

The expected social impact of cultivated and plant-based meats in Brazil, United States and Europe



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This report was prepared by:

Dr Rodrigo Luiz Morais-da-Silva
Professor Germano Glufke Reis
Professor Carla Forte Maiolino Molento

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SUMMARY

EXECUTIVE SUMMARY	3
1 INTRODUCTION.....	5
1.1 PROBLEM AND GOAL	6
1.2 REPORT STRUCTURE	8
2 METHODOLOGY.....	9
3 RESULTS	12
3.1 MARKET EXPECTATIONS.....	12
3.2 CONSUMER ACCESS.....	15
3.3 CONSUMER ACCEPTANCE	19
3.4 IMPACT ON FARMS.....	21
3.5 BUSINESS OPPORTUNITIES ALONG THE NEW CHAIN.....	26
CONCLUSION AND RECOMMENDATIONS.....	31

EXECUTIVE SUMMARY

The meat production chain to supply human consumption has been linked to several issues, including environmental footprint, problems with public health, slaughter and maintenance of poor animal welfare conditions. In this scenario, innovative products and new processes heavily reliant on technologies have been proposed. Cultivated meat and plant-based meat are singled out as two preeminent types of products to supply the growing global demand for meat. Although several studies have been carried out to promote technological progress, analyze environmental impacts and assess consumer acceptance, **the potential social consequences of these innovations have received less attention.** Changes that are either taking place or planned for in the context of meat production chains, even if they are only partial, **can generate relevant social impacts, especially for countries where the production of food of animal origin is large.** To clarify this issue, **our study aimed to study the social impact of the transition from conventional meat production systems to cultivated and plant-based meats.**

We chose three locations to conduct our study: Brazil, the United States and some countries in Europe. Our data source considered the perspective of experts working in the sector, as this is a matter of forecasting. Thus, our study incorporated the opinion of 136 experts from the three regions, with different affiliations such as the cultivated and plant-based meat industry, conventional meat industry, governments, regulatory bodies, non-governmental organizations (NGOs) and researchers, among others. With this, we seek to present a general panorama of the sector regarding the social impacts that the entry of alternative meats may bring to these regions.

Our results are divided into five topics: market expectations, consumer access, consumer acceptance, impact on farms and business opportunities along the new chains of cultivated and plant-based meats. Table 1 presented some key results:

Table 1: Key results of the study

69.1% of experts believe there will be high demand for plant-based meat
53.7% of experts believe there will be high demand for cultivated meat
Brazil and the United States seems to be more favorable to cultivated meat than Europe. Concerning plant-based meat, the three locations have similar values

23.5% of experts believe that people with less purchasing power will have access to cultivated meat in 10 years; 50% believe this will happen in 20 years.
72.8% of experts believe that cultivated meat may be a solution to the need to increase food production
52.9% of experts believe that cultivated meat will be healthier than conventional meat
58.8% of experts believe that plant-based meat will be better accepted than cultivated meat.
75.7% of experts believe that the impact of alternative meats on farms may vary according to their size
57.4% of experts believe that cultivated meat poses challenges for conventional producers; while 47.8% believe that plant-based meat poses challenges for conventional producers
European and US producers may be more affected than Brazilian producers
87.5% of experts believe that conventional producers will be a source of resistance to alternative meats
93.2% of experts believe that there will be business opportunities along the cultivated meat chain
85.4 of experts believe conventional meat processors will have opportunities in the cultivated meat chain
87.1 of experts believe conventional meat processors will have opportunities in the plant-based meat chain

Although specific to the investigated regions, these results may be used as a starting point for other contexts. Our study represents an advance in understanding the potential consequences that the transition in the meat chain may bring to different regions. We hope that our study may contribute to the advancement of knowledge and the implementation of public policies that can design transition strategies to mitigate negative impacts and maximize overall benefits.

1 INTRODUCTION

The consumption of foods of animal origin is associated with various environmental, ethical and public health problems. On the environmental dimension, conventional meat production has been identified as one of the main challenges to improve standards of global sustainability, as it is associated with the emission of greenhouse gases and the advance of pasture and crop areas in forest regions (Herrero et al., 2011; IPCC, 2020; Theurl et al., 2020). The ethical perspective of animal welfare also indicates a variety of problems linked to the intensive meat production systems for human consumption (Tarazona et al., 2020), which has been changing behavior in some consumer groups and pressing the production systems to migrate to more ethical standards (Hölker et al., 2019). The third range of problems includes public health, as overconsumption of meat is associated with various diseases (Godfray et al., 2018; Papier et al., 2021), the emergence of zoonotic diseases that may give rise to endemics and pandemics (Magouras et al., 2020; Rubio et al., 2020), as well as troubling increases in antibiotic-resistant bacteria (Martin et al., 2015).

The problems associated with intensifying conventional meat production and consumption worldwide have motivated a growing market space for alternative proteins. Besides presenting an adequate response to the human appetite for meat, alternative protein-based foods are also being recognized as a powerful contributor to feeding the world's human population (Karmaus & Jones, 2021; Pam Ismail et al., 2020), which is expected to increase considerably in the coming decades (United Nations, 2019). Among the set of alternative proteins being investigated and experimented with by both industry and academia, cultivated and plant-based meats are the most prominent.

Cultivated meat, also known as clean, cultured, in vitro or lab-grown meat (Reis et al., 2020), is based on a well-known cell culture process, which has recently been used to develop meat foods without the need to slaughter animals (Post, 2012). The production process of cultivated meat can be summarized by the removal, through a biopsy, of a small amount of stem cells from a live animal and the cultivation of these cells in a bioreactor (Broad, 2020). Singapore was the first country to regulate and commercialize cultivated chicken meat at the end of 2020 (Aravindan & Geddie, 2020).

Currently more familiar to the consumer, plant-based meat has also been part of an evolved production process. Novel plant-based meat products are made from vegetable ingredients combined and processed to match conventional meat in nutritional and sensory terms (Rubio et al., 2020). The current success of plant-based products is attracting industries and investments in several countries (van Vliet et al., 2020).

1.1 PROBLEM AND GOAL

Studies on cultivated and plant-based meats have been grouped mostly into three main topics. The first is the methodological issue that seeks to advance the technological frontier to produce these alternative proteins. Some studies have been dedicated to this area, investigating, for example, new culture media for cultivated meat (O'Neill et al., 2021) or innovative processes to make plant-based meat similar in texture to conventional meat (Yuliarti et al., 2021).

The second topic involves comparisons between the environmental footprint of alternative proteins comparatively with conventional meats, demonstrating significant advantages of the alternative products (Fresán et al., 2019; Sinke & Odegard, 2021; Smetana et al., 2015; Swartz, 2021; Tuomisto & Teixeira De Mattos, 2011). Although the energy source used in the production process remains a challenge in several countries, if it is renewable, cultivated meat may be 93% less harmful to the environment than conventional beef, 53% than pork and 29% than chicken (Sinke & Odegard, 2021).

The third topic involves consumer acceptance and the challenges that alternative meats may face in the market. Several studies seek to assess the acceptance of cultivated meat (Bryant & Barnett, 2018, 2020) and plant-based meats and other types of alternative proteins (Onwezen et al., 2021). These studies have shown a potentially significant demand in regions such as North America (Wilks et al., 2019), Europe (Bryant & Sanctorum, 2021), South America (Valente et al., 2019), Africa (Szejda et al., 2021) and Asia (Bryant et al., 2019). In a recent review of studies already conducted, Bryant and Barnett (2020) conclude that there is a substantial market for cultivated meat in many countries, being the benefits to the environment and to the animals the main drivers of consumption.

As a consequence of the efforts, knowledge regarding technical procedures, environmental footprint assessment and consumer acceptance has advanced considerably in recent years. However, the social impact that a transition to alternative proteins may bring to those involved with the conventional meat industry has received scarce attention. Although cultivated meat is in the early stages of preparation for global marketing and new plant-based meat products have been available to consumers for a few years, the expectation is that they will represent a high percentage of the total protein market (Gerhardt et al., 2020; Tubb & Seba, 2021; Witte et al., 2021). Such expectation suggests that alternative proteins may hit the conventional animal-origin food production sector and generate societal impacts.

For Newton and Blaustein-Rejto (2021), based on research carried out in the United States, the impact on conventional agriculture is expected to be large, especially for producers and workers in the animal food industry. For Morais-da-Silva et al. (2021), alternative meats may generate social challenges and opportunities in Brazil. Alternative meats can also raise issues of moral ambivalence for conventional meat producers (Bryant & van der Weele, 2021). Even so, "it is not clear what will happen to farmers and those employed in meat production" (Bryant & van der Weele, 2021, p. 3).

