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

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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

1. Introduction

Since the beginning of human existence, food consumption patterns have changed and evolved following the evolution of our species. As Mann (2018) outlined, four million years ago, our bipedal ancestors witnessed a transition in their food habits, introducing animal-source foods into their former frugivorous diet, which has marked the introduction of meat consumption in human diets.

However, meat consumption has recently become a controversial topic. On one hand, meat, especially red meat, is considered crucial to optimal health and healthy lifestyles, by being a source of high-quality protein (Wyness, 2016) and essential nutrients intake (McAfee et al., 2010). On the other hand, it is associated with a negative environmental impact, poor resource use and critical health diseases (Ferreira et al., 2021). With so much information available to the public, consumers' consumption patterns are being shaped, leading to an increased 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.

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 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).

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). By considering several feasible 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 considering 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).

Along with the severe uncertainty that the cattle meat industry is facing, and consequently, the need to understand what may occur, to be able to take proactive action, the fact that there are no scenario planning studies for this sector in Portugal, lead to the need to develop such studies. Hence, this paper focuses on developing and applying a PSP methodology to explore how the future may unfold concerning consumers' preferences and willingness to change cattle meat consumption patterns, in Portugal. To achieve this goal, 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.

The paper is organized as follows: section 2. presents the literature review, section 3. the methodology, section 4. the results, section 5. the discussion and section 6. concludes.

2. Literature review

2.1 Systematic research protocol

To have an overview of what has already been done in this field of study, gaining insights into the entire processes of building the scenarios and identifying gaps in the literature, a systematic review of the existing literature on participatory scenario planning methodologies is performed. The review focuses on scenarios being developed for highly complex environments that consequently deal with a high number of uncertainties.

The systematic research to generate the final set of relevant articles on PSP methodologies is structured following the guidelines of the PRISMA statement and divided into four stages. For the articles to be included in the final set, they must illustrate one PSP method in a complex context, not using mathematical models. Thus, a list of exclusion criteria is set, to assess the retrieved articles. These criteria are not a foresight study, not illustrating the method, not complex (less than 5 uncertainties) or unknown complexity, use of mathematical models, not participatory, other foresight methods rather than scenario planning. Also, duplicate articles and articles that cannot be retrieved are excluded.

The first stage employed "Scenario planning/ building", "Participatory", "Method" and "Stakeholder" to title, abstract and keywords on Scopus, ScienceDirect and Web of Science databases, using an AND operator. From this, 201 articles were identified but only 27 gathered all the conditions to be included.

Four excluded articles from the previous stage did not elaborate on any methodology but quoted three other articles where the methodology was detailed. The second stage was analysing these articles. From these, only two were eligible to include in the final dataset. At this point, in total, only 29 articles were added, leading to think that the first stage was too restrictive.

Thus, a third stage was performed, employing "Participatory scenario planning", "Generation of scenario narratives" and "Foresighting activities" to the same parameters and databases as the first stage but using an OR operator. 114 articles were identified, yet only 12 articles were added, after applying the exclusion criteria.

With the aim of including key publications in the field looking into complexity and uncertainty, a fourth stage of the systematic search was carried out. This had as input an article: "An Approach to Multi-Criteria Decision Problems Under Severe Uncertainty" by (Comes et al., 2013). From this, only two articles were included.

At the end of the research, a final dataset of 43 relevant articles was achieved. To analyse these articles a set of research questions was elaborated and the data from each article documented, as presented in https://docs.google.com/spreadsheets/d/e/2PACX1vSip8LewdPfoDcX3nVuIx5HTWxi254JmSrBuxfChje6QiUOPZE2kLIKQy01TgqQ/pubhtml (PSP documentation taxonomy).

2.2. Results

The sample of articles is considered recent, almost half of them (40%) are from 2018. Also, Europe has a strong publication activity (48%) followed by Africa and the case studies cover 32 different countries. Additionally, these studies are published in 30 different journals.

Seventeen fields of study are addressed in all the articles. The most approached topic is Climate change (ten case studies), followed by water management with 6 case studies. The food industry, which is the general scope of the study developed hereinafter, only has three studies approaching the topic. As for the foresight period applied, the most observed one is 20 years, but they range from 5 to 75 years. Regarding the number of uncertainties to build the scenarios, it goes from 5 to 57, yet very few studies make use of a great number of uncertainties. Nevertheless, throughout the years this number has increased. Most of the studies build between 3 and 5 scenarios which most researches, from a study carried out by (Amer et al., 2013) consider adequate. Also, most of the studies develop descriptive scenarios and display them in the articles. 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. Concerning the name of the methods, they all go around scenario planning and the most common one is participatory scenario planning. Regarding the framework to build the scenarios, some

common steps are observed 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. 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. 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).

