# MEET (SCH)MEAT?

## PERCEPTIONS ON THE POTENTIAL OF NOVEL FOOD TECHNOLOGY IN SOCIETY AS A SILVER BULLET SOLUTION TO A SUSTAINABLE LIVESTOCK SECTOR

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# ABSTRACT

Current livestock production systems have been heavily criticised and are linked to countless detrimental impacts on global sustainability. A growing population has been coupled with an increased demand for animal protein, the implications of this on the food system have resulted in intensification of production and the exploration of alternative innovative technological solutions. A social science approach in situational analysis was used to assess the perceptions on the potential of novel food technologies in society as mitigating strategies for improving sustainability in the European livestock sector. The case of cultured meat technology was studied and analysed based on social science theory relevant to technology and social acceptance. Governance plays a key role in the interaction of technology and society and therefore informants from various sectors of society were used to assess the perceptions of the future of this scenario. Themes surfaced in the data suggesting a need for change and various proposed mitigating strategies emerged – the case of cultured meat technology was used to understand the complexity of this issue. The relationship between technology and society was discussed in relation to social acceptance and behaviour change, leading to the perception that responsible governance of the livestock sector is a collective effort. The specific role of cultured meat and technological solutions in the food system is controversial.

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*Note to reader: Transcriptions, audio files and ethnographic data notes are available at request from martina.g.jensen@gmail.com*

# PHASE I SITUATIONAL ANALYSIS

***What are the key concerns with the current situation? Who is involved?***

Phase one of this report is an introduction to the topic of food system practices and discourses in relation to meat. This phase will provide the reader with the background information, methods and aims of this study. Though the study is documented in Phases, the execution of this research and accumulation of findings was continuous and not segmented. This structure was chosen to simplify presentation and therefore the phases build upon one another.

## 1.0 INTRODUCTION

The consumption and production of food by the European Union (EU) have a reasonably significant impact on global sustainability which result in economic, environmental and social implications. The choices made by EU citizens as consumers and decisions made by EU policy makers influence not only the global environment, but also indirectly affect the health of international societies and economies across the globe [Charles, H. et al. 2010] Over the last decades these choices of food consumption and production in Europe have illustrated a growing rise for the preference of animal products; meat, fish as well as dairy, also known as the nutrition transition. This European trend is also increasing in developing communities in some parts of Asia and South America, responsively resulting in an increase for the demand of these food products [Drewnowski, A. & Popkin, B. M. 1997].

With the growing rise in environmental problems such as climate change, fortunately there has also come an increased level of awareness. Livestock production has been identified as one of the main contributing impacts; the industry has been linked to numerous negative environmental implications exacerbating this currently catastrophic global problem. Environmental impacts make up only a fraction of the complex challenges presented by current livestock production and consumption measures. Current intensive livestock systems also come with wide ranging societal impacts, specifically the unethical distribution of global food supplies, with many overfed yet millions suffering from hunger, while a large portion of food produced is instead fed to animals to satisfy the growing taste for meat. Also, economically, the large-scale industrial practices used in modern day society often leave farmers indebted and breed oligopolies [Charles, H. et al. 2010].

The impacts of EU's livestock production and consumption on global sustainability as well as related policy measures, which present challenges or opportunities in the EU legislative arena, will be further discussed. Identifying potential and relevant objectives in the area governing the food system is necessary to mitigate detrimental impacts of

current practice. The role of food system governance as a tool to address the numerous complications currently faced as well as those to come, will be explored.

Food, lifestyle, environment, health, society, and economy together create a very intertwined and complex food system, which has become increasing difficult to govern. Globalization, international trade agreements, a growing population and the need for consensus in practice measures across EU's multi-level political system, all add to the intricate situation. These current issues have recently become more prominent topics on the environmental and EU agenda and various foresights into the future and meat and food exist among actors [Steinfield, H. et al. 2006 & Gerber, P. et al 2013b]. Actors include not only the key political players and interested organizations but also consumers and citizens. The system is large and challenges of good governance emerge with a large number of varied priorities or definitions of sustainability and ethical standards.

The issues concerning sustainability are increasingly becoming common knowledge, and with the vast societal technological advancement questions raised about the role of technology and innovation in the food sector, are becoming more common as well.

Research by trusted organizations like the Food and Agriculture Organization of the United Nations (FAO), has identified many highly problematic concerns within current food production methods [Steinfield, H. et al. 2006 & Gerber, P. et al 2013a]. It can be argued that these practices are detrimental and cannot continue to meet the supply and demand needs of the growing population. To support environmentally friendly attempts in mitigate the already detrimental effects, on agriculture, livelihoods and the other overarching sectors - change is needed [Charles, H. et al. 2010].

A technology and society paradigm largely exists and it's role in the global food system is complicated. The Public debate regarding new technologies in food, for example that on genetically modified (GMO) foods, has been long and controversial over the decades, beginning around the time of the green revolution in the 70's and still having a large political and public presence [Gaskell, G. et al. 2000]. In the infancy stages of technologies, in this context relating to food, discussions and debates are held between many stakeholders, and regulatory frames shape the dominant actors in the discussion. The introduction of food technologies vary in acceptance, and states have an important role in regulating for consumer safety and health, as well as public acceptance and satisfaction while ensuring a steady food supply, meeting demands and market profits alike.

Among the many exploratory solutions being discussed; one of the technologies introduced to mitigate the current challenges of meeting increased demand for meat production and consumption is in vitro meat. Due to it's apparent foreseen potential in more sustainable and environmentally friendly production, the technology is emerging

in its popularity through exposure in society. The innovators are actively developing and promoting this technology as a promising endeavour.

## 1.1 PROBLEM STATEMENT

The view of relevant stakeholders in the food system, specifically those tied to the role of meat and livestock production is important to understand in order to identify the potential of solutions including but not limited to technology and innovation. The role of specifically alternative innovative meat technologies, such as cultured meat, in society comes with complications of technicalities, politics, consumer acceptance and various other considerations. It is therefore, this author has conducted a situational analysis to better understand;

*How relevant actors view the role of meat in society and what potential exists for change? Specifically identifying opportunities and threats for cultured meat as novel innovative technological solution for addressing current problems? Is this alternative the silver bullet to the sustainability problems?*

## 1.2 RESEARCH QUESTIONS

In order to navigate the large task of the above mentioned situational analysis, more specific explorative questions were generated to help structure and guide research data collection and analysis;

- What is the perception of the current situation in livestock production?
- What is the foreseen future regarding the role of meat in society?
- What are the strengths, weaknesses, opportunities and threats of cultured meat technology?
- With whom does the responsibility lie?
    - Government: governance, legislation, regulation, labelling, taxes, subsidies, recommendations
    - Industry: technology, efficiency, ethics, environment
    - Consumer/Citizen: acceptance, consumption
- What is needed for a food systems approach regarding potential mitigating strategies

## 1.3 AIMS

An interest in the biotechnology, food systems, sustainability and consumer attitudes motivated the initial explorative research. This resulted in the aim of this project to conduct a situational analysis on the role of meat in society, specifically to **a**ssess the views, perceptions and attitudes of relevant actors and literature on;

- The role of meat in terms of sustainability in the food system
- The opportunities and challenges of innovative solutions, specifically cultured meat

- Potential mitigating strategies and prospective steps to alleviate current implications
- The application of Science, Technology and Society theories to the context of innovation in food; including consumer acceptance issues
- Discuss the role of communication in behaviour change

Addressing these issues was a large task and many challenges were presented, it also became apparent that the subject field was broad and therefore data collection and analysis was difficult to navigate.

## 1.4 DELIMITATION AND CHALLENGES

Although the main focus of this study was within the context of the European Union (EU) given the intricacy and complexities of global food production, trade, globalisation and population growth, it is difficult to remain within a specific geo-graphical or geo-political context. However all references to political, legislative and regulatory actions are within EU's multi-governance system as well as reference to citizens and consumers unless otherwise specified.

Most informants referred to were from a European context with a few from North America, when discussion shifts from the European frame it will be stated.

Though ethnographic field studies were conducted in the political arena of Brussels, during a traineeship at the European Commission, it was difficult to find cooperative members of the staff to participate in the interview process. This may have been due to the Commission not yet having a formulated communication for the public on cultured meat.

Given the sociological nature of this study it may have been insightful to further investigate the cultural role of meat in society and it's effects on shaping the current situation, however this was not feasible. The history of meat and evolution, and cultural meaning would add much more depth to this study.

A parallel situation analysis of the media coverage and available non-academic data on the topic would expose a varying angle and present a more thorough depiction of the current situation in relation to society, communication and media.

Another potential for bias was also the absence of informants from the actual production and industrial sector of livestock. There may have been more insightful to the situation in relation to practical implementation feedback but also more economic or social concerns foreseen to the livelihood of farming and livestock production/processing systems. Among absent actors were also those representing the citizens and consumers, though consumer groups provided inputs to the study, individual civilian opinions, perceptions and attitudes may be useful to collect should the

technology continue to make it's way to the public food system – due to resource constraints this was not feasible.

Lastly, the terms in-vitro meat and cultured meat are used to describe the same technology. This decision was taken due to the emergence of unforeseen meanings and perceptions of terminology – issues concerning semiotics and linguistics and interpretation. Original data collection was done under the term 'in-vitro', as was also used in the semi-structured interview guide for empirical data collection. It was later established that the term was not the preferred term by those working with the technology. It was described as possibly even giving the technology a more apprehensible image. Thus the terms are used interchangeable throughout the report, meaning one and the same.

# 2.0 BACKGROUND

Vigilance of food issues has become more apparent during the past decades, naturally, given the number of food safety scares [Valetta, M. 2010]. Psychological, ethnographic and historical perspectives may offer an interesting insight to understanding the unique place food technologies hold in the development of risk governance and societal acceptance of innovation. Behavioural economic perspectives and specifically Science, Technology and Society (STS) theories may offer acuity to understanding consumer attitudes and risk in regards to modern, ground breaking technologies such as cultured meat. At this this time in-vitro meat technology is presently not on the market, and the relevant regulations are yet determined. Specifically, within the EU the regulatory processes on novel foods such as cloned or cultured meat, follow the precautionary principle[1] and are far more rigorous and complex than other new technologies [Tait, J. 2008: Chapter 7]. In the EURObarometer Report requested by the European Commission, EU consumer attitudes and acceptance surveys indicated that cloned animals and GMO foods made the majority feel uneasy and were considered not safe for health and consumption [TNS Opinion and Social (2010:28], the hypothesis of this researcher is that cultured meat may face the same scrutiny and will be investigated in this report.

A relatively simultaneous report, to the EURObarometer, also published in 2010, evaluating the EU legislative framework in the field of GMO food and feed highlighted the little support for the use of GMO foods by citizens. This evaluation also stated a low level of awareness about the specific aspects of the risk assessment and authorization process, and mentioned that public acceptance of GMOs results from general

[1] The precautionary principle enables rapid response in the face of a possible danger to human, animal or plant health, or to protect the environment. In particular, where scientific data do not permit a complete evaluation of the risk, recourse to this principle may, for example, be used to stop distribution or order withdrawal from the market of products likely to be hazardous.
*Source:* *http://ec.europa.eu/dgs/health_consumer/library/pub/pub07_en.pdf*

perceptions of the technology rather then the governing frameworks [TNS Opinion and Social 2010]. The association between the uses of GMO feed in livestock production, the low level of consumer awareness and acceptance, and the potential introduction of cultured meat to the market may be closely linked. This study thesis explores the perceptions and opinions of policy makers, researchers and those actors relevant in the field of livestock production. Also studied are the potential of alternative innovative food technologies in prospective legislative decisions, specifically concerning the role of meat production and consumption in the EU, and the presented opportunities and challenges associated – with cultured meat serving as a case study.

## 2.1 EU LEGISLATION, FOOD TECHNOLOGIES AND SOCIETY

Currently, various sources discuss the potential pitfalls of such low level acceptance among EU citizens in new food technologies. The regulative use of the precautionary principle by EU legislators has created debate regarding it's use in operating as the rule of thumb in EU. Specifically in the food sector debilitating effects on agricultural development and economy in the EU have been discussed in regards to it's implications on global trade. The evaluative report [TNS Opinion and Social 2010] on GMO food and feed warns that the overall economic benefits of GMO might not be realized as a result of the current legislation, and that the EU's agricultural biotechnology sector has the potential to generate excess societal benefits above current day. As mentioned previously, the case of cultured meat may follow the same level of scrutiny and the same potential losses may result. It is therefore important that legislative efforts are prospective and benefit society as oppose to limit. Though these stated potential losses are debateable the introduction of new technologies to society is inevitable and will therefore be investigated further.

Understanding the complex relationship between science and societal acceptance could identify potential drivers in communication strategies to increase transparency of political decisions in order to propagate valid knowledge, generate awareness and increase public trust and efficacy in food consumption behaviours. Theories exist and support the use of multiple actors in evaluation and planning, it is therefore relevant to involve actors in this situational analysis.

In this situational analysis on the role of meat in the food system, many influential factors play a role, it is unrealistic to precisely measure the weight of each of these factors, however, it may be advantageous to policy makers to explore their associations within the entire network. The debate on novel food governance has been analysed through various angles and a perspective has been published by Bengtsson, B. [2011] *Frame dynamics and stakeholders in risk governance – a study of EU safety and GMOs.* The situation has been depicted through multiple frames and expressed from so many diverse angles, with varying levels of detail and complicated tangible definitions of important terms. Many influential factors affecting consumer perceptions and attitudes

toward food technologies exist. Bengtsson, B. [2011] discusses the multi-level power play in respects to the innumerable stakeholders and actors involved in the framing of the political debate. A deeper understanding of these intricate actor networks and their effects on framing and communication to influence consumer attitudes could improve the comprehension of the diverging attitudes in respects to innovative food technologies and cultured meat.

### 2.2 DEFINING SUSTAINABILITY

The term sustainability here is based mainly of the Bruntland Definition of Sustainable Development [UN 1987], where it is defined as "*meeting the need of the present without compromising the ability of future generations to meet their own needs."* It contains 2 keys concepts:

- Needs – essential the world's vulnerable, and;
- Limitations – created by the state of technology and social organization on the environment's ability to meet present and future needs

In order to be considered sustainable a development should meet criteria from all three of the following conceptual pillars; economic, environmental and social (UN 1987).

Understanding sustainability in the food system is challenging and many definitions and interpretations can be found. The definition here is simplified to encompassing the UN's three defined conceptual pillars.

## 3.0 SITUATIONAL ANALYSIS

The principal method behind this study was adapted from the UNFPA's (United Nations Population Fund) use of Situational Analysis as a tool for development. Though the context for the use of the tool differs, the 3 main concepts were followed [UNFDP n.d.];

- Phase I: Situational Analysis – what are the key concerns with the current situation? Who is involved?
- Phase II: Understanding Perceptions and Visions – What are the foreseen ways to move forward? What is the perceived potential of cultured meat as an innovative technological solution? Understand how society interacts with food technology?
- Phase III: Action Plan – What can be done? Who is responsible? What are their roles and suggested actions? Does science, technology and society theory support these perspectives?

As this is the first piece of work orienting this researcher in the field, the first two concepts Situational Analysis and Visions and Goals were covered more thoroughly. McGill University has used this method as a tool, and referred to one of it's main

strengths being the ability to assess situations from a systems perspective which this researcher thought was relative and relatable to the food system. The UNFPA also reported that the use of situational analysis has been helpful in decision making processes, mainly because it encourages the involvement of relevant actors [McGill University 2012 & UNFPA].

This organizational structure of the data presentation emerged based on a combination of grounded theory and situational analysis. It was not until analysis began that the researcher saw the potential to address all 3 Phases in relation to the role of meat in society.

## 3.1 GROUNDED THEORY

The Phases presented have been adapted to suit the presentation of results from this ethnographic study. The theoretical framework used was based on Adele's Clarke's Situational Analysis, often referred to as re-grounding the grounded theory. Originally Strauss and Glaser's social science method of grounded theory aimed to explore, develop and verify theory on behalf of empirical data collection. This theory is based on the premise that empirical data collection is constant and analysis is continuous, in this sense there repetitive reflection on data which may dictate further need for data. Collection and analytical reflection continues until the knowledge gained from the accumulated analysis results reaches a conclusion [Glaser, B. & Strauss, A. 1967].

Adele Clarke's situational analysis is seen as an additional layer to assist in clearer analysis of data collected, the two methods work well together and allow for supplementary analysis of complexity to better understand the social world; specifically arenas involvingg many complex social elements [Clarke, A. 2003]. Complementary to grounded theory, situational analysis and mapping methods, data was collected through various channels; secondary literature, ethnographic studies, semi-structured interviews and surveys.

## 3.2 MAPPING

The purpose of situational analysis and the mapping methods used are described as re-developing the more classical epistemological approach to qualitative analysis method. According to Clarke, A. [2003] maps are used to;

- *"lay out the major human, nonhuman, discursive, and other elements in the research situation of inquiry and provoke analysis of relations among them"* (situational maps)
- *"lay out the collective actors, key nonhuman elements, and the arena(s) of commitment and discourse within which they are engaged in on-going*

*negotiations—meso-level interpretations of the situation"* (social worlds/arenas maps), and

- "*lay out the major positions taken, and not taken, in the data vis-à-vis particular axes of difference, concern, and controversy around issues in the situation of inquiry"* (positional maps) [Clarke, A. 2003: 554]

The maps served as tools to present the complexity, messiness, denseness and dynamic of social construction and situations, specifically the role of meat and innovative technologies in the governance of food systems. An interesting point in describing Clarke's situational analysis is that a given situation is considered without a specific 'context' but rather that the complexity is a fundamental aspect of the situation, and not just an environmental factor. The use of maps is intended to illustrate all given complexities in situations, data that are apparent and blind spots are also drawn out in the process.

The visual depictions used in the mapping exercises are thought to increase the visibility of intricacy and reveal multifarious interactions among actors, actants and discourses. Maps are described as being able to visually display more complexity than narratives can. Clarke, A. [2005:263] states " *the major means of avoiding the present as "a necessary outcome" is problematizing how we have arrived at the present moment, seeking out those elements that each and all had to be in place for this present to "happen," and "how things could have been otherwise."* Basically the idea that understanding how a situation came to be in its actuality can help lead to a better comprehension of outcomes or potential outcomes, this definition is similar to that of narrative therapy. White, M. & Epston, D. [1990], narrative therapists, ask questions about how the current (problematic) situation came to be, what the contributing elements and discourses were, and what alternative stories or strategies might have been or still are possible. Situational Analysis through the documentation of observations, displays the need for understanding and intervening as oppose to defining for the sake of defining, the reason for research is to decide how to best intervene, rather than find "truth" of accountability [Wulff, D. 2008].

Situational Analysis mapping methods were used as data collection and analysis tools in the role of meat, the field of livestock production and consumption, impacts and legislation and possible mitigating strategies to avert further future problems in the food system. A map was first used as an outline displaying the vast number of components involved within the field/arena of the sustainability of livestock production and consumption in the EU and potential mitigating strategies. The first map was a messy situational map, which initiated further analysis into the links and connections between the various facets contributing to the 'situation', concluding in an arena map based around livestock production and sustainability. The next stage of situational analysis was done with colouring coding of the identified concepts and categories. These served as tools to plan data collection on the next layer of research through more observations,

further literature searches as well as preparing a semi-structured interview guide and survey. The purpose of the interviews and surveys was to provide the missing components of data needed to generate an accurate positional map. The mapping methods described by Clarke, A. above served as useful insightful tools in generating knowledge of the situation and in creating associations between identified elements.

The mapping exercises were used in initial stages as mentioned previously to conceptualize the livestock industry and its complex elements, the preliminary maps led to the discovery of the various areas concerning livestock production, the EU and global impacts on sustainability, specific policies and actors involved and their contributions to the complex area of meat production and consumption. Results from data collection and analysis on past and current, mainly industrial, livestock practices and their impacts, generated a discussion raising questions about the future of the industry; production, consumption, sustainability and consumers. A few specific concepts emerged repeatedly and began to shape the themes and categories or further meso-level arena maps, giving insight into relevant actors and discourses concerning the situation, among these discourses innovation and technology in the sector emerged.

Within the situational analysis a social world based around discourses concerning the alternative innovative meat production strategy of cultured meat emerged. This arena served as the case study for positional mapping of the concerns and controversy of the current issues at hand regarding livestock and how potential mitigating strategies are perceived by various relevant actors, as well as which political and civil discourse may affect or be affected by the future of meat's role in the food system. To complement grounded theory and situational analysis, mapping exercises identified potential for multiple furthering qualitative data collection and analysis methods.

# 4.0 QUALITATIVE METHODOLOGIES

In order to better understand the phenomena, a combination of non-probability sample types of data collection were used to support the several different methods used in this qualitative study. The inclusion of varying data collection methods was considered to contribute to the overall picture of the situation as well as strengthen the validity through triangulation of the findings [Harrison, J. 2010: Chp.5]. The role of meat was studied inclusive of various social elements, human and non-human and well as discourses: people, places, discourses, events, time, context etc.

## 4.1 DATA GATHERING

Data throughout this situational analysis, in line with its proposed methods and those of grounded theory, was sourced from various channels;

- Chain/ Snowball: relevant data emerged and led to further data in more specific areas, also informants suggested appropriate or applicable actors to contribute to data collection
- Quota: initial rounds of data collection also led to generating quotas for samples, mapping showed the diverse qualities and varying positions of relevant elements, serving as an indication for a baseline to collect samples from dissimilar angles of the governance triangle; for example the aim of including governmental, non-governmental and civil actors; public and private, as interview informants
- Theoretical: as in line with grounded theory it can be stated that theoretical sampling was also used to some degree, the process is depicted in Figure 1. Theoretical Sampling [Ladner, S. 2008]

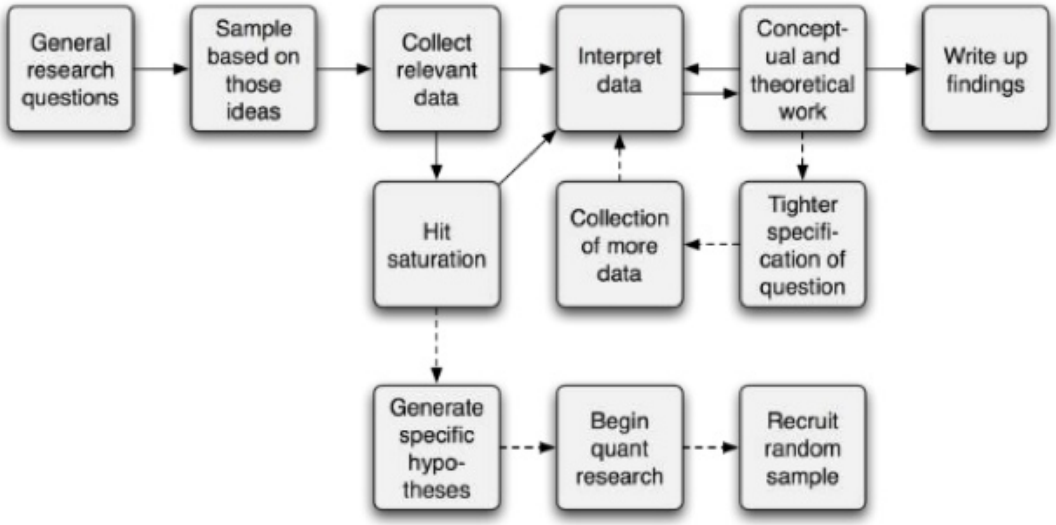



*Figure 1 Theoretical Sampling* [Ladner, S. 2008]

## 4.2 ETHNOGRAPHIC STUDIES

An ethnographic method, with its roots in social qualitative studies; mainly sociology, was applied in an attempt to understand the social world of the role of livestock in the food system. Multiple methods of data collection and continuous analysis were used to grasp a deeper understanding of social meanings and occurrences of social activity in this particular social arena. Context was in this case specific to EU governance; public, private and civil entities. These multiple methods enabled for the emergence of highlighted relationships between informants and their social world or the political community of Brussels; where the majority of data was gathered. Specific data gathering methods in this study included;

- Secondary research (literature, policy documents)

- Observational (note taking and passive participation in meetings and conferences)
- Field studies (actively participating in meetings where power/interest relations emerged)
- Semi-structured Interviews
- Surveys

The complexity and multiple methods applied in varying contexts made it challenging to adamantly follow very structured note taking processes continuously and certain data was collected with more scrutiny than it's counterparts, however the web of information and its related social links are not intended to be separated, as all contribute to the understanding of the social world; understanding the role of meat and the potential of innovative technological solutions. In this postmodern approach of continuous data collection and analysis, used in qualitative ethnographic research, the researcher exhibited reflexivity. A hermeneutical approach used in attempts to understand the influence of involvement in the study, despite attempts biased is inevitable, contributing to one of the main critics of the applied theoretical frameworks and methods [Brewer, J. D. 2000]. Author Goldstein, D. M. [1991] states that a "dialogic" approach to ethnographic techniques derived from the philosophical method of hermeneutic is problematic when confronting issues of political economy in ethnography, this researcher is aware of the challenges and bias presented by selected methods. The method triangulation was considered as helpful to minimize this bias, but came with additional complications in structuring analysis due to the complexity and broad encompassing field studied.