Some societal predictions are more negative and others also bring opportunities for those involved in the chain in transition. Some authors foresee that the alternative meat sector may collapse the conventional meat production system in the United States in 2035 (Tubb & Seba, 2021). The conventional meat industry may seek solutions to its problems such as sustainability, health, and animal welfare issues while competing with emerging alternative protein products (Bonny et al., 2015). On the other hand, the alternative protein chain may also create socio-economic opportunities (Newton & Blaustein-Rejto, 2021). However, the field has not yet received due attention and warrants new contributions to clarify the many issues involved.

Considering the need to better understand the potential social impacts of alternative meats, both their positive and negative consequences, this study sought to study the social impact that the transition from conventional meat production systems to cultivated and plant-based meats may have in Brazil, the United States and Europe.

1.2 REPORT STRUCTURE

This research report presents an introduction, as above, the methodology used in the study, the results in terms of market expectations, consumer access, consumer acceptance, impact on traditional farms and business opportunities along the new chain, followed by the conclusion and recommendations.

2 METHODOLOGY

To achieve the goal of this research, we sought to investigate the viewpoint of experts in the alternative and conventional protein industry in three regions: Brazil, the United States and Europe (Belgium, France, Germany, Italy, Poland and The Netherlands). The strategy of considering the perspective of experts is used primarily when the subject is in the domain of a few people or when there is little information available (Bogner & Menz, 2009). Experts' opinions are also relevant when predicting future events, such as the potential impacts that a technological change may bring (Haleem et al., 2019). Thus, we believe that, for this study, the perspective of experts may contribute to the clarification of the social impacts of the transition, even if partial, from conventional meat production to the production of cultivated and plant-based meats.

We developed a five-point Likert scale questionnaire to assess expert opinion on expected social impacts. The development of this questionnaire was based on a qualitative research stage carried out previously, in which the significant potential social consequences were explored, as well as in the relevant scientific literature. The questionnaire covered questions about market expectations, consumer access to the novel products, aspects of consumer acceptance, the impact for farmers and business opportunities along the new chain. The questionnaire and additional required documents were submitted to the Ethics Committee for Research with Humans at the Federal University of Paraná and the project was approved under protocol number 38617320.0.0000.0102.

The experts included in this study were those who were involved, in some way, with alternative or conventional meat chains. We divided the experts into four large groups. The first comprises people from the industry, such as entrepreneurs and management-level employees of cultivated meat companies, plant-based meat firms, meat processing companies, industry producing alternative meat ingredients and industries related to new equipment development and production. These categories of experts were essential to our study, as they represent the best knowledge about the technological frontier of the area and its potential future social impacts. The second group of experts involved researchers in the field, affiliated with universities and research institutes. As they may represent a more critical opinion, this group was

fundamental to assess more profound social consequences. The third group, composed mainly of third sector organizations, brought the perspective of intermediary organizations which approach the scenario from a distinct perspective. The fourth group involved government organizations and regulatory bodies, which are directly involved in making alternative meats available to consumers, as well as in the transition policies for minimizing negative effects and maximizing positive ones for society.

The identification of potential respondents followed multiple paths. We consulted the list of alternative meat companies on The Good Food Institute (GFI) website to identify industry experts, which featured 416 nominations in our target countries. We then sent invitation emails to these companies from contacts available on their websites. Some of them were not identified because they did not provide websites or contact emails. As we received few responses, we searched for the same companies on LinkedIn, identified people with management positions and sent messages directly, when this option was available on the social network or when the email of the potential respondent was available.

Research experts were identified from publications in the field of cultivated and plant-based meat that were registered on the Web of Science. We listed 165 emails from researchers and sent them individual invitations with this approach. We also looked for experts from third sector organizations related to alternative protein, such as people from NGOs, and government and regulatory bodies working on alternative proteins. We sent invitation emails to all of them. Finally, we used the authors' personal contacts to approach additional potential respondents. We also solicited in the invitation emails that, if possible, all respondents share the links with experts in the field.

In all, we identified and invited 879 experts, received 217 responses, 161 of which were complete. We also excluded 25 responses from countries that were not in our focus. Thus, we have analyzed 136 responses, which were complete and from our target countries. Of all respondents, 25.7% were from Brazil, 33.1% from the United States and 41.2% from Europe (9 from Belgium, 12 from France, 7 from Germany, 10 from Italy, 7 from Poland and 11 from the Netherlands). Table 1 provides more details on the respondent characteristics.

Table 1: Demographic data of the analyzed sample, as per interviews from August to October, 2021.

Variable	Category	Overall (%)	Brazil (%)	Europe (%)	United States (%)
Number of respondents	Location	136 (100)	35 (25.7)	56 (41.2)	45 (33.1)
Gender	Masculine	69 (50.7)	15 (42.8)	28 (50.0)	26 (57.8)
	Feminine	66 (48.5)	20 (57.1)	28 (50.0)	18 (40.0)
	I prefer not to answer	1 (0.74)	0 (0.0)	0 (0.0)	1 (2.2)
Sector	Research	63 (46.1)	14 (40.0)	30 (53.6)	19 (42.2)
	Industry	50 (36.8)	15 (42.9)	16 (28.6)	19 (42.2)
	Third sector	20 (14.7)	3 (8.6)	10 (17.9)	7 (15.6)
	Government	3 (2.2)	3 (8.6)	0 (0.0)	0 (0.0)
Function	Researcher	57 (41.9)	14 (40.0)	26 (46.4)	17 (37.8)
	Others	27 (19.9)	7 (20.0)	8 (14.3)	12 (26.7)
	Director/President	25 (18.4)	6 (17.1)	13 (23.2)	6 (13.3)
	Manager	17 (12.5)	4 (11.4)	6 (10.7)	7 (15.5)
	Specialist	7 (5.1)	3 (8.6)	1 (1.8)	3 (6.7)
	Consultant	3 (2.2)	1 (2.9)	2 (3.6)	0 (0.0)
Self-judgment regarding knowledge of the sector	I have a moderate level of knowledge	59 (43.4)	13 (37.1)	22 (39.3)	24 (53.3)
	I have a high level of knowledge	38 (27.9)	10 (28.6)	17 (30.4)	11 (24.4)
	I know a little	23 (16.9)	7 (20.0)	5 (17.9)	5 (11.1)
	I am a specialist	16 (11.8)	5 (14.3)	6 (10.7)	5 (11.1)
	I have heard about alternative meats	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	I do not know anything about alternative meats	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Based on the responses received and with the non-parametric characteristic of the data, we conducted descriptive and comparison analyzes amongst groups by location with the Kruskal-Wallis test, which is used to compare values from independent samples (Katz & McSweeney, 1980). The Dunn's post hoc test, with Bonferroni correction, was used for multiple comparisons between pairs of location groups.

3 RESULTS

The results of this study were divided into five topics: market expectations, consumer access, consumer acceptance, impact on farms and business opportunities along the new chains of cultivated and plant-based meats.

3.1 MARKET EXPECTATIONS

The expectations that alternative proteins may occupy a considerable share of the food market in the future, as well as the consequences for the production chain of food of animal origin, have been highlighted by some studies. The Rethink X study pointed out a reduction of up to 90% in conventional milk and meat production in the United States by 2035, which would lead to a collapse in the country's production chain (Tubb & Seba, 2021). The Boston Consulting Group forecast shows that by 2035 11% to 22% of the set of protein consumed, such as meat, eggs and dairy products, may be of alternative origin; the percentage varies according to technological and regulatory advances (Witte et al., 2021). However, A. T. Kearney Consulting's forecast has been receiving more prominence, and it presents a scenario where cultivated and plant-based meats will occupy 60% of the global meat market in 2040 (Gerhardt et al., 2020); this forecast indicates that cultivated meat will represent 35%, plant-based 25% and conventional meat 40% of the worldwide meat market by 2040. See Figure 1:

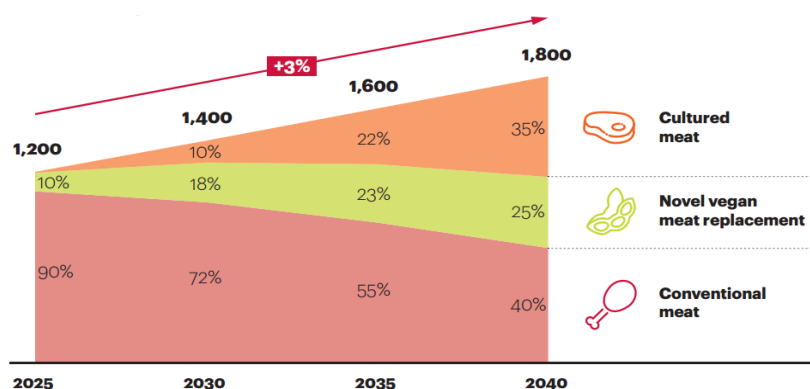


Figure 1: Global meat market by 2040.
Source: Gerhardt et al. (2020, p. 269).