Only five studies involve more than 100 participants (James et al., 2013; Withycombe Keeler et al., 2015; Sisto et al., 2018; Podolak et al., 2017; Ojoyi et al., 2017) and most use only 50 participants. When it comes to selecting the participants, some case studies employ different methods and some only specify the criteria to do so. As for the nature of the scenario team, 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). To incorporate the participants in the studies it is necessary to choose the most appropriate methods. Information on eight methods was gathered, and workshops and interviews are the most used participatory methods. When referring to the studies involving more than 100 participants, also workshops are the most used, followed by questionnaires/surveys. Additionally, it is commonly observed that these methods are used in combination. The most frequent combination of tools is workshops and interviews followed by questionnaires/ surveys and workshops. Regarding the purpose of these participatory methods, 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.

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, but the majority do not work with any information. Making the interaction with and between the participants, a guided, structured, and easy-going exercise is a crucial task, and, to do so it is convenient to have a facilitating team or member. Few case studies elaborate on the role of the facilitators, the ones that do, mention that their tasks are 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).

From what is observed, most of the scenario planning processes took more than one year, and only one took exactly six months. Also, most of the studies build qualitative scenarios instead of qualitative ones. Concerning the purpose of the scenarios, six use them for policy-making contexts and five for decision-making. At the end of the process sometimes participants were asked to give feedback, and it was mostly positive. As an evaluation exercise, authors pointed out challenges and lessons learned. As for the challenges some common aspects are the participants' little time available and their management. For the lessons, authors learned from the experience that participation in the scenario planning process is key In line with what was said, one common recommendation given is to guide every participant with the same objectives, from the beginning of the process.

2.3 Lessons learned

In Portugal, there is an extremely small amount of participatory scenario planning studies developed, and even none regarding the food industry, when considering the sample of articles retrieved from the systematic search. Regarding the number of uncertainties used to build the scenarios, there has also been an increase throughout the years, nevertheless, it is not common to use a great number of uncertainties. Also, it is important to highlight that, only a few studies focus on including participants described as overall citizens in the scenario building process, and more importantly reaching a high number of participants.

3. Adapted methodology

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. The construction of the scenarios involves a large number of citizens and experts from FeedInvov 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). 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 for how the future of 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 Fig. 1. Only adaptations to the social component of the original methodology are made, while the technical component remains the same.

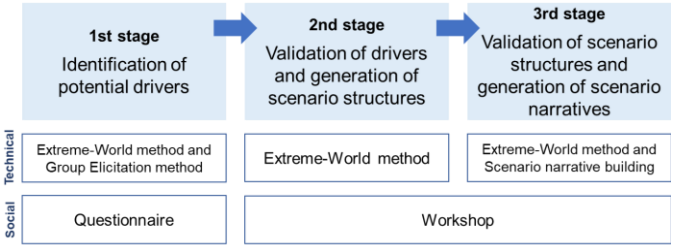

Figure 1 - Three-stage socio-technical approach

For the first stage, 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/). 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 drivers 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 and used to make an individual analysis of the results from the questionnaire, 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).

Regarding the second stage, 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.

In the third, and last 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 is made 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/) from the Future of food transformation map. This 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.

With the objective of designing a suitable, user-friendly, and non-exhaustive questionnaire for the participants to answer, a first questionnaire is developed to gather feedback, from a sample of participants (experts and non-experts) to identify which indicators are most relevant to be included in the second questionnaire. Participants are faced with six areas of concern and their definitions, and the corresponding indicators. 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. 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. 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). Participants are faced with a set of future-of-food determinants' indicators, clustered by seven different main areas of concern regarding this topic, and their respective most recent performance values for Portugal. 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. 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.

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. 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.

As the last step in this stage, the drivers of change identified are organized into the six DESTEP categories, with their corresponding collected configurations, to be validated later.

3.2 Validation of drivers and generation of scenario structures

This stage is developed in a workshop with eight experts from FeedInov CoLAB and a facilitator. 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 and asked to validate three parameters. To check if the terms used to describe the drivers are appropriate and eliminate remaining redundancies; to generate configurations for the drivers that did not have and validate the existing ones; check if the drivers are allocated to the right DESTEP category.