## 4.3 PRELIMINARY DATA COLLECTION

The methodology and theoretical framework of situational analysis was used as the basis of this research and data collection. The bulk of data was collected during a 3 month period in the capital of Europe, Brussels – home to the political arena of EU policy and governance.

### 4.3.1 SECONDARY RESEARCH

The data collected was comprised of a collage of various formats including secondary research from various literature sources such as scientific journals, articles, policy documents and research reports drafted for the commission. These sources were published by numerous actors in the field, including academics, policy officers, research consultancy firms, and non-governmental organizations (NGOs) from difference interest fields and perspectives in the governance triangle. Hermeneutical considerations were made when evaluating the material gathered based on the source, for example scientific peer reviews versus interest groups or NGOs. The data accumulated from various search engines online and scientific journals, through use of the European Commission library and database as well as documents collected from various attended events. These

served as the basic ground work at the initial phases of research, in line with the grounded theory method and situational analysis the process continued, the first phase of secondary research was documented in a systematic literature table, many references from preliminary findings presented chain sampling opportunities for further relevant texts. Along with this secondary research, observational data collection accompanied the process through multiple meetings attended between commission officials, politicians and relevant actors/stakeholders, coupled with mapping exercises contributed to data in Phase II of this report Understanding Perceptions and Visions. Not all observations affecting data analysis were exclusive to the case of the role of meat in more sustainable diets but still served as relevant in relation to mapping the positions of various actors in the arena.

### 4.3.2 OBSERVATIONAL DATA AND FIELD STUDIES

Specific conferences attended provided a bulk of observational data were the *Averting Farmageddon: Sustainable Food For All*[2] hosted by The Greek Presidency of the EU and Compassion in World Farming. This conference was closely linked to the release of Philip Lymbery's new book and held in Brussels on February 18th 2014. Presenters included a wide range of actors related to agriculture including professor Mark Post on cultured meat and Philip Lymbery who summarized many of the current environmental implications of current practice**.** Another key event contributing to the observational data collection was the conference on *Sustainable Intensification*[3] hosted by the Forum For Agriculture (FFA), also in Brussels on April the 1st 2014, where professor Erik Mathijs, a contributing author of the Foresight SCAR [2011], *Sustainable food consumption and production in a resource-constrained world*, who was also interviewed, spoke along with many other experts in the field. The relevant key talks were recorded and contributed to analysis. Lastly the event hosted by the European Parliament and organized by EU's Food Sense: *Sustainable Food Conference – The Commissions Imminent Food Policy: Sustainability or Standing Still?*[4]. With the main issue being concerned with food waste, the data collected was in a broader sense. This conference was used to map the positions and views of experts in the field such as Olivier DeSchütter, The UN Rapporteur on Right to Food (also present at the Averting Farmageddon event) as well as Tristram Stuart a well known voice and activist on the EU front of food waste and Ben Casper, a policy officer responsible for the Communication on Sustainable food from the European Commission – Directorate General for Environment. The presentations by these specific speakers were loosely used in the data collection, which contributed to the coding and analysis phase of highlighting key concerns, perceptions, visions and perspectives.

[2] Program Summary Averting Farmageddon: http://www.presscenter.org/en/event/averting-farmageddon-sustainable-food-for-all
[3] Program Summary Sustainable Intensification: http://www.forumforagriculture.com/ffa-agenda.html
[4] Program Summary: Sustainable Food For All: http://www.eufoodsense.com/draft-agenda/4583621075

## 4.4 PRELIMINARY DISCOVERIES

A situational analysis of the role of meat in more sustainable diets across the EU, and an understanding of how this role is perceived by different actors will give light to what potential is thought to exist for mitigating strategies, according to the UNFPA , situational analysis is a helpful development policy planning tool [UNFPA n.d.] The role of meat in society is very complex and spans across many sectors and aspects of sustainability, the most commonly identified ramification of current meat production and consumption were it's environmental impacts in a wide variety of areas. Several options have been proposed for moderating these problematic aspects, ranging from returning to more traditional methods used throughout history to more recent innovative and alternative technological solutions. The acceptance of these varying strategic solutions came with an array of diverging opinions from informants and different predictions for the future of meat in society, politically and culturally.

Meat production and consumption also make up a large portion of the economic sector of Europe, not only in terms of agricultural production but also in consumer consumption patterns, these have been identified by mapping exercises and empirical data collection from various actors as elements which need some more specific attention in terms of political action and governance.

Among many proposed alleviating strategies, mapping exercises identified novel technological advancements for innovative alternative meat production, for example cultured meat which was used as a case study to investigate the differing perceptions from actors/stakeholders and specific informants in several aspects related to todays food system. Involving various participants associated to the meat production and consumption aspects of the current food system as well as those involved with the technology of cultured meat provided insight into the diverse views on apropos topics. It also highlighted the complexity and diverging perceptions, raised questions about best practice governance of the food system in relation to sustainable diets and of the cultural implications of future mitigating strategies.

According to the theoretical framework of situational analysis, grounded in the grounded theory method, data collection and analysis followed the common epistemological approach to qualitative research. Data was collected in stages and built up in layers, deepening understanding and complexity of the phenomena, analysis began shortly after data collection, but more systematic methods of analysis were used concluding the empirical data collection phase.

Additional data collected, which added mainly to the situational analysis positioning maps, was that which was collected through passively participating in stakeholder and communication meetings hosted by the European Commission on topics such as novel foods, sustainable food, genetically modified food and feed and physical activity, diet and health platforms. These meetings were hosted mainly by the Directorate General

for Health and Consumers (SANCO), concerned with Health and Consumers and then depending on the meeting a diverse selection of stakeholders from the civil and private sector, non-governmental organizations, industry and representatives from Member States. The number and mixture of attendees varied from meeting to meeting but the data collected here was again used to contribute to further accuracy in the situational analysis and positional mapping of actors involved, mainly based on power and interest to acquire a clearer sense of their ability to influence decisions and/or the likelihood to which they may aim to do so based on the various topics.

Throughout the internship of 3 months various relevant events, meetings and conferences were attended as mentioned. These also contributed to the data collection and analytical reflections within the situational analysis theoretical framework. Many reputable actors also spoke at these events and some were also recorded. Data collection in the field and through observation was documented in a similar but slightly more abstract fashion. Unstructured notes were taken throughout and reflections about themes were later summarized and transferred to a table, which encompassed similar themes to those of the semi structured interview guide. Key findings and observations were recorded here, those collected through observations, note taking as well as replaying audio files of events, conferences and meetings during analysis.

Secondary research of recent literature coupled with empirical data collection from a cross-section of informants identified a wide assortment of various reasons for these impacts and a collection of proposed mitigating tactics to reduce the severity of the negative repercussions resulting from today's food system. Several diverse sources gave light to the complexity of this issue and the various angles in which it can be and is currently framed. This data and primary round of analysis served as the skeleton for the semi-structured interview guide, by providing themes and controversial topics.

## 4.5 EMPIRICAL DATA COLLECTION

Initial data was coded in tables, by adapting methods from grounded theory and situational analysis techniques, and was further analysed by highlighting similar or opposing view points by the various actors and matching it by colour to data collected through studied literature. These various colour-coding practices identified the most predominant findings in terms of perceptions, attitudes, views and opinions by actors involved with the case study of the potential for cultured meat as a mitigating political strategy for improving sustainability regarding the role of meat in society. Data collection and analysis lead to results, which allowed for the positions of actors/stakeholders and later specific informants in different theme maps. In some cases actors were split on their conflicting views and in some instances specific categories within the themes indicated consensus and shared attitudes or opinions for the most part, this trend among data continued throughout.

Following the methods of situational analysis and grounded theory the preliminary discoveries found through content analysis shed light on various new relevant paths which could build upon the understanding of the role of meat, livestock production and innovative technological food advancements as potential solutions. The initial research provided the frames needed to address more specific themes and deepen the comprehension of the situation.

### 4.5.1 SEMI-STRUCTURED STAKEHOLDER INTERVIEWS

Throughout the secondary data collection process, and continuous mapping exercises, many actors, actants and discourses were emphasized in regards to the more precise field of in vitro meat within the arena of livestock production and consumption. Literature and secondary data collection was analysed and inspired a series of questions, mainly about the future of in vitro meat in society or the feasibility of its acceptance and regulation in the EU to be more specific. A semi-structured interview guide was devised accompanied by a short more quantitative survey; both addressing inquisitions about the future of the food system in relation to livestock rearing and the opportunities and challenges of in vitro meat as a possible technologically innovative solution; these can be seen in Appendix A. Data was collected from a series of informants with various expertise; food systems, in-vitro meat, livestock farming, public health, technology and society, policy etc. 31 potential informants were approached and 14 informants answered conclusively, those contacted and incorporated in the data collection and analysis resulted from chain/snowball, quota and theoretical samples. Many were identified through the mapping processes, some specifically as actors involved and other as experts who work with for example regulations or legislations which in vitro meat would fall under. A portion of interviewees were approached via an existing academic and professional network. Interviews with some experts lead to connections with others that were not initially identified. Citations are given under an informant number, some informants chose to remain anonymous while others allowed the use of their or their organizations name. Informants are referred to by number only, a simple depiction of their expertise or field of relevance is illustrated in Table 1 Informant Index.

*Table 1 Informant Index*

| Informant | Expertise | Method of collection |
|---|---|---|
| **1** | Professor of Agricultural and Resource Economics | Skype (BE) |
| **2** | Policy Advisor - Animal Rights (NGO) | Face to Face (UK) |
| **3** | Public Health Professional (NGO) | Face to Face(BE) |
| **4** | Professor at the Department of Farm Animal Health | Skype (NO) |
| **5** | Professor of Food Policy | Phone (UK) |
| **6** | Professor in the Faculty of Medicine (BioTech) | Skype (NL) |
| **7** | Executive Director of New Harvest (NGO) – BSc. Cell and Molecular Biology MSc. Bio-Tech | Skype (Canada) |
| **8** | Postdoctoral Researcher in the Department of Molecular, Cell, and Developmental Biology | Skype (USA) |
| **9** | Director of Programs at IDDRI (The Institute for Sustainable Development and International Relations-non-profit policy research institute) | Skype (FR) |
| **10** | European Food and Farming Policy Specialist – (Euro-Coop) consumer cooperative organization | Phone (BE) |
| **11** | EU Policy Director on Agriculture – Greenpeace (environmental NGO) | Face to Face (BE) |
| **12** | Nutrition Scientist and Food Researcher | Phone (AU) |
| **13** | Policy Co-ordinator – Eating Better (A national alliance on sustainable food) | Email response (UK) |
| **14** | Senior Researcher –PETA People for the Ethical Treatment of Animals (animal rights non-profit organization) | Email response (UK) |

An initial round of interview requests was sent to 20 potential informants via email, attached were the documents which can be seen in Appendix A; including a short summary of purpose, directions, informed consent, a semi-structured interview guide and survey. Some responses and further research lead to a subsequent 11 more requests, totalling 31 requests of which 14 were fully fulfilled.

The structure of the semi-structured interview guide followed the suggested methods from Laforest, L. [2009] from Canada's National Institute for Public Health: Guide to Semi-Structured Interviews with Key Informants. The questions were broken down into columns main questions, additional questions and clarifying questions, with a section at the end allowing for concluding questions. This type of guide was chosen for it's allowed flexibility. Not all questions need be asked and depending on the informant or specific stakeholder maybe not all are relevant or can be answered by the individual.

As mentioned the guide was sent out prior to the interviews, the intention of this was to allow for the informant to have time to reflect on the issues addressed and develop their responses. The topic cultured meat technology is quite new age and maybe not all those approached are familiar with it's more detailed aspects. Considerations to carry out the methods this way also allowed for those representing an organization and not

just themselves to consult with their peers to collectively agree on any uncertainties about where the organization stands on the specific issues.

The main and additional questions for the interview guide were developed through the exposed themes, which were unveiled during preliminary secondary research, data collection and literature reviews previously mentioned. Generally, the informants were asked about their perceptions on in-vitro meat and insect proteins as innovative food technologies and the possible acceptance, opportunities and challenges of these technologies being introduced into society. The topic proteins was not further investigated.

Of the 31 contacted actors a total of 15 agreed to take part in an interview and complete the short survey, one last minute cancellation led to only 14 completed requests. The majority of interviews were conducted over Skype while a handful was carried out face to face and 2 informants replied by email in text documents. All interviews were recorded for further analysis and documentation. Interviewees were asked to also stipulate how they would like to be quoted or referenced if cited. Responses varied between cited as an individual professional, cited as a representative of an organization and some people chose to remain anonymous and cited only by their professional or academic title – therefore to keep consistency all informants are referred to by informant no.

Interviews were carried out over the span of 4 weeks, when all were concluded the audio files were replayed and data coding began. A theme and category framework for analysis was created in which each time a informant made reference to one of the main themes, it was documented and then categorized depending on the type of statement it was, for example a threat or an opportunity, a reflection, opinion or fact and so forth. The semi structured interview guide helped to maintain consistent themes throughout the discussions held.

### 4.5.2 STAKEHOLDER SURVEY

Along with the semi-structured guide a short survey was sent with direct statements relating to the specific foreseen opportunities and weaknesses identified in relation to the selected novel innovative meat alternative technologies; mainly in-vitro meat. The informants were the same sample as the executed interviews. The statements were non-elaborative and accompanied with a likert scale ranging from 1 to 5 allowing informants to state their position between strongly agreeing or strongly disagreeing, with room for voluntary commentary and explanation. The survey was not intended to reference or quote stakeholder on specific absolute and definitive answers but rather to categorize attitudes and opinions among the informants, into social groups based on shared views. The aim of the questionnaire was to highlight opportunities for strategic communication and appropriate frames among shared positions between social group

on the use of novel innovative alternative meat source technologies in future society. It was used to position stakeholders and specific informants on particular topics on a broader continuum. The results were used to identify shared or strongly opposing views on particular topics among the actors involved relating to the main themes, the results were layered in analysis with initial positional maps to strengthen the understanding of actor/stakeholder positions in the social arena of livestock production and innovative food technologies, such as cultured meat.

# PHASE II UNDERSTANDING PERCEPTIONS AND VISIONS

***What are the foreseen ways to move forward? What is the perceived potential of cultured meat as an innovative technological solution? Understand how society interacts with food technology?***

Phase II continues the situational analysis on the role of meat in society but begins to present more findings and introduce new areas which emerged. The idea that technology in food, like in-vitro meat, was explored and evaluated based on informant commentary and research. These discussions also highlighted many other emerging themes within sustainability of the current system and facilitated reflections on the future of food.

## 1.0 INTRODUCING IS IN-VITRO MEAT'

In-vitro meat, also known as cultured meat, schmeat, sheet meat, laboratory meat, cruelty free meat, test tube meat, is the growth of animal muscles cells (meat) from the use of stem cells. Semiotic meanings may be generated differently depending on the choice of linguistics in the future of this innovation.

In brief, the purpose of proliferating stem cells to create meat in the absence of the actual animal which is a complicated technical endeavour, which is controversially seen as a potentially more sustainable marketable meat alternative. More details about the specific technology and its progress can be found in Haagsman, H.P. et al. [2009] Production of Animal Proteins by Stem Cells[5] a report commissioned by the Ministry of Agriculture, Nature and Food Quality in The Netherlands as part of a survey on meat alternatives.

It presents the current state of research and development of cultured meat, and presents it *"as a completely new idea to produce edible skeletal muscle (meat) by*

[5] http://new-harvest.org/wp-content/uploads/2013/03/production_of_animal_proteins_1207.pdf

*culturing and differentiating stem cells of farm animal species to skeletal muscle cells (…) this hypothetical method of producing 'meat' has been patented by the Dutchman Willem van Eelen in 1999"* [Haagsman, H.P. et al. 2009:4]. The report published by the researchers goes into the specific technical and scientific aspects of production, and states an extensive global network has built up interest on this subject. They describe this network to consist of a range from scientists, technical engineers, food specialists, and representatives of vegetarian organizations to psychologists and sociologists. Haagsman, H.P. [6]et al. [2009] describe their study as broad, encompassing factors raised by all relevant network actors. The researchers consider not only scientific aspects but also social and economic factors – since research and development of cultured meat is still in it's infancy. Figure 2. The In-Vitro Process depicts the technology briefly.

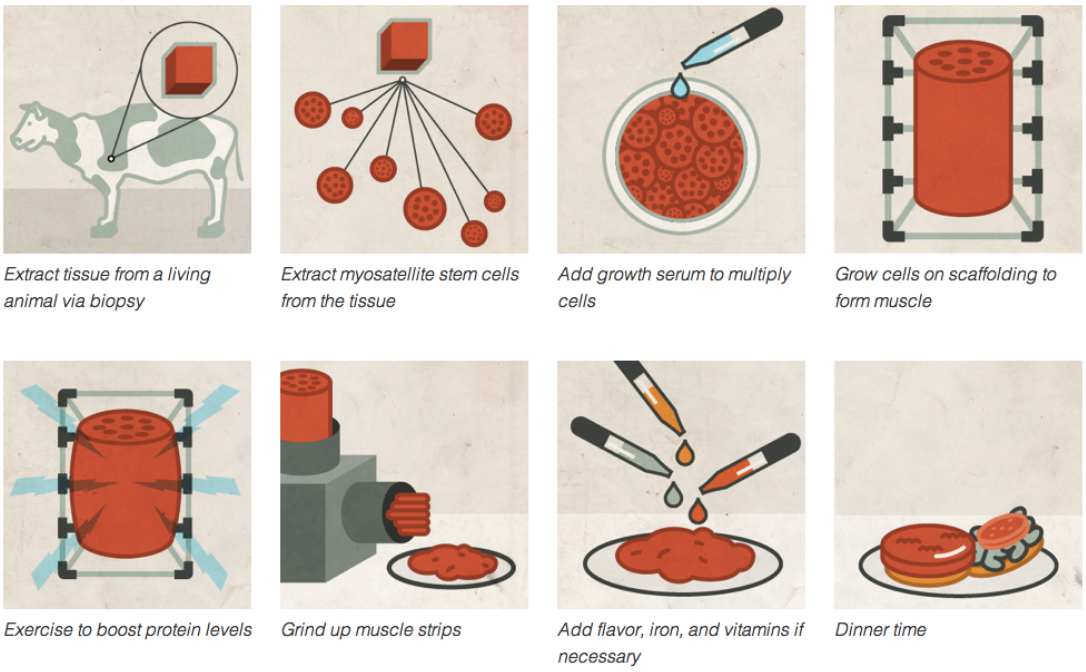



*Figure 2 The Cultured Meat Process*[7]

## 1.1 THE HISTORY OF CULTURED MEAT

Within the cultured meat network, which is comprised of many innovators[8], reference is often made to a statement by Winston Churchill [1936], "*Fifty years hence, we shall escape the absurdity of growing a whole chicken in order to eat the breast or the wing, by growing these parts separately in a suitable medium".* In 2002, research for space missions explored the possibilities of culturing animal muscle protein, initially from the common goldfish. Researchers found the first results promising, the product was tasted and said to likely be approved by the Food and Drug Administration (FDA). This project lacked funding however and did not

[6] an author from this publication also contributed as an interview respondent
[7] Source: TedX http://blog.tedx.com/post/58160025369/thisistheverge-your-meat-addiction-is
[8] Defined in 10.2.1.1. Diffusion of Innovations on Cultured Meat Versus Communication and Framing

continue [Haagsman, H.P. et al. 2009:7], similar problems exist for advancements in current efforts as well.

In the early 1950s, Willem van Eelen, from The Netherlands, followed his idea of using tissue culture for the creation of meat products. It was not until 1999 that the theoretical idea was patented [Haagsman, H.P. et al. 2009:7].

Recently more universities, biologists and researchers have joined the network and a consortium was formed. Many of these actors were contacted as informants and the development of more private based companies involved with this technology have also emerged in society ie. New Harvest and Modern Meadows. Strong support has come from animal rights organizations like PETA offering funding rewards for new developments in the technology. Many sceptics however also exist and media has actively exposed the diverging attitudes.

## 1.2 MEDIA, PERCEPTIONS AND CULTURED MEAT

Numerous articles and forums exist where the controversial topic has been discussed in varying areas and sometimes conflicting angles. An abundance of material is opinionated and subjective due to the early nature of the innovation, little is 'actually' known. Both supportive and non-supportive commentary can be found on the web, those who are seeking information about the technology will find conflicting attitudes exist, as was also found to be the case among the informants of this study.

Very little is published in scientific journals and the material which exists is highly technical and full of biological detail or is hypothetical forecasting. These considerations where taken into account during analysis. A phenomenological approach was applied to the best abilities of the researcher, it maybe stated that given the qualitative and subject nature of this study, a degree of bias may be observed, also given the lack of technical biological knowledge used in the in-vitro technology. However, the professional position and academic background of each researcher was considered during the coding and interpretation of data regarding specifically in-vitro meat.

## 1.3 IN- VITRO MEAT IN THE SITUATIONAL ANALYSIS

In the preliminary stages of the situational analysis of the role of meat in the current food system, a novel innovative technological solution was identified as a rather small discourse in the entire situation. It's role may be only marginal due to various factors which also came to light when further investigated; the technology of in-vitro meat is still in its infancy and considered alternative and new age, limited awareness and promotion, and a perception by some actors/stakeholders and informants is that society is rather techno-phobic when it comes to food innovations.

Cultured meat was presented at a conference *Averting Farmaggedon* hosted by contributing informant *Compassion in World Farming,* a non-governmental organization from the United States supporting animal welfare. The conference was closely linked to the release of Philip Lymbery's new book and held at the Square Hotel on February 18th 2014 in Brussels, Belgium. Professor Mark Post, one of the head researchers studying in-vitro meat from Maastricht University presented the technology. It was presented as a very possible consideration for addressing negative environmental implications of today's current livestock production practices. Situational analysis allowed for a more comprehensive insight into actor's perceptions on the evaluation of this technology as a mitigating strategy. It is important to note that a situational analysis revealed the limited knowledge in regards to the future of in-vitro meat technology and the potential for cultured meat on sustainability impacts; economic, environmental and social – many assumptions have been drawn but are considered to be highly qualified foresights with the subjective framing considerations taken into account.

The technology proposing a method of meat production where only the animal muscle tissue is grown in-vitro as oppose the entire animal. This technology using stem cells and a complex method performed in a laboratory, currently it is still in it's research stages with limited experts and high financial demands. Tuomisto, H. [et al. 2011] date the development of producing cultured meat for human consumption back to the 1950's and explain that though limited quantities of cultured meat are currently produced, large scale production requires additional funding investments and research, specifically an estimated $160 million before commercializing production.

## 2.0 INITIAL ANALYSIS OF IN-VITRO MEAT

An initial analysis of in-vitro meat was sparked from an introduction at the Compassion in World Farming event mentioned previously. This lead to a series of links online; both academic and non- academic. Many were from blogs on topics such as food policy, sustainable food, sustainability, technology, innovations etc. These blogs were also accompanied by many hits for media coverage by news outlets such as The Guardian or The New York Times or Blogs such as Next Nature.

