	Socio-cultural component of food	Strong	Weak
	Understanding of the food production process, by the population	Existing	Non-existent
	Public awareness (on food, animal welfare, and sustainability)	High	Little
	Social inequalities	Decrease	Increase
	Diet	Inclusion of animal-based products	Exclusion of meat or animal-based products
	Nutritionally balanced diet	Existing	Non-existent
	Food education	Addressed	Not addressed
	Environmental education	Addressed	Not addressed
	Lifestyle	Consumerist	Non-consumerist
	Consumers requirements	Greater	Fewer

Table 43 - The two scenario structures, composed by drivers and drivers' configurations (continued)

DESTEP	Driver	High cattle meat consumption	Low cattle meat consumption
Socio-cultural	Food security	Guaranteed	Not guaranteed
	Villainization of livestock farming	Decrease	Increase
Technological	Attractiveness of the technological and innovation sector	Increase	Decrease
	Automation of processes in the agricultural sector	Increasing	Remains the same
	Self-sufficiency in production	High	Low
	Innovation and technology companies	Increase	Decrease
	Recycling system management	Efficient	Non-efficient
	Artificial Intelligence (AI)	Increase	Remains the same
	Level of development of the R&D activities	High	Low
	Sustainability of the agricultural and livestock production systems	High	Low
	Ecological	Climate change adaptation	Efficient
Environmental conservation		Increase	Decrease
Resource availability		High	Low
Climate emergency		Non-existent	Existing
Extreme atmospheric phenomena		Decrease	Increase
Ecologic footprint of the value chain		Low	High
Use of antibiotics in agriculture and animal production		Reduction	Remains the same
Use of renewable energy		Increase	Remains the same
Political-Legal	By-products valorisation	Increase	Remains the same
	Government actions and incentives for the adoption of a healthy lifestyle	Existing	Non-existent
	Government support and investment in technology and innovation	Existing	Non-existent
	Bureaucracies	Do not impose barriers	Impose barriers
	European guidelines to fight the environmental impact	Remain the same	Increase
	Radical groups against livestock production	Very influential	Have little influence
	Encouragement for the adoption of the Mediterranean diet	Increase	Decrease
	Measures to increase value chain efficiency	Existing	Non-existent
	Tax on processed food	Existing	Non-existent
Carbon emission charges	Non-existent	Existing	

From all the most mentioned drivers in the second questionnaire, only one was not chosen by the participants to be integrated into the scenario structures, namely the Cattle meat price.

### 4.3 The third stage of the methodology

The generated scenario structures were validated, according to the parameters described in the adapted methodology chapter, and no changes were made after this exercise. The final version of the two

scenario structures is presented in the last section (Table 43). Later, two names for the two contrasting scenarios were given in discussion with the participants. The scenario where there is a high cattle meat consumption was called “Beef deal” and the opposite scenario, where there is a low cattle meat consumption was called “No deal”. For each scenario structure, a narrative was also generated as shown ahead. These narratives are written as if in the future (2050).

#### **“Beef Deal” scenario**

We are in 2050, the birth rate is high, and we have an increase in the resident population in general and in particular in the young population. There is a greater distribution of the resident population in the territory, and despite existing social inequalities, they are more subtle, and the rural areas are more populated. There is a higher standard of living in general, with high purchasing power and the country's economic growth.

As a result of investment and incentives in technology in general, particularly in the agri-food area, food production systems are highly sustainable and self-sufficient. Also, there is a high guarantee of food security. Adaptations to climate change are efficient, and the ecological footprint of production systems and the value chain is reduced.

Government actions for the adoption of a healthy lifestyle and education, and the understanding of food production systems by the population lead to an awareness of what a healthy diet is, realising the importance of having a varied and non-restrictive diet, which includes foods from all segments of the food wheel, avoiding processed and pre-cooked foods. There is even a tax on highly processed foods, which is intended to reflect their low nutritional value. Despite the low pressure from radical ideological groups against the production and consumption of animal products, the villainization of livestock production has no impact on an informed and demanding population. On the other hand, production systems are highly efficient, due to implemented measures, and sustainable, meeting consumer requirements. There is an appreciation of the value of products from efficient, circular and sustainable systems. Food waste is very low, and the use of circular approaches to reuse by-products is maximum.

The importance of including food of animal origin in a balanced and healthy diet is known and implemented by the general population. Thus, the consumption of beef, included in a balanced diet, encompassing the production systems in a circular approach, and including the social and cultural values is promoted and growing.

#### **“No deal” scenario**

Portugal is now down-turning. We are in 2050, the observed birth rate is at its lowest and the resident population has fallen, especially among the younger generation. More people are leaving rural areas for urban areas, where there is a greater supply of meat substitutes and easier access to a wide variety of processed food since there is no taxation on these. Additionally, the government is not acting or encouraging the adoption of healthy lifestyles nor adequate marketing and communication strategies are being implemented in the food sector. Thus, people are changing their eating habits and reducing meat consumption, or even animal-based product consumption, contributing to less healthy diets that

are not nutritionally balanced. Also, the so-implemented socio-cultural value of food in Portugal is no longer seen as it always was.

Further, the economy plays a part in what is happening. The current crisis the country is going through, and its economic situation is getting worse. People have less purchase power, opting for cheaper foods. This also contributes to the increased food insecurity the country is now facing. Social inequalities are severe and the standard of living of society, in general, is at its worst.

People have little awareness of relevant topics such as food, animal welfare and sustainability, and do not understand the food production process at its finest. Also, reducing food waste is not a priority.

The government is failing, once again, when it comes to supporting and investing in technology and innovation, which, in turn, only adds to what can be observed: agricultural and livestock production systems that are not sustainable and low self-sufficient production. The economy is as circular as it was 30 years ago, and the same level of by-product valorisation is seen. The current value chains have an extreme impact on the ecological footprint and no regulations are made to counteract this situation, such as carbon emissions charges. Hence, climate change adaptations are not efficient at all.

Not forgetting that the villainization of livestock farming has increased, and the radical groups against livestock production are very influential on the population. All contributing to low cattle meat consumption by the population.

As the last step, two factsheets describing the main characteristics of each of the two narratives were developed. These are as follows (Figure 20):



Figure 20 - Factsheets for the two scenarios: "Beef deal" (on the left) and "No deal" (on the right)

## 5 Discussion

By answering the questions at the beginning of each of the five sections, in which the chapter is divided, this chapter presents an overall discussion of the work developed in this dissertation. The first compares the adopted approach with what was observed in the literature. Section 5.2 demonstrates a comparison between the methodology applied and the original methodology, developed by Alvarenga et al. (2019), as well as the reasons for the adaptations made. Later, in section 5.3, the feedback gathered from the participants is detailed, either regarding the study itself or the methodology applied. Section 5.4 elaborates on the drivers of change and the two narratives constructed. At the end of the chapter, section 5.5, the strengths and limitations of the study are presented.

### 5.1 Where does our work stand in the literature?

This dissertation presents a review of participatory scenario planning methodologies in complex contexts, that are described in the literature. Also, a PSP methodology is developed, taking into consideration 60 identified drivers of change, and involving a large number of citizens. The final outcome of the applied methodology are scenarios for cattle meat consumption in the Portuguese population, for the time horizon of 2050.

When comparing the work conducted to the identified studies from the initial review performed, very few studies develop scenarios in the food industry, namely three by Djouma et al. (2018), Freeth & Drimie (2016) and Ram et al. (2011). None of these address any kind of cattle meat consumption issue, and neither is developed in Portugal. This way, this dissertation contributes to the literature due to the innovation of using a scenario planning methodology to tackle cattle meat consumption in the Portuguese population. A small number of studies identified use a foresight period over 26 years. Once the time horizon used herein for the scenarios is 2050, the foresight period is 28 years. Hence, this adds to the increase in the number of studies having a foresight period over 26 years. Another innovative aspect of the work developed, compared to the final dataset of articles, is the number of uncertainties used to build the scenarios. The observed maximum number of uncertainties is 57 (Podolak et al., 2017) while the scenarios developed herein are built from 60 different uncertainties. The most common number of scenarios constructed in the literature is three, and very few build only two. Originally, the aim was to construct three scenarios, per the literature, but due to time constraints, only two were constructed.

The scenario perspective adopted is in line with most of the previously developed, following a descriptive approach. Also, like the majority of the identified studies present in the literature, the name adopted for the methodology is simply participatory scenario planning. Regarding the framework to build the scenarios, the one used herein follows the overall framework identified in the literature review, from the studies that have this information available. Nevertheless, some steps that were not recurrent or distinguished/identified in the literature, except for the study on which our methodology is based (Alvarenga et al., 2019), are implemented, such as the validation of the driving forces, the generation of scenario structures and their validation. Also, the two auxiliary methods used here are only used in this same study. None of the remaining auxiliary methods are the same as the ones used here.



Concerning the methods and criteria adopted to select the participants, no method was applied, as in most of the studies from the literature, and there were no other criteria to identify the participants, rather than targeting as many general citizens as possible and the experts from FeedInov CoLAB. Although the aim was to target more people from the young generations, no restriction on the participants' age was included in the questionnaire. Only two studies from the literature have the same criteria to identify the participants as the one adopted here, this is, it must involve general citizens and experts, these were developed by Palacios-Agundez et al. (2013) and Alvarenga et al. (2019). As for the actual nature of the scenario team, by applying the described criteria, it is evident that the participants included in the study are citizens who are residents of Portugal (mainland and islands) and experts from FeedInov CoLAB. The type of participants involved in the scenario planning process is not aligned with the type of participants from most of the studies identified. Few studies from the literature involve the same type of participants: nine studies reveal that they include experts in the scenario process and only five include overall citizens within the territory of study (Nanninga et al., 2012; Hatzilacou et al., 2007; Jiren et al., 2020; Brown et al., 2016).

In total 141 participants took part in the process, namely eight from the laboratory and 133 overall citizens who are residents of Portugal. When analysing the literature, very few studies involve more than 100 participants, namely five (James et al., 2013; Withycombe Keeler et al., 2015; Sisto et al., 2018; Podolak et al., 2017; Ojoyi et al., 2017). The work developed herein is out of the scope of the majority of the studies and thus, adds to the literature in this aspect.

Regarding the adopted participatory methods to integrate the participants in the process, all the methods used are in line with what has been used in the literature. One of the methods is the most observed participatory method in the literature; workshops, used in almost every study. Concerning the other method applied, questionnaires, although they are not the second most used method, have been used quite often, and have witnessed an increase in application in recent years when compared to earlier studies. Additionally, these methods are the most used in combination with others and most of the studies apply only two methods combined, which is in line with what was developed. Despite this, the most observed combination is workshops with interviews. Workshops combined with questionnaires are not the most used participatory methods in combination but still, are commonly observed in the literature.