In order to understand how the experts consulted considered the future of meat production, we asked them four questions (Q). In Q1, experts were asked whether the

Gerhardt et al (2020) scenario for cultivated meat in 2040 (Figure 1) applied to their country. In Q2, the same question was inquired, but regarding plant-based meat. In the last two questions, respondents were asked whether they thought there would be a high demand for cultivated meat (Q3) and plant-based meat (Q4) in their countries. The results of descriptive statistics are shown in Table 3.

Table 3: Analysis for Q1-Q4 regarding marketing expectation in Brazil (N = 35), Europe (N = 56) and the United States (N = 45) using Likert scale from 1 (strongly disagree) to 5 (strongly agree), as per interviews from August to October, 2021.

Question	Location	Mean	Median	95% Confidence Interval for Mean		Kruskal-Wallis Test Sig.
				Lower	Upper	
Q1 - The scenario foreseen for 2040 (Gerhardt et al., 2020) applies to my country regarding cultivated meat	Brazil	3.17	4	2.70	3.65	0.216
	Europe	2.68	2	2.35	3.01	
	United States	2.80	3	2.43	3.17	
	Overall	2.85	2.5	2.63	3.06	
Q2 - The scenario foreseen for 2040 (Gerhardt et al., 2020) applies to my country regarding plant-based meat	Brazil	3.63	4	3.15	4.11	0.433
	Europe	3.68	4	3.36	3.99	
	United States	3.42	4	3.06	3.78	
	Overall	3.58	4	3.37	3.79	
Q3 - We will have a high demand for cultivated meat in my country	Brazil	3.54 ^b	4	3.12	3.97	0.016
	Europe	2.91 ^a	3	2.57	3.25	
	United States	3.51 ^b	4	3.16	3.86	
	Overall	3.27	4	3.06	3.48	
Q4 - We will have a high demand for plant-based meat in my country	Brazil	3.74	4	3.32	4.17	0.948
	Europe	3.82	4	3.56	4.09	
	United States	3.71	4	3.37	4.05	
	Overall	3.76	4	3.58	3.95	

The data regarding market expectation are presented in Figure 2.

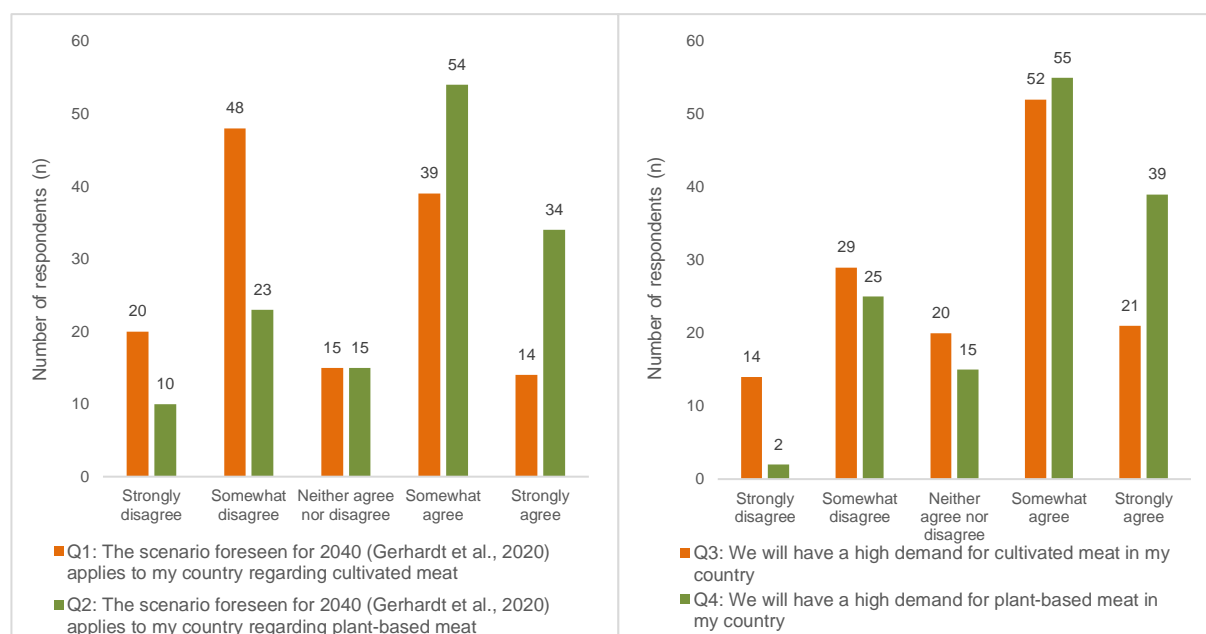


Figure 2: Market expectations for cultivated meat and plant-based meat (Q1-Q4) as per 136 experts, via online questionnaire from August to October, 2021.

Considering the information about the scenario predicted by Gerhardt et al. (2020) and the expectations of the experts consulted, expressed in the left part of Figure 2, a higher trend of agreement is seen concerning the market for plant-based meat in 2040. In this case, 64.7% of the experts agreed or strongly agreed with the prediction that plant-based products may dominate 25% of the meat market. About cultivated meat, 38.9% of the experts agreed with an expected share of 35% of the meat market in 2040. Regarding the questions without reference to future market share percentages, shown in the right part of figure 2, the results are also more optimistic for plant-based meat than for cultivated meat, as 69.1% of the experts positioned themselves in agreement and strongly agreement with the high demand for plant-based meat, while 53.7% of them positioned themselves the same way for cultivated meat.

These results may be related to the current availability of plant-based products for consumers in the three studied markets (Brazil, United States and Europe) compared to the novelty of cultivated meat. The concepts of neophobia (Krings et al., 2022; Wilks et al., 2019) and unnaturalness (Laestadius, 2015; Laestadius & Caldwell, 2015) concerning the rejection of new foods may help explaining the expected more favorable consumer behavior towards foods which are already known by consumers as compared to completely new foods, which are not yet available in the supermarkets, such as cultivated meat.

Furthermore, required technological advances and the reduction in consumer prices may be identified as relevant elements which, considering the moment of the responses, may have placed cultivated meat in a less favorable position than plant-based meat in the experts' answers. Although cultivated meat technology has evolved considerably in recent years, there are still important technical barriers, especially concerning culture media (Hadi & Brightwell, 2021; O'Neill et al., 2021) and scaffolds (Seah et al., 2021), for example. The high costs involved and the production on a timid scale may also affect the more conservative position of respondents concerning cultivated meat, as several studies point to price as one of the leading conditioning factors for consumer acceptance (Bekker et al., 2017; Bryant & Barnett, 2020; Valente et al., 2019; Verbeke et al., 2015; Wilks & Phillips, 2017).

In addition to the overall analysis with all the study data, one of the questions showed different response patterns across location. Question 3 highlighted differences

between Europe as compared with Brazil and with the United States. No significant difference was observed in the comparison between Brazil and the United States. Thus, our data suggest that experts recognize a more promising potential for consuming cultivated meat in Brazil and the United States than in Europe. The literature presents several studies that can be discussed with our results on this topic. Surveys conducted in Brazil show that 59.3% (Fernandes et al., 2021) and 63.3% (Valente et al., 2019) of consumers are willing to try cultivated meat. In the United States, the consumer acceptance was pointed as 64.6% (Bryant & Dillard, 2019) and 66.6% (Wilks & Phillips, 2017). In Europe, although results vary from country to country, some studies indicate that 39.3% of Belgians (Bryant & Sanctorem, 2021), 54% of Italians (Mancini & Antonioli, 2019), 58.3% of Germans and 44.2% of French (Bryant et al., 2020) would be willing to try cultivated meat. Such acceptance percentages suggest a more favorable position in Brazil and the United States in relation to Europe, corroborating our results. However, the study by Gómez-Luciano et al. (2020) showed that the acceptance of cultivated meat should be lower in Brazil than in the United Kingdom, Spain and the Dominican Republic. The difference in the results regarding the acceptance of cultivated meat in Brazil needs to be better investigated in future studies.