Titles of these blogs, books or articles in media outlets included:

- What's wrong with in-vitro meat? (Verdict- Legal Analysis and Commentary from Justia)
- Meat the Future Blog- Solving Protein Crisis (Next Nature)
- The world's first cruelty-free hamburger - Today's tasting of in vitro meat could herald a future free from needless animal suffering and polluting factory farms (The Guardian)

- Inside the meat lab: the future of food- With billions of mouths to feed, we can't go on producing food in the traditional way. Scientists are coming up with novel ways to cater for future generations. In-vitro burger, anyone? (The Guardian)
- High Steaks: Why and How to Eat Less Meat a book by Eleanor Boyle
- Test-Tube Meat: Have Your Pig and Eat It Too- *Don't kill the pig, say Dutch researchers—just grow its cells in the village meat factory*
- Is Lab-Grown Meat Good for Us?-No saturated fat, no heme iron, no growth hormone—cultured meat seems to have many potential benefits (The Atlantic)
- A Lab-Grown Burger Gets a Taste Test (The Times)
- Lab-grown burger costing £250,000 fails to blow tasters away (Wired.co.uk)
- Lab-grown meat is here– but will vegetarians eat it? (NBC News)
- The Consortium on In-vitro Meat

Numerous additional articles and blogs can be found but most cover the same themes and debates, since the topic is new little is known and a reliance on expert opinions is dominant in the field. In some cases professionals were interviewed, some of these lead to the snow-ball sampling and the interviewees were contacted and became contributing informants to this situational analysis.

This initial analysis along with mapping and field studies contributed to the generation of the coding legend, used to orient among the data during analysis and find associations and divergence points in attitudes as well as commonly occurring themes and perceptions.

## 2.1 CODING

Literature was coded while reading with various colours to isolate the several different concepts and themes which arose early on, messy maps were also organized into arena/field maps and positional maps to help understand the components relationally within the complex total frame. Examples of themes and categories of coding were for example environmental issues life climate change, biodiversity, non-renewable resources – first highlighted as themes in green – then further categorized.

Interviews were subject to content analysis and colour coded according to emerging categories and themes, relevant and specific quotes were identified and highlighted for the purpose of illustrating expert opinions on the situation. These coded findings then lead to further mapping, illustrating and strengthening the understanding of the associations and intricacy within the field and among the various actors, and then again specifically in relation to the various concepts and themes. The brief summary of this process can be seen in Table 2 Mapping Exercises.

*Table 2 Mapping Exercises*

| Map No. | Type of Map | Key Concepts and Purpose | Analysis |
|---|---|---|---|
| **1** | Messy | Identify actors food system actors relevant to meat | Governance triangle inclusive |
| **2** | Messy | Identify discourses | Media |
| **3** | Field | Identify more specific actors | Innovators, Researchers, DG's |
| **4** | Arena | Specific politics | Novel foods, EFSA |
| **5** | Positional | Connections between each actor and the emerging themes | Interaction between civil and public actors |
| **6** | Positional | Interconnectedness of actors, concepts/themes and one another | Grouping based on opinion |
| **7** | Arena | Each concept and theme from interviews with corresponding categories | Main categories emerged from various themes and concepts |
| **8** | Arena | Consistency or inconsistency on categories among actors | Divergence points |

The surveys were initially intended to be analysed in more depth but for the purpose of this situational analysis, were interpreted hermeneutically to gain a more conceptual understanding of the position of each informant regarding specific issues. These understandings lead to categories such as strengths, weaknesses, opportunities and threats which may exist in relation to in-vitro meat technology specifically.

## 2.2 SITUATIONAL SWOT ANALYSIS

Strength, Weaknesses, Opportunity and Threat (SWOT) Analysis was presented as a strategic tool in planning but is also often used as a risk management tool. It's purpose is to structurally analyse potential of projects or innovations, in this case to provide a framework studying cultured meat technology, in the relation to the role of meat in society today. The results are depicted in a 2x2 matrix; separating the internal environment and external conditions, also referred to as the meso and macro contexts. The purpose of such an analysis is to give rise to the conceivable risks associated with implementation, and prospectively design appropriate strategies to manage these foreseen threats [Paraskevas, A. 2013].

### 2.2.1 SWOT ANALYSIS WITH CULTURED MEAT AS A CASE STUDY

SWOT is also sometimes referred to as IE (Internal/External) Matrix given it's application in assessing and separating aspects which are internal and external in terms of control of the given technology. The specific categories are also further divided into factors which can be seen as favourable and those as unfavourable. More specifically in Table 3 SWOT Elements in Summary (Harrison, J. 2010: Chp.5);

*Table 3 SWOT Elements in Summary* (adapted from Harrison, J. 2010: Chp.5)

| **Internal Components considered to be in 'control' of the venture** | |
|---|---|
| ***Strengths*** | -Within the 'control' of the venture or technology, such as the access to advantageous resources including marketability, financing, production methods, organizational structure and those involved.<br>-Exclusive knowledge, backgrounds, education, credentials, contacts of the experts in the field are considered strengths as well as more tangible advantages such as available capital, or access to credit, established networks and existing channels, intellectual properties, copyrighted material, patents etc. |
| ***Weaknesses*** | -Within the 'control' of the venture or technology but that weaken or reduce the capacity of the technology to gain or obtain a successful competitive edge.<br>-Factors are relationally opposing to the strengths, so examples include a lack of expertise or other intangible resources or again the more substantial and material resources such as funds. |
| **External components of the matrix include the opportunities and threats which can be seen as less in 'control' versus the internal components and their analysis requires a slight more suggestive or hypothetical approach, foresight based on solid reasoning.** | |
| ***Opportunities*** | -Evaluate the positive, more peripheral elemental influences affecting the venture or technology. Similar to mapping identifying prospects which may be beneficial/constructive in the broader context.<br>-A more holistic societal evaluation of the technology, calculating potential for acceptance based on the technology's ability to resolve current problems, the existence of a positive perception of the technology, perceived value among actors.<br>-Consider the temporal element of opportunities as well, often there is a specific time or stage that opportunities are presented and taking these periods into account can help improve the understanding of various intervals at which certain opportunities may succeed. |
| ***Threats*** | -Consider the most ominous aspects; those that are uncontrollable, complex and dynamic based on society and less predictable factors.<br>-Analysis of the threats includes predicting possible obstacles and challenges such as lack of political or social support from various actors, changes in trends or efforts from competing ventures |

Overall the IE Matrix is often used to raise awareness of the critical concerns and issues affecting the marketability of a given venture, in this case the innovative technology of cultured meat. Methodology and the use of this analytical tool, particular to this case was more experimental and hypothetical to generally map the potential and foreseen direction cultured meat might take in the situational analysis of meat in the current society. Some sources also state that collaboration with various actors and several angles of contribution can strengthen the matrix analysis, offering insight to niche facets and diverse perspectives [Harrison, J. 2010: Chp.5]. Literature and empirical data analysis led to a basic and general SWOT analysis of the potential role of cultured meat to enter the market as a mitigating strategy to the outlined detrimental challenges currently faced by conventional livestock rearing methods and consumer consumption behaviour, seen in Table 4.

*Table 4 SWOT Matrix evaluating the potential of cultured meat and novel innovative meat technology*

| | FAVOURABLE | UNFAVOURABLE |
|---|---|---|
| **INTERNAL** | **Strengths** | **Weaknesses** |
| | • Highly skilled ambitious professions eager to develop the technology<br>• Existing business models such as New Harvest and Modern Meadows<br>• Interest from some investors<br>• Existing patents skills and information for stem cell culture grow<br>• Competitive, new, innovative technology<br>• Profitable due to high demand | • Lack of funding and investments for further research<br>• Difficult, challenging and time consuming technological advancements needed<br>• Limited existing knowledge both from researchers and potential funders<br>• Still small scale and very expensive to produce<br>• Technology is not yet marketable |
| **EXTERNAL** | **Opportunities** | **Threats** |
| | • High demand for meat products, growing middle class and population growth<br>• Potential to become affordably priced<br>• Potential to minimize environmental impacts compared to existing methods of production<br>• Can become 'healthier' than conventional meat products (limit saturated fat, less hormonal and antibiotic inputs)<br>• Higher levels of food safety, traceability and transparency for the consumer<br>• Less land use and better management of resources<br>• Animal welfare<br>• Humanitarian concerns such as right to food and efficiency of use of land and food improved<br>• Political decisions made could favour more support for facilitation<br>• Many technologies can eventually been accepted by society if there is a perceived benefit to the consumer | • Technology ownership may breed oligopolies<br>• Not accepted by the novel food legislative actions or other political decisions<br>• Food safety testing and questions<br>• Time constraints<br>• Lack of societal acceptance; food is not technology therefore challenging to gain acceptance<br>• Alternative technologies covering the same market gap available sooner and cheaper<br>• Trend to move toward more plant based diets, based on political push and communication (health and/or environmental arguments) |

Data collection, mapping and analysis resulted in a SWOT Analysis of cultured meat to systematically present key findings of the situational analysis. This method was thought to represent the initial stages which might be considered in the future legislation regarding in-vitro meat marketability, the findings would have to be further explored through a structured impact assessment carried out by the EU Commission and European Food Safety Authority (EFSA).

In the specific case of cultured meat in today's food system, the SWOT matrix method illustrated pre-innovation circumstances as well as hypothetical post-innovation likelihoods according to relevant actors, though as expressed earlier these views were not always in line according to the interests, attitudes and perceptions of the given actors.

The purpose of such an analysis in a market sense is to facilitate a foresight and assist in drafting prospective contingencies for the predicted threats and acknowledged weaknesses, challenging the success of a venture or technology. In this case gathering an understanding of the role of a proposed technical solution in society allowed for mapping other prospective mitigating strategies, which may be more suitable or complimentary. For example; one informant when asked about the commercial viability of in-vitro meat exemplified the proceeding steps of the SWOT analysis by identifying suggestions to overcome the potential threats foreseen.

*"yes it is commercially viable , if marketed to create consumer demand (…) in order for this to happen there is a need for the private sector food production to see it as an opportunity not a threat (…) and for independent or corporate investors to sponsor development (which is happening) (…) also a need government to endorse it or at least legitimize it (such as USDA certification and sponsor research - make a commitment for health reasons, supply reasons, environmental. Need to parallel fossil fuel energy production alternatives (solar, wind etc.)"* (Informant 14 – email response)

It may be noteworthy that this informant expressed strong support an optimistic interpretation of in-vitro meat technology, and held a respectable position at an organization that had expressed desire to potentially fund the endeavour.

This SWOT analysis along with other preliminary findings, resulted in categorization of data seen in Table 5 Preliminary Themes Identified. Data collection and analysis continued in order to investigate if the average perception of categories was accurate, not all actors and data collected expressed consensus over specific views and therefore more detail through empirical data was collected on informant's perceptions. This was again coupled with relevant supporting literature, to further develop this situational analysis.

*Table 5 Preliminary Themes Identified*

| Concept | Theme |
|---|---|
| **Health** | • Testing and further research<br>• Potential benefits and challenges<br>• Public health concerns with meat consumption |
| **Society** | • Ethics<br>• Consumer behaviour and Technology acceptance<br>• Food culture<br>• Food safety scares |
| **Governance** | • Oligopolies<br>• Transparency<br>• Recommendations<br>• Labelling |
| **Legislation** | • Policy<br>• Subsidies and Taxes<br>• Regulation on novel foods<br>• GM comparisons |

# 3.0 INTERPRETATION

A semi-structured guide was developed based on these concept themes, while conducting interviews and facilitating discussions more specific categories became apparent. It was more precisely these categories, which were used to position actors according to their coordinated and occasionally opposing views and attitudes. As mentioned previously this guide can be found in Appendix A.

As themes were determined prior to interviews and used in the semi-structured guide, analysis began during the facilitation of the dialogues and continued post interview, during transcription and cross-triangulations with other interviews and data material. Analysis was executed through methodologically coding during the process of note taking, material collection, audio recordings, maps, and transcription codes. Table 6 Emerging Categories Used for Continuing Research depicts the narrower categories;

*Table 6 Emerging Categories Used for Continuing Research*

| Theme | Categories |
|---|---|
| **Current Situation** | • Negative environmental impacts<br>• Inefficiency<br>• Unsustainable<br>• Animal welfare |
| **Future Scenario** | • Population growth and demand<br>• Need for more alternative meat sources |
| **Communication** | • Transparency<br>• Framing<br>• Awareness and knowledge<br>• Food safety scares |
| **Potential of Cultured Meat Technology** | • Environmental impacts<br>• Health benefits<br>• Food safety<br>• Society and technology over time |

Many of the emerging categories, overlap and frequently came up inconsistently throughout the concept themes, but as situational analysis and mapping have stated as their core relationships within wider contextual situations are complex, intricate and without finite boundaries, all is subjective in social interaction and striving for a hermeneutical understanding of the situation and each actors position within it difficult but it remained the objective during research [Goldstein, D 1991].

# 4.0 EMERGING CONCEPTS

Continuing data collection and analysis in line with grounded theory and situational analysis eventually led to the emergence of consistent concepts, portraying a more comprehensive understanding in situational analysis. Specifically the use of dialogue

collected and analysis from key informants complimented with secondary research and various other findings allowed for the proceeding central concerns to surface.

## 5.1 IN THE PAST

The Green Revolution and many other historical moments when technology entered the food system can be found throughout history, and this continues to happen. For example the introduction of the tin can for preservation or microwave ovens, GMOs etc.; these instances were also met with initial apprehensions; and some technologies prevail while others do not. According to author Davis, P. [2003], historically conventional crop breeding has increased food production to meet the demands of population growth. Davis, P. [2003] also states that for agricultural development to continue, the exploitation of greater genetic diversity and modern biotechnology are becoming increasingly important. The article [ibid] discusses the milestones achieved by the Green Revolution and many of the other recent breakthroughs of modern biotechnology, these was seen by this author as highlighting the fact that the path in-vitro meat technology is taking is nothing new, nor are technological solutions in food to improve access and availability.

## 5.2 CURRENT SITUATION OF 'THE ROLE OF MEAT TODAY'

Technology is currently widely used in the food production, some of which may be contributing to the detrimental environmental impacts of the system. Many texts and articles regarding this subject exist and evidence has been produced from a wide range of sources, sometimes these texts can be quite subjective, the challenge is that many of the issues which arise can be linked to ethics, choice, attitudes, and perceptions as well as more objective measures such as environment and economy. The subjectivity of the texts was often connected to organizations with specific aims and objectives, which may have presented their more narrow view on certain issues. Illustrated are some of the highlighted issues presented by informants in the food system, pertaining to a situational analysis of the role of meat in society.

The results are presented by coupling secondary research findings with empirical data through quotes collected during dialogue with informants.

## 5.3 ENVIRONMENTAL CONCERNS

Current EU production methods and above global average meat consumption habits, result in the subsequent intensive industrialized animal husbandry systems which have been linked to many detrimental environmental impacts. These practices have implications not only on local environments but also on global ecology, contribute to climate change, excess nitrogen in the environment, land overuse and degradation, loss of biodiversity, water over use and pollution [Gerber, P. et al [2013b]. Specific themes and more detailed categories such as these emerged as the most prevalent concerns among the informants, in relation to environmental impacts of today's methods.

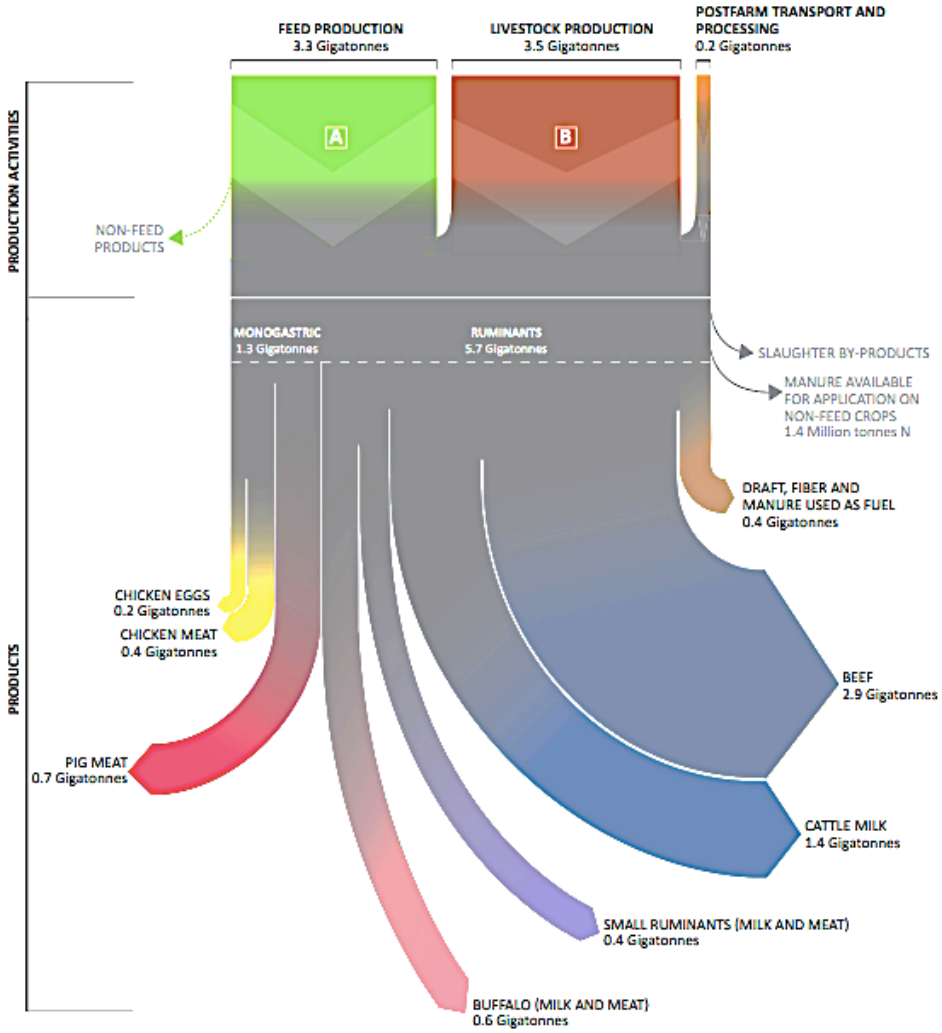
### 5.3.1 LIVESTOCK PRODUCTION LINKS TO DETRIMENTAL ENVIRONMENTAL IMPACTS

Taylor, R. [2011] explains that due to the implications of increased demand for soy production on the South American environment, the demand has resulted in deforestation of the Amazon and Atlantic forest and the conversion of Brazil's Cerrado savannah into agricultural land. Implications include not only an increase in carbon emissions from the farming practices but also a decrease in the available trees to convert $CO_2$ emission as well as the loss of habitat for many indigenous bird and plants species, resulting in a loss of biodiversity. These conversions of land have also been attributed to a loss of important water sources. Tropical forests are responsible for a wide array of ecological maintenance systems of genetic biodiversity, control of soil erosion, water purification and downstream flood protection. Air pollution control and pollination, continuing to clean forest areas can be linked to significant negative environmental consequences [Taylor, R. 2011]. This specific example highlights the effects that EU imports of feed for livestock production have on the global environment and that implications are complex and multifaceted. EU's meat consumption habits are resulting in a need for more fertile lands and resulting in the detrimental effects such as deforestation and inefficient land use [EC 2010b]. Tuomisto, H. [2011] explains meat as a major contributor to global climate change, producing 18% of the world's greenhouse gas (GHG) emissions, which according to *FAO's Livestock's Long Shadow* [Steinfield, H. et al. 2006] is higher than that of the global transport sector. Statements like these caused expressed concern from many informants.

The subsequent from FAO, titled Tackling Climate Change through Livestock [Gerber, P. et al [2013b] breaks this figure down further stating that production of beef accounts for 41% and dairy cattle 20% within the sector, resulting in the majority. Pig, poultry meat and eggs contribute less but still 9% and 8% can be attributed to the production of these foodstuffs. A noteworthy 45% can also be ascribed to methane produced by enteric fermentation from ruminants.

It is not only the implications from onsite animal production facilities but also the considerable amount of land used to produce feed; 45% of the sectors come from production and processing of feed, which comes with a whole array of other issues such as reducing forest areas to expand pastures and feed crop lands (9%). Manure storage and processing account for 10 % and the rest is a result of the processing and transportation of animal products. A brief break down of the distribution between emissions based on production and products can be seen in Figure 3. GHG Emissions From Global Livestock Supply Chains (Process and Products) [Gerber, P.et al. 2013b].

*Figure 3. GHG Emissions From Global Livestock Supply Chains (Process and Products)* [Gerber, P.et al. 2013b].




It was in reference to the FAO's Livestock's Longs Shadow [Steinfield, H. et al. 2006] report that one of the informants expressed his inspiration to start research into innovative technological solutions, agreeing with the conclusion that meat production is one of the main casual drivers to climate change. He articulated that his motivations were majorly environmental, stating;

*"for me in-vitro meat was one of the things we had to do in order to be able to make a much less foot (…) so for me it is at least an environmental thing in the first place, so I think if you look at the food production systems on the planet and what is driving climate change, meat production is one of the main drivers*" (Informant 6 –03.42).

Another informant with a slightly different view and background, also stated his awareness of the contributions of livestock production to negative emissions but that it

may not be an indication that we should be without these systems entirely and that they serve well in other ecological aspects;

*"emissions of greenhouse gases, it is true that livestock production systems emit a lot but I am not sure that the only way forward would be to not have them, and then if we look at biodiversity degradation animal production systems play a quite complex role I mean the extensive animal production"* (Informant 9- 07.13)

Another alternative outlook on the same concept explained that aiming for climate efficient production through the reduction of specifically emission is problematic, as with many other environmental parametrics, reducing one may increase another or simple not take any other detrimental impacts into account [Gerber, P. et al. 2013a].

Only reducing the emission as a change strategy overlooks the many other negative impacts seen within the system, which some informants listed as: impacts on land, soil, water, nitrogen run off, ammonia release or air quality emission, methane etc.

"*environmental ideas have been the victim of their own success I mean if its climate efficient then its sustainable, but again – it is NOT, because rearing livestock produces greenhouse gas emissions but it also have many other impacts first of all impacts on land, soil, , nitrogen run off, ammonia release or air quality emission, methane – there is a new package of air quality which looks at 6 cities and study of them are related to agriculture and livestock, so pollutions of water of soils and of course it then goes, because nitrogen run offs causes pollution, depletes o-zones, and acidification of water streams and seas, also related there are also serious health related impacts because of diet related problems, over consumption, cardiovascular diseases and so forth"* (Informant 11 –10.20)

and another informant adds;

*"EIPRO study in 200* [EUR 22284 EN] *showed that 30% of their average European consumers carbon footprint was through food, if we don't reduce the meat and dairy consumption of Europe, and what's produced in Europe, there is no hope"* (Informant 5- 04.35).

As mentioned above by the Greenpeace EU Environmental Policy Director and frequently in reference literature; many more environmental concerns are attributed to current methods of meat production and trends in consumption, this attitude and perception in regards to the role of meat in today's society was shared by the informants and research informants.

### 5.3.2 LIVESTOCK PRODUCTION IMPACTS ON WATER OVERUSE AND POLLUTION

The growing trend of increased meat consumption puts pressure on production, thus relying heavily on an increased demand for grain fed for livestock. Industrial farming, specifically pork and beef, are quite inefficient in the use of water, a vital resource in food production which is becoming less available. In 2010, circa 25% of the world's fresh water was used for animal production [Mekonnen, M. & Hoekstra, A. 2013].

Generally animal products per tonne have a more substantial water footprint than crop products, but even among specific meat products the ranging impact on global water resources is different, depending on the type of feed and feed conversion efficiencies [Mekonnen, M. & Hoekstra, A. 2013]. Livestock feed conversion efficiency is often simply calculated as feed input per unit of meat output; and authors Parente, S. & Lewis-Brown, E. [2012] argue that efficiency is a more complex equation than feed to meat ratio, but that it should also encompass maximizing the use of resources.