When it comes to the stage of the methodology on which the participatory methods were implemented, only two studies identify the drivers of change through questionnaires (Jurgilevich et al., 2021; Varho & Tapio, 2013), as it is in the work developed herein. Most of the studies identify the drivers through workshops. Their validation is only documented in four studies which use workshops, questionnaires and meetings to do so (Alvarenga et al., 2019; Graveline et al., 2014; Tassew et al., 2019; Jurgilevich et al., 2021). For this step, workshops were used, as observed three times in the literature. To rank the identified drivers, what was developed is in line with most of the literature, performing this step in workshops. Also, if the generation of the scenario structures and its validation can be embedded in the identified steps of building the scenarios and validating them, since only one study distinguishes these first two steps from the last two, again, the work developed is in line with most of the literature, by performing these steps in the workshop. To get feedback from the participants, a questionnaire and the

workshop were used while the only documented participatory method used in the literature are questionnaires/surveys.

In the scenario planning process developed, the participants did not have any type of material as input to help build the scenarios nor work with scientific evidence following the same approach as the majority of the studies identified from the literature. As for the role of the facilitator, all the tasks performed have been previously performed in the identified studies, such as informing stakeholders about the strategy development and helping them through the process giving additional information when needed (Düspohl & Döll, 2016; Palacios-Agundez et al., 2013), encouraging participants to work together (Campos et al., 2016), organising and manage the participants and record all the information from the questionnaire and workshop (Ritchey, 2006). Besides these tasks, the facilitator had the role to create the questionnaire, analyse the results from the questionnaire and apply the GEM to refine the drivers that were identified from the participants, which was not observed in the literature.

Ideally, the scenario planning process would require more time to be completed, but due to time constraints, it only lasted approximately six months. From the literature, it is possible to observe that most of the studies take more than a year to finish. However, even if only a few, two studies took the same amount of time as the one herein (Campos et al., 2016; Enfors et al., 2008). As for the time spent with the participatory methods, the only information available allowing a comparison is regarding the workshops (Hossard et al., 2013; Djouma et al., 2018; Fofiu & Dobus, 2015; Ritchey, 2006). The workshop conducted had a duration of one working day, which has not been observed in the literature, where all the workshops took more than one working day.

Following most of the studies identified, the process outputs are narratives, described as qualitative storylines, not containing any type of quantitative data. These narratives are to be used for decision-making. Despite more studies from the literature create scenarios for policy-making, scenarios for decision-making are very common as well.

Regarding the feedback from the participants, as in many studies from the literature, most of the feedback obtained was positive and will be addressed in detail later in this chapter. When it comes to the challenges and lessons learned in the literature, they are accurate and observed in the work developed. The involvement of participants in the process is key, and the more participation and diversity of the participants' backgrounds the better. However, managing the participants to be involved and run a pleasant discussion was challenging. Given the recommendations in the literature, this study followed the most observed one, guiding the participants toward the same objective from the beginning of the process. Additionally, some identified studies developed other methods in combination with the participatory scenario planning method. In this dissertation, only this methodology was developed, because developing additional methods was out of its scope.

In general, most of the parameters of the scenario development process are aligned with what has been previously made in the literature, except for six. This dissertation has an innovative concept in terms of the subject of study, cattle meat consumption and the country of study, Portugal. Also, from the identified studies, this is the only one using as many as 60 drivers of change to build the scenarios. It is also the

only study that gathers feedback from the participants through workshops and where the facilitator has the tasks of creating the questionnaire and refining the drivers of change, by implementing the GEM to the identified drivers. Finally, it is the only study requiring only one working day for the workshop.

## 5.2 What are our methodological learnings?

The adaptations to the original methodology developed by Alvarenga et al. (2019) are regarding the social component of the process. In the original methodology, this component is divided into three modules: a Web-Delphi process, and two separate workshops, as shown in Figure 21.

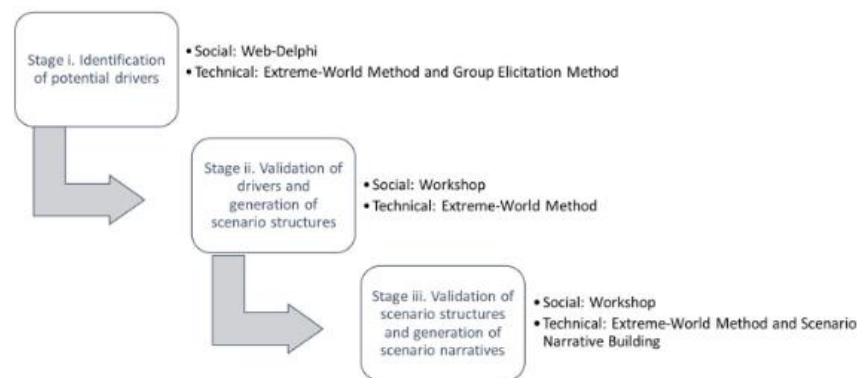


Figure 21 - Three-stage socio-technical approach for scenario building (Alvarenga et al., 2019)

The Web-Delphi process involved two different rounds, the first one to identify the drivers of change and the second one to reduce the drivers to the most important ones. Involving two rounds in the process involves a greater engagement from the participants, and the requirement to gather personal data like their contacts, so they could be reached for a second round. Since the work developed aimed at targeting as many participants as possible, the lack of anonymity of the participants could lead to a reduction in the number of responses. Also, since it involved 141 participants it would not be feasible to reach out to 141 participants again to perform the second task. Therefore, a questionnaire was implemented to perform only what is equivalent to the first round of the Web-Delphi. Besides this questionnaire, a preliminary questionnaire was developed to understand, with a small sample of the population, which information should be put in the final questionnaire, to make it easily understandable and user-friendly. Since the participants are general citizens, the questionnaire must be adapted so everyone can answer. This preliminary questionnaire was an additional step to the original methodology.

Moreover, stages two and three were originally performed in different workshops. Due to time constraints, these two stages were both performed in only one workshop, and the final narratives were produced in a back-office concept by FeedInov CoLAB members. This workshop comprised the activity from the second round of the Web-Delphi and the remaining tasks until the generation of the narratives. Also, given the same reasons, it was not possible to build a BAU scenario like in the study developed by Alvarenga et al. (2019) nor scientifically validate the two contrasting scenarios built with future-oriented evidence. Regarding the categorization of the drivers of change, the adaptation was from using a PESTLE framework to using a DESTEP framework. This is due to the focus given to demographic aspects in the questionnaire, fostering the identification of drivers related to demographics. This way,

using the DESTEP framework, which has a Demographic category, allows a better categorization of the drivers.

All in all, the adaptations made to the original methodology developed by Alvarenga et al. (2019) aimed at making the process suitable for the type and number of participants that were involved, and adjusting to the time available and the topic.

### **5.3 What is the participants' feedback?**

Feedback from the participants was gathered via questionnaire and workshop, either concerning the study in itself (questionnaire) or the methodology applied (workshop). Regarding the questionnaire, this feedback was not asked straightforward. There was a section, at the end, where participants had the opportunity to leave any comments that they felt were relevant. From this, it was possible to gather five positive feedbacks on the type of study performed and one negative. The positive feedback is all related to the importance of developing such studies. Participants mentioned that carrying out studies like this one encourages change and will positively impact society, thus, are necessary to the world. Also, they mentioned that this study is crucial for decision-making or even policy-making. As mentioned by the participants: "Acho muito importante estudos assim"; "Gostaria de realçar a extrema importância deste tipo de estudos..."; "Parabenizar pela iniciativa na produção de um estudo que certamente será um ponto de partida para suscitar muita reflexão e incentivar à mudança."; "São necessários este tipo de questionários e serem apresentados onde tenha impacto social, na televisão deveriam passar mais destas notícias..."; "Muito pertinente será, que após os resultados, os mesmo possam ser estudados por quem de direito - empresários, governo, decisores, e que sejam apresentadas, desde já, soluções e medidas, até mesmo políticas e legislação, para que a evolução até 2050 seja a melhor possível no sentido de promoção da saúde, da economia e do planeta".

Regarding the negative feedback, one participant mentioned that it is hard to imagine the world in 2050, this is in a period of 28 years. In this case, it is interesting to relate this feedback with the literature since there is one study, by Carlsen et al. (2013), which states that the participants struggled to relate to the time horizon chosen, 20 years.

On the other hand, in the workshop participants were asked to give their feedback on the methodology adopted. The only feedback given was concerning the validation of the drivers of change identified from the questionnaire. The participants stated that this step was extremely time-consuming and that the validation of the drivers should only be done after ranking the most relevant/impacting ones, this way only a few drivers were to be validated and the step would require less time. Regardless of this aspect, they stated that the remaining activities were adequate and ran smoothly.

The drivers' validation was originally made after having only the relevant/impacting drivers, as mentioned in the previous section, but in this specific case it was not feasible to rank the drivers in a second round of the questionnaire, so the team opted to perform it in the workshop. Therefore, as observed, this was also not a sustainable option.

## **5.4 How does our work compare with previously published scenario work in the field?**

To the best of our knowledge, this is the first time a PSP methodology has been developed and applied to generate scenarios for cattle meat consumption in Portugal. Despite this, some similar studies, on the food industry or concerning the cattle sector, adopt the same approach, which allows comparing the drivers used here and in the studies. Two of these studies were not captured in the systematic review but addressed the future of food (Herman Mostert et al., 2022; World Economic Forum's System Initiative & Deloitte Consulting LLP, 2017), while the remaining were included (Djouma et al., 2018; Freeth & Drimie, 2016; Ram et al., 2011; Boden et al., 2015). Nevertheless, the study developed by Freeth & Drimie (2016) does not state which are the key uncertainties used to build the scenarios, only the list of uncertainties generated by the participants to later be ranked, so the comparison to this one will not be made.

Herman Mostert et al. (2022) made an assessment of future food systems for 2040 in Dhaka. Six key uncertainties were identified to build the scenarios: Resilience to climate, resource degradation and disease, trade, equity, food price, consumption patterns, and future business structure of Dhaka's food system; where some capture the same dimensions as the drivers used herein, such as climate change adaptation, food security and nutritionally balanced diet. In the study developed by the World Economic Forum's System Initiative & Deloitte Consulting LLP (2017), only two key uncertainties were used as axes to build scenarios for assessing global food systems until 2030. These are Demand shift and market connectivity, which, by their definition, relate to three key drivers used in this study, namely changes in dietary habits, diet and automation of processes in the agricultural sector. As for the study developed by Djouma et al. (2018) two different sites were analysed with different key drivers. In total eight drivers were identified to build the scenarios to assess win-win partnerships in the palm oil sector until 2030 and 2050: terms of the partnership contract between the industry and the out-growers, access to managerial capacity building for smallholders, cooperatives, access to technical capacity building for out-growers, road network quality, access to holding shares in the mill for the union of smallholders, adaptation of the contract to national public policy, and trust and transparency among partners. These only relate to bureaucracies in this study. Ram et al. (2011) develop scenarios for 2017 on the agricultural sector in Trinidad and Tobago using six key drivers of change: Severity of natural disasters, regulation in supplier countries, state of global economy, consumer demand for safe foods, and cost of farming inputs. Some capture the same dimensions as the ones in this study, such as extreme atmospheric phenomena, country's economic situation and nutritionally balanced diet. Lastly, Boden et al. (2015) build scenarios with only three axes but perform a backcasting exercise with 33 key drivers of change for 2040. The comparison will be made based only on the three drivers used to build the scenarios: industry demographics, the role of government support and regulation and the capacity for technological innovation to support the industry to meet local and global market demand. These can be related to some of the key drivers identified herein, including Government actions and incentives for the adoption of a healthy lifestyle, government support and investment in technology and innovation and automation of processes in the agricultural sector.