3.2 CONSUMER ACCESS

Consumer access to the products is a key issue in the alternative meat market. Several studies show that price is a central challenge and a potential barrier around the acceptance of alternative proteins (Bekker et al., 2017; Bryant & Barnett, 2020; GFI, 2020; Gómez-Luciano et al., 2019; Valente et al., 2019; Verbeke et al., 2015; Wilks & Phillips, 2017). Although some consumer groups state that they are willing to pay a premium price for cultivated meat compared to conventional meat due to the benefits of the first (Bryant & Sanctorem, 2021; Verbeke et al., 2015), most are not willing to do so (Bryant & Barnett, 2020). However, besides price difficulties, there is a promise that alternative meats, mainly cultivated meat, may be one of the ways to reduce hunger in the world (Bekker et al., 2017; Gómez-Luciano et al., 2019; Tucker, 2014; Wilks & Phillips, 2017; Zhang et al., 2020). This ambition contrasts with the

argument that alternative meats, especially cultivated meat, may be directed towards the elite, mainly due to the high expected price (Laestadius & Caldwell, 2015).

Considering the importance of access to alternative meats, we asked experts if people with lower purchasing power will have access to cultivated meat in 10 years (Q5) or in 20 years (Q6), whether low-income may be an obstacle to the commercialization of cultivated meat (Q7) or plant-based meat (Q8). We also asked whether low purchasing power may be an advantage for cultivated meat as its price decreases (Q9) and if cultivated meat may be a solution to the need to increase food production (Q10). The results are shown in Table 4.

Table 4: Analysis for Q5-Q10 regarding consumer access in Brazil (N = 35), Europe (N = 56) and the United States (N = 45) using Likert scale from 1 (strongly disagree) to 5 (strongly agree), as per interviews from August to October, 2021.

Question	Location	Mean	Median	95% Confidence Interval for Mean		Kruskal-Wallis Test Sig.
				Lower	Upper	
Q5 - People with less purchasing power will be able to access cultivated meat within 10 years	Brazil	2.54	3	2.11	2.98	0.858
	Europe	2.54	2	2.26	2.82	
	United States	2.67	3	2.29	3.04	
	Overall	2.58	3	2.38	2.78	
Q6 - People with lower purchasing power will be able to access cultivated meat within 20 years	Brazil	3.34	3	2.93	3.76	0.469
	Europe	3.45	4	3.16	3.73	
	United States	3.60	4	3.22	3.98	
	Overall	3.47	3.5	3.27	3.67	
Q7 - The low income of consumers is likely to be an obstacle to the marketing of cultivated meat	Brazil	3.91*	4	3.50	4.33	0.039
	Europe	3.43*	4	3.10	3.75	
	United States	3.98	3	3.78	4.18	
	Overall	3.74	4	3.55	3.92	
Q8 - The low income of consumers is likely to be an obstacle to the marketing of plant-based meat	Brazil	3.66	4	3.19	4.13	0.221
	Europe	3.09	3	2.77	3.41	
	United States	3.53	4	3.25	3.82	
	Overall	3.38	4	3.18	3.58	
Q9 - The low purchasing power of consumers will become an advantage for cultivated meat, as its price decreases	Brazil	3.57	4	3.13	4.01	0.071
	Europe	3.34	4	3.04	3.64	
	United States	3.04	3	2.71	3.38	
	Overall	3.30	3	3.10	3.50	
Q10 - Cultivated meat should be a solution to the need for increased production and food due to the population increase	Brazil	4.20	5	3.77	4.63	0.132
	Europe	3.73	4	3.36	4.11	
	United States	3.93	5	3.53	4.34	
	Overall	3.92	4	3.69	4.15	

*P=0.058

The results regarding consumer access to alternative meats are presented in Figure 3.

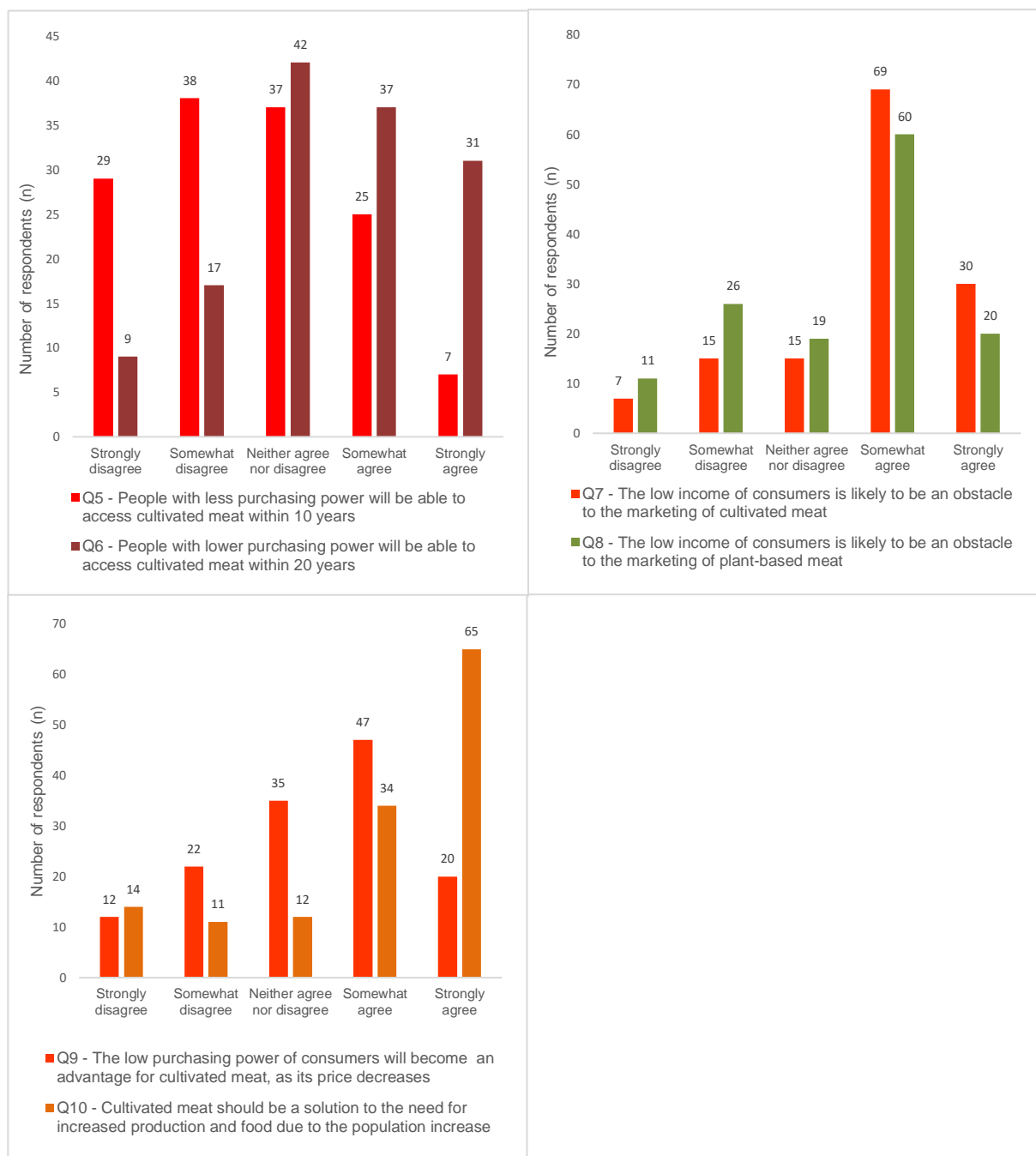


Figure 3 – Consumer access for cultivated meat and plant-based meat (Q5-Q10) as per 136 experts, via online questionnaire from August to October, 2021.

In Figure 3, for the questions about the access to alternative meats over time by consumers with lower purchasing power, 23.5% of experts agreed or strongly agreed that there will be access to cultivated meat for these people in 10 years, while 50% estimated this access in 20 years (Q6). This finding is in line with the argument that initially the price of cultivated meat will be higher and, consequently, cell-based

products will be more focused on people with higher income (Laestadius & Caldwell, 2015). As time goes on, access may become expanded mainly through competition between producers and the greater efficiency in the process that may be achieved (Bryant & Barnett, 2020), pushing conventional meat into the premium segment and taking mass market shares for cultivated meat (Bonny et al., 2015). The innovation management theory explains that radically innovative products are more expensive when they are placed on the market, but the prices tend to decrease as incremental improvements in the product and its process help reducing costs over time (Dosi, 1982).

Questions Q7 and Q8 (right part of figure 3) also show the experts' concern about the price of alternative meats. Our data shows that 72.8% of experts agree or strongly agree that the price of cultivated meat will be an obstacle to commercialization, while 58.8% of experts have this concern for plant-based meats. A robust body of research supports this finding in several countries, for which price is an important predictor of alternative protein consumption (Bekker et al., 2017; Bryant & Barnett, 2020; GFI, 2020; Gómez-Luciano et al., 2019; Valente et al., 2019; Verbeke et al., 2015; Wilks & Phillips, 2017). Although the Kruskal-Wallis test indicated a significant difference among the responses considering the location in Q7, the post hoc test identified a trend for the comparison between Brazil and Europe (adjusted $P=0.058$), suggesting greater concern in the Brazilian scenario than the European one regarding the low income of consumers as an obstacle to the commercialization of cultivated meat. Further research to clarify this potential difference is warranted.