*Table 7 Estimated Amount of Water in Liters Used to Produce One Kilogram of Food*
[Adapted from Save Our Water: www.vrg.org/environment/water_brochure.php]

| Food Item L/kg | Hoekstra & Chapagain L/kg | Zimmer & Renault L/kg | Pimentel, D. et al. 2004 L/kg |
|---|---|---|---|
| Corn | 500 | 700 | 650 |
| Wheat | 850 | 1,200 | 900 |
| Soybeans | 1,900 | -- | 2,000 |
| Rice | 1,600 | 1,400 | 1,600 |
| Cow's Milk | 700 | 800 | -- |
| Eggs | 1,500 | 2,700 | -- |
| Beef (feedlot) | 13,000 | 13,500 | 143,000 |
| Beef (rangeland) | 12,000* | -- | 120,000-200,000 |
| Pork | 3,900 | 4,600 | 6,000 |
| Poultry | 2,400 | 4,100 | 3,500 |

Table 7 Estimated Amount of Water in Liters Used to Produce One Kilogram of Food shows that a literature review done by the FAO indicates that various reputable sources have demonstrated through research findings that meat as an energy source in the diet comes with a high demand of water use. With fresh water being vital to human life as well as a non-renewable resource, many have expressed it with great concern.

The UN World economic and social survey [UN 2011] states *"intensive livestock production is probably the largest sector-specific source of water pollution"* [Steinfeld, H. et al., 2006; p.xxii]. Industrial livestock production is estimated to use significantly more water than alternative forms of animal farming and this is not a result of the water drunk by animals but rather the water needed to grow crops for sufficient feed for the animals.

The use of synthetic fertilisers to grow feed crops contain high levels of nitrogen, and plants only absorb 30-60% of the nitrogen fertilisers applied to them, resulting in a massive source of water pollution [Sutton, M. et al. 2011]. The composition of feed used in industrial animal husbandry is abundant in nitrogen and not all is assimilated by the animals; pigs use just 30% and broiler chickens 45%, the rest is excreted and as waste. The manure is full of unabsorbed nitrogen and resulting in it being washed into rivers and lakes, where it seeps into ground water, contaminates drinking water and disrupts aqueous ecosystems [Steinfield, H. et al. 2006].

*A global assessment of water footprint of farm animal productions;* explains it would be most beneficial in reducing water pollution to particularly reduce the consumption of industrially produced meat. The authors Mekonnen, M. & Hoekstra, A. [2013].concluded that industrial systems used to produce animal products generally consume and pollute more ground and surface water resources than mixed methods and grazing practices used in animal production, particularly due to the dependence of industriall systems on cereal based feed.

Concerns about water and soil pollution were expressed and shared by many informants. References were made to specific reports and also links between the further perpetuating implications of these detrimental impacts. An environmental NGO articulated that in recent European Commissions' package[9] on air quality 6 cities were looked at in relation to agriculture and livestock. Many issues about water and soil pollution were mentioned, consequential in an eco-system this pollution is not stagnant, as he mentioned specifically nitrogen run-off causes pollution, depletes the o-zone and results in the acidification of water sources, not to mention the methane produced and ammonia released. (Informant 11- quoted previously)

Another NGO concerned with animal welfare, voiced strong concern for the inefficient use of water, using a non-renewable resource in excessive ways to produce feed for animals is in his opinion is an inefficient and unethical conversion.

*"what we've got at the moment is a very resource inefficient livestock system, I mean the core of some of the problems, is the use of human edible crops to feed animals, there is a number of different studies but one of the most conservative estimates is that on average of every hundred calories that we feed to animals, from human edible food, we are just getting 30 calories back, other figures suggest that figure is quite lower, a conservative 30%, is resource inefficient -that means that provide a unit of nutrition we using much more land and more energy because of its inefficiency, and theirs alternatives like direct consumption of crops or make sure that the fed that we are using is not human edible cereals"* (Informant 2 -03:44)

[9] http://ec.europa.eu/environment/air/clean_air_policy.htm

Specific reference was also made by Informant 2 to the water foot print. He explained that as more awareness is raised about environmental issues, it is not only the carbon foot print being discussed, but also the use of water – 84% of the modern consumers water footprint comes from food[10] and as can be seen in Table 7 this number can be greatly reduced by a conscientious consumption and more plant based diet.

### 5.3.3 FOOD PRODUCTION EFFECTS ON ARABLE LAND

A more region specific perspective by an environmental engineer raised concerns about the current intensive systems and the trend to produce the more profitable crops. This is an industrialized approach to animal production, which seems to be leading the future. This actor articulated how specialization in farming is not compatible with political environmental objectives like the water framework directive;

*"more farmers transform their pastures into fields of wheat or rapeseed because it is more profitable for them and that trend is the trend with which we have to deal, that is quite consistent with quite an industrialized and intensified systems of animal production that will be the only profitable ones in the future, while if I look at my concerns about biodiversity and landscapes but also nitrogen cycle, phosphorous cycle in the agricultural landscape that specialization if it continues is really not compatible with the environmental objectives like the water framework directive, so (…) at the European scale the tricky scenario is (…) to develop a scenario where we reintroduce animal production systems in regions which are specialized in cereal production for instance, because they would play a key role for re-diversifying agricultural systems at the regional scale which is necessary for environmental purposes"* (Informant 9- 07.13)

Arable land is currently largely used up the production of livestock feed. An FAO report [FAO 2011]; exemplifies livestock feed as being responsible for one third of global cereal production and up to 55% of all coarse grains. Gustavsson, J. et al. [2011]; concluded that by converting the use of 16 staple crops from animal feed or other uses, to solely for human consumption, food availability for human consumption would rise by 28%, over a billion tonnes, and specifically an increase of 49% in available food kilocalories. A study by Lundqvist, J. et al. [2008] stated that just 30 calories in the form of meat of milk requires 100 calories of feed from crop edible by humans, and this can arguably be seen an unethical and inefficient use of 60% of EU cereals. With the UN and FAO reporting an approximate 870 million people in the world, a figure that equates to one in eight people globally, suffering from under-nutrition in 2010-2012, the use of cereals to feed livestock can be defined as inefficient. Of those undernourished, 98% reside in developing countries and still 16 million people living hungry in developed countries [FAOb 2012].

[10] http://www.waterfootprint.org/?page=files/home

## 5.4 SOCIAL CONCERN OF LIVESTOCK PRODUCTION

Drawing the line between effects of current production methods within the realm of sustainability is difficult. The intricacy and complexity of the food system presents many integrated 'situations' and separating them based on the classic pillars of sustainability; environment, social and economic is challenging. Ethics, health and food safety are here expressed as more  to do with social concerns.

The negative environmental impacts discussed are not so cut and dry according to the FAO, the livestock sector is a major global economy, generating just under 1.5 percent of total GDP. Specifically in developing countries the sector is socially and politically important providing food and income. Particularly in dry areas where other forms of agriculture are difficult to cultivate livestock is sometimes the only source of livelihoods for one billion of the world's poor. *"Since livestock production is an expression of the poverty of people who have no other options, (…) "the huge number of people involved in livestock for lack of alternatives, particularly in Africa and Asia, is a major consideration for policy makers."* [FAO 2006]. Concerns such as these expressed by the FAO demonstrate the potential effectiveness of the proposed agro-ecological approach, which as mentioned includes participatory action from various actors resulting in 'empowerment' and considers socioeconomic and sociocultural dimensions within specific contexts such as the above mentioned vulnerable societies.

### 5.4.1 LAND USE, ETHICS AND NON-FOOD

It is not only the implications from onsite animal production facilities but also the considerable amount of land used to produce feed; 45% of the sectors come from production and processing of feed, which comes with a whole array of other issues such as reducing forest areas to expand pastures and feed crop lands (9%). Manure storage and processing account for 10 % and the rest is a result of the processing and transportation of animal products. A brief break down of the distribution between emissions based on production and products can be seen in Figure 3. GHG Emissions From Global Livestock Supply Chains (Process and Products) [Gerber, P.et al. 2013b].

In 2011 Argentina and Brazil harvested 44.3 million hectares of soy, (26%) was produced for the EU market [FAOSTAT 2013]. Data from the European Commission shows that 30 million tonnes of soy is imported per year, a larger majority is for animal feed and 27.4 million tonnes came from Argentina and Brazil in 2011-2012. The use of arable lands for feed production poses some ethical considerations in regards to social impacts as additional detrimental environmental impacts as some were previously mentioned.

Biofuels is another concern in regards to the issue of land use in production, as it can offer another perspective on social impact to this situational analysis. The growing use

of biofuels for energy is increasing in demand, specifically by developing countries, resulting in agricultural resources like labour and land being used to produce biomass. This growing demand for biofuels, coupled with an increase in population and growing economies drives food prices up [Schaffnit-Chatterjee, C. et al. 2011]. For those already malnourished and hungry these price increases will lead to public health problems, specifically protein malnutrition. It is forecasted that by 2020 prices of cereals are expected to rise 20% and meats by 50% [Von Braun, J. et al. 2012]. If growing biomass is more profitable than producing food this creates a challenging ethical situation, it also creates a difficult economical situation for those producing in developing countries, especially when competing for land with large companies responsible for land grabbing[11].

Olivier De Schutter, UN Special Rapporteur on the Right to Food has documented his concern that land grabs are limiting communal access to land and small-scale producers' livelihoods, and therefore threatening the realization of the right to food [De Schutter, O. 2011]. From the Right to Adequate Food's report Land Grabbing in Kenya and Mozambique (2010); it was expressed that the majority of current international investors are the Gulf States specifically China, South, India, Japan, Libya and Egypt, but the United Nations World Investment Report identified that Italy, Norway, Germany, Denmark, the United Kingdom, and France were amidst the largest investors [UNCTD 2011]. The increasing demand for land for agricultural production to support EU production and consumption habits has been shown in this report to negatively impact livelihoods of those globally.

Concluding, the density of agricultural systems is difficult to map, and the interdependent components cannot be used individually to evaluate the respective sustainability of a system or production method. Isolating specific environmental or economic metrics can also result in a failure of assessing the entirety of the situation. Reflections throughout the situational analysis on the whole livestock production system drew conclusions on several occasions that indicated apprehensions of it's efficiency.

An ethical perspective on inefficiency can be discussed in relation to the right to food, with a growing population and still a massive gap between people being over and under nourished it can be argued that the current use of edible crops for animal feed may be inefficient. A policy director from an animal organization points out that the methods that are being used at the moment create a very resource inefficient livestock system, and the core of some of the problems, is the use of human edible crops to feed animals. He refers to a number of different studies and concludes that the most conservative estimates present that on average, of every hundred calories that we feed to animals,

[11] Murphy, S. [2013]; defines land grabs as a term coined by the media to describe large scale purchases or leases of agricultural or forest land on considerably unethical terms, often negatively impacting livelihoods of those already inhabiting the land.

form human edible food, 30 calories are returned, other figures suggest that number is lower, in his opinion even a conservative 30%, is resource inefficient meaning that to provide a unit of nutrition much more land and energy is used because due to inefficiency.

(Informant 2- 03:44 quoted previously)

The director of a technology innovation company also discussed the inefficient use of land describing it as the ultimate non-renewable resource and stating specific ratios of land use. Frustrations were expressed in regards to the level of inefficiency and its results on environmental impacts, describing meat production as one the largest contributors to environmental problems.

*"The ultimate non-renewable resource and we are already using 30% of our ice free land for livestock farming and that represents about 70% of agricultural land so we're really using the vast majority of land to create a food that not everyone eats and is often wasted and its very, very inefficient and its kind of ridiculous how inefficient it is so the environmental impact was the numbers, just got me you know when I was researching about it because you know, they are immense and huge and I mean you usually think of farming as you know now contributing to you know disasters to the environment but definitely I mean I would say the meat production industry is probably one of the biggest wears on the environment"* (Informant 7- 02.20)

Along with the above mentioned implications of consumption on the ethical considerations regarding the distribution of food also come more concerns of human health and animal health and welfare.

### 5.4.2 HUMAN AND ANIMAL HEALTH

A position paper written by the European Public Health and Agriculture Consortium (EPHAC) on "The Future of the Common Agriculture Policy" defined dietary determinants of non-communicable diseases (NCDs) as main contributors and explained the interrelation with co-morbidity. Among the main contributing dietary determinants was red meat and highly processed meats; of those meats which have been smoked, salted or added preservatives are persuasively linked with an increased risk of NCDs especially cardiovascular disease (CVD) and several cancers [WCRF 2007]. The World Cancer Research Fund [2007]; found negative effects on blood cholesterol to be linked primarily to red meats together with dairy products as the major sources of saturated fat in the diet. The same study stated that 12 % of colorectal cancers could be prevented by avoiding processed meat due to their tendency to exhaust the digestive tract. Processed meats and animal products are often preserved with salt and have a content of salt additives, which are associated with increased blood pressure, cholesterol levels and risk of cancer [WCRF 2009].

Recommendations for fat intake should be between a minimum of 15% to a maximum of 30-35% of and adults total energy consumption according the United Nation's (UN) Food and Agriculture Organization (FAO)[FAO 2010]. Statistics on European cardiovascular disease display that in many member states fat intake exceeds these recommendations and some countries fat makes up more the 40% of energy intake. There is a correlation to livestock products containing substantial amounts of saturated fat, a known risk factor for cardiovascular disease [Nichols, M.et al. 2012 & Friel, S. et al. 2009] one of the leading causes of premature death among EU citizens [WHO 2012]. Evidence exists linking the intake of saturated fat to cardiovascular disease due to its effect on serum cholesterol concentrations [Friel, S. et al. 2009]. In the European Heart Network's (EHN) review of dietary determinants, evidence suggested it is likely that an excess intake of overall fat. The dietary habits of western diets contain a high proportion of animal products, which increase the intake of saturated fats, energy density and dietary cholesterol increasing blood pressure and therefore increase the risk of strokes [EHN 2011].

Many of the informants discussed the considerable health implications of the high meat intake of today's society and the need to reduce consumption of animal products. Specific considerations and mitigating strategies proposed by the different actors/stakeholders and informants, will be discussed further on. Cultured meat has been, through analysis revealed to be, controversially capable of producing a 'healthier' product than conventional meat. This discussion entails technological methods of culturing polyunsaturated fat cells as oppose to saturated fat cells, working with 'healthy' omega 3:6 ratio or reduced fat in general. The attitude regarding the level of manipulation differed among the informants and by some may even be where the line would be drawn for acceptable/unacceptable, or GMO or non-GMO.

Both informants from the field of biology and a high level of knowledge regarding the technology, responses to questions about whether or not in-vitro meat has the potential to be healthier than conventional meat;

*"you can change cells as such but then you go to a next level of manipulation, then you can for instance have a genetically modified cell type but then it's a new level of manipulation, so I would never sell it as such because that's just a little bit too much"* (Informant 4- 15:00)

*"yea actually it can, actually people have approached me with that because they say that in animals you see this deterioration of DNA and amino acid and you don't get high quality protein and that by having this short term culture, you actually have a more, and of course we can adjust the omega fatty acid ratio or whatever we want into this so it will be some sort of bioactive food in any case"* (Informant 6- 44.46)

In relation to the level of manipulation, this may also affect the food safety evaluation cultured meat would be subject to.

### 5.4.3 FOOD SAFETY

Health concerns also affect other actors in the food system; the health of the animals consumed is a key factor in food safety and is greatly affected by the methods used in livestock production. These specific methods have also been linked to many food scares specifically within Europe but also globally. Issues of transparency and traceability with animal products have become high priority, for all actors in the governance triangle.

EFSA's research from 2014 indicates that between 33 and 50% of all human infectious diseases are transmitted from animals; also called zoonotic sources. In the past 10 years, their research has indicated that approximately 75% of the new diseases that have affected humans have originated from animals or animal products. Zoonoses can be transferred between animal and human in various ways, but most relevant to this case is through the instance of food borne disease [EFSA n.d.].

Assessing risk along the EU food chain and ensuring adequate consumer protection and animal health are the main roles of EFSA, this is done in support of the Member States through collective data sharing and assists EU policy makers in decision making processes. The specific work by EFSA on Zoonoses includes;

- *Annual Monitoring*
- *Data Collection*
- *Risk Analysis*
- *Risk Assessment*
- *Recommendations and advice on risk management* [EFSAd 2011]

Common food-borne zoonotic infections in the European Union (EU) are caused by bacteria such as Campylobacter and Salmonella and can be contracted for indirectly from consuming contaminated foodstuffs [EFSA n.d.]. The WHO defines Campylobacter as a bacterium causing intestinal infections, in most cases the infections are mild but can lead to death among vulnerable groups such as children, the elderly or immunosuppressed individuals. The bacteria can be found in foods coming from warm blooded animals, as the bacteria typically populates the intestinal tract of animals such as poultry and cattle [WHO1].

A separate report by EFSA's Panal on Biological Hazards (BIOHAZ), from 2010 attributed an annual of 9 million cases of Campylobacter per year among the EU-27 member states, consequently resulting in 350,000 disability adjusted life years (DALYs)[12] per year.

[12]Disability-Adjusted Life Year, a metric used to quantify the burden of disease from mortality and morbidity; defined by the World Health Organization as, one DALY can be thought of as one lost year of "healthy" life. The sum of these DALYs across the population, or the burden of disease, can be thought of as

This figure has been equated to a total annual cost of 2.4€ billion with a 4% increase from 2008 to 2009 in confirmed reported human cases, and 2009 reports state Campylobacter as the highest frequently reported gastrointestinal bacterial pathogen in humans in the EU [EFSAd 2011], showing that these impacts are integrated and effect health system economics as well.

Salmonella has been defined by the WHO as a genus of bacteria which is a large contributor to food borne illnesses worldwide and is typically transferred to humans through consumption of food of animal origin, mainly meat, poultry, eggs and milk, which has been contaminated [WHO2].

In the EU over 100,000 human cases of salmonella are reported each year, this food borne disease is a weighty source of economic loss, morbidity and even mortality. As high as 3€ billion annually has been the estimated overall economic burden on the EU, where most frequent cases have been found in eggs and raw meat from pigs, turkeys and chickens Again the importance of rearing practices have been shown to play a role in the spread of disease and the bulk of EU poultry and pig production is industrial, thus increasing the susceptibility to disease [EFSA3]. It can be concluded that among campylobacter and salmonella outbreaks many other serious food borne illnesses with detrimental consequential effects can be linked to the production and consumption of livestock in the EU, and result in high health care costs as well.

With the growing exposure to such illnesses and outbreaks, it is daunting to consider the current discussions antimicrobial resistance as global public health problem.

### 5.4.4 ANTIMICROBIAL RESISTANCE

In order to safe guard against more food safety scares, like BSE[13], precautionary measures are taken in livestock production [Silbergeld, K. 2008]. Agricultural use of antimicrobials is utilized as veterinary medicine and added to feed, as well as in crops and fruits as biocides. Antimicrobials are also used in aquaculture, but the predominant use is in livestock production of poultry, pork, and cattle, with minimal use in plants. These changes in the way antimicrobials are used in agronomy can be attributed to the changes in the system of over the last 60 years, back to the beginning of the green revolution and the intensification of agricultural industry. The growth in industry created a shift in the relationship between animals and humans in relation to the food borne illness and infectious diseases [Cabello, F.C., 2006 & MacManus, P, R. et al. 2002].

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a measurement of the gap between current health status and an ideal health situation where the entire population lives to an advanced age, free of disease and disability. Source: http://www.who.int/healthinfo/global_burden_disease/metrics_daly/en/

[13] Bovine spongiform encephalopathy (BSE), commonly known as mad cow disease

Currently, common practice of the production of animal products has animals crowded and/or confined to houses or feedlots, creating sub optimal sanitary conditions, and strong catalysts for host-to-host transfer of disease. This disease has in many cases been passed on to humans through consumption or exposure of some kind, for example BSE or Swineflu. Antimicrobials have therefore been used as nontherapeutic precautionary tools, supplemented in as feed additives, whereto Silbergeld, K. [2008] conclude this to be a foremost precursor in driving the growing incidence rates of antimicrobial resistance globally. Simply put the nontherapeutic use in animal's breeds a resistance among them, increasing likelihood of infection. An abundant intake of meat and animal products reared on such a basis can expose humans to the same nontherapeutic medicines and build a resistance within the human system, in which case the body's immune system will simply no longer respond to medications and they lose their curative effect.

The expressed concerns were also shared by some of the informants, when asked about opinions in regards to livestock and public health, the director of an innovation company described the current situation of viral epidemics as scary and correlated their occurrence in the food chain as being linked to specific production methods. Elaboration illustrated associating these occurrences to environments where animals were packed too closely together, enabling viruses to quickly jump from animal to animal and animal to human, and continue to spread rapidly across the globe, given international trade's role in the current food system. Additionally the over use of antibiotics, by informants, was worrying because building a resistance would mean these epidemics were even more complicated to deal with, a specific reference was made conveying frustration, explaining that historically the technology behind antibiotics was thought to be able to save the world and current processes seem to be undoing societal progress.

*"I am talking more about viral epidemics that come out of these situations where animals are just so closely packed together that viruses can quickly jump from animal to animal and animal to human to animal again and create these epidemics that spread across the world insanely quickly and then of course there is the antibiotic resistance, we have done so much in our history to create antibiotics to you know save the world and now we are undoing all that progress by you know feeding them to animals so, it's a really terrible in that sense"* (Informant 7- 18.30)

A microbiology expert acknowledged awareness of the current over use of antibiotics, and the likely repercussions of a built up resistance to this over exposure. Furthermore, considering the life cycle of these antibiotics;

*"like with animals when you are overfeeding with antibiotics, you also have bacteria that are living in the system that can become resistant, the same problems of over exposure and resistance from animal to human etc. (…) we have to consider where those*

*[antibiotics] are going and how much of those would get into the food itself"* (Informant 8 – 27.08)

An environmental engineer also expressed the need to consider not only the over use of antibiotics in terms of animal health but to also reflect on the lack of biodiversity among species breed for consumption due to their high productivity and to alternatively also consider their robustness in relation to health Increasing breed selection to include immunity and more health components is considered to be helpful in reducing the vulnerability associated with the use of antibiotics and highly specialized animals;

*"we have lots of concerns about the trends that are at stake, trends about the disappearance of the extensive systems about the probable trend toward intensification and the apparent trends that go with that intensification that are about the difficulty to avoid using antibiotics at very levels and probably what might be the linked the vulnerability of those very specialized animals"* (Informant 9 - 18.19)

Silbergeld, K. [2008]; conclude that the ways in which antimicrobials are used in agriculture affect food safety, environmental quality, and community health risks, are very complex. Their use affects animal, human and plant health but entire ecosystems. Resistance can flow among organisms when resulting reservoirs of microbial resistance are produced in ecosystems, largely at the cost of current agricultural practices, the public health impacts are considerably wide spread, as was mentioned as a concern by Informant 8 previously.

Even though research exists explaining many of these detrimental effects such as antimicrobial over use; some underlying power/interest structures and relations are thought to be responsible for allowing such practices to continue, as was indicated during this situational analysis.

## 5.5 POWER/ INTEREST AND LIVESTOCK PRODUCTION

The common theme when discussing economics and the industrial sector regarding the role of meat was analysed through positional mapping based on power and interest of actors. The main emerging theme expressed by informants was the challenges this proposed to governance. The strong interest of industry to profit, and of course national interests as well – coupled with the high level of power these financial incentives drive in society and politics were discussed. How this power and interest relation plays out in consumers was also discussed, but generally the findings expressed that informants considered the current distribution of power in the food system to be problematic and challenging to implementing positive change;

*"Industry reactions to governments campaign or recommendation reduced meat consumption: Would react very defensively, is reacting very defensively, no doubt about it"* (Informant 1- 13.00)

Power and interest discussions from the consumer perspective was also discussed;

*"yea the consumer has a certain amount of power but the space the amount of power is shrinking continuously and we as an organization, we are skilled at working at that power in the sense that we try to expose the issues to consumers in order for them to react or demand or urge a change that food companies and retailers can internalize in their system so we are aware of that power but that power is limited to an extent that I don't think, its very difficult that that power will be able to change in the system it is definitely able to amend some aspects for the system, whether this is cosmetic or substantial ones, well the jury is still out, I am slightly pessimistic, I think that is consumers can drive in Europe a rejection of genetically modified food and feed, has been clear, consumers have been directing that kind of rejection to retailers and retailers have closed in on that"* (Informant 11 -40.14)

and from an informant from an American context;
*"in the United States genetically modified plants are totally the norm, so like when people do know about it or like there's definitely a group of people who are very vocal about being opposed to it – but it is a major part of the American food system, because of the ways that the law is terms of the labelling, they were hashed out like 30 years ago if in-vitro meat lobby is able to put meat into the supply in a way that is similar to genetically modified plants, that you don't see, like it just becomes a commodity that's like unlabeled and mixed into this very big system of food production um then I think that people will eat it, people might be upset about it, and there might be opposition but I think overall that it could follow similar trajectory to the way genetically modified plants have gone".* (Informant 9 -19.23)

As the informants above have indicated the dispersion of power around the issue is challenging, and Informant 9 specifically expresses how strong the industrial lobby is. Though this is a case outside the EU, the lobby from industry is strong everywhere and happens in the EU as well. Also given the globalized nature of the food system, effects of lobbying in the US may still have impacts overseas, since governance of food is also covered by international legislation, for example the Transatlantic Free Trade Agreement.