All in all, all the studies use fewer drivers to build the scenarios, but they capture some similar dimensions as the ones identified in this study. Nevertheless, none use the same terms to describe the drivers nor capture all the drivers identified. The identified demographic drivers were not captured in any similar study, only one from each the economic and the technological, four from the socio-cultural, two from the ecological, and three from the political-legal category are captured.

The reader must understand that the drivers of change are identified from insights gathered through a questionnaire, targeting the Portuguese population, which are later used to construct the scenario structures (scenario backbones), by experts in the field, in a workshop. Further, these structures originated the scenario narratives. Hence, two contrasting scenarios are built, “Beef deal” and “No deal”. The “Beef deal” scenario corresponds to a narrative reflecting a future where there is a high cattle meat consumption while the “No deal” scenario reflects a future where cattle meat consumption is low, both regarding the Portuguese population. These scenarios describe possible future evolutions, having the configurations leading to each of the two situations. Using the scenario literature as a model, the narratives are written as if in the future, so the reader must place himself/herself in the future when reading. These are expected to provide useful insights on key drivers of change affecting cattle meat consumption crucial to inform decision-makers in the industry.

## **5.5 What are the strengths and limitations of the work developed?**

The three-stage socio-technical approach followed to generate cattle meat consumption scenarios demonstrated to be an efficient and effective tool, in its overall application, to understand how the future of cattle meat consumption in the Portuguese population may evolve until 2050.

The combination of the two participatory methods, both the questionnaires and the workshop, enabled to tackle the technical challenges of identifying the drivers of change which are expected to affect the future of cattle meat consumption, as well as its configurations, this is their hypothesis for evolution. Having this participatory dimension is crucial to the scenario building process. Involving many participants with diversified backgrounds allows for gathering heterogeneous perspectives which, in turn, only adds to the integration of every significant detail essential to the study and to a build-up of relevant knowledge. Also, working with FeedInov CoLAB not only gave the opportunity to work with a real subject, experts, and decision-makers, as it also allowed to generate scenarios with a group of people who have expertise in the topic, giving useful insights. Additionally, the scenarios show plausible, relevant, and unique perspectives on cattle meat consumption patterns.

As a result of not building a reference scenario (business-as-usual), which is more realistic and most likely to occur, it becomes harder to improve critical thinking about the extreme-case scenarios. As Wack (1985) mentions, a BAU scenario is crucial since it is based on the implicit future beliefs shared by most stakeholders allowing them to “recognize their outlook in the scenario package”. Furthermore, the scenarios are lacking in future-oriented evidence which allows turning the scenarios built into scientifically validated scenarios. Although participation is considered a strength it can also be a limitation. The nature of the scenarios is heavily influenced by the information provided, and the

participants' background and ability to picture the future. Also, the scenario planning process is very time-consuming.

## 6 Conclusion

The introduction of animal-sourced foods into our bipedal ancestors' former frugivorous diet, four million years ago, marked the beginning of human meat consumption, which has been increasing over the years. However, cattle meat consumption has become controversial due to contradictory information available. Public access to this information shapes consumers' consumption patterns, which only contributes to an increasing uncertainty regarding consumers' preferences and willingness to replace meat with meat substitutes, or not. Furthermore, the pandemic situation and the ongoing war add to this uncertainty. Hence, the industry is now facing extreme uncertainty regarding cattle meat consumption. With this, arises the need for the industry to acknowledge how this consumption may evolve so it can take proactive action.

The topic at hand can be described as a complex problem and to understand how cattle meat consumption may evolve in the future, it is necessary to take into consideration insights from people whose futures are at stake.

Therefore, this dissertation aimed to aid and improve the industry's decision-making process so they are prepared and can plan appropriate strategies for what may possibly happen, by creating scenarios for possible evolutions of cattle meat consumption, through a participatory scenario planning approach, involving a large number of citizens. The work was developed in collaboration with FeedInov CoLAB, allowing to be in contact with experts in the field, reach a higher sample of participants and have a real impact on the industry.

With this purpose in mind, the dissertation begins with a literature review of existent studies on PSP. The goal was to explore how uncertainty has been incorporated into the scenario development process, and how methods have been developed in these complex contexts involving participants. Many authors develop different approaches, and throughout this chapter, key insights are provided on how to develop such methodologies. Additionally, it is possible to observe the lack of studies in the field and even in Portugal, adding to the necessity to develop such work.

Further, a PSP methodology was developed based on a previous study conducted by Alvarenga et al. (2019) on "Scenarios for population health inequalities in 2030 in Europe: the EURO-HEALTHY project experience". Some adaptations to this methodology are made to better suit the number and type of participants involved, the topic chosen and the time available. This methodology comprises a three-stage socio-technical approach following the Extreme-World method, to build two contrasting scenarios, one where there is a high cattle meat consumption and the other one where there is a low cattle meat consumption.

The first stage of the methodology involves identifying the drivers of change that are expected to influence cattle meat consumption in the future, through a questionnaire targeting the Portuguese population. For this purpose, participants were not asked directly to identify the drivers of change. In order to adapt to the type of participants involved, as the participants are mainly general citizens, several future-of-food determinants' indicators, organized by seven different areas of concern are presented to



them. Asking non-experts to straightforwardly identify drivers of change would be too demanding or even unfeasible, so the aim was to enable participants to reflect upon the topic, and consequently give useful insights on drivers without directly asking them to identify these drivers.

The identification of the drivers of change is a crucial step, and the questionnaire had an extreme outreach, targeting 141 participants. Thus, contributing to a substantial diversity of insights and details essential to the scenario development. From this, 201 drivers of change were identified, divided into the six DESTEP categories, as well as their hypothesis for evolution in the future (configurations). Stage two is divided into two steps: validation of the drivers and generation of scenario structures. Both activities were performed in a workshop with experts from the FeedInov laboratory. The drivers were validated according to four criteria adapted from the GEM and the validated drivers were then ranked in terms of relevance/impact on affecting the future of cattle meat consumption. Out of the initial drivers, only 60 were chosen to be incorporated in the scenarios. For the scenario structures, which are the scenario backbones, the configurations of the chosen drivers were organized into two opposite scenarios. One with all the configurations leading to a high cattle meat consumption and the other one with all the configurations leading to a low cattle meat consumption. In the last step, the structures were validated to check for their plausibility, compatibility, representativeness and meaningfulness and the narratives are constructed. Additionally, two factsheets, each one for each narrative, describing their main characteristics were constructed.

Given the identified key drivers of change, the scenarios provide information on possible future developments in cattle meat consumption in Portugal. These are to be scientifically validated so they are ready to be used. Subsequently, FeedInov CoLAB, which is responsible to make the connection between the industry and academia, can use the scenarios as a tool to inform decision-makers, allowing them to better understand plausible future developments and be prepared to react to any changes in cattle meat consumption.

The adopted methodology has several innovative aspects compared to what is observed in the literature. Nevertheless, it proved to meet the needs and to be a clear and replicable method for building relevant scenarios.

## 7 Future work

Several aspects of this dissertation can be identified as potential future work improvements. Consequently, the following suggestions are highlighted.

Regarding the articles from the final dataset of the systematic research, in the PSP documentation taxonomy, only information on the number of times that each article was cited is mentioned, as to their applicability. It would be relevant to further analyse these citations, this is analysing the studies in which they are mentioned in order to understand in which context they are being cited, if the constructed scenarios are being used for other studies and if yes, also in which context.

When building a set of future scenarios, the construction of a reference scenario, known as BAU, is crucial. Thus, it is recommended to construct a BAU scenario to improve the ability to critically think about the two contrasting scenarios built. After having this reference scenario, one must revise the two contrasting scenarios and critically think about them.

For the scenarios to be fully finalized and ready to apply in decision-making contexts or even other contexts, it is necessary to enrich these with future-oriented evidence. By doing this, the scenarios have a solid foundation and the information used to build them has been scientifically validated.

As the last suggestion, as many studies from the literature do, an image of each of the scenarios, this is each future state, could be drawn, making a visual representation of the scenarios. Thus, enabling a more captivating demonstration and dissemination.

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# Appendix A: PSP documentation taxonomy (not complete)