Further, 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 in affecting cattle meat consumption in the future. These drivers are then validated 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 resulted in two preliminary scenario structures.

3.3 Validation of scenario structures and generation of scenario narratives

This stage is performed in the same workshop as the previous stage. In the continuation, the participants are asked to validate and adjust the two contrasting scenario structures, considering four main scenario characteristics referred to by Amer et al. (2013): plausibility, compatibility, meaningfulness, and representativeness. 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 in (Alvarenga et al., 2019).

The scenario structures serve as backbones for the generation of the scenario narratives. For this, 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. A name for each scenario is given by the participants in the workshop. Also, participants are asked, in an informal way, to give feedback on the process and on the methods used.

4. Results

From the first questionnaire, nine responses were collected and ten indicators were removed. Later, as a result of the test round of the second questionnaire and 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, to guide the participants through the questionnaire. Some indicators were also included, removed, or allocated to other areas.

4.1 First stage of the methodology

4.1.1 Participants' characteristics

A group of 141 participants (80% women, 19% men) 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, followed by the agriculture and

livestock sector. Few participants only have a secondary education level. Mainly, they have a bachelor's degree and a master's degree. When it comes to geographical dispersion participants are from every autonomous region and district of Portugal, except Guarda and Bragança.

4.1.2 Type of responses

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 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.

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. 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%. Some answers given, either reasons or justifications did not allow the identification of any driver. From the total of 567 reasons and justifications collected, 478 responses led to the extraction of drivers. 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

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. After analysing the answers, it was possible to obtain a list of 201 drivers of change some with configurations, organized by DESTEP category.

4.2 Second stage of the methodology

As a result of the first step of the workshop, modifications to the final list of 201 drivers were made. Sixty-three drivers were eliminated because they did not meet all the criteria adapted from GEM, configurations for all drivers were given by the participants. And some drivers were allocated to another DESTEP category. At the end of this step, the participants achieved a list of 138 drivers of change with their corresponding configurations. From the ranking of the drivers, sixty different drivers were chosen as most relevant/impacting and these were the basis to generate the scenario structures as shown in Tab. 1. 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 drivers are organised by DESTEP category: Demographic (nine drivers), Economic (12 drivers), Societal (13 drivers), Technological (eight drivers), Ecological (nine drivers), Political-Legal (nine drivers).

4.3 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. 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:

Beef Deal

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,

Table 1 - 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
Societal	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
	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	Non-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
	By-products valorisation	Increase	Remains the same

Table 1 - The two scenario structures, composed by drivers and drivers' configurations (continued)

DESTEP	Driver	High cattle meat consumption	Low cattle meat consumption
Political-Legal	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

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

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.

5. Discussion

5.1 Where does our work stand in the literature?

Most of the parameters of the scenario development process developed herein 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, 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?

In the original methodology developed by Alvarenga et al. (2019,) for the first stage, a Web-Delphi process involved two different rounds. 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. Also, the first questionnaire was an additional step. 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. Given the same reasons, a BAU scenario was not built neither the participants worked with future 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 on demographic aspects in the questionnaire.

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). From the questionnaire, 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. However, one participant mentioned that it is hard to imagine the world in 2050. From the workshop, participants mentioned the validation of drivers was too exhaustive.

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. All these 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 are not captured in any similar study, only one from each the economic and the technological, four from the societal, two from the ecological, and three from the political-legal category are captured. 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.

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

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. 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.

As a result of not building a BAU scenario, which is more realistic and most likely to occur, it becomes harder to improve critical thinking about the extreme-case scenarios (Wack, 1985). 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

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. The entity is responsible for making the connection between the industry and academia and is expected to 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: identify a set of relevant drivers of change that are expected to influence cattle meat consumption in the future, through participation with many citizens, and based on these, build meaningful scenarios to aid in decision-making contexts; Also, the methodology proved to be a clear and replicable method for building relevant scenarios. Additionally, performing a systematic search of existing

PSP studies enabled to gain insights into how these methodologies have been developed in the literature in complex contexts, by exploring how uncertainty has been incorporated into the scenario development process, and how methods have been developed in these complex contexts involving participants.

6.1 Future work

Several aspects of this paper can be identified as potential future work improvements. 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 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 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. 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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