## 5.6 THE FUTURE ROLE OF MEAT IN SOCIETY

Identifying the current situation in relation to the role of meat in society gave rise to foresights and perspectives of the future situation. Many of the identified concerns are difficult to isolate temporally in the situational contextual analysis and have future implications as well as relevant prior casual factors. The issues concerning the current

system according to available literature, informants and this researcher far exceed what has been mentioned briefly preceding this section of the report. The early depiction has introduced the reasons for interest in the situation and the motivation for investigating mitigating strategies. Distinguishing best practice among the options suggested is not the aim, but rather to illustrate the potential of the various optional solutions or strategies proposed by the various actors/stakeholders and specifically informants and the resulting implications. Mainly, the potential for the role of cultured meat as a mitigating alternative technological solution has been studied, meanwhile the situational analysis gave rise to numerous complimentary or different resolution ideas.

## 5.7 THE POTENTIAL OF CULTURED MEAT IN SOCIETY

***Is there Room for Cultured Meat on the shelf? – A Case Study investigating actor perceptions on the potential for in-vitro meat as a mitigating solution to Europe's conventional livestock systems challenging implications.***

Along with environmental impacts, the consumption patterns of animal products in the EU also have impacts on societies globally. Specific EU issues such as food safety can be discussed taking into account the numerous scares in regards to foodborne disease linked to livestock production and consumption in EU member states, as well as the lack of transparency in livestock rearing practices; composition of feed, animal welfare etc. In this regard there are also the international issues of antimicrobial resistance on health and the distribution of food globally. Summing up the environmental, social and economic impacts on sustainability of the meat production and consumption practices lead to the discovery of some the proposal of some conventional solutions, but also novel innovative alternative meat producing technologies; specifically cultured meat.

Informants displayed a wide array of attitudes toward this issue;

*"a solution that attracts attention while not really solving the basis of the problem and of course there is a practical problem that according to professor Post is still, the price, even considering other kinds of scales is still absolutely astronomical for the time being – currently forecasting 65 dollars per kg, the best meat in Europe the highest finest quality I don't think, even organic cannot get to 65 dollars per kg, the highest animal product I can see is Parma ham of the highest quality is around 50 and its crazy already"* (Informant 11- 21.13)

*"In vitro meat, however, is unambiguously a cruelty-free concept/product (especially if grown in a non-animal serum or medium and produced from cells already in the bank. There are some who may argue - even within the animal rights/welfare community that it still incorrectly puts the emphasis and resource/research into simulating the anachronistic meat production and we should focus on alternatives that don't try to*

*reproduce that faulty and primitive logic. However, in vitro meat is cruelty free and that's the bottom line for us - we are pragmatic that way: it's the "beef without the cow", without the cruelty of intensive farming and slaughter, and without the environmental destruction/contamination and health consequences caused by conventional meat production. PETA has supported the development of in vitro meat through the funding of a three-year post doctoral fellowship contract that was completed this spring (Dr. Nicholas Genovese) - we also ran a million dollar contest challenge for the development of the first commercially viable in vitro chicken product"* (Informant 14 – response via email).

Preceding quotes support some of the threats expressed in the SWOT analysis, additional concerns were articulated by other informants;

*"there are all kinds of fundamental questions behind it, supermarket chains or even production chains are the companies I think that will eventually sell or produce this in-vitro meat … but when you speak with those people they all say well its too early at the moment and they are not really wanting to invest, at least the people that I spoke to, because they are afraid that they invest and somebody else will produce it and make profit out of it so its just too early for them*" (Informant 4- 23.29)

Specifically addressing to the weakness and threat of lack of funding to further develop the technology, informants shared the following;

*"if the technology is correct we will have a push on this when things are even more detrimental but we should have started well before that but I would say that this needs billions of €'s of investment and this can drive a lot of technological development etc. but it has to come from environmental money (…)*[14] *primarily governmental funding has driven the big technological changes, it is a myth that venture capitalists have driven anything, they come at a much later stage (…) we can absolutely produce a large volume of this stuff at a low price but as long as there is no one funding this there will not be any development"* (Informant 6- 11.04)

and from a private organization supporting cultured meat;

"*the challenge right now for New Harvest is there is no real established industry so we are kind of now working together just with academia and philanthropists, to take the place of funding through industry and its very interesting but I you know I think it is going to change slowly as more companies emerge"* (Informant 7 -14.45)

[14] Reference made to publication by Marianna Mazzucato on innovation and technology called The Entrepreneurial State – Debunking Public vs. Private Sector Myths

New Harvest director and their homepage[15] also mentioned opportunities the in-vitro technology cold provide, many were in relation to addressing the emerging themes on detrimental environmental impacts.

### 5.7.1 IN-VITRO MEAT AND ENVIRONMENTAL SUSTAINABILITY

Despite the stated financial challenges, motivation for developing this technology is largely driven by it's anticipated or foreseen prospective capacity to operate with lessened detrimental impacts in relation to current methods; most specifically environmental and human and animal health. The need for reducing the over use of non-therapeutic anti-biotics has been again mentioned by Pluhar, E. [2010] as necessary, even for vegetarians since the effects have impacts on the entire ecological system – cultured meat is anticipated to have the potential to be harvested without the overuse of such antibiotics and improve food safety [Tuomisto, H. et al. 2011]. Though the European Union regulated against this type of use of antibiotics in 2006, it is still common practice in the US and taken trade into account, Europe can not avoid these effects and the number of antimicrobial resistant strains of bacteria are increasing. Tuomisto, H. [et al. 2011] explain cultured meat can prevent the spread of animal-borne diseases and epidemic zoonoses by the reduced need for animal contact; between animals and animal to human. Another perk of the technology according to Tuomisto, H. [et al. 2011] is stated as, the controlled conditions in which the 'meat' will be produced will facilitate the manipulation of nutritional, textural, and taste profiles; quantity and quality of fat can be reduced. Moderating some of the human nutritional problems mentioned previously in relation to consumption of animal products, saturated fats and the increased risk of nutrition related non-communicable diseases.

Tuomisto, H. & Roy, A. [2012] estimated the potential environmental impacts of large-scale cultured meat production and compared them with conventionally produced meat products, given the infancy of the technology calculations are based on qualified estimations and the use of the Life Cycle Assessment (LCA) methodology. The results concluded that the production of cultured meat would reduce the demand for land use compared to current European livestock production practice and produce considerably less GHG emissions. Specific calculations demonstrated efficiency in production would be linked to the specific type of meat production; the energy required to produce cultured meat was calculated as being lower than that of beef, pork and sheep but higher than the current production of poultry.

[15] New Harvest is a non-profit research organization advancing alternatives to conventionally farmed meat http://www.new-harvest.org

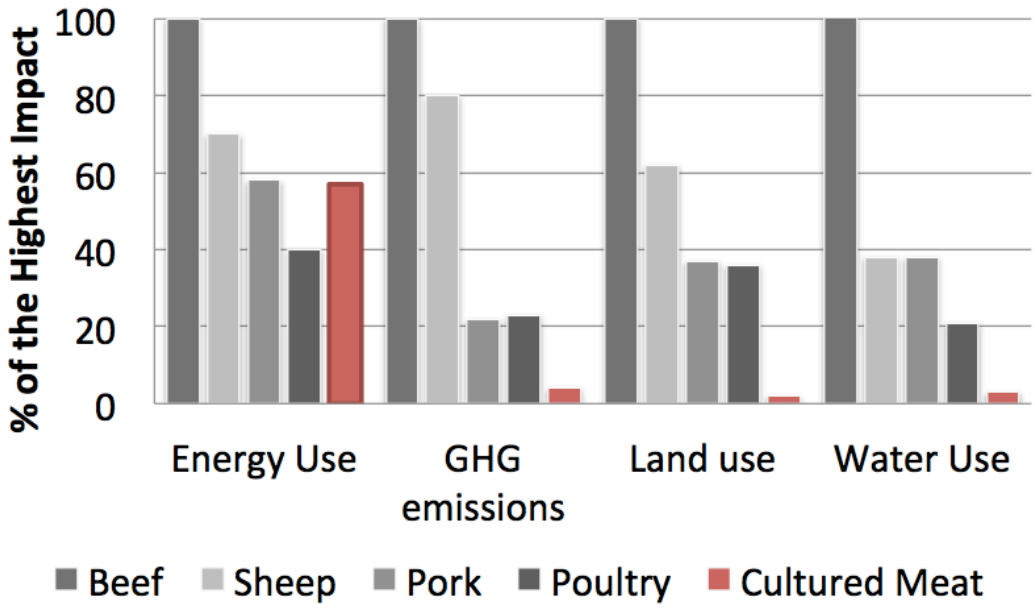


*Figure 3 A comparison of various meat production on environmental impacts* [adapted from Tuomisto, H. et al. 2011]

Figure 3 from Tuomisto, H. et al. (2011) also illustrates a predicted lower need for water in the production of cultured meat, along with a reduced need for land use, which have both proven to be major concerns in current livestock production methods by informants and literature sources. Many informants expressed differing opinions in the accuracy of these estimates, or felt as though many peripheral factors were not taken into account; such as other potential strategies. The large scale production capacity of the technology, affordability, consumer behaviour and acceptance, different environmental impacts, legislative and governing issues all surfaced as questionable aspects which needed further research. Triangulation in this situational analysis illustrated the different synergies and opposing opinion among the actors in regards to the different themes.

Particularly in relation to the plausibly positive environmental improvements, some actors were very sceptical while others very enthusiastic. Informants that seemed to view the novel technology with an optimistic outlook for the future of environmental impacts tended to be those directly working with the technology and animal welfare/rights organizations.

### 5.7.2 CULTURED MEAT AND ENVIRONMENTAL ECONOMICS (JEVON'S PARADOX)

An interesting perspective was shared by the Greenpeace EU Environmental policy director (Informant 11). In reference to the apparent increased sustainability of the new innovative technology, he framed it through the economic theory, Jevons paradox or the rebound effect. This theory explained by Alcott, B. [2005] in the Ecological Economics

Journal, but first observed proposed by Jevons, W. S. in 1865 as *The Coal Question* states that "*It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth"* [Jevons, W.S: 1866 VII.3]. This economic growth theory rationalizes that technological innovation and advancement is the main cause of increased production and consumption, this idea is controversial by different social groups and stakeholders; some believing that it is possible to lessen negative environmental impacts by efficiency gains, which may allow for lower demand of consumption. The opposing view is that moving toward sustainability through the 'efficiency strategy' may alternatively end in the 'rebound effect' [Alcott, B. 2005].

The researcher hypothesizes here that, this effect may apply to, not only, the forecasted innovative technologies such as cultured meat but also past technological events in the food system; where the green revolution resulted in the increased production and consumption. Additionally, technological advancements like GMO feed reducing production costs of meat, and simultaneously a rise in consumption of animal products in proceeding years may exemplify another instance of this theory expressed in the food system.

Often used in energy economics and conservation studies, the rebound effect is represented as a ratio of loss versus gains, in environmental economics gains would be considering reduced negative ecological impacts. This effect is most often referred to in relation to energy consumption but can be applied to natural resource use, or other various social inputs for example labour. It suggests insight into social responses; behavioural or other systemic responses resulting in more efficient use of resources as a result of technology. As mentioned by Jevons paradox these societal responses contradict the proposed favourable outcomes of the new technology or innovation. According to Grubb, M.J. [1990] the existence of the rebound effect is uncontended but questions surfaced in regards to the magnitude of it's relevance in real world situations [Grubb, M.J. 1990]. Greenpeace Environmental Policy Director believes the global food system and livestock production through an increase in technology methods, may be relevant expressive example.

Three economic responses have been summarized according to rebound effect theory; explained here through the case study of in-vitro meat as a hypothetical feasible innovative technological solution:

1. Direct Rebound Effect: increases in consumption of cultured meat because of the substitution effect lowering the cost relative to conventional meat
2. Indirect Rebound Effect: an increased savings on the price of meat results in more consumption
3. Economy Wide Effects: in-vitro meat technology generates economic growth and new production possibilities

Wackernagel, M. & Rees, W. [1997] add that maintaining original costs of commodities through taxation or other regulatory efforts of these new cost saving technological advances is important in evading rebound effect.

Wackernagel, M. [et al. 1997] defines the rebound effect by illustrating the varying consequences based on the scope:

- Negative Rebound Effect: the actual saving in resources is higher than expected, can occur as a result of governance supporting the use of more resource efficient technologies despite higher monetary costs and no reduction in the cost of goods.
- Take Back Effect: the actual savings less than expected savings – the rebound effect is between 0% and 100%; the most common result of empirical studies on individual markets.
- Jevons Paradox: The actual resource savings are negative – the rebound effect is higher than 100%.

In summary, by reducing inputs and therefore costs, grows the demand – countering any intended savings. Increased efficiency accelerates economic growth, further increasing the demand for resources [Alcott, B. 2008]. If in-vitro meat can reach the production stage in the manner suggested by Tuomisto, H. [et al. 2011] and fulfil the predictions of some of the 'pro' cultured meat technology informants a debate about the predictions and Jevons paradox can be generated, questioning whether the technology will increase meat consumption per capita and demand other resources or have 'other' detrimental impacts on the environment.

Though not all informants mentioned *Jevons Paradox* or the *Rebound Effect* many expressed concerns which may lie within the forecast of this theory when it came to considerations about cultured meat production, especially when framed as a mitigating strategy to rectify detrimental impacts of current livestock production methods.

During discussions with the informants various concerns were expressed confirming apprehensions in line with Jevons' Paradox. As mentioned previously many of the efficiency assumptions are based on predictions which created a lot of scepticism, regardless of these predictions the conclusion among many was that either way this technology will require some inputs;

"*the stem cells need to be 'fed' and exercised, kept warm etc."* [Informant 8 – 14.55]

The most optimistic scenario would have this system as environmentally efficient in terms of sustainability as technologically possible, recycling water and feeding with cells with algae etc. but as the informants voiced, that hypothetically if the technology reached the stage of industrialized production it would require large quantities of these inputs, stressing other aspects of the environment perhaps and still disrupting eco-

systems. The algae will also need to be produced somewhere and if the demand becomes high it will also be farmed intensively a postdoctoral biologist articulated thoughts regarding technologies abilities to address these issues adequately, stating;

*"getting caught up in it's 'high-tech-ness' many of the key problems may be hidden – specifically the limited dialogue about the resources that will be needed to produce on a large scale, some details are missing from the whole story and when considering food systems specific components need to be explained; the rhetoric and hype avoid potential difficulties like what will be used to feed the cells, if it should be algae where will be produced and generally the amount of assumptions and level of positive framing mask the challenges".* [Informant 8 – 12.53]

The idea was described as being in line with the reductionist approach by Informant 8, as a proposed solution, multiple informants agreed it may not be so simple;

*"it looks like the third generation of biofuels using algae it seems that it would be in a fabric, so you wouldn't have any environmental impact you would deal with any emanations of gases to exactly capture them because they would be just a co-product of a new resources for energy and everything should be under control. The thing is that, how do think of a deployment scenario of those technologies and what is the order of magnitude of what you need to produce as inputs for those systems in terms of algae for instance then where do you produce the algae and what does that have as an impact , so my point would be to say that cultured meat would have, it will be an interesting way to try and control every part of the environmental impact or air influence on green house gases and that might be something to be explored, I have a question or a doubt about the remaining environmental impact through the production of nutrients even if its algae, because I don't know where and how you produce algae, and then my other question would be we might also need the real animals to, if we want to have a more complex agricultural landscapes"* [Informant 9 – 49.17]

Informant 5 expressed an over all approach stating that it would not be a sufficient solution, even if the technology was more efficient because it is not the root of the problem;

*"I think we need sustainable dietary guidelines, we have got to be saying – do we want consumers to reduce their carbon footprint in total or do we just want to leave it to individual products to have their carbon reduced, if we do the later, that wont deliver sustainable diets – if people eat more of slightly lower carbon food products, the total carbon goes up so it's a non-sense unless we have at a population level sustainable dietary guidelines"* (Informant 5 – 08.15)

Another biologist agreed but was more optimistic about the foreseen calculations and production assumptions, the actor stated that the foresight was not really a best case scenario; it can be even be better but in his opinion it is not a pessimistic scenario.

*"so these people have made calculations on a number of assumptions, and like for instance one of the assumptions is that the water that is being used for the cultured production can be re-used and then of course when you can re-use the water you need much less water, it also assumes that the ingredients for the culture media like the sugars come from cultured algae and so again that's an assumption, if that does not work or that cannot be produced at a large scale than the calculations will be different, while it's not really a best case scenario it can be even be better but its not a pessimistic scenario"* (Informant 4- 29.11)

Popular consensus among the actors involved was in agreement with Alcott, B. [2008] in that the majority of environmental problems, which have already be linked to current livestock production methods, demand rapid and clear policy recommendations. From a political perspective Alcott, B. [2008] concludes that ecological economics should be a high priority and scrutiny should be applied when considering efficiency policies because as Jevons theory has demonstrated, there is a risk of counter productivity or the need for price control through regulatory and legislative measures, this opinion as illustrated is shared by many actors/stakeholders and informants expressing various angles of the governance triangle.

## 5.8 THE TRUE COST OF MEAT WITHIN SOCIETY

Another dominant theme which emerged was the topic of *cost* and *price.* Informants were almost in complete agreement in explaining that the current cost of meat is simply too low, not real and needs to be addressed. Specifically the external costs of its impacts on environment and the production costs without subsides need to be brought to the political agenda. Specific comments included;

*"another problem is the final price of products we buy is not the price at farm level, it's the price that the supply chain creates so even there, what is essential is that farmers should not be paying the price for increasing the price of animal products, of changing the way livestock in being managed, the cost should be shared by the whole supply chain, so the farmer can change without having to be discouraged, create incentives for them, there is room for manoeuvre there"* [Informant 11 -19.40]

Additionally a perspective from a policy director of a consumer co-operative organization;

*"In general there is actually a larger problem linked to meat consumption, which can apply also to other foods and that is the fact that the actual price of food doesn't reflect*

*its value, and now meat that you find in supermarkets for example is simply too cheap, and consumers should be made more aware of the costs of production, producing these meats also in environmental terms, so that would also then have an impact on waste because if you pay a little bit more than you also, you pay more attention to what you have bought and also would solve also maybe a decrease in consumption"* [Informant 10- 15.33]

From a "pro" innovation informant;

*"products should be diversified I think they should be diversified on all measures, meat should be accordingly priced based so its environmental impact, I mean I think the future is moving towards things being priced based on environmental impacts anyway*"[Informant 7- 17.40]

A cell biologist states;

*"so if meat prices were more closely matched to what the actual cost was people would eat less meat and we could have like a cultural shift around consumption, that wouldn't have to sort of have new technologies or we can kind of keep doing the same thing at the same price with this kind of hidden technology inside – so I think in the short term, my approach would be like lobby for higher prices and less resources going into agriculture, different kinds of systems, and technology can be part of that and technology is a part of that, so new technologies in agriculture, new methods of sort of communication or food whatever is part of that too"* [Informant 8- 01.20]

Additionally from an environmental engineer;

*"my point would probably be more that it would be useful to internalize, to have the European meat production industry internalize the environmental externalities"* (Informant 9- 34.45)

And representation from a public health professional;

*"create the proposition, with meat, that all the externalities so probably that would be the environmental impacts of meat production whether its industrialized or organic, but then also the health impacts, so probably along the lines of fat content and lack of processing and there is a substantial body of research that has linked red meat consumption with certain NCD's more so than just white meat being considered healthier, oh yea processed or unprocessed that would be as well, probably a couple of determinants in stating 'this particular meat should have' you know VAT of 7%, and incrementally"* [Informant 3- 28.00]

It is clear that the majority of informants from diverse areas of the society and the sectors of the governance triangle share concern in regards to the currents costs and price of meat and animal products. Many contributing informants expressed clear suggestions or visions on how this matter should be tackled; mainly through governance, legislation and regulation, most specifically through taxation or alternate subsidy structures.

# PART III PROPOSED ACTION PLANS

***What can be done? Who is responsible? What are their roles and suggested actions? Does science, technology and society theory support these perspectives?***

This Phase again continues in the situational analysis and begins to specify each actor/stakeholder's role in the situation through the perception of informant and interpreted research. Specific and general responsible areas were highlighted for all sector of the governance triangle, and specific suggestions and perspectives were discussed in relation to mitigating strategies, inclusive of cultured meat technology. These general themes were compared with science, technology and society theories to elaborate on the meaning of this phenomena [the role of meat in and technological food solutions] in society.

## 1.0 PROPOSED COMPLEMENTARY OR ALTERNATIVE MITIGATING STRATEGIES

A situational analysis illustrated the current role of meat in society not only be of great concern globally for all aspects of sustainability; environmental, economic and social, but also that the solution is by no means simple and exclusive. The complexity, intricacy and multi-faceted nature of livestock's role in the current global food system create challenges for current governance. A general theme surfacing in this research was that given it's complexity; informants and data suggested the way forward would be a combination of various solutions, meaning there is no silver bullet, including the innovative technology of in-vitro meat.

The main components to be included in the mixed systems approach to a better functioning sustainable role of livestock in the food system were identified as; more support for agro-ecology systems in the sector, advocacy for reducing meat

consumption, various suggested regulatory and legislative tools in the nature of governance. Lastly, potentially, innovative technologies for alternatives such as cultured meat. The last option however came with a strong divide among informants and many varying opinions were raised in relation to the public acceptance and consumer attitudes regarding the final product.

## 1.1 AGRO-ECOLOGY AND SOCIETAL ROLES

Informants and data, a popular consensus for increasing the use of more agro-ecological systems of production as proposed mitigating strategy to the previously mentioned challenges. Agro-ecological systems of production imply unique innovative methods of operational management, the term is often interpreted within different meanings; a science, a movement or a practice [Wezel, A. et al. 2009].

According to Pretty, J. [2008] within the agro-ecology paradigm; varying opinions about the use of technological inputs or how technology fits into natural, social and human assets exist. This was supported throughout the situational analysis and the surfacing of opposing opinions from multiple actors and specific informants.

Conway, G.R. [1985] explains that context is important in these management techniques and again no 'silver bullet' or standard for practice prescription exists. Instead each site needs to be considered individually based on its particular ecology and social dimensions. These production systems are concerned with productivity, stability, sustainability and equality; simultaneously through an integrated approach, methodologies from both natural and social sciences.

Agro-ecology has been identified as a potential method of re-understanding traditional farming and the relationship with ecology to help counter the escalating complications resulting from an increasingly globalized and industrialized agro-food system [Altieri, M.A. 1987]. According to Altieri, M.A. [1987], earlier, agro-ecologies main principles were central to the design of sustainable agriculture systems, later more social concepts were integrated creating a more comprehensive approach understanding the complexity of the sociocultural context of these systems [Mendez, V.E. et al. 2013].

Oliver De Schutter, the United Nations Special Rapporteur on the Right to Food has repeatedly advocated for the use of an agro-ecological approach to confront global food insecurity and food sovereignty and sustainability issues [De Schutter, O. 2011 & 2014]. The field is expanding and hence many perspectives and opinions have emerged. The idea is not new in agriculture and policy debates but has more often been used by non-governmental organizations in regards to sustainability and developmental efforts; empowering small scale farmers and poor resource communities for example. As with many social studies, over time many perspectives on the topic have emerged, Méndez, V.E. et al. [2013] refer to these as agro-ecologies. In relation to the various views of

informants it is difficult to distinguish exactly which perspective they may have been referring to but it is implicit that these perspectives can co-exist and support trans-disciplinary and participatory approaches. Authors Méndez, V.E. et al. [2013] have illustrated where the perspectives diverge, representing different roles in terms of governance and implementation but rooted in the same basic natural science concepts.