Table A.44 – Four topics of the PSP documentation taxonomy

Group Item Definition #	Bibliographic information		Participatory concept	Evaluation	
	Title	Journal	Nature of scenario team	Recommendations	
1	(Hossard et al., 2013)	A participatory approach to design spatial scenarios of cropping systems and assess their effects on phoma stem canker management at a regional scale	Environmental Modelling & Software	Frainers, Crop collectors, Crop breeder, Specialist technical organization, Extension and advisory services, Policy makers, Researchers	Recommendations given for the scenario construction process or use of scenarios Build a robust partnership between a key local actor and the research team to avoid different priorities, increase the participation of farmers or create fuzzy cognitive maps with stakeholders to have better structured scenarios, build confidence with stakeholders in the beginning of the process giving more insight on model functioning and processes instead of only key variables, perform an integrated analysis of scenarios to evaluate the trade-offs between the different model outputs
2	(Mitake et al., 2020)	A Strategic Planning Method to Guide Product—Service System Development and Implementation	Sustainability	Policy planning division, agriculture and forestry division, forest ranger, university that the authors of this paper belong to, the company providing wildlife damage research and management services, and the industrial technology research institution.	Have formal procedures and follow-up steps in the roadmap development process for the roadmap to be enough as a strategic resource that can be utilized for PSS development
3	(Musse et al., 2018)	Applying backcasting and system dynamics towards sustainable development: The housing planning case for low-income citizens in Brazil	Journal of Cleaner Production	Lecturers/scientists, experts, policy makers and community representatives	-
4	(Jurgilevich et al., 2021)	Assessing the dynamics of urban vulnerability to climate change: Case of Helsinki, Finland	Environmental Science and Policy	Researchers and city administration practitioners belonging to the climate change and adaptation working group of the City of Helsinki (experts)	Practitioners can use the results as the first step in anticipatory adaptation governance, for example, when developing no-regret, worst case or flexible urban development strategies"
5	(Düspohl & Döll, 2016)	Causal networks and scenarios: participatory strategy development for promoting renewable electricity generation	Journal of Cleaner Production	Representatives of the waste industry, regional energy provider, utility company, bank finance group, power engineering, municipality, regional planning, environmental agency, energy competence centre, framers' association, nature conservation organization, chamber of industry and commerce and chamber of handicrafts.	"To clarify goals and responsibilities a coordinative plan among the researchers and key stakeholder should be drafted at the beginning of the PSD, to give stakeholder the feeling that their problem perception was clearly understood by the other stakeholders, we recommend a short feedback session after the presentation of each PG_IND, to increase the awareness of the uncertainty of future development of external factors, we suggest asking stakeholders to explicitly rank the external factors during the step of scenario development with regard to their importance and their uncertainty, to overcome the problem that stakeholders did not refer to the BN modelling results when selecting the possible actions for a strategy to reach the 30% goal of the county, we recommend a different construction and application procedure with more time for stakeholders to work on BNs, an additional workshop focusing on concretizing the identified actions should be organized at the end of the PSD
6	(Djouma et al., 2018)	Co-designing win-win partnerships between agroindustries and smallholders in the palm oil sector in Cameroon	Biotechnol. Agron. Soc. Environ.	Representatives of industries, representatives of the Ministry of Agriculture, independent growers, growers with a contract partnership with the industry, intermediaries at the processing level, representative of a microfinance institution	Implement the ARDI method to identify actors, resources and the surrounding dynamics,
7	(Proswitz et al., 2021)	Complex Socio-Ecological Systems: Translating Narratives into Future Land Use and Land Cover Scenarios in the Kilombero Catchment, Tanzania	Sustainability	-	"the results build a starting point for further research on the impacts of the different LULCC scenarios on biodiversity, hydrological processes, or livelihoods, thereby supporting the identification of intervention priorities and the development of adapted and sustainable future strategies."
8	(Graveline et al., 2014)	Coping with Urban & Agriculture Water Demand Uncertainty in Water Management Plan Design: the Interest of Participatory Scenario Analysis	Water resource Management	From urban water and irrigation sectors	"The scenarios produced may also be used in contexts other than water management, since general issues such as the local economy, land use and households have been treated."
9	(Nanninga et al., 2012)	Discussion on Sustainable Water Technologies for Peri-Urban Areas of Mexico City: Balancing Urbanization and Environmental Conservation	Water	Chinamperos, local government representatives, NGOs and academics	Make an assessment from an economic and social perspectives, instead of just making it from an environmental point of view
10	(Pollastri et al., 2018)	Envisioning Urban Futures as Conversations to Inform Design and Research	Proceedings of the Institution of Civil Engineers - Urban Design and Planning	From the following sectors: retail, transport and mobility, environmental and natural sciences, heritage, culture, and archaeology, education, information technologies (IT), utilities, ageing, architecture and urbanism.	-
11 (a)	(Corrigan & Nieuwenhuis, 2019)	Evaluating Goal Programming as a Backcasting Tool to Assess the Impact of Local Stakeholder Determined Policies on the Future Provision of Ecosystem Services in Forested Landscapes	Forests	They represented organizations which collectively provided a diverse range of perspectives on forestry in Ireland, including statutory regulatory bodies, commercial forestry companies, sawmilling industry, governmental and non-governmental environmental, ecology, cultural and heritage organizations and forest research institutions.	-

#	Group Item Definition	Bibliographic information		Participatory concept	Evaluation
		Title	Journal	Nature of scenario team	Recommendations
				Background of the participants	Recommendations given for the scenario construction process or use of scenarios
11 (b)		Evaluating Goal Programming as a Backcasting Tool to Assess the Impact of Local Stakeholder Determined Policies on the Future Provision of Ecosystem Services in Forested Landscapes	Forests	They represented organizations which collectively provided a diverse range of perspectives on forestry in Ireland, including statutory regulatory bodies, commercial forestry companies, sawmilling industry, governmental and non-governmental environmental, ecology, cultural and heritage organizations and forest research institutions.	-
11 (c)		Evaluating Goal Programming as a Backcasting Tool to Assess the Impact of Local Stakeholder Determined Policies on the Future Provision of Ecosystem Services in Forested Landscapes	Forests	They represented organizations which collectively provided a diverse range of perspectives on forestry in Ireland, including statutory regulatory bodies, commercial forestry companies, sawmilling industry, governmental and non-governmental environmental, ecology, cultural and heritage organizations and forest research institutions.	-
12	(Soria-Lara & Banister, 2018)	Evaluating the impacts of transport backcasting scenarios with multi-criteria analysis	Transportation Research Part A: Policy and Practice	Practitioners from different professional domains and policy-makers	"The proposed "collaborative appraisal framework" would need to be customised for each particular situation, providing "unique experiences",
13	(Tassew et al., 2019)	Future of beekeeping in North-western Ethiopia: Scenarios, local adaptation measures and its implications for farmers' livelihoods	Biodiversitas Journal of Biological Diversity	Live stock development agents, beekeeping development and research officials, farmers' representatives, the chairman of the peasant association, district beekeeping experts, the head of district office of agriculture, and the head of district administration	-
14	(Do et al., 2021)	Governing Landscapes for Ecosystem Services: A Participatory Land Use Scenario Development in the Northwest Montane Region of Vietnam	Environmental Management	From the department of Agriculture and Rural Development, the Department of Natural Resources and Environment (DONRE), commune leaders, agriculture extension staff, environment and cadastral staff, and some village heads.	-
15	(James et al., 2013)	"Ground truths" and scenarios: Examining and testing regional policy in North West Wales	Local Economy: The Journal of the Local Economy Policy Unit	Local policy makers, business representatives	-
16	(Rouillard et al., 2022)	Initiating collective action for the management of deep confined aquifer systems: application of a participatory scenario approach in France	Hydrogeology Journal	Users of the deep aquifers, including public drinking water utilities, the gas storage public company, the spa industry, agricultural and industrial sectors, and state agencies	"More formal, comprehensive and inclusive processes would be needed to ensure the robustness and acceptability of the final operational goals, targets and measures of an integrated plan of the deep aquifers."
17	(Alizadeh et al., 2022)	Integrated assessment of localized SSP-RCP narratives for climate change adaptation in coupled human-water systems	Science of the Total Environment	-	"This can provide information useful in guiding local adaptation actions."
18	(Withycombe Keeler et al., 2015)	Linking stakeholder survey, scenario analysis, and simulation modelling to explore the long-term impacts of regional water governance regimes	Environmental Science & Policy	Stakeholders with interests and expertise in water management, urban development, farming and agriculture, and environmental conservation	-
19	(Terrapon-Pfaff et al., 2020)	Localizing the Water-Energy Nexus: The Relationship between Solar Thermal Power Plants and Future Developments in Local Water Demand	Sustainability	Participants included representatives from the high commission for water and forests, province council, electricity supplier, hydrological agency, meteorological service, provincial delegation of energy and mines, agricultural associations from the different oases, and the agricultural chamber, as well as from local NGOs also, representatives of youth and women groups.	-
20	(Campos et al., 2016)	Participation, scenarios and pathways in long-term planning for climate change adaptation	Planning Theory & Practice	Representatives of local administrations (e.g. municipality mayors, policymakers and spatial planners, the Aveiro Harbour Administration), regional and national administrative bodies (e.g. regional association of municipalities, the National environmental Agency), environmental associations, the Aveiro University (close to the case study area), associations of local business owners, professional associations of farmers and fishermen, surfers and resident associations.	-
21	(Bergez et al., 2011)	Participatory foresight analysis of the cash crop sector at the regional level: case study from southwestern France	Regional Environmental Change	Professionals from the cash crop sector, private and public institutions, extension services, the French technical institute of the cash crop sector, and researchers from the disciplines previously mentioned.	-
22	(Jiren et al., 2020)	Reconciling food security and biodiversity conservation: participatory scenario planning in southwestern Ethiopia	Ecology and Society	Local people as well as stakeholder organizations operating at the three administration levels: kebele, woreda, and the zone. Stakeholders from government organizations, nongovernmental organizations, and community organizations. Stakeholders from multiple sectors, including biodiversity and food security.	-
23	(Hatzilacou et al., 2007)	Scenario workshops: A useful method for participatory water resources planning?	Water Resources Research	Policy makers, scientists, business representatives, and citizens from different parts of the island	-
24	(Sisto et al., 2018)	Stakeholder participation in planning rural development strategies: Using backcasting to support Local Action Groups in complying with CLLD requirements	Land Use Policy	Public institutions and private organisations, agro-food network and other local stakeholders (producers associations, officers of local municipalities, voluntary organisations, social cooperatives, etc.)	-

Group Item Definition	Bibliographic information		Participatory concept	Evaluation
	Title	Journal	Nature of scenario team	Recommendations
#			Background of the participants	Recommendations given for the scenario construction process or use of scenarios
25 (a) (Carlsen et al., 2013)	Tailor-made scenario planning for local adaptation to climate change	Mitigation and Adaptation Strategies for Global Change	Key stakeholders from health sector	"Adopt a consistency-approach, which reduce the problems caused by a limited knowledge of global change factor (a hybrid of a "bottom-up" approach and a "consistency" approach may be developed in order to improve the presented methodology by removing a local bias, and in order to enable re-use and intercomparison between different studies, across sectors and across regions.)"
25 (b)	Tailor-made scenario planning for local adaptation to climate change	Mitigation and Adaptation Strategies for Global Change	-	"Adopt a consistency-approach, which reduce the problems caused by a limited knowledge of global change factor (a hybrid of a "bottom-up" approach and a "consistency" approach may be developed in order to improve the presented methodology by removing a local bias, and in order to enable re-use and intercomparison between different studies, across sectors and across regions.)"
25 (c)	Tailor-made scenario planning for local adaptation to climate change	Mitigation and Adaptation Strategies for Global Change	-	"Adopt a consistency-approach, which reduce the problems caused by a limited knowledge of global change factor (a hybrid of a "bottom-up" approach and a "consistency" approach may be developed in order to improve the presented methodology by removing a local bias, and in order to enable re-use and intercomparison between different studies, across sectors and across regions.)"
26 (Palacios-Agundez et al., 2013)	The Relevance of Local Participatory Scenario Planning for Ecosystem Management Policies in the Basque Country, Northern Spain	Ecology and Society	Public administration technicians and policymakers, researchers and experts in different areas, e.g., architecture, economics, biology, geology, engineering, teaching, and journalism, personnel from environmental associations and NGOs, environmental education professionals, and representatives of agriculture, i.e., the farmers' union, the forestry sector, i.e., a cluster of private forest land owners, and the private sector	-
27 (Podolak et al., 2017)	Using a multimethod approach to develop implementation strategies for a cervical self-sampling program in Kenya	Global Environmental Change	Project management team members, Action Africa help International employees, researchers, consultant, Grand challenges Canada representative, Ministry of Health leaders, Public health laboratory leaders, private laboratory leaders, university professor, NGO leader, practicing gynaecologists, clinicians, pharmacists, administrators, female community health volunteers, village women, health system administrator	-
28 (Varho & Tapio, 2013)	Combining the qualitative and quantitative with the Q2 scenario technique — The case of transport and climate	Technological Forecasting and Social Change	Transport experts and high school students	-
29 (Fofiu & Dobus, 2015)	GLAMURS – Green Lifestyles, Alternative Models and Upscaling Regional Sustainability. Case Study Exchange	-	Pioneers of sustainability, researchers from the Sustainable Research Institute	-
30 (Rakotomahazo et al., 2021)	Community Perceptions of a Payment for Ecosystem Services Project in Southwest Madagascar: A Preliminary Study	Land	Local association, health, education, public administration, local administrative authorities (villages chiefs, school heads and local health clinic representatives), local management association (Velondriake association), and representatives from the local communities in the 10 study villages.	-
31 (Kuzdas & Wiek, 2014)	Governance scenarios for addressing water conflicts and climate change impacts	Environmental Science & Policy	PC commission, Environment Ministry branches, Environmental NGOs, PC Commission, Agriculture Associations, Universidad Nacional, ASADAs, Timber Business, Environment Ministry, Health Ministry, Agriculture Ministry, AyA, Irrigation (SENARA-Cañías/ SENARA-San José), Education Ministry), ASADAs, universities, tourism associations, agriculture associations, municipal governments, community groups, environmental groups	-
32 (Enfors et al., 2008)	Making Investments in Dryland Development Work: Participatory Scenario Planning in the Makanya Catchment, Tanzania	Ecology and Society	Farmers from the catchment, Chairmen from different villages in the catchment, Extension workers, a Representative of the District council, and a representative of the major NGO in the area	Use multi-scale scenarios, where storylines are developed at several organizational levels and then linked together to reduce the risk for bias (but there are still very few examples of scenario-planning processes that have successfully integrated multiple scales)
33 (a) (Brown et al., 2016)	Participatory scenario planning for developing innovation in community adaptation responses: three contrasting examples from Latin America	Regional Environmental Change	Local fishermen, park rangers, a local NGO, coastguards, Local politicians, tourists and commercial tourism operators, petrochemical industry, port industry, government departments for fisheries	-
33 (b)	Participatory scenario planning for developing innovation in community adaptation responses: three contrasting examples from Latin America	Regional Environmental Change	Local people and their Consejo comunitarios, Guerillas, illegal crop cultivators/traders, the army, the environmental agency, ministry of environment, NGOs, research organisations	-
33 (c)	Participatory scenario planning for developing innovation in community adaptation responses: three contrasting examples from Latin America	Regional Environmental Change	Local people within the territory, municipal authorities, Environmental agency, NGOs, public forest company. CONAFOR (National Forest Commission)	-