Question Q9 brings an interesting aspect in relation to access to cultivated meat by the poorest. When the experts were asked whether low income may be an advantage for the sale of cultivated meat when its price becomes reduced, 49.3% of respondents agreed or strongly agreed with this statement. This result may suggest that although a high price is expected for alternative meats, the cost will likely reduce over time and turn the products accessible to people with less purchasing power, a rationale that has been published by Bryant and Barnett (2020).

As for Q10, 72.8% of experts agreed or strongly agreed that cultivated meat may be considered a solution to food security given the expected human population growth. This finding is in line with the expectation that cultivated meat be a promising technology to increase food production (Sharma et al., 2015), considered by

consumers as a potential aid in dealing with world hunger (Bryant & Barnett, 2020; Laestadius, 2015; Mancini & Antonioli, 2019).

3.3 CONSUMER ACCEPTANCE

A significant body of literature has been devoted to understanding consumer preferences for alternative proteins. The study by Onwezen (2021) mapped 91 investigations carried out between 2014 and mid-2020, in different countries and continents. Two other studies also reviewed the results in terms of consumer acceptance of alternative proteins (Bryant & Barnett, 2018, 2020). Most of these studies considered the opinion of consumers; our research, however, addresses questions about consumer acceptance from the standpoint of the participant experts. We asked experts whether cultivated meat may be well accepted by consumers (Q11), whether it may be healthier than cultivated meat (Q12), and whether plant-based meat would be better accepted than cultivated meat (Q13). The results for these questions are shown in Table 5.

Table 5: Analysis for Q11-Q13 regarding consumer acceptance in Brazil (N = 35), Europe (N = 56) and the United States (N = 45) using Likert scale from 1 (strongly disagree) to 5 (strongly agree), as per interviews from August to October, 2021.

Question	Location	Mean	Median	95% Confidence Interval for Mean		Kruskal-Wallis Test
				Lower	Upper	Sig.
Q11 - Cultivated meat will be well accepted by consumers in my country due to its positive aspects compared to conventional meat	Brazil	3.34	4.00	2.92	3.77	0.221
	Europe	2.96	3.00	2.68	3.25	
	United States	3.27	3.00	2.91	3.62	
	Overall	3.16	3.00	2.97	3.36	
Q12 - Cultivated meat will be healthier than conventional meat for human consumption.	Brazil	4.00	4.00	3.60	4.40	0.056
	Europe	3.29	3.00	2.90	3.67	
	United States	3.60	4.00	3.21	3.99	
	Overall	3.57	4.00	3.35	3.80	
Q13 - Plant-based meat products are likely to have a greater acceptance than cultivated meat in my country	Brazil	3.29	4.00	2.84	3.73	0.298
	Europe	3.73	4.00	3.45	4.01	
	United States	3.62	4.00	3.25	4.00	
	Overall	3.58	4.00	3.38	3.78	

The data regarding consumer acceptance are presented in Figure 4.

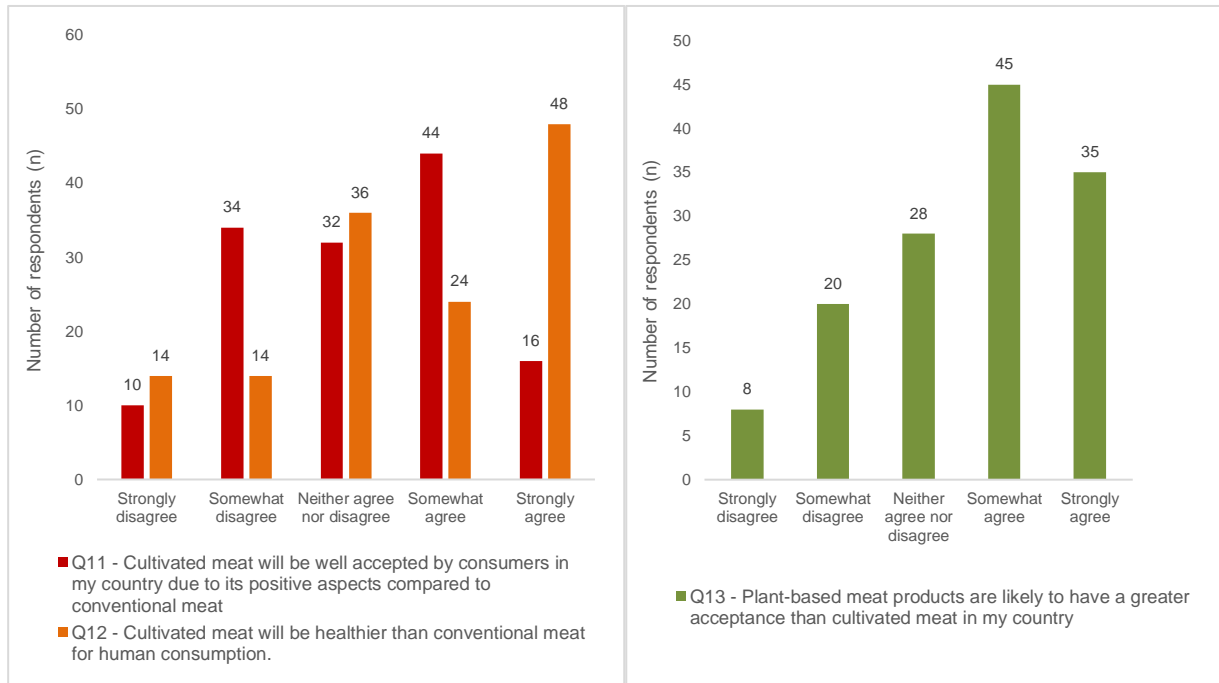


Figure 4 – Consumer acceptance of cultivated and plant-based meats (Q11-Q13) as per 136 experts, via online questionnaire from August to October, 2021.

For Q11, on whether cultivated meat will be well accepted in the investigated locations, 44% of experts agreed or strongly agreed with high acceptance levels. This percentage is slightly below the percentages observed by consumer surveys in the focus locations. When consumers are questioned, responses regarding the willingness to taste cultivated meat were between 50% and 70% (Bryant & Dillard, 2019; Bryant et al., 2020; Fernandes et al., 2021; Mancini & Antonioli, 2019; Valente et al., 2019; Wilks & Phillips, 2017).

In Q12, we asked if cultivated meat will be healthier than conventional meat products, considering that healthiness is an essential element for the acceptance of cultivated meat. Results showed that 52.9% of the experts believed that cultivated meat will be healthier. The Kruskal-Wallis test shows a trend for the difference between countries ($P=0.056$), in which Brazilian specialists were more optimistic about the healthiness of cultivated meat compared to conventional meat. The literature has shown that the perception of the healthiness of alternative products is closely linked to cultivated meat being considered unnatural by a considerable part of consumers (Bekker et al., 2017; Laestadius, 2015; Laestadius & Caldwell, 2015). On the other hand, some results suggest that health claims may lead to greater acceptance of

cultivated meat products (Bryant & Barnett, 2020). The study by Gomez-Luciano et al. (2019), for example, found that the healthiness and nutritional properties of cultivated meat products are predictors for potential consumers in Brazil, the United Kingdom, Spain and the Dominican Republic.

In Q13, we asked experts about the acceptance of plant-based meat relative to cultivated meat and observed that 58.8% of respondents strongly agreed or agreed that plant-based meat may be more acceptable by consumers than cultivated meat. This trend has also been suggested by other studies in the field (Bryant & Barnett, 2020; Onwezen et al., 2021). However, this position may change as cultivated meat becomes more common, as has already happened with other products that have emerged along human history (van der Weele & Driessen, 2019).

3.4 IMPACT ON FARMS

Some studies have pointed out that the potential impacts on animal farms may be a major problem linked to the emergence of alternative meats. For example, Shaw and Imaire (2019) reported that Irish consumers were concerned about farms, as meat production is an important sector of the country's economy. Bekker et al. (2017) and Wilks and Phillips (2017) also mentioned consumer concerns involving current meat producers. Only three studies focusing on the socio-economic impact for animal producers were identified (Bryant & van der Weele, 2021; Morais-da-Silva et al., 2021; Newton & Blaustein-Rejto, 2021).

To further clarify the impact of alternative meats may have for animal farmers, our study asked experts whether all farm sizes will face the same impact (Q14), whether there will be opportunities for farmers within the cultivated meat sector (Q15), if animal producers will enter in the cultivated meat (Q16) or plant-based meat (Q17) chains, if cultivated meat (Q18) or plant-based meat (Q19) will pose threats for animal producers, and if animal producers tend to organize themselves into associations and unions to be a source of resistance to changes in the sector (Q20, Q21). The results regarding the opinion of our respondents in these matters are presented in Table 6.