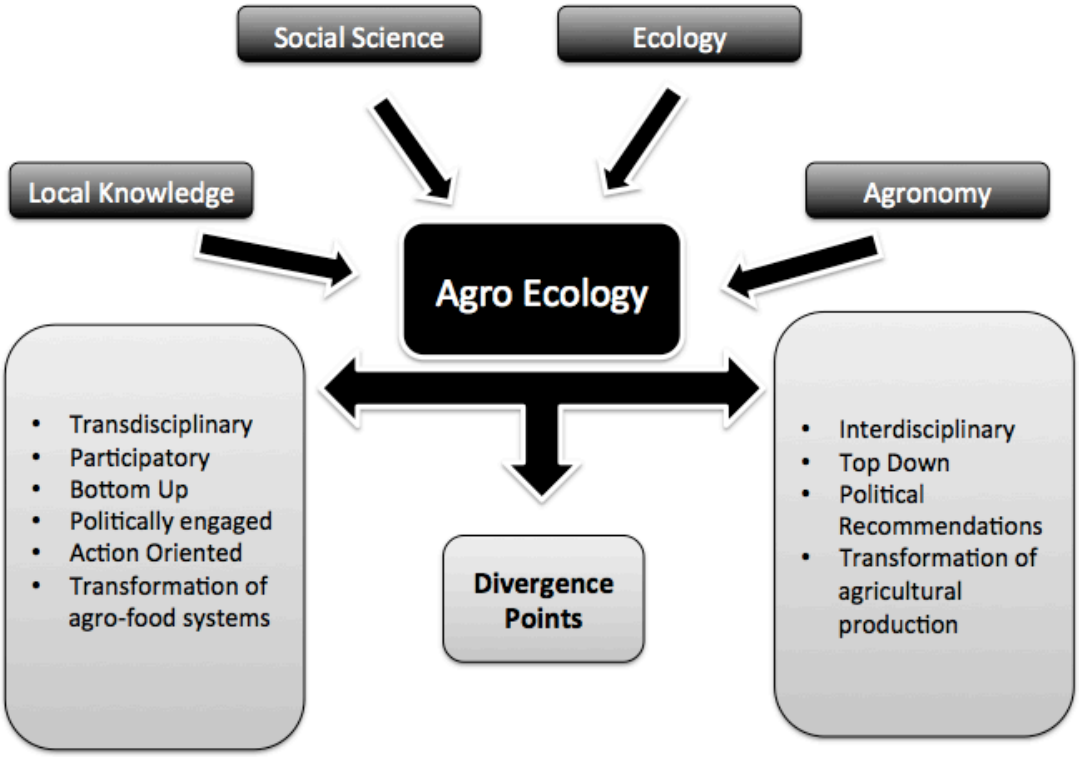


*Figure 4 Divergence Points of Agro-Ecological Views* [adapted from Méndez, V.E. et al. 2013]

Situational analysis suggested that relevant actors/stakeholders and informants fall within both categories of dominant perspectives. In line with the agro-ecology methodology, context may be considered the key determinant in implementation and facilitation decisions. An understanding of complexity and uniqueness of individual situation should be the driving factor in determining optimal execution and facilitation strategies.

Analysis also expressed a strong majority in favour of a multi-actor/stakeholder and informant approach, holding faith in the idea that involving players from all aspects and governing levels of the contextual situation improves the potential of positive effects, acceptance and continued interest. Bacon, C. et al. [2005] on Participatory Action Research inspired a comparison to Agro-ecology principle by Méndez, V.E. et al. [2013] and this table illustrates the compatibility in the approaches.

*Table 8 Comparison of Selected Participatory Action Research and Agro-ecological Principles* [Méndez, V.E. et al. 2013].

| Participatory action research principles | Agro-ecology principles |
|---|---|
| • PAR foregrounds empowerments as community partners play key roles in defining the research agenda.<br>• PAR processes are context dependent as they bring together interdisciplinary teams responding to stakeholder aspirations.<br>• PAR research processes inform action at multiple scales for positive social change.<br>• PAR processes deepen as long-term relationships are formed and multiple iterations of this cycle occur.<br>• PAR processes listen to a diversity of voices and knowledge systems to democratize the research and social change processes. | • Agro-ecologists work with farmers, food consumers, communities, agricultural ministries, food advocates and others to empower people.<br>• Agro-ecology establishes farming and food systems that adjust to local environments.<br>• Agro-ecology seeks to manage whole systems.<br>• Agro-ecology develops strategies to maximize long-term benefits.<br>• Agro-ecology implies processes to diversify biota, landscapes and social institutions. |

Though only few informants referred these particular practices in theoretical terminology, analysis communicated that the general consensus among informants and actors/stakeholders was in favour of agro-ecology methods of production and an overall Participatory Action Research Approach to be taken with strategically planning mitigation strategies. Discussion highlighted the various roles and responsibilities of the players involved in the governance triangle and another main theme identified within this concept was the topic of reducing meat consumption. A divergence appeared within this general consensus on the specific topic of cultured meat.

Informant 12 expresses how divergence may be seen for example in different geo-political contexts;

*"I don't see one technology in meat production as the solution, (…) people in the German speaking countries are very afraid of technology and even these journalists which I talked to the week after, they were not really informed but they were full of prejudice (…) this was a little bit shocking, I did have quite a couple of interesting discussions with journalists from Australia and Southern America from the States and they had a different view of in-vitro meat, and I don't think that in-vitro meat will be solution in the centre of Europe (…) parts would be more open, so I think this is an option we should think of and go a step further but we have to be aware that it the solution for the world, its more complex so there will be many more variety solutions for meat in the future"* [Informant 12 – 03.58]

Agro-ecology in the opinion of some can include innovative technologies; including cultured meat in the correct context for optimal efficiency according to agro-ecology principles. Those in favour of the technology also expressed strong concern for the inclusion of various actors in the technology developmental processes, specifically to

cater to consumer needs and illustrate transparency throughout the process to maintain trust in line with the above mentioned PAR principles.

Informant 8 explains the need for re-examining the current methods and focusing on more area specific solutions;

*"technology will be a part of those sustainable moves to a more sustainable system, agro-ecology and agronomy are all the sort of things like that pose hard technological questions but I think that they tend to be ignored by the high tech hype machine, so its very easy to focus on in-vitro meat and the sort of 10 people that are working on it and ignore the thousands of people who are working on agricultural solutions to the things that are actually happening now like desertification of certain areas and all sorts of like different kinds of methods of improving agricultural output and systems in much smaller scales"* [Informant 8- 29.20]

Another expressed the potential role of technology in these alternative methods;

*"We also need innovation in designing those agriculture systems that would be diversified and more complex than today, less specialized but nevertheless still as productive or more productive than todays systems, (…) innovation is not just at the scale of products but it might also be at the scale of production systems trying to design mix agriculture livestock production systems that would be more integrated into the ecosystems and landscapes I see that as a key priority for innovation and I have stated that many times at DG Research as a priority and not to focus bio-economy only on technology, but have technology integrated in the design of whole systems*" [Informant 9- 45.01]

Agro-ecology and Participatory Action Research can work together, and as has been found during this situational analysis, no silver bullet solution is seen by informants. Along with changing methods of production to mixed, more sustainable or 'agro-ecology' many informants expressed the responsibility of other actors in the governance triangle and their role in the solution. As indicated above by Informant 9, policy and legislation have a role to play and will be discussed in the section on perspectives but an emerging theme concerning the reducing meat consumption again showed the intricacy of the food system.

## 1.2 REDUCING MEAT CONSUMPTION

Globally the growing taste for meat and animal products has also been attributed to poor ethical practices, concerning the right to food, with millions starving and without water it has been discussed if using crops to feed livestock is considered morally acceptable. The implications of an increasing demand of land needed, also affects livelihoods of people globally, as previously mentioned. Vanham, D. [et al. 2013];

expressed findings comparing various diets illustrated that a decrease in meat intake would contribute most to a reduction of the EU's food-related water footprint. Many similar conclusions can be found linking alternative production methods and reduced consumption to improving the detrimental implications of the current situation identified. The informants shared these concerns on many levels and advocacy for agro-ecological methods of production such as more mixed farming systems or grazing; as identified by the authors Mekonnen, M. & Hoekstra, A. [2013] along with the reduction of consumption by consumer were indicated throughout this situational analysis.

With current practice exhibiting such negative implications, the situational analysis also underlined a strong concern over the growing population and increase in meat consumption. Currently the population is at approximately 7.2 billion according to the Population Reference Bureau. Considering the distribution of this population among the various continents and the predicted growth for 2050 [Steck, T. L. et al. 2008], the population of the EU is not expected to increase, however, it is still noteworthy to consider that their food supply chain production and consumption habits have global impacts. As illustrated previously the environmental impacts of feeding these populations under current methods are detrimental. With the growing population, changes in demographics are also happening putting a further strain on resources.

According to Motavalli, J. [2002] meat intake has increased fourfold globally in the past 50 years. The rise in incomes over the last 20 years in countries such as China and India has been significant, and with this economic growth the middle class has grown, changing consumption patterns to reflect that of wealthier countries; a diet richer in animal derived foods [Von Braun, J. et al. 2008 & Fuller, F. et al. 2002]. This phenomena has been coined the nutrition transition by author Popkin, B. [2001] explaining that major dietary changes are reported; including a large increase in the consumption of fat and added sugar in the diet, often through an increase in animal food products and a decrease in total cereal and fiber intake.The distribution of meat intake across countries is very uneven [Speedy, A. 2003], consumers with higher income consume more animal products and general global food resources. In 2000 the most affluent 20% of nations worldwide consumed 40% of total red meat and 60% of all poultry [Paul, J. et al. 2002].

In the context of Europe, although only few Member State have official recommended daily intakes for meat, the World Cancer Research Fund, has recommended that population consumption be less than 500 grams of cooked meat per week[16]. Current average consumption in EU Member states is considerably higher than recommended [Elmadfa, I. (ed.) 2009], though this type of data in very generalizing it has been valued as giving a strong impression that consumption patterns in most Member States exceed what is recommended.

[16] WCRF Recommendations: www.wcrf-uk.org/cancer_prevention/recommendations/meat_and_cancer.php

The dialogue with informants illustrated the perception that the task of reducing meat consumption is a shared responsibility in governance; consumers and civil society, politicians and industry together need to produce and consume less meat, as is expressed below;

*"it is not enough just to tell consumers eat less meat and dairy, we've got to produce less, but the Common Agriculture Policy has to be recast, the implications are enormous- it's systems change not advising consumers, its systems change that is needed and people don't get it, this is absolutely extensive – this is total change!"* [Informant 5-04.35]

*"(…) one of the challenges we have as a society is to reduce materials consumption in general, one of the examples to do that is car sharing (…) a challenging thought experiment is how to transpose that thought to the food sector –how can you convince business industry to actually sell less, it's a bit the same as the waste issue, its not really an incentive to reduce waste at the consumer level because that would involve industry to sell less, it's a bit the same with meat consumption, selling less meat would make more healthy consumers but industry would have to sell less meat. The answer lies in the changing of the nature of the food industry, if the food companies reframe their own product service combination and move their business model away from just pushing commodities to selling healthy diets, that would be, I think a good way forward"* [Informant 1 – 14.07]

Additional informants express concern;

*"it is the shear quantity that we consumer in western societies that means we have such an intensive system, if we were eating less meat we could be less intense, we could be cutting on the amount of human edible cereals used"* [Informant 2 – 35.34]

"*I think that there's not one solution which will be the solution, I think there be a lot of small solutions like education and awareness, educate people so they will eat less meat but also look alternatives look for more sustainable livestock production all these kind of things"* [Informant 4 – 26.06]

Situational analysis lead to the perception that many informants were strongly concerned with the levels of consumption and expressed various considerable resolution tactics, among which cultured meat was featured by some as a constructive strategy and highly criticized by others. Most support was displayed from those working directly with the technology or concerned with animal welfare, and controversially the sceptics were more those concerned with health, consumers and more agro-ecological focus.

Informants from similar positions in the governance triangle illustrate and an example of this divergence and difference in perceptions and framing of the potential of cultured meat technology.

*"Eating Better: for a fair, green, healthy future is a broad UK based alliance working together to help people move towards eating less meat and more food that's better for us and the planet, as part of the vital task of creating sustainable food and farming systems"* [Informant 13- email].

This informant explains a position and objectives which are in line with aims and principles of agro-ecology; productivity, stability, sustainability and equality.

Informant 12 explains a vision for the future of the food system;

***"****High meat consuming countries and individuals have reduced their consumption in line with health recommendations and greenhouse gas reduction targets. Meat is produced humanely and sustainably, its production provides sustainable livelihoods, environmental benefits and it is consumed in quantities consistent with good health and global resource use capacity"* [Informant 13- email response].

With their vision this actor further explains how their approach to food systems considers both natural and social science aspects, as well as a participatory approach, sharing responsibility among the difference societal actors.

*"Global meat consumption has doubled in the last fifty years and is predicted to double again by 2050 due to increasing population that is more affluent and aspirational. If everyone in the world lived and ate as we do in the rich world we would need three planets – and we only have one. Therefore we need to make some drastic changes to the way in which we consume food (as well as to how we produce it). Eating less meat is part of the dietary transition towards a healthier, greener, fairer future food system. Evidence suggests that high consuming countries (such as UK) should halve meat consumption, particularly from grain-fed animals (…) Meat substitutes are a growing area of interest with funding going into initiatives such as 'Beyond Meat' and to improve the taste/acceptability of existing meat substitutes. What is often overlooked is that primarily plant-based eating (which can include small amounts of meat) doesn't need technological solutions – just some good recipes!*
[Informant 13 – email response]

This informant clearly displays the position that the technology is not needed in the mixed systems solution approach, though the vision and idea seems to be coherent with the agro-ecology model the divergence among meanings of the methods were apparent in this situation analysis. Another informant, felt very strongly about the potential of cultured meat as an innovative technological solution and expressed many angles and considerations, addressing many of the aspects identified in the SWOT analysis.

Informant 14 stated clear support for the inclusive of in-vitro meat technology in the solution to the current challenges;

*[re: in-vitro meat]*

- "It's even more natural than natural
- It's not genetically modified
- It's not imitation/synthetic meat - but actual meat (custom grown , efficiently just for the specific piece of meat or organ)
- It's pure meat – without contamination
- In vitro meat is both modern and inevitable...need to be marketed as the next desirable premium thing" [Informant 14 – email response]

As mentioned by informants there is a role for the consumer to play and ways in which they can contribute; parallel to industry and governing structures the consumer or citizen is a part of the participatory approach. The perceived role, responsibility and assumed attitudes of consumers in society is however interpreted very differently by the informants, specifically on the acceptance of cultured meat as an innovative solution or part of a mixed productions systems approach.

Some informants were more adamant that this role was not the responsibility of the consumer, or at least that they were not capable if the change.

*"Consumers are flotsam and Jetsam, consumers are mouths, consumers are mouths with brains, consumers are mouths with culture and tradition, consumers are going to have to change what they have been use to eating as consumers in Europe have gotten richer in the last 50, 60 , 70 years – they have consumed more and more extensively, which has deepened their environmental footprint"* [Informant 5 – 04.35]

## 2.0 ROLES AND RESPONSIBILITY IN GOVERNANCE

According to author Bevir, M. [2013: 01] governance is defined as *"all processes of governing, whether undertaken by a government, market or network, whether over a family, tribe, formal or informal organization or territory and whether through laws, norms, power or language."* It is further described as relating to processes and decisions which aim to define actions, grant power and verify performance. It differs from government in the sense that it is a specific interest that reproduces a formal or informal organization. In the formal organizations, the act of governance refers primarily to what the governing body does, such as laws. Whether the organization is a geo-political entity (nation-state), a corporate entity (business), a socio-political entity (citizen or civil organization, etc.), or an informal one, its governance is the way the rules and actions are produced, sustained, and regulated [Bevir, M. 2013].

The United Nations Development Programme (UNDP) defined governance as the rules of the political system to address problems between actors and adopt decision through legal measures and the adequate performance of institutions and their acceptance by the public; their legitimacy. Participation is also considered to be an aspect of governance in its ability to petition the effectiveness of government through the achievement of consensus by democratic means [Applebaugh, J. 2010].

The collective process that determines whether or not decisions are implemented or not implemented, defined as governance can be analysed based on 3 components; process, participation and accountability [Applebaugh, J. 2010].

In this situational analysis of the role of meat in society, the role of governance has been informally analysed and discussed by informants. The main themes revealed that there is a need for better governance of meat in the food system. This is however not expressed as being seen as an easy task.

The complexity of the food system, within the EU, and it's globally overarching affects on society are broad, therefore it is challenging to study through situational analysis. The specific situation of livestock production in the EU is a situation which has been identified as concerning in many facets of society, and need to change is clear – however defining the specific role of each element and responsibility for these changes within society presents an interesting debate and varying perceptions exist.

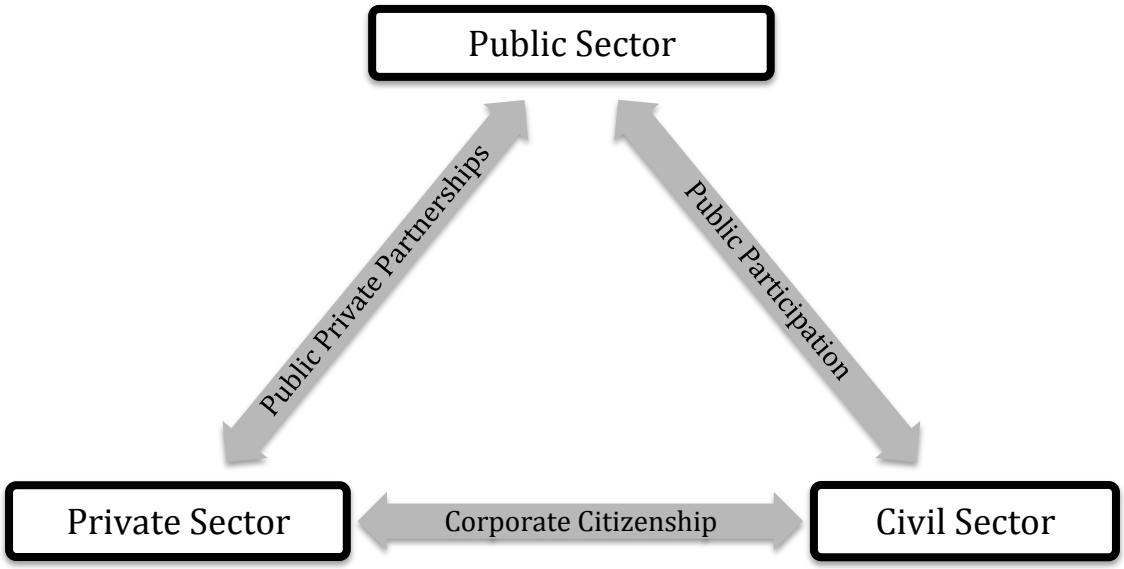


*Figure 5 Triangle of Actors in Governance* (adapted from Council of Europe 2006)

The Council of Europe depicts the governance triangle in Figure 5 Triangle of Actors in Governance (adapted from Council of Europe 2006). It also deepens the potential of the three key elements of the triangle, by beginning to illustrate that the roles do not have to be

isolated and potential to work together across sectors exists, as was mentioned as vital to agro-economy and also Participatory Action Research. Cross-Sectorial work may also be, by this author, hypothesized to minimize the risk of the 'rebound effect' when searching for new innovative technological solutions like in-vitro meat.

The Situational Analysis illustrated that the role of each actor in the governance triangle is important but the weight and specific responsibilities presented a discursive stance among informants and literature. Particularly in this section the perception of power play between the various was highlighted and considered influential to the situation.

## 2.1 PUBIC SECTOR – POLITICAL ACTION

Many informants voiced their opinions, perceptions or suggestions for the specific use of legislative tools. Specific tools used in governance of the food system are often taxes on products and subsidies to production have already been mentioned. Lang, T. et al. [2009] explains that these mechanisms are used in food governance through taxation to control behaviour and subsidy to control food prices and production. Some expressed critique about current regulations or governing mechanisms and many presented advisory recommendations. As mentioned earlier specific areas related mainly to taxes and the allocation of subsidies through various structures.

*"Rather than tax the 'bads', which is politically sensitive, you subsidize the good things and there are various ways of doing that, I think governments could do much more in simulating the consumption of vegetable and fruit for example, they can use subsides or have for example reduced VAT and there are all kinds of theory mechanisms you could use for that (…) research has shown that at a national level it will never move forward (…) CAP (The Common Agriculture Policy) is likely to be more favourable as national policy than an EU policy"* [Informant 1- 10.50]

Here the informant has mentioned an existing regulation and suggested that it may not be as effective in the situation of EU Multi-level governance and lower level governing policy may be more favourable. This was a common theme in the situational analysis and further reiterates the proposed potential of more agro-ecology in food systems;

*"Instead of seeing what is being done as punitive, I would like to see taxes being used positively so that one would (…) help farmers that are making a good (…) don't punish the factory farm for making poor choices but reward the low impact, the high welfare and those not using human edible cereals or you know the things you want, they would have nil tax or low level of VAT, and if because of that at a certain point you go into the shop and a free range egg is cheaper than a factory farm you would buy the free range – so you can make it easier for the farmer by making it cheaper for the consumer not by subsidies but through the tax system. I would like to see us use taxes more in the world of food"* [Informant 2- 15.00]

Another informant expressed a slightly oppositional view on taxation, but a suggestion on other possible legislative actions;

*"I was quite convinced by many of the economists I heard, saying that it's a very tricky problem to see what you should actually tax for instance the Nutella tax or the soda tax is something that no economist can really accept as an efficient way to influence consumer behaviour (…) I have understood that the legislative proposals that have been implemented in some countries, were assessed as not efficient, so I don't know particularly if we think of meat, I wouldn't say that we need to have a specific tax on meat or something like that, my point would probably be more that it would be useful to internalize, to have the European meat production industry internalize the environmental externalities"* [Informant 9 – 35.30]

Informant 11 is also critical about already existing structures and advisory strategies for perceived improvement;

*"it is other kinds of policy and even communication tools that must be put in place, various forms, taxes – very unpopular but there direct or indirect subsidies that go into livestock, for example the fact that VAT is extremely low in some countries, in Italy where I come from VAT for agricultural activities is as low as 4% where normally it is 21%, last month there was a proposal to increase VAT from 21 to 22% and it almost lead to a revolution in the country, we are talking about 4% now, so the margin of manoeuvre is essential this is an indirect subsidy it should be changed"* [Informant 11-11.20]

The above mentioned quotes from informants illustrate the strong majority voice and opinion that a political intervention is needed as an aspect in the foreseen mitigating solutions to current challenged outlined previously.

Material which surfaced in this arena was abundant and it has been summed up as a challenging task to regulate and legislate the complex food system and problems associated with meat production. There is a strong voice expressing an urgent need for political decisions to be taken in this regard. In relation to legislation and governance it is important to consider the regulatory decision in-vitro meat would be subject to if the technology progresses.

### 2.1.1 CULTURED MEAT AND POLICY

Given the existing food safety legislation and its stringent regulations as a result of recent food scares in the EU, accepting new technologies in food and society was proposed as being difficult by many informants. Many informants expressed there was little concern specifically related to the safety of consuming in-vitro meat, it seemed to be more the perception that consumers would not accept it – parallel technologies in food like cloning or GMO were considered precedent.