Group Item Definition #	Bibliographic information		Participatory concept	Evaluation	
	Title	Journal	Nature of scenario team	Recommendations	
			<i>Background of the participants</i>	<i>Recommendations given for the scenario construction process or use of scenarios</i>	
34	(Freeth & Drimie, 2016)	Participatory Scenario Planning: From Scenario 'Stakeholders' to Scenario 'Owners'	Environment: Science and Policy for Sustainable Development	Government, agribusiness, farmers' unions, nongovernmental organizations, social movements, and academia.	-
35	(Boden et al., 2015)	Scenario planning: The future of the cattle and sheep industries in Scotland and their resiliency to disease	Preventive Veterinary Medicine	From Scottish cattle or sheep sectors, farming, wildlife/forestry, Centres of Expertise on water and climate change, economists, agricultural and social scientists, veterinarians, epidemiologists, EPIC scientists and Scottish Government policy staff.	-
36	(Ojoyi et al., 2017)	Scenario-based approach in dealing with climate change impacts in Central Tanzania	Futures	Government and NGOs' representatives, smallholder farmers	-
37	(Alvarenga et al., 2019)	Scenarios for population health inequalities in 2030 in Europe: the EURO-HEALTHY project experience	International Journal for Equity in Health	Experts with a wide view about PH inequalities, linked to the public and private sector and the society at large. Their fields of expertise covered a large spectrum, such as public health, urban and regional planning, social inequalities, environment, and groups at-risk,	"The scenarios obtained can be considered as a tool for European policy makers to have a better understanding about plausible future developments of PH, preparing them to counteract increases in inequalities."
38	(Best et al., 2021)	Toward Inclusive Landscape Governance in Contested Landscapes: Exploring the Contribution of Participatory Tools in the Upper Suriname River Basin	Environmental Management	-	-
39	(Zorrilla-Miras et al., 2021)	Understanding Complex Relationships between Human Well-Being and Land Use Change in Mozambique: Using a Multi-Scale Participatory Scenario Planning Process	Sustainability	Government, private sector, NGOs and academia	-
40	(Malinga et al., 2013)	Using Participatory Scenario Planning to Identify Ecosystem Services in Changing Landscapes	Ecology and Society	Small-scale subsistence farmers, large-scale commercial farmers, and representatives from nature reserves, researchers, policy makers, practitioners, resource managers, and resource users	-
41	(Chirozva et al., 2013)	Using scenario planning for stakeholder engagement in livelihood futures in the Great Limpopo Trans frontier Conservation Area	Development Southern Africa	A councillor, a headman, local District Council representatives, a representative from local government ministry and chairman of the Combination Management Authority, non-governmental organisations representatives working on food relief, and a representative from a nongovernmental organisation working on trans frontier conservation.	-
42	(Ram et al., 2011)	Extending the use of scenario planning and MCDA for the evaluation of strategic options	Journal of the Operational Research Society	Expert in the field of agriculture	-
43	(Ritchey, 2006)	Problem structuring using computer-aided morphological analysis	Journal of the Operational Research Society	Researchers from the Swedish EPA and other relevant government authorities, from two NGOs and from two private companies involved in waste management and recycling	-

# Appendix B: Questionnaire 1

## Indicadores dos determinantes do futuro da alimentação

No âmbito da minha Dissertação de Mestrado, que visa o desenvolvimento de cenários para avaliar o futuro dos hábitos de consumo da carne de bovino na população Portuguesa, um dos objetivos é reunir um conjunto significativo de indicadores que estejam relacionados com o futuro da alimentação.

Dentro deste domínio, os indicadores foram divididos em seis áreas de preocupação:

- Mudanças demográficas e alterações na procura;
- Impacto ambiental;
- Inclusividade na agricultura;
- Eficiência da cadeia de valor;
- Nutrição e saúde;
- Tecnologia alimentar e inovação.

Este questionário tem como objetivo reunir feedback relativamente aos indicadores de cada área de preocupação de modo a averiguar se estes caracterizam a respetiva área, são perceptíveis e fomentam a reflexão no tópico.

As seis áreas de preocupação serão apresentadas nas próximas secções (uma em cada secção) com uma breve descrição. Dentro de cada área estarão apresentados também os respetivos indicadores definidos. Junto aos indicadores estará uma escala de 1 a 5:

- Em que 5 exprime concordância total para incluir o indicador no estudo, significando que esse indicador caracteriza a área de preocupação, é perceptível e fomenta a reflexão nesse tópico;
- Ao contrário, 1 expressa discordância total para incluir o indicador no estudo, significando que o indicador não caracteriza a área de preocupação, não é perceptível e não fomenta a reflexão nesse tópico.

### Mudanças demográficas e alterações na procura

Esta área de preocupação caracteriza as alterações observadas na população humana e as suas características bem como alterações nas preferências dos consumidores aquando da aquisição de um determinado produto ou serviço, independentemente do seu preço. Concorda que os seguintes indicadores caracterizam a área de preocupação em questão, são perceptíveis e fomentam a reflexão no tópico?

População atual (quantidade total de pessoas que vivem numa determinada área)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Procura alimentar (procura alimentar por parte do consumidor, expressa em consumo total por habitante em, Kg)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Residentes em áreas urbanas (percentagem de população que vive em áreas urbanas)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Dimensão da classe média (percentagem da população que se enquadra na definição de classe média)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Consumo de carne de bovino (consumo total de carne de bovino expresso em Kg por habitante)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Produção alimentar (total de colheitas primárias e processadas, animais vivos e gado primário e processado produzido, medido em toneladas)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

### Impacto ambiental

O impacto ambiental é caracterizado pelo impacto de atividades humanas medido em termos de área biologicamente produtiva e água necessária para produzir os bens consumidos e assimilar os resíduos gerados. Concorda que os seguintes indicadores caracterizam a área de preocupação em questão, são perceptíveis e fomentam a reflexão no tópico?

Índice de exploração da água (média anual da procura total de água doce dividida pela média de longo prazo dos recursos de água doce)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Deflorestação (quantidade de perda total de cobertura arbórea num ano, em Kha)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Água para agricultura (percentagem de água destinada à agricultura comparativamente com o total de captação de água)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Aumento médio anual da temperatura (medido em °C comparando um determinado ano com o anterior)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Precipitação (quantidade de água proveniente da chuva, medido em mm através de um pluviômetro)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Índice de degradação do solo (percentagem de solo degradado comparativamente com a área total de solo)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Emissões de gases de efeitos de estufa (total de emissões de gases de efeito de estufa medidos em CO<sub>2</sub>e)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Uso de pesticidas (quantidade, medida em Kg, de substâncias ativas do grupo dos pesticidas vendidas, por hectare de área destinada a agricultura)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

### Inclusividade na Agricultura

Inclusividade na agricultura trata-se de adotar uma ideologia de aceitação de todos os tipos de pessoas e ideias de maneira justa e igual no setor da agricultura. Concorda que os seguintes indicadores caracterizam a área de preocupação em questão, são perceptíveis e fomentam a reflexão no tópico?

Índice de pobreza (rácio do número de pessoas cujos rendimento é inferior à linha de pobreza)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Emprego na Agricultura, Silvicultura e Indústria da Pesca (percentagem de população com 15 ou mais anos empregada na agricultura, silvicultura ou indústria da pesca)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Acesso à educação básica (percentagem de estudantes matriculados, entre os 10 e 14 anos de idade, comparativamente com a população residente)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Mulheres empregadas na Agricultura, Silvicultura e Indústria da Pesca (percentagem de população feminina com 15 ou mais anos empregada na agricultura, silvicultura ou indústria da pesca)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Taxa de desemprego jovem (percentagem de população com idade entre 15 e 24 anos desempregada comparativamente com o total de força de trabalho jovem)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Despesa doméstica em alimentação (percentagem de despesa doméstica destinada a alimentação comparativamente com a totalidade de despesa doméstica)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

### Eficiência da cadeia de valor

A eficiência na cadeia de valor pode ser caracterizada como uma medida das atividades compreendidas entre a conceção e a distribuição de um produto ou serviço, que permite avaliar se estas fazem um uso otimizado de recursos de modo a tirar o maior partido do menor número de recursos possível. Concorda que os seguintes indicadores caracterizam a área de preocupação em questão, são perceptíveis e fomentam a reflexão no tópico?