Table 6 - Analysis for Q14-Q21 regarding impact on farms in Brazil (N = 35), Europe (N = 56) and the United States (N = 45) using Likert scale from 1 (strongly disagree) to 5 (strongly agree), as per interviews from August to October, 2021.

Question	Location	Mean	Median	95% Confidence Interval for Mean		Kruskal-Wallis Test Sig.
				Lower	Upper	
Q14 - All animal farms, regardless of size, will have their production reduced at the same intensity due to the entry of cultivated meat; i.e., there will be no different pattern of impact according to farm size	Brazil	1.91	2	1.51	2.32	0.227
	Europe	2.20	2	1.91	2.48	
	United States	2.02	2	1.69	2.35	
	Overall	2.07	2	1.88	2.25	
Q15 - Cultivated meat will bring opportunities for animal farmers to switch to other activities within the meat production field	Brazil	3.26	3	2.82	3.69	0.361
	Europe	2.93	3	2.59	3.27	
	United States	2.87	3	2.51	3.23	
	Overall	2.99	3	2.78	3.20	
Q16 - Animal producers are likely to enter new activities related to cultivated meat production	Brazil	3.37 ^a	4	2.90	3.84	0.003
	Europe	2.59 ^b	2	2.28	2.90	
	United States	3.31 ^a	4	2.94	3.68	
	Overall	3.03	3	2.81	3.25	
Q17 - Animal producers are likely to enter new activities related to producing plant-based products	Brazil	2.91	3	2.52	3.31	0.196
	Europe	3.29	3	2.98	3.59	
	United States	3.36	4	2.99	3.72	
	Overall	3.21	3	3.02	3.41	
Q18 - Cultivated meat will bring major threats to the activities of animal farmers	Brazil	2.77 ^a	3	2.78	3.20	0.000
	Europe	3.43 ^b	4	2.31	3.23	
	United States	3.93 ^b	3	3.10	3.76	
	Overall	3.43	4	3.61	4.26	
Q19 - Plant-based meat will bring major threats to the activities of animal farmers	Brazil	2.26 ^a	2	1.87	2.64	0.000
	Europe	3.52 ^b	4	3.23	3.80	
	United States	3.29 ^b	4	2.91	3.67	
	Overall	3.12	3	2.91	3.33	
Q20 - A major source of resistance will be animal producers' associations and unions	Brazil	4.29	5.00	3.94	4.63	0.570
	Europe	4.27	4.00	4.02	4.52	
	United States	4.42	5.00	4.16	4.68	
	Overall	4.32	5.00	4.17	4.48	
Q21 - Any resistance from animal farmers' associations tends to be temporary as new activities for them become available.	Brazil	3.63 ^a	4.00	3.26	4.00	0.000
	Europe	2.79 ^b	3.00	2.48	3.10	
	United States	2.60 ^b	2.00	2.29	2.91	
	Overall	2.94	3.00	2.74	3.14	

The data regarding impact on farms are presented in Figure 5.

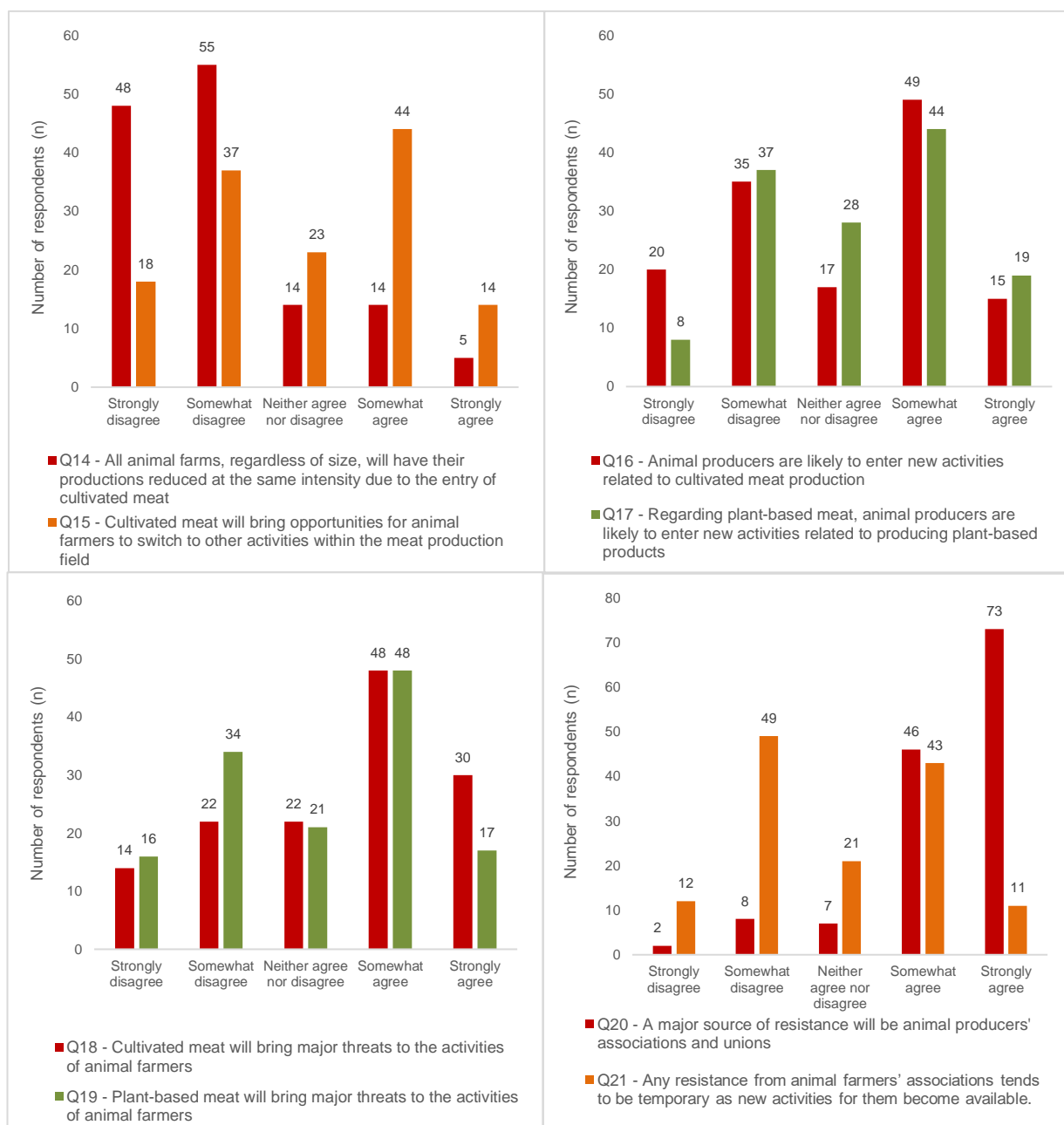


Figure 5 – Impact on farms due cultivated and plant-based meats (Q18-Q21) as per 136 experts, via online questionnaire from August to October, 2021.

Question Q14 shows that 75.7% of experts disagree or strongly disagree that all sizes of animal farms are expected to have the same impact from the entry of cultivated meat into the market. There are different scenarios in the literature concerning this issue. According to the study by Newton & Blaustein-Rejto (2021), carried out in the United States, larger farms should be impacted first because they are poorly diversified, unlike smaller farms with multiple fronts. On the other hand, in

the study by Morais-da-Silva et al. (2021), conducted in Brazil, it is suggested that small farms may suffer first because they have fewer scale gains and, thus, less advantage to compete in a more limited market. Further studies seem warranted to clarify this issue further or confirm that the effect differs according to location. The answers to question Q15, about the opportunities that may arise for animal farmers, showed no expected trend among the respondents, whose answers varied considerably. This suggests that opportunities may not be straightforward, or that they may be less deterministic, depending heavily on decisions yet to be made.

Experts were also asked whether animal producers may enter new activities in the cultivated meat production chain (Q16) and the plant-based meat chain (Q17). Expert opinion was similar for both cases, with 47.1% agreeing with this possibility for cultivated meat and 46.3% for plant-based meat. Both research's Newton and Blaustein-Rejto (2021), conducted in the United States, and Morais-da-Silva et al. (2021), conducted in Brazil, proposed that animal producers may enter the new alternative meat chains, mainly as suppliers of vegetable ingredients. Newton and Blaustein-Rejto (2021) also revealed that animal producers may specialize in providing animal cells to produce cultivated meat; however, this activity will likely not be able to absorb a significant proportion of animal farmers.