*"well I suppose, it would be just among the other meats with a specific label I hope, but that's also when we speak about consumer acceptance and we speak about the cloning of animals, consumers don't want that and I think that of course the process is different but in a way the two things are linked (…)we are against cloning first of all and secondly we think that it absolutely needs to be labelled"* [Informant 10 – 31.11]

A more elaborative comparison was expressed by a natural science academic;

*"well I think it's the same as any new food that comes, I don't know how it works with really artificial things for example like sweets, that are really made in a factory or other things that are made in a factory like all these specialized yogurts that are "healthier", I don't know how this is organized and I don't know how you get the approval to sell it, but in principle in-vitro meat would just be muscle cells from a cow or a pig, they are not genetically modified so in that respect, I would not see a problem but maybe the legislators see a problem [ed. interviewer gives explanation of the novel food legislation] I guess it's the same as meat from cloned animals there's also a debate on whether or not that's healthy or dangerous and how can you discriminate between one or the other (…) I think food from cloned animals is just, meat or milk from a cloned cow, that's exactly the same as normal milk or normal meat, so I don't see a problem at all, its impossible to check whether or not the milk is from a cloned cow or not or descendants from a cloned cow which is probably what will happen and I think the FDA has said that there is no way whether we can check that the great grandmother of a cow has been cloned and there's also no reason to believe that it would be unhealthy [on in-vitro] well yes I am convinced its not dangerous so it can be tested in all kinds of ways, I think it will pass all the tests"* [Informant 4 – 19.00]

As discussed with the informants, in order for in-vitro meat to be marketable, hypothetically speaking if existing weaknesses were addressed and this was possible, it must fulfil the EU regulation on 'novel foods'. It was also be most likely subject to scrutiny in relation to labelling.

*"I think it should be labelled what it is [interviewer asked what about the case of GMO fed livestock and labelling] well I am a cell biologist so I am not so afraid of genetically modified organisms, but I mean of course you want to be transparent to the public like, this scandal with horse meat, of course there is nothing wrong with horse meat, but there is something wrong when people think that they eat cow meat when they in fact it is horse meat, so it should be correctly labelled but it should also not make people afraid so it should be transparent and exampling I think which is part of being a scientist which I think is try to explain lay people what you do and why you are doing and sometimes that's difficult but I think its very important"* [Informant 4 – 21.45]

Like many other novel foods, entry to the market will include evaluation and legislative decisions will be made to it's specific regulation, cultured meat would as mentioned previously therefore be subject to pass the novel foods framework.

#### *2.1.1.1 Novel Foods Legislation on In-Vitro Meat Technology*

The arena of legislation on Novel Foods was accessed in observational and field studies, and was ethnographically studied in combination with informant feedback.

The Regulation on novel foods and food ingredients by the EU is currently "*Regulation (EC) No 258/97 and has been in effect since 1997. This regulation lays down the general principles for authorization of novel foods and food ingredients in the European Union, specifically detailed rules for making certain information available to the public and for the protection of information submitted.*

*Currently, an application for a pre-market authorization is first assessed by a Member State food assessment body. The initial assessment report is circulated for comments and objections to all Member States by the Commission. If no reasoned safety objections are presented, the novel food may be placed on the market. If reasoned safety objections are presented, an authorization decision is required by the Commission. This in most cases includes an additional assessment which is carried out by the European Food Safety Authority (EFSA)*" [EC 2013) 894 final].

The above regulation explains the risk assessment cultured meat would be subject to before becoming available for sale in the EU. EFSA applies a standard food safety evaluation as inline with the precautionary principle. If the food is found to be safe, legislative steps will proceed to regulation such as labelling etc.

The ethnographic field work which contributed to this study revealed that many challenges are seen by the framework of the current legislations. Meetings with Member States often include questions on defining 'novel foods', what classifies a food as new, and if for example plant foods should be separated in relation to parts such as leaves, buds, stems etc. The same challenges can be seen with specifics of for example insects for other future innovative meat alternatives solutions. The framework is currently in the process of being reformed. The specific safety of these foods is often first evaluated by each Member State, and sometimes simultaneous evaluations are done and results are different. It is therefore important there is an overarching institution like EFSA to harmonize safety evaluations on novel foods.

The process novel foods are subject to in the EU is interesting because of the power play between actors in the governance triangle. For example, although GMO foods have been subject to the same stringent tests as many other foods, they have been authorized as safe for human consumption and pose not direct health risks, according to EFSA and the EU Commission [EUR 24473 EN 2010], the results of these studies are however controversial and questions have been raised on the interest and power play

related. The interpretation of this situational analysis lead to the inclination that industry is thought to heavily influence research in this area to promote their own interest. Given their strong financial capital – they have gained some successes in this regard. This as mentioned above has also been the case for cloned animals, and demonstrates the strength of the civil voice in legislation versus scientific evidence. The majority of opposition for these technologies often has controversial evidence on 'safety' but it has drive from civic actor apprehension or socio-ethical issues; oligopolies, livelihoods, transparency, right to food etc.

Again, it is noteworthy to mention that the roles and positions of actors in the governance triangle are not isolated and their actions and discourses affect the entire situation. Regulation and legislation in these specific areas are overarching and it is therefore seen as challenging to separate only food safety evaluations as a means of acceptance, and it is essential for political action to be in cooperation with other governing actors as mentioned in the Participatory Action Research (PAR) Approach. Conceivably the potential of working collaboratively between society and technology are further discussed in the section on civil society. PAR also highlights potential for working with actors in the market sector.

## 2.2 INDUSTRY AND ECONOMY

Situational Analysis also exposed the interconnectedness of implications of actions from various actors in the governance triangle. Ethnographic observations and participatory studies exposed this interconnectedness to be strongly influential to political decisions and the implementation of new regulations in the food system.

Industry stakeholders in the economic sector of the food system are active in political discussions on how to best govern the food system. Ethnographic field study findings suggested implementing new legislation is timely and costly and it is often seen as advantageous to use voluntary regulations, research suggestions multiple reasons for this;

- Strong industrial lobby
- Protecting the single market
- Limited resources

Informants also had relevant perspectives in this area, regarding both current systems and the potential for cultured meat to follow the same path;

- Power and monopolies or oligopolies in the food system
- Lack of transparency
- Consumer awareness, knowledge and information
- Food Recommendations

*"we are not against the technology in principle we are just a bit cautious and we and we just don't think that is a priority(…) [on consumer acceptance] I think it is the same that as the genetically modified foods for example, the technology is expensive and I mean besides the pure financial considerations, which I believe is not very accessible I believe right now, so there is a concrete risk that only a few if not only one industry would be behind it and this is for sure something that we don't want, so I don't know if this can also maybe fit into the ethical considerations, maybe somehow, because of course we don't want the monopoly or oligopolies of some big guys on, that can grant the access to proteins"* [Informant 10- 24.09]

Explaining concern for power in the food system controlling the access to protein, another informant had a similar position;

*"Any economist, neo liberal economist can tell you that when one market or 50% of one market is owned by less than 5-6 companies – its oligopoly its bad, there is not a way out there is a need to change the system, fertilisers industry is the same, when it comes to distribution, A B C D four companies pretty much ship food (US, Brazil, Canada, France) and then on the other side you have the processing industry, with increasingly vertically controlled food chains mega retailers, Walmart, Carrefour, Tesco and food companies Kraft Unilever, Nestle Coca Cola, literally deciding what kind of food consumers will get, so to close the parable, if one step solutions [in-vitro meat] become economically interesting those players will simply swallow it and it will be part of a system which we believe must change because the system should be based on sustainability on locality on diversity is really the essential part"* [Informant 11-38.11]

Another informant who generally seemed more positive about the technology than the two above stated, expressed a view on economy in the food system;

*"I am always trying to balance the science of nature with the philosophy of sociology especially talking about food, we need both – it is not enough to talk about food, tradition and history, we need to focus on the economy as well, I like this book*[17] *very much because it has broadened my mind on the way we follow economy, well it is a science or it is not but it is something which became very powerful in our society and on a day to day level people, humans are not aware of the power of this, to me economy became too important talking about food and if we have a historical view, in the old days it was the owner of the land was the most powerful and with the industrialization, it's the industry that became more powerful and now I would say that the retail is very powerful but the next to come is the consumer and for the consumer economy is not on this big scale, so I think we have to be aware that there always will be big business but the smaller regional business will become more powerful! The consumer is not on a level*

[17] Economics of Good and Evil: The Quest for Economic Meaning from Gilgamesh to Wallstreet by Tomas Sedlacek

*of economy thinking on this level of the food scale so I think we need to be aware also of switching the awareness in this field - adopting new technologies is much more about sociology and psychology and culture and tradition."* (Informant 12- 36.37)

As can be seen from the responses from informants a concern exists in the way this technology may appear in society; industry, civil and public sector alike.

### 2.2.1 INDUSTRY, ECONOMY AND CULTURED MEAT

Referring back to Wackernagel, M. & Rees, W. [1997] in relation to Jevons Paradox, as stated, maintaining original costs of commodities through taxation or other regulatory efforts of these new cost saving technological advances is important in evading rebound effect. It is therefore seen as important to consider 'final prices' of food products, the term original cost here is what was previously deliberated among the informants, as it was not seen to be the 'original' cost to begin with and this is mentioned one of the drivers in regards to the problems regarding meat in society.

In order to prevent such foreseen oligopolies the informants highlighted may emerge, some informants had contingency plans for this weakness or mitigating strategies;

*"trying to patent things I mean I don't know what they are talking about, the worst thing that can happen with that is that you stifle the whole innovation chain because someone is sitting on the patent that prevents other companies from coming in later*" [Informant 6 – 28.45]

Another informant expresses thoughts on why in-vitro meat will not follow suit to GMO technology in society in relation to ethics and governance, the technologies differ in process and patent potential;

*"genetically modified organisms are wrong mostly from the patent and litigation side not necessarily from the scientific side so because of the way these patented genes have been protected it really blocks out the academics investigating the long term problems which might occur with genetically modified organisms and just generally testing has been blocked because of these patents and there has been all kinds of crazy fighting with farmers over the seeds and stuff like that I think that is mostly because of the patenting and when I see that a genetically modified organism and a gene can very easily be patented (…) the same with beer breweries, they probably have their patents on their beer and their processes but its not as definable as a gene, so someone has their process but you can change what the bioreactor looks like and you can change what the starting cell culture looks like, so it is very possible for there to be all these alternate processes just because it would be hard to patent everything and secure it so tightly, so that is another main reason why cultured meat is different I don't see that clear exclusion of competition."* [Informant 7- 22.00]

If the technology overcomes the current challenges it is faced with, it will still have to deal with the threat of consumer acceptance.

## 2.3 CIVIL SOCIETY

The role of the consumer in this situational analysis was revealed to be by informants, in need of change. This change can be considered as a behaviour change and would involve, essentially consuming less but also the potential to begin consuming differently – accepting new innovations. A role has been established for citizens and consumers based on the feedback from the majority of informants, in regards to their responsibility to change their diets by reducing meat consumption.

Though as mentioned previously, Informant 5 (p.64) felt that the consumer was not the key responsible actor in this change many other informants felt there was potential in terms of increasing awareness and knowledge among consumers to promote change; and possibly the acceptance of new innovative technological solutions like cultured meat if they were proven to be beneficial to society and its current challenges;

*"I do not want to overlook the role and importance of working with the consumers but until now unfortunately, really the vast majority of the efforts done by the commission, but also the parliament, the political debate is about putting everything on the consumers, and relying on the fact that the solution will come about, when we educate people, individuals and for the last 10 years, 20 years, and clearly, its not really working when you just do that and so around that, it has just escalated, just spun off towards the systemic changes so the environment – the social environment, the physical environment, the price, the access and the availability but also on the acceptability"* [Informant 3 – 25.00]

Informant 13 added to the need of more public institutional action;

*"We are already starting to see some changes in awareness and attitudes towards meat eating in the developed world (ex. rise in 'flexitarian' eating) but the challenge will be to raise awareness and put in place the policies and practices that help support that transition, particularly in cultures where meat eating is seen as increasingly aspirational"* [Informant 13- email response]

Even if knowledge and awareness increased among consumers, and public authorities took a stronger stance, Informant 10 has little faith for the acceptance of technology in food by consumers;

*"consumers in general are sceptical of new technologies and I think they can not be blamed for this because I think that in general that behind technologies there are big interests from(…) [in-vitro meat] we also don't think it is a priority because we are not sure that all the investments would then be efficient in a way"* [Informant 10- 27.41]

Though diverging opinions emerged the general consensus was change in consumption through consumer behaviour change was seen as a feasible potential as a strategy.

# 3.0 SOCIETY, TECHNOLOGY, BEHAVIOUR CHANGE AND A COMPARISON OF THEORIES

*-an exploratory case of in-vitro meat in society*

Interesting perceptions about society and technology exist, in a philosophical sense the aspects have been discussed in a relational manner, does technology shape society or society shape technology.

Various theories exist within the field of sociological explorations of these relations, specifically related to society and the adoption of new innovations and technologies. The social construction of technology versus technological determinism for example and then additionally the diffusion of innovations model to explain projected acceptance stages of a new technology in society. It can also be discussed how various communication strategies and framing can influence or affect these aspects of society, technology and innovation, as well as the specifics of food technology due to its uniqueness as a cultural, personal dimension of society which may lie in an innovation field of its own.

## 3.1 FOOD AS TECHNOLOGY

It may be interesting to consider the relationship between society and technology, and how they impact one another. Popular but opposing views exist and both would mean very different considerations in relation to livestock production and consumption, and food technology; specifically cultured meat.

Ellul, J. [1904] have been noted as stating that it is precisely that which people have come to think and desire which produces the technological society. They further elaborate that the advancements are sequential and logical. Other informants seemed more sceptical for various reasons; Jevons Paradox for example, but most who were in agreement that in-vitro meat would not be accepted as a potential solution in society, highlighted it will mainly be due to cultural aspects surrounding food, but that it may enter the market as a novel food for a smaller demographic.

According to the Diffusion of Innovation Model, if food can be considered a technology, it may eventually be accepted by society. Informant 2 strongly expressed his belief that consumer acceptance over time through accurate framing would not be a barrier, and Informant 14 agreed.

*“Kosher and Halal consumers are discussing the potential of in vitro meat and debating whether it's acceptable by religious laws. Since in vitro meat circumvents slaughter, this*

*opens up many possibilities in terms of volume of in vitro meat kosher/halal production and types of meat that can be produced"* [Informant 14 –email response]

However, not all informants agreed that food could be evaluated through this theory as a standard technology or innovation;

*"but food is something completely different food is a part of us, we are apart of food, so it is a very strong and a very emotional and cultural combination between humans and food, so I think you cant compare it to communication and talking about cars every thing is fine and talking about technology sustainability yes can be very sympathetic but not when we are talking about food"* [Informant 10 -15.00]

## 3.2 SOCIAL CONSTRUCTION OF TECHNOLOGY (SCOT)

If food, and specifically in-vitro meat can indeed be considered a technology or innovation, the theory of the Social Construction of Technology may serve as a relevant and helpful tool in understanding consumer acceptance in society. Social Construction of technology is a theory arguing that technology does not determine human action, but that rather, human action shapes technology. Bijker, W. et al., eds. [1987], key authors on the social construction of technology theory discuss the need to assess science and technology together, from a sociology or philosophy of science view this theory is believed to support constructivism – central notions that when investigating beliefs, scientists should be impartial to the truth or falsity of those beliefs. This notion supports that all knowledge and its claims are considered to be socially constructed; the genesis, acceptance and rejection of knowledge are found in the social world as oppose to the natural world.

Authors Bijker, W. et al., eds. [1987] commented that successes and failures of certain knowledge cultures still need to be explained. Innovation researchers strive to comprehend the relationship between science and technology to understand the degree to which technological innovation integrates, or initiates from basic science. The authors Bijker, W. et al., eds. [1987] state that science and technology are socially constructed cultures utilizing appropriate available cultural resources for the task, in a sense meaning that cultured meat and GMOs and other food technologies were created through culture.

Technological studies can encompass many smaller types of studies such as innovation studies, or historical studies of technological artefacts and as mentioned sociology of technology. Innovation studies tend to be more economic in their approach and seek to identify potential for success of an innovation. It is important that innovation researchers understand the technology from the inside, the specifics as well as the relevant social system in which the innovation or technology will operate and present itself. Haagsman, H. P.  et al. [2009] expressed that current in-vitro meat researchers are

aware of these importances and a relevant supportive network exists.

Author Layton, E. [1977] has been repeatedly quoted for his statement referring *to technology often being treated as a 'black box', who's contents and behavior may be assumed to be common knowledge* [Layton,E. 1977:198]. An example of this in the food system can be seen with the GM technology, where the specifics were not made transparent to consumers and the end users of the technology, and the information that was given was complicated and difficult to understand, creating a sense of mistrust or apprehension from society. Informants expressed that it would be important to be transparent and clear about the technology.

*"I think the consumer is getting more powerful, especially the foodies which are more into this topic, they know quite a lot and if you hide information they suspect you hiding this information and they wont trust you and they are very much in an information network so this news is spreading very fast so I think in the future, these aspects will become more powerful so its worth while to really think about how can we get this information closer "* [Informant 12 -16.28]

The popular book The Social Construction of Technological Systems [Bijker, W. et al., eds. [1987] often quoted in SES studies, points out that in the past most historical technological research was done on successful technologies and little focus was given to failed ones, leading scholars to assume that an artefacts success can be attributed to it stages of development. The success of technologies in society has been seen as evidence that no further work needed to be done on in order to explain the process, however this was criticized and gave rise to the empirical programme of relativism (EPOR) and Social Construction of Technology (SCOT) theories.

Collins, M. [1981] describes the stages of the Empirical Programme of Relativism (EPOR), with the first stage as interpretive flexibility, where the focus shifts explaining scientific developments in the natural world to the social world. It can however been seen that the so-called flexibility illustrated here is often lost and the "truth" more in line with the scientific consensus prevails – meaning that the discussion regarding in-vitro meat has become very technical and little emphasis is placed on the social aspect of its emergence as a technology.

Interpretive flexibility is described as technological artefacts being culturally constructed and interpreted, meaning there is flexibility in social perceptions of artefacts but also there may be variation and flexibility in design and interpretation. This interpretative flexibility can happen at any given stage of a technologies construction, from foreseen opportunities or problems to the functionality and acceptance, every social group or actor may have a different meaning, understanding or interpretation of a given artefact. This perception may or may not be due to culture, exposure, knowledge and awareness or a lack of these [Bijker, W. et al., eds. [1987].

Considering social groups is an important aspect to take into account with discussing science, technology and society (STS) theories, which has been discussed by Bijker, W. et al., eds. [1987], as well as by Latour, B. [1987] and Callon, M. [1986].) in other terms. Particular social groups should have the same set of 'meanings' when understanding how they relate to an artefact (vaguely, consumers or users or just bystanders within in a specific context for example cultural). Meanings can however be stronger or more influential among certain social groups, causing them to have a different view, stance or perception of the artefact.

Often times relevant social groups need to be divided; if the users are too heterogeneous as is often the case with food and technology, as everyone eats and but not everyone is within the same social group of specific demographic. Age ethnicity, culture, location, gender, religion, taste, preference, availability and countless more criteria affect how, why people consume the particular foods they do. In this case all these considerations affect acceptance or rejection specific food technologies.

It is not difficult to understand that the different social groups have different perception and meanings depending on their relation to the specific technology. Bijker, W. et al., eds. [1987], have also explained that understanding the developmental process also requires one to understand the power and economic strength or influence of the different actors (social groups) involved – relating more to also to actor network theory or stakeholder analysis approach.

Particularly in the case of food, science and technology – many varying perspectives can be found pertaining to one technology, artefact or system. Just briefly, the view of technology for producers versus consumers for example would be very different, or that of public health agencies and the food and beverage industry would differ very much in their perceived meaning – or opportunities and threats of a given innovation in food science technology. The previously discussed power and interest reflections which sometimes result in market oligopolies or unethical distribution are also a part of this developmental process.

A situational analysis of the role of meat in food systems illustrated that the perception of many informants in relation to their perception of social groups and cultured meat technology in society; the farmers for example:

*"it is a new topic and if I talk to the farmers working in the meat business they say well its no option at all and they are just not willing to think about it, we are not use to think about this at all and this is very dangerous we don't trust and we don't think on our own, so we need to get in the discussion to get people to think about it (livelihoods and sociological impacts discussion ed.) it's a different world it's a different profession and especially the farmers are, their self understanding is very narrow, they are a very old*

*profession, they have been farmers for ages and they are not use to dealing with different professions they are not use to think about their plates and all the politicians working with them are not helping on this field, so I think this makes them very powerful but they are not prepared for the future, we will need to talk about the profession"* [Informant 12 – 31.09]

The second stage of EPOR is closure and stabilization and is described as having two possible outcomes, and these can be highly influenced by communication strategies. Closure can be categorized into 2 types; rhetoric or the redefinition of the problem [Collins, M. 1981].

Rhetorical Closure involves stabilization of an artefact at the disappearance of problems, to close the technological controversy, explaining that when a social group feels the problem is solved, there is not longer a need to alter the technology [Collins, M. 1981]. In the case of in-vitro meat informants expressed that this closure has clearly not yet been met;

*"I had this meeting with these in-vitro meat people in just a few months back and there is this naivety when it comes to making just a few pieces of stem cell cultures on a lab batch and then say we are close to having an industry no, no this is an extremely challenging engineering technology thing*" [Informant 6- 06.09]

The theory continues on to state that strategic communication can be an influential driver in shaping the meaning of the given artefact [Collins, M. 1981] or in this case, cultured meat. For example advertising by trusted stakeholders that promotes consumption, may result in societal acceptance if the innovation is framed appropriately. Informants in favour of the innovation agreed;

*"so we are calling it cultured meat and the scientific community calls it cultured meat and the reason for that is because it is cell cultured meat, so its literally what's happening where as in-vitro means in glass (…) cultured meat also brings to mind that the fact that we also culture a lot of other foods like butter and yogurt and beer and wine, and there is kind of the third meaning which is you know 'culture' this is a product of human ingenuity and civilization and it's a word we are trying to perpetuate, because not only does it have this nice condemnation but it is also literally what is happening and in-vitro I think steers people into thinking about things that are completely unrelated"* [Informant 7 – 12.30]

Additionally on semiotics and linguistic framing influence;

*"Language for Marketing: As mentioned earlier, we need to change vocabulary from lab meat to "cultured meat" or other terms ('artisan meat', 'hydroponic meat' etc. etc. (…) 'Cultured meat' may work well for the premium market because other cultured and/or*

*yeast products: breads, beer, cheese wine etc. have premium artisan brands"* [Informant 14 – email response]

The other option for closure is Redefining the Problem; which in theory explains that even though something may be considered uncontrollable, if it finds a solution to a problem, than it is accepted [Collins, M. 1981]. Regarding cultured meat, for example, maybe be a less desirable source of meat today, it may be seen as unnatural or may not provide the same sensory satisfaction. However if conventional meat prices become too high as a result of encompassing externalities or taxes; or the detrimental environmental impacts become unmanageable and production suffers resulting in less availability, in-vitro meat maybe chosen as the lesser of the inconveniences.

Closure of the technology debate was forecasted to be more acceptable by consumers in it's less identifiable form, meaning that mince meat for burgers or chicken fingers would receive more positive attitudes than steaks, this level of development is also seen as much more achievable;

*"Slabs of steak would be harder to structurally develop but hot dog/sausages would easier"* [Informant 14- email response].

And;

*"well what I have been tasting was not meat but its some kind of mince, well it tasted like mince meat, and I don't like the idea to go further in the production, I don't see a 3D printer to make the bones and the vessels and then do a complete T bone steak, I think this is very far away and I don't see really the solution of this, but the mince meat I think is something fits already quite nicely as a part of the solution, there might be a couple of more questions but otherwise I think its this is like a matter of 10-20 years and this might be helpful for example for the feed or animals like my cat or dogs or whatever so but this is one view one scenario talking about the future, this Is not talking about Europe because I think in-vitro in Europe we will have"* [Informant 12 – 07.18]

Redefining the problem can also be seen as using the technological innovation for another purpose, which is seen as more acceptable by social groups; when asked about the potential of cultured meat Informant 8 stated;

*"in terms of opportunity, I don't know I think there is opportunity in this kind of arty, molecular, gastronomy, high cost –low volume kind of world where you could create various specialized things add different flavours and tastes and textures and the sort of experimental component of it, and also if you have so much control over cellular processes there are other technologies or like medical organ replacements that become more possible and in that case I think the opportunity would become you know very great and the economics are more reasonable I think, I mean the cost of an organ in your*

*body could be much more than the cost of a steak that's for dinner so the technological problems that are encountered in medical tissue engineering are more feasible but still pretty far off in long term in terms of the technology"* [Informant 8 -16.27]

A slightly opposing view on the role of technology in society also exists among STS theories where it is thought that technological developments occur according to some naturally given logic which is not culturally or socially determined and these developments force social adaptation and change. This theory is called Technological Determinism and differs from SCOT on some accounts.