Preço da carne de bovino (preço da carne de bovino por Kg)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Produção de carne de bovino (quantidade de carne de bovino produzida, medida em toneladas por ano)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Importação de carne de bovino (quantidade de carne de bovino importada, medida em toneladas por ano)

	1	2	3	4	5	
Discordo totalmente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Concordo totalmente

Exportação de carne de bovino (quantidade de carne de bovino exportada, medida em toneladas por ano)

1 2 3 4 5  
Discordo totalmente      Concordo totalmente

Inflação no preço da carne de bovino (percentagem de aumento no preço da carne de bovino num ano)

1 2 3 4 5  
Discordo totalmente      Concordo totalmente

Despesa em agricultura (percentagem de despesa em agricultura por parte do governo comparativamente com o total de despesas)

1 2 3 4 5  
Discordo totalmente      Concordo totalmnete

Produtividade de trabalho (mede a produtividade de trabalho por hora num rácio PPS - purchasing power standards)

1 2 3 4 5  
Discordo totalmente      Concordo totalmente

Receita da indústria da carne (rendimento gerado pelas vendas de carne num ano)

1 2 3 4 5  
Discordo totalmente      Concordo totalmente

Índice de perda alimentar (quantidade de alimentos perdidos durante todo o processo da cadeia de abastecimento antes de chegar ao consumidor final)

1 2 3 4 5  
Discordo totalmente      Concordo totalmente

Índice de desperdício alimentar (quantidade de alimentos que não são consumidos apesar de estarem próprios para consumo, normalmente na fase de retalhista ou consumidor)

1 2 3 4 5  
Discordo totalmente      Concordo totalmente

Índice de obesidade (percentagem de população com 15 ou mais anos de idade que é considerada obesa)

1 2 3 4 5  
Discordo totalmente      Concordo totalmente

Prevalência de subnutrição (percentagem de população que se encontra subnutrida)

1 2 3 4 5  
Discordo totalmnete      Concordo totalmente

Prevalência de insegurança alimentar moderada ou grave (percentagem de população que tem dificuldade no acesso à alimentação numa base moderada ou grave)

1 2 3 4 5  
Discordo totalmente      Concordo totalmente

Consumo de proteína (percentagem da contribuição do consumo médio de proteína para a ingestão total de energia)

1 2 3 4 5  
Discordo totalmente      Concordo totalmente

Consumo de açúcares (percentagem de contribuição do consumo médio de açúcar para a ingestão total de energia)

1 2 3 4 5  
Discordo totalmente      Concordo totalmente

Consumo calórico (quantidade de energia consumida através de alimentos e bebida, medida em Kcal por dia)

1 2 3 4 5  
Discordo totalmente      Concordo totalmente

Despesas em Saúde (quantidade média de dinheiro dispendido em saúde por habitante, num ano)

1 2 3 4 5  
Discordo totalmente      Concordo totalmente

## Nutrição e saúde

A nutrição é uma necessidade essencial aos humanos, assim como uma exigência para obter e manter uma vida saudável tendo um papel fundamental no desenvolvimento humano e na saúde. A definição de saúde, por sua vez, vai para além da ausência de doença ou enfermidade e abrange um estado de completo de bem-estar físico, mental e social.

Concorda que os seguintes indicadores caracterizam a área de preocupação em questão, são perceptíveis e fomentam a reflexão no tópico?



## Tecnologia alimentar e inovação

Tecnologia no setor da alimentação é caracterizada pela aplicação da ciência dos alimentos em atividades como a seleção, preservação, processamento, empacotamento, distribuição e uso de alimentos seguros. Na ciência dos alimentos, cientistas e técnicos implementam disciplinas científicas, nomeadamente química, engenharia, microbiologia e nutrição para melhorar os alimentos em vários aspectos. A dimensão de inovação compreende o desenvolvimento de processos inovadores para aplicação em tecnologia alimentar.

Concorda que os seguintes indicadores caracterizam a área de preocupação em questão, são perceptíveis e fomentam a reflexão no tópico?

Investimento em pesquisa e desenvolvimento R&D (percentagem de investimento em pesquisa e desenvolvimento por parte de empresas comparativamente ao produto interno bruto num ano)

1    2    3    4    5

Discordo totalmente                  Concordo totalmente

Desempenho científico (mede a educação científica de um jovem de 15 anos ao usar o conhecimento científico para identificar questões, obter novos conhecimentos, explicar fenómenos científicos e tirar conclusões baseadas em evidências sobre tópicos relacionados à ciência)

1    2    3    4    5

Discordo totalmente                  Concordo totalmente

Empresas com atividade inovativa (total de empresas que completaram atividades de inovação, bem como empresas que estão no processo de implementação destas atividades e ainda não as completaram)

1    2    3    4    5

Discordo totalmente                  Concordo totalmente

## Appendix C: Indicators by area of concern

Table C.45 - Areas of concern and corresponding indicators included in questionnaire 1 (left) and questionnaire 2 (right)

QUESTIONNAIRE 1	QUESTIONNAIRE 2
<b>Demographic changes and demand shifts</b>	<b>Demographic changes and demand shifts</b>
Current population (n° of inhabitants)	Current population (n° of inhabitants)
Food demand	Food demand
% of people living in urban areas	% of people living in urban areas
Size of middle class	Size of middle class
Cattle Meat consumption	Food production
Food production	Household expenditure on food
<b>Environmental footprint</b>	<b>Environmental footprint</b>
Water exploitation index	Water exploitation index
Deforestation	Deforestation
Use of water for agriculture	Average annual Temperature rise
Average annual Temperature rise	Greenhouse gas emissions
Precipitation	Use of pesticides
Land degradation	
Greenhouse gas emissions	
Use of pesticides	
<b>Nutrition and Health</b>	<b>Nutrition and Health</b>
Rate of obesity on people with 15+ years old	Rate of obesity on people with 15+ years old
Prevalence of undernourishment	Prevalence of undernourishment
Prevalence of moderate or severe food insecurity	Prevalence of moderate or severe food insecurity
Protein contribution to the daily energy intake	Protein contribution to the daily energy intake
Sugar contribution to the daily energy intake	
Daily caloric intake	
Total health expenditure	
<b>Agricultural inclusivity</b>	<b>Consumer proximity to the agriculture sector</b>
Poverty rate	Youth employment in agriculture
Employment in the Agriculture, Forestry and Fishery industry	Woman employment in agriculture
Access to basic education	Graduates in agriculture
Woman Employment in Agriculture, Forestry and Fishery industry	Organic farming
Youth unemployment rate	Livestock production
Household expenditure on food	Crop production
<b>Food technology and innovation</b>	<b>Technology and innovation</b>
Investment in R&D	Investment in R&D
Science performance	Science performance
Enterprises with innovation activity	Enterprises with innovation activity

Table B.44 - Areas of concern and corresponding indicators included in questionnaire 1 (left) and questionnaire 2 (right)

QUESTIONNAIRE 1	QUESTIONNAIRE 2
<b>Value chain efficiency</b>	<b>Food chain efficiency</b>
Cattle meat price	Food loss
Cattle meat Production	Food waste
Cattle meat Import	Food production
Cattle meat export	
Cattle meat price inflation	
Agriculture expenditure	
Labour productivity per hour	
Meat industry revenue	
Food loss	
Food waste	
	<b>New area --&gt; Consumption patterns</b>
	Cattle meat price
	Cattle meat Production
	Self-sufficiency index

## Appendix D: Questionnaire 2



### Ajude-nos a perceber como é que os padrões de consumo alimentar em Portugal poderão evoluir!

Os portugueses comem hoje de forma muito diferente do que há cinquenta anos. Vivemos em tempos de constante mudança e grande incerteza, um assunto a destacar relativamente ao nosso futuro é a evolução dos padrões de consumo alimentar. O fornecimento de uma dieta nutricionalmente equilibrada, acessível a todos e sustentável é essencial para garantir as necessidades nutricionais da população portuguesa, cumprindo os Objetivos de Desenvolvimento Sustentável das Nações Unidas.

O Laboratório Colaborativo FeedInov (FeedInov CoLAB), em parceria com o Instituto Superior Técnico (IST) estão a desenvolver um estudo com o fim de perspetivar o futuro dos padrões de consumo alimentar na população portuguesa. O objetivo não passa por prever o que irá acontecer, mas sim perceber o futuro, julgando corretamente os seus possíveis desenvolvimentos. Serão imensos os fatores que influenciam a escolha dos consumidores. Percepcionar a influência de alguns destes fatores e como o consumidor os equaciona (ou não) nas suas escolhas e perspetivas futuras de consumo alimentar será de extrema importância.

Próximo

### Como participar: Instruções

Para nos ajudar a atingir o nosso objetivo, pedimos que imagine como a situação em Portugal poderá mudar até 2050 relativamente a um conjunto de áreas de preocupação que englobam os principais fatores passíveis de influenciar as nossas escolhas enquanto consumidores. Solicitamos assim a sua colaboração na resposta às questões seguintes justificando sempre que possível as suas opções. Estarão apresentadas sete áreas de preocupação: 1. Mudanças demográficas e procura alimentar; 2. Impacto ambiental; 3. Nutrição e saúde; 4. Proximidade do consumidor ao setor agrícola; 5. Tecnologia e inovação; 6. Eficiência da cadeia alimentar; 7. Padrões de consumo. Para o ajudar na sua reflexão, apresentamos alguns indicadores recentes e que são exemplificativos destas áreas.

A sua participação é totalmente voluntária. As suas respostas serão confidenciais e apenas acedidas pelos membros da equipa de investigação do Instituto Superior Técnico e do Laboratório FeedInov envolvidos no estudo. Ao continuar, está a aceitar que os dados recolhidos sejam utilizados por estas entidades, para desenvolvimento de cenários de padrões de consumo alimentar.

Obrigada por colaborar! Por favor carregue no botão "Próximo" para iniciar.

Voltar

Próximo

Com que género se identifica?

- Feminino
- Masculino
- Outro
- Prefiro não responder

Qual das categorias abaixo inclui a sua idade?

- 17 anos ou menos
- 18 - 20 anos
- 21 - 29 anos
- 30 - 39 anos
- 40 - 49 anos
- 50 - 59 anos
- 60 anos ou mais

Qual é o distrito/região autónoma em que reside?

Please Select

Qual é o seu nível de escolaridade?

- 1º ciclo
- 2º ciclo
- 3º ciclo
- Ensino secundário
- Licenciatura
- Pós-graduação
- Mestrado
- Doutoramento
- Outro

Qual das seguintes opções melhor descreve a sua área de estudos/trabalho?

- Saúde
- Direito
- Engenharia
- Finanças
- Gestão
- Artes
- Comunicação
- Psicologia
- Ciências sociais
- Agricultura e pecuária
- Outro

Voltar

Próximo

### 1. Mudanças demográficas e procura alimentar

Esta área de preocupação engloba os fatores relacionados com as alterações demográficas observadas na população portuguesa e as suas características, bem como fatores relacionados com a aquisição de bens alimentares.