In relation to Q16, a difference was found in Europe-Brazil and Europe-United States. Europe had a lower mean and median than the other two locations. These results suggest that experts from Brazil and United States are more optimistic than Europeans about the opportunities for farmers in the cultivated meat chain. Possibly, opportunities as suppliers of vegetable ingredients (Morais-da-Silva et al., 2021; Newton & Blaustein-Rejto, 2021) or animal cells (Newton & Blaustein-Rejto, 2021) for the new chain are currently more perceptible to Brazilian and United States respondents.

The responses for Q18 and Q19 were also similar. When asked whether cultivated meat (Q18) or plant-based meat (Q19) will pose challenges for animal producers, 57.4% respondents agreed with the statement for cultivated meat and 47.8% for plant-based meat. This position shows concern with the conventional sector if alternative proteins advance, especially with the proportions that some forecasts have estimated (Gerhardt et al., 2020; Tubb & Seba, 2021; Witte et al., 2021).

Significant differences were found for Q18 and 19. In Q18, the Brazil-United States responses was significantly different, suggesting that experts believe that Brazilian animal producers will face less negative impact with the entry of cultivated meat. In Q19, both the Brazil-United States and the Brazil-Europe responses were different, suggesting that experts believe Brazilian animal producers will be less affected than those in the United States and Europe regarding the entry of plant-based meat. This more optimistic position concerning Brazil may have at least two justifications.

The first is that the transition in Brazil tends to be more gradual as the country has strong cultural connections with conventional meat and because animal products are cheaper in the country than other countries (Morais-da-Silva, et al. 2021). The study by Gómez-Luciano et al. (2020) also shows that acceptance for meat grown in Brazil would be lower than in the United Kingdom, Spain and the Dominican Republic. Thus, from this perspective, animal producers in Brazil would be less affected concerning the entry of cultivated meat and plant-based meat because the demand in the country would be smaller or attenuated in the long term.

The second justification considers a substantial demand for alternative meats in the Brazilian scenario. Some Brazilian studies already show that the demand for alternative meats should be significant in Brazil, with rates of 59.3% (Fernandes et al., 2021) and 63.3% (Valente et al., 2019) of acceptance for cultivated meat. This new market would also bring opportunities in the new chains for animal producers in Brazil, with the supply of vegetable ingredients being the main one (Morais-da-Silva et al. 2021). From this perspective, although alternative meats gain participation on the national scene, animal producers would find activities within the new chain, which would bring them less negative impact. Thus, further studies are needed to explore better the effects that animal producers should have with the entry of alternative meats.

Questions Q20 and Q21 brought to the debate how animal producers may act to stop the advance of alternative meats. In Q20, 87.5% of experts agreed or strongly agreed that animal producer associations and unions will be a significant source of resistance to new products. In Q21, 39.7% of them agreed or strongly agreed that this resistance tends to diminish over time and with the opportunities that may arise for animal producers. Thus, the data suggest that animal producers will present a resistance position and that the chances of changing their position over time are low.

Regarding the comparison amongst locations, there was a statistically significant difference in Q21 for Brazil, concerning Europe and the United States, suggesting that Brazilian producers will reduce their resistance as soon as more opportunities arise for them. Thus, the differences point to a more favorable scenario for decreasing resistance in Brazil, which seems coherent with other differences observed in our results, which tend to depict a more positive scenario for alternative meats in Brazil. These are interesting and unexpected findings which warrant further studies.

Resistance among animal farmers was first addressed by Bryant and van der Weele (2021), who revealed that moral concern related to the use of animals for food production among people working directly in animal production is growing, but that addressing this issue may be considered a betrayal of the category. Another study found, interestingly, that the propensity to eat cultivated meat is greater among farmers and workers in the meat chain than in the general population (Bryant et al., 2020). These findings help to explain our results that while there should be resistance among animal producers to the entry of alternative proteins, this resistance may diminish over time as new opportunities for them arise. This position seems more optimistic in Brazil than in the United States and Europe.

3.5 BUSINESS OPPORTUNITIES ALONG THE NEW CHAIN

Business opportunities may arise when economic imbalances arise from innovation waves (Schumpeter, 1983) or technological paradigm changes (Dosi, 1982), which affect how social needs are met, bringing opportunities for new ventures adjusted to the new paradigm. In this sense, the new plant-based and cultivated meats may open up new business opportunities along their production chains.

To better clarify this topic, experts were asked whether cultivated (Q22) or plant-based (Q23) meats may open new business opportunities at the initial stage of the chain, and whether cultivated meat may open new business opportunities for cultivated meat growing factories (Q24). We also asked whether cultivated (Q25) or plant-based (Q26) meats may bring new opportunities for conventional meat processing companies already operating in the market. The results regarding the opinion of our experts in these matters are presented in Table 7.

Table 7 - Analysis for Q22-Q26 regarding business opportunities along the new chain in Brazil (N = 35), Europe (N = 56) and the United States (N = 45) using Likert scale from 1 (strongly disagree) to 5 (strongly agree), as per interviews from August to October, 2021.

Question	Location	Mean	Median	95% Confidence Interval for Mean		Kruskal-Wallis Test
				Lower	Upper	Sig.
Q22 - Cultivated meat will generate opportunities for new ventures and businesses in the country on the first stage of the chain (suppliers of the systems)	Brazil	4.83 ^a	5	4.70	4.96	0.037
	Europe	4.42 ^b	5	4.17	4.66	
	United States	4.51 ^{ab}	5	4.28	4.74	
	Overall	4.56	5	4.43	4.69	
Q23 - Regarding plant-based meat, it will bring new business opportunities for ingredient suppliers	Brazil	4.45	5	4.08	4.83	0.100
	Europe	4.24	4	4.01	4.47	
	United States	4.39	4	4.18	4.60	
	Overall	4.35	5	4.20	4.50	
Q24 - Cultivated meat chain is likely to create opportunities for new ventures and businesses in the country on the second stage of the chain (cultivated meat growing factories)	Brazil	4.91 ^a	5	4.82	5.01	0.000
	Europe	4.29 ^b	5	4.03	4.55	
	United States	4.48 ^b	5	4.22	4.74	
	Overall	4.52	5	4.38	4.66	
Q25 - Cultivated meat will bring new business and product opportunities to conventional meat processing companies	Brazil	4.50	5	4.21	4.79	0.052
	Europe	4.04	4	3.75	4.33	
	United States	4.24	4	3.98	4.51	
	Overall	4.23	4	4.06	4.39	
Q26 - Regarding plant-based meat, it will bring new business and product opportunities to conventional meat processing companies	Brazil	4.36	5	4.01	4.72	0.527
	Europe	4.24	4	3.98	4.50	
	United States	4.27	4	4.00	4.53	
	Overall	4.28	4	4.12	4.44	

The data concerning business opportunities along the new chain are presented in Figure 6.