## 3.3 TECHNOLOGICAL DETERMINISM

Ellul, J. [1904] expresses that it is what people think and desire that produces the technological society. This theory has been heavily criticized, in saying that social structures evolve by adapting to technological change. Meaning that given a specific technology, the subsequent development of society would be the same no matter what people thought or desired [Bimber, B. 1990]. This theory claims advancements are sequential and logical. Technological determinism believes that naturally pre-determined by scientific laws paths to technology exist and are discovered by people, in their application is inevitable and drives social development. The theory suggests it is only within these limits people may exercise their own collective or individual agency and will, regarding acceptance or use.

Bimber, B. [1990] discusses unintended consequences, highlighting that often advancements come with unforeseen consequences that were not or could not have been seen or understood by the actors driving the new technological developments. Technology is exactly that, so new that the implications can only been assumed and never really predetermined until they are allowed to take their applicable course in society – an important considerations when taking into account the important of food in society.

## 3.4 INFORMANT VIEWS ON SCIENCE, TECHNOLOGY AND SOCIETY (STS)

When discussing food and technology and specifically the case of in-vitro meat, theories such as technological determinism and other society, science and technology (STS) studies can be considered very relevant; the perception of technology in food and society was also a clear divergence point between many of the actors.

It was apparent and as expected that the informants working closely with the technology had more faith in its acceptance among consumers and thriving on the market, showing the importance of understanding social groups. This view was also shared by informants with strong interests in animals rights and welfare.

*"The strategy of people proposing the in-vitro approach is that we could keep on eating meat based products, I mean if you look at our diets and the way eat meat, we*

*increasingly eat meat in a processed form, and in this form I think it will be more acceptable…where the product is less identifiable"* [Informant 1 – 05.10]

Other informants seemed more sceptical for various reasons, Jevons Paradox for example, that in-vitro meat would not be accepted as a potential solution in society, highlighted it will mainly be due to cultural aspects surrounding food.

"*sustainability yes can be very sympathetic but not when we are talking about food"* [Informant 10 -15.00]

And;

*"I think the theory from which you are drawing is more for the consumer as a user , so that would be perfect for a smart phone right, but if you co-design it with the consumer obviously he will make better use of it and have a more positive attitude that's of course different with genetically modified and in-vitro meat, because yea you can inform the consumer but you know that's basically all you can do, I think maybe you can have them have a say in what attributes for example of in-vitro meat they would prefer but yea that would be the same as just an ordinary marketing study , so yes in terms of information obviously and I think biotech has admitted its failure in that respect (…) Can we use consumers as more involved stakeholders in the process as users of food well, yes, an outburst of negative opinions in the press have emerged because you are not informed of something you want to avoid"* [Informant 1 – 21.21]

In close line with the situational analysis SCOT authors Bijker, W. et al., eds. [1987] explain the importance of the wider context and the inevitability of sociocultural and political elements of social groups influencing norms and values, thus determining the meaning of the given artefact. Informants felt strongly about communication and various attitudes were shared in relation to the responsibility of the strategic messages and influential actor roles in their implementation.

Technology is becoming more widely used in todays society, including it's growing presence in the food system, understanding this social phenomena of it's presence in society may be helpful in policy formulation, technology development and consumer rights. Theories exploring technology and society can arguably be useful in improving acceptance of particularly beneficial food technologies by theorizing behaviour, attitudes and interpretation, or to understand the diffusion process of innovations in society.

## 3.5 BEHAVIOURAL CHANGE AND THEORY APPLICATION

Regardless of which specific mitigating strategy is considered; in relation to consumers – behavioural change will be inevitable so acknowledging the drivers and barriers to facilitation may be beneficial.

Discussing behaviour change, as mentioned previously, through reducing meat consumption was a common theme in the findings of this situational analysis, and almost all informants shared the same view – that it would be a part of the solution to the identified problems.

Power, K. [2010] explains that the choices we make in relation to food are deeply embedded in social norms, personal values, habits and motivations; similar to those driving acceptance of technology as discussed earlier. This complex mix of determinants is unique to each individual and context and therefore Power, K. [2010] states that intervening in dietary behaviour change is a difficult and controversial area. However, if changes in the role of meat in society are to be made as was stressed as highly needed by the informants and entire situational analysis the diets of Europeans will need to change.

In Power, K. [2010] article *Introducing Behavior Changes Towards Sustainable Food Consumption,* she theorized that consumer behaviour is motivated by a mix of social-psychological drivers;

- Social norms,
- Values,
- Attitudes,
- Identity,
- Habits etc. and;
- Infrastructural drivers (prices, regulations, availability, technology, advertising etc).

The dynamic of all these influential drivers make changing behaviour, and particularly food difficult. Power, K. [2010] continues to explain that food is an *'emotive issue'* and is bond by perceptions and meaning. This understanding is supportive of social meanings and the theories explained regarding STS and Situational Analysis in general, informants brought this issue up on their own when questioned about consumer acceptance;

Informants also began to discuss the changing of social norms over time, as Power, K. [2010] also mentioned examples of attitudes toward smoking or drinking and driving – it was expressed the changes in normal practices were lead by governments and were promoted by the industrial and civil sector, completing cooperation of all sectors in the governance triangle as explained by Informant 2;

1. *"We need to gradually educate- again I can give you another example of that changes things, take smoking, years of education has meant that smoking has gone down, it is no longer thought of as cool, in fact it its seen as a bit pathetic (…)*

2. *A lot of policy makers assume that nothing can be done to change human habits, in eating patterns, though this is very pessimistic, change is not easy, but when I was growing up in the UK, homosexuality was a criminal offense and then you know you stopped being a criminal offence and we now have gay marriage – which was actually brought forward in the UK by a conservative party, which at some time was unthinkable as recently as 30 years ago it was illegal to engage in gay sex! It is a process and it takes more than one thought to make change (…)*

3. *we have this general perception with the EU and in the UK where they say changes in the food system need to be driven by consumers but than at the same time, there is this attitude of absolutely not, consumers should not be allowed to know how their food is produced – its immensely cynical …It has worked very well with eggs, for example in 2004 the eggs were reported as 'Egg-Nots', as to say, either its from caged hens, free range or barn, this has helped shift consumers so yes consumers have expressed concern and demand in the way we produce things – they want to know what is going on"* [Informant 2 - [1] 05.56 [2] 14.00 [3] 36.33]

DEFRA [2007 & 2008] presented research which showed that the attitude toward changing these consumption habits was not well received, dairy even more so than meat. An example was given by informants illustrating how strategic communication through for example product placement, driven by industry could help promote changes;

*"we need to think about meat in the more broad spectrum of products and I think we have kind of seen that happen with dairy products, more recently where a lot had to do with dairy products being side by side with non dairy alternatives at the grocery store, like right now when people think milk they go to Starbucks and they have soy milk and almond milk and all these options I mean not everywhere but in a lot of places, I think a lot of that has to do with Silk the soy milk really trying hard to be in the fridge beside milk even though it doesn't not need to be refrigerated, that makes a huge deal and right now we have meat alternatives and they are often in some weird alternative vegetarian section with the tofu instead of beside meat in the meat shelf, and you might say that ok maybe some vegetarians don't want to see their alternatives beside meat on the meat shelf but on the other hand, usually they are in the fridge and also in some other section, but anyway you can have the opinions in a variety of locations"* [Informant 7 – 28.00]

Power, K. [2010] and DEFRA [2008] explained that strong social norms, habits, values, attitudes etc. exist in relation to the consumption of animal products, and that improving sustainable diets through for example food waste was seen as more accepted. This shows that meat holds a particular role in society and that the acceptance of a proposed change in behaviour to reduce the consumption of animal products or the acceptance of novel innovative meat alternatives as solution will require strategic communication and framing.

## 3.6 DIFFUSION OF INNOVATIONS ON CULTURED MEAT VERSUS COMMUNICATION AND FRAMING

The social world and changing behaviour are, as is the food system, dynamic and complex, consisting of many elements. Not only are the structural aspects complex they are also unique and can sometimes act independently – they been studied through various theories. Technology and society theories exist, as do theories about behaviour change, direct or indirect communication strategies such as nudging in social marketing or stricter regulatory policies. In regards to food many of theses theories, in the opinion of the author post-situational analysis, tend to inadequately describe the entire phenomena. Some theories come close to capturing the entirety and deepen the understanding of the role technologies such as GM, cloning of animals or in-vitro meat in society but gaps prevail. Attempts to use non-food theory for innovation and behaviour change/acceptance in society have been applied to the case study of cultured meat, with the help of informant expertise – each theory exhibited specific parallels where opportunity windows may be found but also indicated weaknesses in regards to acceptance.

### 3.6.1 DIFFUSION OF INNOVATION

The theory originally proposed by Rogers, E. [2003] proposing five qualities that influence an innovations success;

- Relative Advantage (affected by cultural perceptions and needs)
- Compatibility with Existing Values and practices
- Simplicity and Ease of Use
- Tri-ability
- Observable Results

Many of these determining qualities are also inline with those of the SCOT theory, these two theories, unlike many other change theories, do not focus on persuasion but rather the 'reinvention' of products or behaviours to become better suited to the needs of social groups. So it is not the people who change but the innovations.

Robison, L. [2009] says the success of reinvention can be supported through making users into partners and allowing a continuous process of redevelopment. The concept of

reinvention is important because it shows no product or process can rest on it's successes, continuous improvement is the key to spreading an innovation – in the food system many examples exist like the continuous development of GM technologies.

Information is spread through impersonal marketing methods like advertising and media coverage, but according to Robinson, L. [2009] adoption of new innovations is based mainly on word of mouth. This is believed to be due to the risk element and uncertainty involved – the trust factor among familiar people. Trusting people in the social network can create assurance, and a perception of safety from embarrassment, humiliation, financial loss or wasted time.

In the Diffusion of Innovations theory early adopters are seen as being an exception to the rule – they are described as looking for an advantage and tend to see the risks as low because they are financially more secure, more personally confident, and better informed about the particular product or behaviour.
Diffusion researchers believe that a population can be broken down into five different segments, based on their propensity to adopt a specific innovation, according to Rogers, E. [2003] they can be described as;

- Innovators- *first individuals to adopt an innovation, willing to take risks, have the highest social class, have great financial liquidity, are very social and have closest contact to scientific sources and interaction with other innovators. Risk tolerance has them adopting technologies which may ultimately fail, financial resources help absorb these failures (Rogers, E. 2003: 282).*
- Early adopters*: the highest degree of opinion leadership among the other adopter categories, higher social status, have more financial liquidity, advanced education, and are more socially forward than late adopters. More discrete in adoption choices than innovators, realize judicious choice of adoption will help them maintain central communication position (Rogers, E. 2003: 283).*
- Early Majorities: *adopt an innovation after a varying degree of time, time of adoption is significantly longer than the innovators and early adopters. Early Majority tend to be slower in the adoption process, have above average social status, contact with early adopters, and seldom hold positions of opinion leadership in a system (Rogers, E. 2003: 283).*
- Late majorities: *adopt an innovation after the average member of the society, approach an innovation with a high degree of doubt and after the majority of society has adopted the innovation, typically sceptical about an innovation, have below average social status, very little financial liquidity, in contact with others in late majority and early majority, very little opinion leadership (Rogers, E. 2003: 283).*
- Laggards: *the last to adopt an innovation, show little to no opinion leadership, typically have an aversion to change-agents. Laggards typically tend to be focused on "traditions", likely to have lowest social status, lowest financial liquidity, be oldest of all other adopters, in contact with only family and close friends (Rogers, E. 2003: 284).*

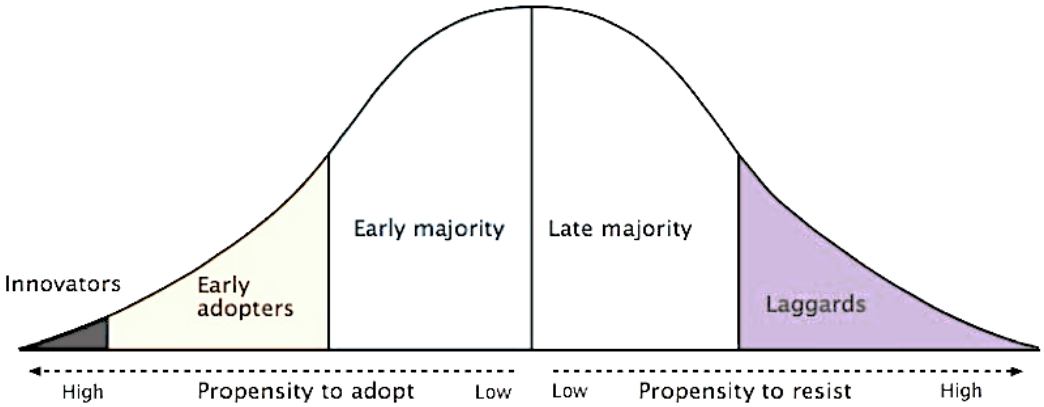


*Figure 6 Dispersion of Acceptance of Innovation Over Time* [Robinson, L. 2009]

On a larger scale this phenomena can be observed in the governing of GMO foods in the EU. Farmers in the United States and some other countries may be considered as 'early adopters'; those who have embraced and accepted the technology and have more favourable legislation. This acceptance has thus spread to more and more countries, as an increase in GMO production can be seen [Freibauer, A. et al. 2012] classifying these other countries as majority adopters. The EU can be seen as the late majority, as they have recognized and accepted some aspects of GMO production and have authorized a few crops for the use of feed and even fewer for food – but labelling legislation still displays a scepticisms toward the technology. In relation to the adoption in food they may be seen as laggards. This perception or categorizing of countries based on their approach to the legislation of GMO is subjective.

According to Rogers, E. [2003] there are 4 specific components to consider in the diffusion of innovation;

- Innovation: the idea, practice or object which is perceived as new
- Communication on channels: the means by which the message is spread
- Time: the length of time it takes for the decision process, the 'rate of adoption' is the temporal element of societal adoption
- Social System: interrelated units that are engaged in joint problem solving to accomplish a common goal

Though this theory can be discussed in greater detail the last elements relevant to this analysis are the stages of the decision making process; in the case of in-vitro meat the food consumer. As displayed in the stages of adoption, within the specific adopters there is still an individual decision process, Rogers, E. [2003] defined this processes in stages that can be seen in Figure 7 Decision Making Process of Innovation Adoption.

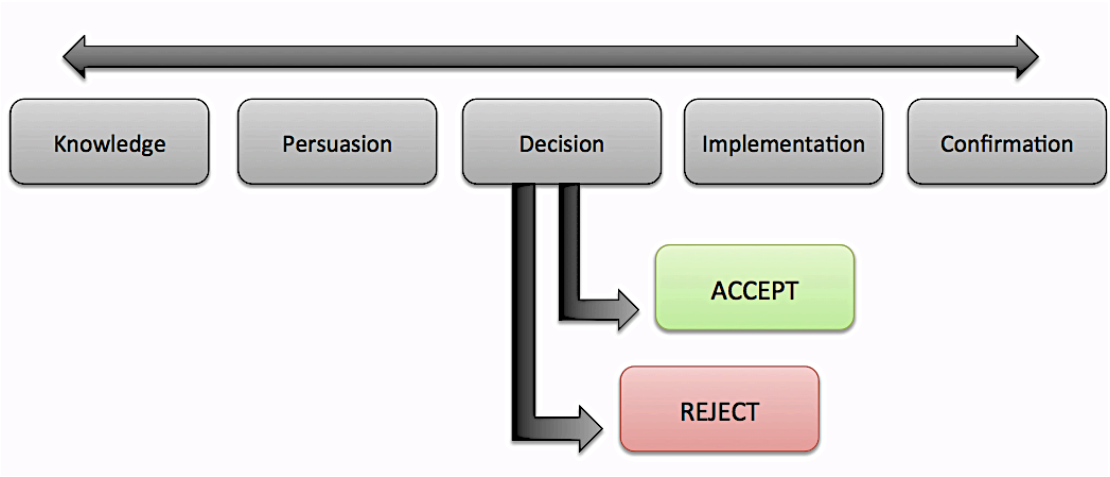


*Figure 7 Decision Making Process of Innovation Adoption* [adapted from Rogers, E. 2003]

These stages are described in more detail in Table 9 Stages of the Adoption Process (Rogers, E. 2003) Adoption differs from diffusion in the sense that the adoption is on an individual (micro) level and diffusion is larger, societal acceptance or within a social group (meso and/or macro).

*Table 9 Stages of the Adoption Process* (Rogers, E. 2003)

| Stage | Definition |
|---|---|
| **Knowledge** | First exposure to the innovation but lacking information and not motivated to seek it. |
| **Persuasion** | Interest is developed, becomes more keen to attain information |
| **Decision** | Begins to assess the pros/cons and decides whether or not to accept or reject. Individual values, attitudes, perceptions, culture etc. make this stage difficult to study and grasp understanding about. |
| **Implementation** | Begins to use the innovation, varies in degree and more information may be sought to increase usefulness. |
| **Confirmation** | No longer questions the use of the innovation and continues implementation, confirmation the right decision has been made. |

An informant commented on empowering the consumer and possibly affecting the persuasion and decision phase;

*"framing is a very important issue, if I may make the analogy of genetically modified , one of the very important points about genetically modified is it doesn't benefit consumers, and the big difference with in-vitro that it would benefit consumers – I mean based on environmental aspects alone only the pricing would be a way to convince consumers. The current genetically modified applications they all benefit industry and farmers, there is no benefit for the consumer, at all, only the later generation genetically modified, you know some, so why would a consumer support a technology they don't benefit from"* [Informant 1-23:15]

### 3.6.2 THE ROLE OF COMMUNICATION IN SOCIAL CHANGE AND TECHNOLOGY ACCEPTANCE

As mentioned previously, Rogers, E. [2003] has explained this happens with a strong influence from communication channels, over a period of time in a given social system. In-vitro meat has already made headlines and been present in the media, since it is such a new technology it is not apparent how the average consumer will perceive it but the model of the diffusion of innovative may serve as the hypothesised path. The technology is subject to legislative acceptance however, it is only possible for consumers to eventually accept a technology if authorities allow it to be accessible. In terms of communication and framing, the acceptance may likely depend on much more than simple accessibility. Again as can been seen with the GM debate and low level of acceptance, framing and communication, have played a key role in the technologies place in society and its regulation.

Communication channels have also changed and are far more personalized and direct. With specific, directed advertisements, on social media sites like Facebook, or the ability to follow specific businesses or interests – the way information is communicated to consumers is quickly changing. Some of these changes may affect acceptance and should be studied in order to optimize legislative decisions.

# 4.0 PROPOSED PERSPECTIVES

According to Power, K. [2010] and in accordance with Rogers Diffusion of Innovations Theory, in order to change behaviour which in this case is in relation to either accepting cultured meat and/or reducing meat consumption in general, more information needs to be disseminated. Infrastructure should promote these more 'sustainable' choices through pricing policy and social marketing. These specific suggestions for changing infrastructure can be arguably described as responsibilities of the macro level of governance, or public sector in the governance triangle.

Power, K. [2010] discussed studies, which concluded choice editing by industrial sector like regulators, retailers and manufacturers has been responsible for the majority of cases of change success.

Power, K. & Mont, O. [2010] published a paper in which their main goal was to map out the most critical factors that have influenced and shaped contemporary consumption patterns and levels in an integrated approach, they then proceeded to understand how the knowledge of factors shaping consumption might be useful for mitigating strategies of unsustainable consumption. Their findings and discussion are focused on sustainable diets in general without specific detail to meat and cultured meat, though they do speak about technology as well – the conclusions reached further confirmed the findings of this situational analysis and will be used to draw parallels to respondent answers discursively.

As mentioned by Power, K. & Mont, O. [2010] and confirmed by informants, change to more sustainable diets – in this case the specific behaviours of reducing meat consumption and /or consuming innovative novel meat alternatives such as cultured meat could be supported through increasing transparency – cooperation between all sectors in the governance triangle to ensure the 'right' products are appropriately priced, easily available and that labeling is clear and helpful.

Understanding the role of meat in society and its impacts, lead to the prospective roles and responsibilities of each actor in the governance triangle – a need to work together to achieve a realistic behavior changing environment. An environment which promotes favoured consumption may assist in mitigating the negative implications of current meat production methods. Though many informants and data questioned the ability to apply STS theories to food, the author has identified many links or overlaps and believes a combination of behavioral change theories; such as strategic communication or nudging or choice editing could work together to achieve the called for change toward more sustainable consumption in regards to meat. As highlighted by the informants, there is no silver bullet and a mixed methods approach is needed therefore, society will be challenged with changing consumption behavior not only among available products but innovative novel foods.

The Situational Analysis highlighted that informants and relevant actors felt action should be taken. In summary more specific suggested actions are as follows;

- Choice editing to remove acknowledged unsustainably produced meat from the market (whether it be ethically or environmentally) – removing some of the already complicated choice responsibility from the consumer
- Social marketing to inform increase awareness of problems with current practice of meat production and consumption and in parallel highlight the benefits of changed behavior for society (this can be done through campaigning, interventions or other strategic communication strategies developed to specific target groups; school, communities, public spaces, work places etc. –working with social groups allows change to be more accepted; and the message should come from all sectors in the governance triangle, in order to catch as large an audience as possible realize that people respond differently to messages and trust of the sender is varied – so use multiple diverse channels) [Windahl, S. et al. 2009]
- Improve transparency and clarify issues such as multiple labels, the issue of methods of production and information about their implications, etc. – there is a need for all stakeholders to work together
- Regulations put in place to address highly negative impacting meats versus healthy low impacting meats (in relation to sustainability): through as mentioned previously tools such as taxation, subsidies, VAT, labeling
- Increased awareness and knowledge; in general dissemination of existing

information on these key issues regarding meat production and consumption affecting society need to be shared by governments and civil actors such as NGOs to empower consumer to change

# 5.0 CONCLUSION

This situational analysis suggested actors/ stakeholders and specific informants throughout the sector have a number of diverse concerns and the sense of urgency to address them also fluctuates depending on the power and interest position of each stakeholder. It is apparent and well understood by the majority of actors, but perhaps less so by the individual consumer in society that, specifically the consumption patterns and production methods used to feed the growing desire for animal products, have enormous implications and impacts on sustainability.

The debate about where the responsibility for improvement and change toward a more sustainable food system; specifically livestock production/consumption aspect, is extremely complex. Though many divergence points in perceptions were identified – strong majority perceptions also prevailed.

Specifically, the role of innovation and technology in improving sustainability through alternative meat sources, like the in-vitro solution, have been highly critiqued and the presence of scepticism is strong among many of the informants and relevant actors. This can however be understood through the mentioned models of diffusion and social construction of technology, according to these theories, this innovation is following a natural progression in society and more questions need to be answered before early adopters and the majority will accept the technology, if they accept the technology. Theory also suggest the push of changes in consumption habits, encouraging reduced meat consumption in general and/or the acceptance of alternatives takes time to diffusion throughout social groups and society and that various stakeholders and communication channels may have a strong influence on the outcome.

Controversially, in relation to the above mentioned potential of these communication channels it can be concluded that the case of food and the food system can not be solely viewed as technology but is heavily interlaced with culture and values – arguably technology is a result of the same societal culture and values. These relations can be further investigated.

The choice is method allowed for extensive data collection but presented challenges in analysis – it was difficult to find a completely representative sample of the governance triangle discussed and navigating the data during collection often lead tedious

investigations of very narrow fields in order to continue orientation. The importance and meaning of each theme was difficult to assess in relative value to the larger context due to the abundance of data and numerous informant perceptions. The integrated nature of the food system and the themes, along with chosen methods in this situational analysis made the presentation of results difficult to keep ordered. Also, expertise in some themes was limited by the researchers knowledge and all data was subject to interpretation, in this sense a degree of bias is acknowledged. However the triangulation of methods was thought to increase the validity of this situational analysis.

The situational analysis reveals that it is unlikely that a single silver bullet solution exists to mitigating the problems caused by the role of meat in society. It suggests that informants suggest a selection of mixed methods should be applied, and there is *some* room for cultured meat and similar novel innovative alternative meat product developments.
The responsibilities of the public, private and civil sector are diverse but all serve an important roles in facilitating the changes needed regarding the role of meat in society, for a more sustainable food system.

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