Indicador	Definição	Valor mais atual
População atual (nº de habitantes)	Total de pessoas que vive em Portugal.	10 344 802 habitantes
Residentes em áreas urbanas (%)	Percentagem da população Portuguesa que reside em áreas urbanas.	66%
Dimensão da classe média (%)	Percentagem da população Portuguesa que se enquadra na definição de classe média. Famílias com rendimento entre 75% e 200% do rendimento médio nacional.	60%
Procura alimentar (kg/dia)	Procura alimentar expressa em consumo médio por habitante, relativa a: Fruta, hortícolas, leguminosas, cereais, derivados, tubérculos, carne, pescado, ovos, óleos e gorduras.	1,1 Kg/dia
Produção alimentar (toneladas)	Total de colheitas primárias e processadas, e animais vivos.	11 970 972 toneladas
Despesa doméstica em alimentação (%)	Percentagem de despesa doméstica destinada a alimentação comparativamente com a totalidade de despesa doméstica.	16,10%

Tendo como exemplo o conjunto de indicadores acima apresentados, por favor indique qual das três afirmações considera plausível (pode selecionar mais do que uma): \*

- Até 2050 haverá um aumento na procura alimentar em Portugal.
- Até 2050 haverá uma diminuição na procura alimentar em Portugal.
- Até 2050 a procura alimentar em Portugal irá manter-se igual.
- Não sei/Não quero responder.

Indique uma ou duas razões para o aumento:

Digite aqui...

Indique uma ou duas razões para a diminuição:

Digite aqui...

Indique uma ou duas razões para a não alteração:

Digite aqui...

Justifique:

Digite aqui...

Voltar

Próximo

## 2. Impacto ambiental

Esta área de preocupação engloba fatores relacionados com o impacto ambiental (alteração das condições do meio ambiente e/ou dos elementos presentes neste em consequência de atividades humanas (antrópicas)).

Indicador	Definição	Valor mais atual
Índice de exploração da água (%)	Percentagem de uso de água em relação aos recursos de água doce num determinado lugar e tempo.	12,70%
Deflorestação (khectar)	Quantidade de perda total de cobertura arbórea num ano.	37,2 Kha
Aumento médio anual da temperatura (°C)	Aumento da temperatura média no período de um ano.	0,33 °C
Emissões de gases de efeito de estufa (tCO2e)	Total de emissões de gases de efeito de estufa.	6,7 tCO2e
Uso de pesticidas (Kg)	Quantidade de substâncias ativas do grupo dos pesticidas vendidas, por hectare de área destinada a agricultura.	2,2 Kg

Tendo como exemplo o conjunto de indicadores acima apresentados, por favor indique qual das três afirmações considera plausível (pode selecionar mais do que uma): \*

- Até 2050 haverá um aumento do impacto ambiental em Portugal.
- Até 2050 haverá uma diminuição do impacto ambiental em Portugal.
- Até 2050 o quadro de impacto ambiental em Portugal irá manter-se.

Indique uma ou duas razões para o aumento:

Digite aqui...

Indique uma ou duas razões para a diminuição:

Digite aqui...

Indique uma ou duas razões para a não alteração:

Digite aqui...

Justifique:

Digite aqui...

Voltar

Próximo

## 3. Nutrição e saúde

Esta área de preocupação engloba fatores relacionados com a nutrição e saúde. A nutrição é uma necessidade essencial aos humanos, assim como uma exigência para obter e manter uma vida saudável tendo um papel fundamental no desenvolvimento humano e na saúde. A definição de saúde, por sua vez, vai para além da ausência de doença ou enfermidade e abrange um estado de completo de bem-estar físico, mental e social.

Indicador	Definição	Valor mais atual
Índice de obesidade (%)	Percentagem de população com 15 ou mais anos de idade que é considerada obesa.	53,50%
Prevalência de subnutrição (%)	Percentagem de população que encontra subnutrida.	<2,5%
Prevalência de insegurança alimentar moderada ou grave (%)	Percentagem de população que tem dificuldade no acesso à alimentação numa base moderada ou grave.	11,50%
Consumo de proteína (%)	Percentagem da contribuição do consumo médio de proteína para a ingestão total de energia.	19,90%

Tendo como exemplo o conjunto de indicadores acima apresentados, por favor indique qual das três afirmações considera plausível (pode selecionar mais do que uma): \*

- Até 2050 as condições de nutrição e saúde irão melhorar em Portugal.
- Até 2050 as condições de nutrição e saúde irão piorar em Portugal.
- Até 2050 as condições de nutrição e saúde não irão sofrer alteração em Portugal.
- Não sei/Não quero responder.

Indique uma ou duas razões para o melhoramento:

Digite aqui...

Indique uma ou duas razões para a deterioração:

Digite aqui...

Indique uma ou duas razões para a não alteração:

Justifique:

Voltar

Próximo

#### 4. Proximidade do consumidor ao setor agrícola

Esta área de preocupação engloba um conjunto de fatores que caracteriza a proximidade que o consumidor sente em relação ao setor agrícola, ao acesso a informação sobre práticas produtivas, cadeias de abastecimento, circuitos de distribuição, entre outros.

Indicador	Definição	Valor mais atual
Jovens empregados na agricultura (%)	Percentagem de produtores agrícolas com menos de 25 anos de idade.	0,30%
Mulheres empregadas na agricultura (%)	Percentagem de produtores agrícolas do género feminino.	32,90%
População formada em agricultura (%)	Percentagem de população com formação superior em agricultura.	1,30%
Produção biológica (%)	Percentagem de superfície agrícola utilizada para produção biológica comparativamente com a superfície agrícola utilizada total.	5,30%
Produção pecuária (nº de cabeças)	Quantidade total de bovinos, suínos, ovinos, caprinos, aves e coelhos produzidos.	60 852 837 nº de cabeças
Produção vegetal (hectares)	Área total destinada à produção de frutos frescos, citrinos, frutos subtropicais, frutos pequenos de boga, frutos de casca rija, olivais e vinhas.	858 184 hectares

Tendo como exemplo o conjunto de indicadores acima apresentados, por favor indique qual das três afirmações considera plausível (pode selecionar mais do que uma): \*

- Em 2050 haverá uma maior proximidade do consumidor ao setor agrícola em Portugal.
- Em 2050 haverá uma menor proximidade do consumidor ao setor agrícola em Portugal.
- Em 2050 haverá uma igual proximidade do consumidor ao setor agrícola em Portugal.

Indique uma ou duas razões para a maior proximidade:

Indique uma ou duas razões para a menor proximidade:

Indique uma ou duas razões para a não alteração:

Justifique:

Voltar

Próximo

#### 5. Tecnologia e inovação

Esta área de preocupação engloba fatores relacionados com a aplicação da ciência em atividades que vão desde a produção agrícola primária (práticas produtivas, de manejo, etc), seleção, preservação, processamento, embalagem, distribuição e uso de alimentos seguros. Investigadores e técnicos implementam disciplinas científicas, nomeadamente agronomia e zootecnia, engenharia, química, microbiologia e nutrição. A dimensão de inovação compreende o desenvolvimento de processos produtivos inovadores para aplicação em produção e tecnologia alimentar.

Indicador	Definição	Valor mais atual
Investimento em pesquisa e desenvolvimento (% do PIB)	Percentagem de investimento em pesquisa e desenvolvimento por parte de empresas comparativamente ao produto interno bruto num ano.	0,92%
Desempenho científico (pontuação PISA)	Mede a educação científica de um jovem de 15 anos ao usar o conhecimento científico para identificar questões, obter novos conhecimentos, explicar fenômenos científicos e tirar conclusões baseadas em evidências sobre tópicos relacionados à ciência. Os resultados são dimensionados para se ajustarem aproximadamente a distribuições normais, com médias de 500 pontos para os países da OCDE e desvios padrão em torno dos 100 pontos de pontuação.	492
Empresas com atividade inovativa (nº de empresas)	Total de empresas que completaram atividades de inovação, bem como empresas que estão no processo de implementação destas atividades e ainda não as completaram.	10 416 empresas

Tendo como exemplo o conjunto de indicadores acima apresentados, por favor indique qual das três afirmações considera plausível (pode selecionar mais do que uma): \*

- Até 2050 haverá um avanço na tecnologia alimentar e inovação em Portugal.
- Até 2050 haverá uma retrocesso na tecnologia alimentar e inovação em Portugal.
- Até 2050 o quadro de tecnologia alimentar e inovação em Portugal irá manter-se igual.

Indique uma ou duas razões para o avanço:

Indique uma ou duas razões para a retrocesso:

Indique uma ou duas razões para a não alteração:

Justifique:

Voltar

Próximo

## 6. Eficiência da cadeia alimentar

Esta área de preocupação engloba os fatores relacionados com a eficiência na cadeia alimentar que pode ser caracterizada como uma medida das atividades compreendidas entre a conceção e a distribuição de um produto ou serviço, que permite avaliar se estas fazem um uso otimizado de recursos de modo a tirar o maior partido do menor número de recursos possível.

Indicador	Definição	Valor mais atual
Índice de perda alimentar (toneladas)	Quantidade de alimentos perdidos durante todo o processo da cadeia de abastecimento antes de chegar ao consumidor final.	573 413 toneladas
Índice de desperdício alimentar (Kg)	Quantidade de alimentos que não são consumidos apesar de estarem próprios para consumo, normalmente na fase de retalhista ou consumidor.	861 831 Kg
Produção alimentar (toneladas)	Total de colheitas primárias e processadas, e animais vivos.	11 970 972 toneladas

Tendo como exemplo o conjunto de indicadores acima apresentados, por favor indique qual das três afirmações considera plausível (pode selecionar mais do que uma): \*

- Até 2050 haverá uma melhoria na eficiência da cadeia de valor em Portugal.
- Até 2050 haverá uma deterioração na eficiência da cadeia de valor em Portugal.
- Até 2050 a eficiência na cadeia de valor não irá sofrer alteração em Portugal.

Indique uma ou duas razões para a melhoria:

Digite aqui...

Indique uma ou duas razões para a deterioração:

Digite aqui...

Indique uma ou duas razões para a não alteração:

Digite aqui...

Justifique:

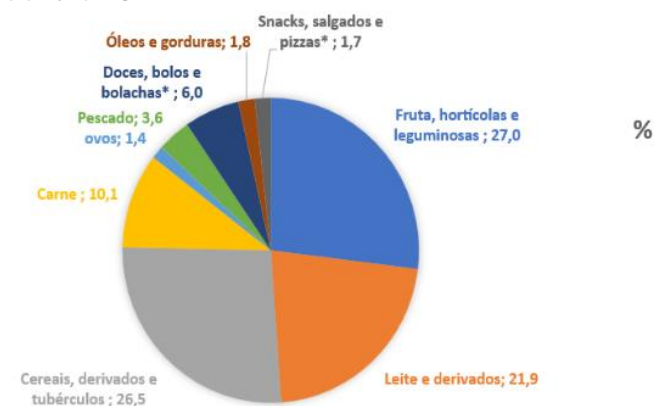
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Voltar

Próximo

## 7. Padrões de consumo

Esta área de preocupação engloba fatores relacionados com os padrões de consumo atuais da população portuguesa.