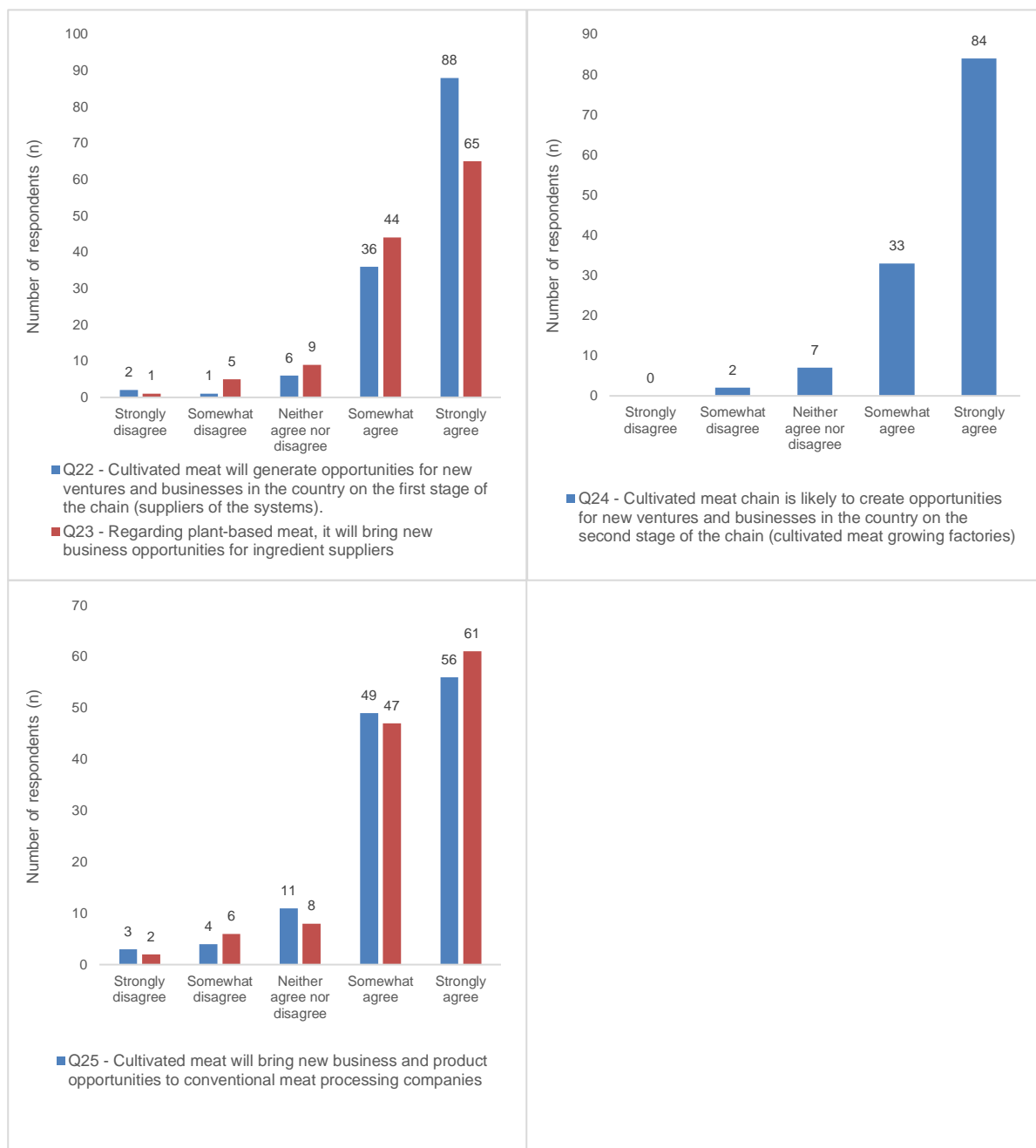


Figure 6 – Business opportunities along the new chains (Q22-Q25) as per 136 experts, via online questionnaire from August to October, 2021.

When experts were asked whether new business opportunities may arise regarding supplies for the new cultivated meat chain (Q22), 93.2% agreed or strongly agreed with this statement. There was a significant difference between Brazil and Europe. Brazilian values were higher, indicating a greater trend of business opportunities in the supply of ingredients for the meat chain grown in the country. The study by Morais-da-Silva et al. (2021) indicated that business opportunities may be

associated with vegetable ingredients for culture media, scaffolding structures for cell growth, and plant ingredients for mixed meat products, which aggregate cultivated meat with plant ingredients directly in the final stage of product preparation. The study by Newton & Blaustein-Rejto (2021), conducted in the United States, also indicated the opportunity for providing genetic material with local animal breeds; maybe Brazilian producers may also take advantage of this opportunity. However, this tends to be a very small-scale activity if alternative proteins are to deliver the expected results in terms of environmental and animal welfare benefits. As such, not many opportunities are likely in this area.

Considering the Q23 results, 87.9% of experts agreed or strongly agreed that plant-based meats may open up business opportunities for ingredient suppliers. The two studies that have already considered these opportunities (Morais-da-Silva et al., 2021; Newton & Blaustein-Rejto, 2021) agree that plant ingredients may be highly demanded. Besides the plant ingredient opportunities for plant-based meats, there will also be a demand for plant ingredients to serve as a growing medium for cultivated meat. As for Q24, 91.4% of experts agreed or strongly agreed that cultivated meat may open up entrepreneurial opportunities in cell-growing factories. The Brazilian data were significantly different from both European and the United States data, demonstrating greater optimism from Brazilian specialists regarding the opportunities that may arise at the stage of cell-culturing factories for cultivated meat in the country.

For these opportunities to be taken advantage of, some capabilities may be required. According to Reis et al. (2020), in a study on the main capacities of the industries operating in the up-to-date business for cultivated meat, their main competencies are related to technology, business structuring, market positioning and relationship with stakeholder capabilities. The authors also describe that the companies that have been dominating the sector are startups and small highly technological companies (Reis et al., 2020). However, the scenario is beginning to change with the most recent entry of world giants from the conventional meat sector, such as BRF, Cargill, JBS and Tyson (Baker, 2021).

The entry of companies typically from the conventional meat sector may help explain the results obtained in Q25 and Q26, for which 85.4% of experts agreed or strongly agreed that the conventional industry may have new business opportunities in the cultivated meat sector. In comparison, 87.1% of experts held the same position

for plant-based meat. According to an article in The Guardian, although the alternative protein market was initially more tied to startups, it is now also in the hands of giants from the conventional meat sector, such as Tyson, and from other sectors, such as Merck, which invested companies in the alternative meat sector (Dutkiewicz & Rosenberg, 2021).

CONCLUSION AND RECOMMENDATIONS

In general, the results of the study point to a future scenario with a high share of alternative meats in the total protein consumed. Plant-based meats, however, look more promising at the moment. Experts view cultivated meats as having higher chances of resistance within a two-decade future scenario. These data are consistent with several surveys on consumer preference that are available in the literature.

As for consumer access, experts believe that cultivated meat may be available and accessible to low-income consumers in 20 years, not 10. So, initially, the expected price for cultivated meat may impede its advancement. Experts were also in favor of the assumptions that cultivated meat tends to be one of the solutions to the need for increasing food production due to human population growth. Considered jointly, these results seem to show a tendency for cultivated meat to have a higher price at first, but this price will tend to fall over time and become available to people with less purchasing power.

As for consumer acceptance of alternative meats, again plant-based meat is currently considered more attractive to consumers. Cultivated meat is still perceived as eliciting greater fear by specialists, which may be related to neophobia or the unavailability of the product in the investigated markets. However, our results show that cultivated meat may be considered healthier than conventional meat, which is a significant concern frequently expressed by consumers. Communicating this possible positive determinant may be a challenge.

The impact for animal farmers may be one of the most complex social challenges in the food system transition. In general, experts believe that animal farmers tend to be heavily affected, but the intensity of the impact may vary with the characteristics of the farms. Current literature differs on whether smaller or larger farms will be more affected, but the range of products offered may be a way out. It is expected that producers who can offer a greater variety of products to the market, which go beyond animal products, tend to be less affected as they are better able to move among the types of products offered. So, even if experts do not see many opportunities for animal farmers in the cultivated meat chain, they probably occur on other fronts, such as plant production. Therefore, cultivated meat is seen as more potentially harmful to animal farms, leading to resistance organized by the animal producer

groups. On the other hand, the new chain of alternative meats may bring several business opportunities. The experts' responses were relatively consistent concerning business opportunities and new products that may arise in the investigated locations, including plant-based and cultivated meat products. However, how a more comprehensive range of entrepreneurs may adopt these opportunities tends to be a challenge, mainly due to the technological sophistication and the high costs involved, that favor bigger competitors.

Even then, some interesting differences were found for the three investigated contexts. Brazilian and the United States experts seemed to perceive a higher demand for cultivated meat than European respondents. Brazilian specialists were also more optimistic than European and the United States experts in relation to cultivated meat being healthier than conventional meat. Regarding the impact on animal farms, specialists from Brazil and the United States were more optimistic regarding cultivated meat's opportunities to conventional producers. Specialists from the United States and Europe were more concerned than Brazilians about the impacts that conventional farmers may suffer with the entry of alternative meats. Brazilian and United States specialists were also more optimistic about the business opportunities that may arise in the ingredients stage of the cultivated meat chain, and Brazilian respondents maintained this optimism for the cultivated meat production stage. Finally, these differences suggest an overall more optimistic view from experts in Brazil and the United States compared to those in Europe. In some cases, Brazilian experts were even more optimistic than those in the United States. Despite these initial findings, further studies are needed, especially with a larger number of respondents.

In any case, the aggregated data show that the social impacts may be substantial, especially for animal producers. Thus, transitional public policies are required to make the process less challenging and allow for more opportunities. As the significant negative impacts seem to be with the producers and our data indicated that there may be opportunities for them on other fronts of food production, policies to encourage transition may have an important beneficial effect. On the other hand, for the business opportunities in new chains to be better seized, such opportunities may be facilitated by the institutional environment, with the approval of regulations and the opening of markets. As for consumers, our data indicated significant openness with important concerns about price and health. These findings can help producers and

traders to think about how to solve or mitigate the main identified challenges emanating from the development of alternative meat production systems.

Finally, it is worth noting that innovation in food production systems is set to be intense, either to solve the problems related to traditional meat production or to improve productivity in the face of growing human demand for protein. How innovation will change the social balance should be studied and guided to reduce negative impacts while seeking to seize the potential opportunities. Our work bring relevant data and original insights, contributing to the clarification of aspects which may support the establishment of best strategies, so that the expected transition leaves no one behind.

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