Indicador	Definição	Valor mais atual
Preço da carne de bovino (€/kg)	Preço grossista da carne de bovino.	2,93 €/Kg
Produção de carne de bovino (toneladas)	Quantidade de carne de bovino produzida.	92 030 toneladas
Índice de autossuficiência (%)	Capacidade para suprir, em termos de valor, a procura de um país através da produção nacional.	81%

No gráfico acima estão apresentados os dados de consumo alimentar, da população portuguesa, para os diferentes tipos de alimentos. Tendo como exemplo os dados do gráfico e o conjunto de indicadores acima apresentados na tabela, por favor indique qual das três afirmações considera plausível (pode selecionar mais do que uma): \*

- Até 2050 haverá um aumento do consumo da carne de bovino em Portugal.
- Até 2050 haverá uma diminuição do consumo da carne de bovino em Portugal.
- Até 2050 o consumo da carne de bovino em Portugal irá manter-se igual.
- Não sei/Não quero responder.

Indique uma ou duas razões para o aumento:

Digite aqui...

Indique uma ou duas razões para a diminuição:

Digite aqui...

Indique uma ou duas razões para a não alteração:

Digite aqui...

Justifique:

Digite aqui...

Voltar

Próximo

Gostaria de deixar mais alguma observação/reflexão?

Digite aqui...

Caso tenha interesse em manter-se atualizado quanto aos resultados deste estudo, deixe por favor o seu contacto (e-mail).

Digite aqui...

Voltar

Enviar

## Appendix E: Drivers of change obtained from stage 1

Table E.46 - List of drivers obtained from stage one with configuration's proposals, by DESTEP category

DESTEP	Driver	Proposal (1)	Proposal (2)	Proposal (3)
Demographic	Ageing population	Increase		
	Birth rate	Decrease	Increase	
	Coastal urbanisation	Increasing		
	Death rate	Stagnation	High	
	Emigration			
	Immigration	High		
	Level of education	High		
	Nutrition graduates	Increase		
	Poverty levels	High		
	Resident population	Increase	Decrease	Stagnation
	Rural exodus	Increase		
	Urban exodus	Increase		
	Urbanisation	Increasing		
	Young people living in rural areas	Decrease		
	Young resident population	Decrease		
Economic	Agricultural production	Intensive		
	Available manpower	Reduced		
	Benchmarking of the agricultural sector			
	Cattle meat price	Increase		
	Cattle meat production	Decrease		
	Circular economy	Large-scale implementation		
	Competitive prices			
	Corporate profits			
	Cost of energy	Increase		
	Country's economic situation	Increasing		
	Demand for innovative products	Increase		
	Demand for natural resources	Increase		
	Demand-supply ratio	More supply than demand	More demand than supply	
	Economic crisis	Existing		
	Fast food price	Reduced		
	Financial capabilities of the agricultural sector	Reduced		
	Food dependency on other countries	Reduced		
	Food exports	Increase		
	Food production	Stagnation	Decrease	Efficient
	Food production for self-consumption	Non-existent	Existing	
Food waste	Decrease	Increase		



Table E.46 - List of drivers obtained from stage one with configuration's proposals, by DESTEP category  
(continued)

DESTEP	Driver	Proposal (1)	Proposal (2)	Proposal (3)
Economic	Fuel prices			
	Global market size	High		
	Healthcare costs	Increase		
	Healthy food supply	Higher		
	Household expenditure on food	Prioritised		
	Household income	Low		
	Imports	Stagnation	Increase	Reduced
	Industrialisation	Increasing		
	Innovative products	Developed		
	Investment in marketing and communication in the food sector	Low		
	Investment in preventive health	Higher	Lower	Non-existent
	Local production	More valued		
	Mass production	Increase		
	Organic crops	More valued		
	Priorities in terms of economic model: green-based vs fossil-fuel-based	Green-based	Fossil-fuel-based	
	Processed food supply	Increase		
	Production	Efficient		
	Production costs	High	Low	
	Production process	Unstructured	Optimised	
	Productivity	Low	High	
	Profitability of the agricultural sector	Low		
	Purchase power	Lost	Gained	
	Size of the middle class	Increasing		
	Transition to upper class	Increase		
	Waste generation	Increase		
	Working conditions	Favourable		
Working hours	Reduced			
Youth employment in the agricultural sector	Increase	Reduced		
Socio-cultural	Access to education	Broad		
	Access to healthcare	Broad	Reduced	
	Agricultural literacy	Reduced		
	Alternatives to animal protein	More sustainable		
	Animal protein consumption	Decrease	Increase	
	Attractiveness of the agricultural sector for young generations	Low		
	Availability of livestock feed	Low		
	Awareness-raising campaigns	stagnation		
	Awareness-raising campaigns for sustainability	stagnation	More	

Table E.46 - List of drivers obtained from stage one with configuration's proposals, by DESTEP category  
(continued)

DESTEP	Driver	Proposal (1)	Proposal (2)	Proposal (3)
	Changes in dietary habits	Non-existent	Existing	
	Concern about food	High		
	Concern about health	High	Little	
	Consumers' requirements			
	Consumption capacity	Increase		
	Consumption of animal-based food	Decrease	Increase	
	Consumption of high-calorie-density food	Increase		
	Consumption of local food	High		
	Cultural traditions	Evolve	Stagnation	
	Demystification of trends			
	Diet	Less healthy	More healthy	
	Diversity of unprocessed food	Low		
	Domestically produced foodstuffs	Certified		
	Efforts to reduce food waste	Increase	Decrease	
	Efforts to reduce global hunger	Increase		
	Efforts towards sustainability, by the population	Non-existent	Existing	
	Employability uncertainty	High		
	Energy consumption	High		
Socio-cultural	Environmental education	Incorporated into basic education		
	Facilitation			
	Family bonds to the countryside	Reduced		
	Farming practice	Scarce		
	Food- and environment-related diseases	Increase		
	Food consumption	Beyond basic needs	Increase	
	Food education	Incorporated into basic education	Incident in the parental figures	Addressed
	Food Marketing	Does not encourage healthy eating		
	Food patterns	Vegetarian/vegan		
	Food purchasing mode: online vs. face-to-face	Online		
	Food quality	Improved	Declining	
	Food security	Compromised		
	Food shopping at supermarkets			
	Free time available	Little		
	Graduates in technology and innovation	Increase		
	Graduates in the agricultural area	Increase		
	Graduates in the agricultural sector	Increase	Reduction	

Table E.46 - List of drivers obtained from stage one with configuration's proposals, by DESTEP category  
(continued)

DESTEP	Driver	Proposal (1)	Proposal (2)	Proposal (3)
Socio-cultural	Health education	Better quality	High	
	Hunger	Increase		
	Interest in healthy options	Increasing		
	Interest in information	Increasing	Reduced	
	Lifestyle	Consumerist	Non-consumerist	Sedentary
	Mental health problems	Common		
	National healthcare service's response time	Unreasonable		
	Natural evolution	Fast		
	Nutritionists' workplaces	Exclusion of health centres	Diversified	
	Pandemic situation			
	Perception of the impact of food on health	Increase		
	Personal care	Prioritised	Increase	
	Personal relation with body image	Important		
	Predictability of Agricultural and Livestock activity	Unpredictable		
	Producer renewal rate	Insufficient		
	Professional experience of young people until their PhD	Little		
	Protein consumption	Increase		
	Public awareness (on food, animal welfare, and sustainability)	Reduced	Large	
	Public information	Increase	Reduced	
	Quality of life	Declining	High	
	Quality of preventive healthcare	Higher		
	Recognition of nutritional sciences	Greater		
	Scientific performance of young generations			
	Social component of food	Strong		
	Social inequalities	Increase	Decrease	
	Medical experts practising	Few	Increase	
	Sports practice	Increase		
	Support and adherence to urban and community gardens			
	Touristic activity	High		
	Understanding of the food production process, by the population	Non-existent	Existing	
	Urban-depressive population			
	Veterinary graduates	Increase		
	Villainization of livestock farming	Low	High	
War	stagnation			

Table E.46 - List of drivers obtained from stage one with configuration's proposals, by DESTEP category  
(continued)

DESTEP	Driver	Proposal (1)	Proposal (2)	Proposal (3)
Technological	Agricultural and livestock production systems	Sustainable		
	Artificial Intelligence (AI)	More developed		
	Attractiveness of the technological and innovation sector	High		
	Automation of processes in the agricultural sector	Increasing		
	Community projects and support for technological development, at an academic and business level			
	Implemented technology in healthcare services	Developed		
	Innovation and technology companies	Increase		
	Motivation to innovate technology	Increase		
	Project development/maintenance	Hard to develop/maintain		
	R&D activities	Developed		
	Recycling system management	Non-efficient and non-effective		
	Resource management	Existing	Efficient	
	Scientific studies in the field of nutrition and health	Developed		
	Scientific studies in the field of technology and innovation	Stagnate	Increase	
Ecological	Self-sufficiency in production	High		
	Size of the public transport network	Increase		
	Quantity of fires	Stagnation	Increase	
	Areas devoted to organic farming	Increased quantity		
	Connection of aggravated environmental impact to cattle meat production	Strong connection		
	Atmospheric phenomena			
	By-products valorisation	Increase		
	Climate change	Adaptation		
	Climate emergency	Existing		
	Compensation for the consequences of anthropic activities	Insufficient		
	Concern about desertification in the agricultural sector	High		
	Deforestation phenomena	Increase	Stagnation	
	Drought	Intensification		
	Ecologic footprint of commerce	High		
	Emissions of pollutants into the ocean	Existing		
	Environmental conservation			
	Exposure to environmental toxics			
Greenhouse gas emissions	Increase	Decrease	Stagnation	

Table E.46 - List of drivers obtained from stage one with configuration's proposals, by DESTEP category (continued)

DESTEP	Driver	Proposal (1)	Proposal (2)	Proposal (3)
Ecological	Impact of war on the environment	Negative		
	Resource availability	Low	High	
	Resource usage	Non-efficient	Efficient	
	Soil exploitation	Excessive	Controlled	
	Use of additives	High		
	Use of antibiotics in agriculture and animal production	Low		
	Use of chemicals	Higher	Lower	
	Use of environmentally friendly transports	Lower	Higher	
	Use of plastic and disposable products	Lower	Higher	
	Use of renewable energy	Higher		
	Volcanic activity	High		
Political-Legal	Actions to promote graduation in agriculture	No actions		
	Bureaucracies	Do not allow an easy operation		
	Carbon emission charges			
	Effectiveness of government measures for sustainability	Low		
	Encouragement for the adoption of the Mediterranean diet			
	European guidelines to fight the environmental impact	Existing		
	Government actions and incentives for the adoption of a healthy lifestyle	Efficient	Existing	
	Government measures for sustainability	Not implemented	Implemented	
	Government support and investment in technology and innovation	No support	Not controlled	Existing
	Importance given to health by government members	Low		
	Measures to increase value chain efficiency	Non-existent	Existing	
	Measures to tackle food waste	Few	Increase	
	Policies to raise the population's awareness of healthy eating	Active		
	Political commitment to improving public healthcare	Weak		
Political forces operating in the country	Socialism			
Tax on processed food				