FEASTS
Fostering European Cellular Agriculture for Sustainable Transition Solutions

Ethical Impact Assessment of Cultured Meat and Seafood

Version 1 (Month 18)

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CM	Cultured Meat
CSF	Cultured Seafood
EC	European Commission
EIA	Ethical Impact Assessment
EU	European Union
FAO	Food and Agricultural Organisation of the United Nations
IEC	International Electrotechnical Commission
IEEE	Institution of Electrical and Electronics Engineers
ISO	International Standard Organisation
UDAW	Universal Declaration on Animal Welfare
UN	United Nations
VBE	Value-Based Engineering

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Executive Summary

This Ethical Impact Assessment (EIA), developed under the FEASTS project, explores the ethical dimensions of cultured meat and seafood (CM/CSF) technologies. It aims to provide a comprehensive, balanced, and structured analysis of the potential ethical opportunities and risks associated with CM/CSF, using the Value-Based Engineering (VBE) methodology. The assessment is grounded in stakeholder engagement, literature reviews, workshops, and interviews.

The EIA follows the IEEE 7000 standard for ethically aligned design, structured into three phases:

1. **Concept and Context Exploration** – Mapping stakeholders and understanding the broader food system.
2. **Ethical Values Elicitation** – Identifying core values and their manifestations (value qualities).
3. **Ethically Aligned Design** – To be addressed in the final report (Month 36).

The assessment draws from over 379 descriptions of ethical effects, identifying 55 value qualities and 8 core values.

The core values identified in the Ethical Impact Assessment (EIA) for cultured meat and seafood (CM/CSF) are:

1. **Animal Welfare**: Focuses on the well-being of farmed animals, including aspects like reduced diseases, stress, and pain, and respect for animals.

   Chances: Reduced animal suffering, stress, and slaughter; increased respect for animals.

   Risks: Continued use of animal-derived inputs (e.g. fetal bovine serum), potential exploitation of donor animals.

2. **Ecological Sustainability**: Involves maintaining essential ecosystem functions and processes over the long term, ensuring resilience and health of the natural environment. This includes protection and regeneration of biodiversity, reduced pollution, and efficient use of resources.

   Chances: Reduced land and water use, lower emissions, biodiversity regeneration.

   Risks: High energy demands, potential monocultures, and loss of traditional biodiversity-supporting practices.

3. **Human Health**: Refers to physical and mental well-being, particularly in relation to the normal functioning of the human body. Relevant factors include reduced contaminants and pathogens, and improved nutritional value of meat.

   Chances: Lower contamination risks, reduced antibiotic use, potential for tailored nutrition.

   Risks: Unknown long-term health effects, risk of harmful additives or contaminants.

4. **Food Security / Food Justice**: Ensures that all people have access to sufficient, safe, and nutritious food at all times. It also addresses inequalities within food systems, aiming for fair access to nutritious food for marginalised communities.

   Chances: Stable protein supply, resilience to climate change, potential affordability.

Risks: Risk of monopolisation, unequal access, and exclusion of traditional producers.

5. **Economic Security**: Means having a stable income or resources to support a certain standard of living. This includes income security, job attractiveness, and product availability.

   Chances: New job creation in biotech and food innovation sectors.

   Risks: Job losses in traditional farming, disruption of rural economies, loss of secondary livestock products.

6. **Social Cohesion**: Characterised by mutual trust, an integrative identity, a sense of belonging, and working together for the common good. It includes aspects like social tension, regional identity, and cultural heritage.

   Chances: Inclusive dietary options, reduced polarisation between dietary groups.

   Risks: Cultural disruption, loss of regional identity, generational divides.

7. **Trust**: The firm belief in the integrity or character of a person, organisation, or technology, ensuring it is safe and reliable. This includes transparent communication and truthfulness.

   Chances: Transparent communication and ethical branding can build consumer confidence.

   Risks: Corporate dominance, lack of transparency, and ethical 'greenwashing'.

8. **Integrity**: Means remaining true to one's values and acting honestly and fairly. It involves cognitive consonance, reflection, respect for life, and mindfulness.

   Chances: Alignment of personal ethics with consumption, reduced cognitive dissonance.

   Risks: Alienation from food systems, overreliance on technology, and loss of traditional food practices.

These core values are central to the ethical assessment of CM/CSF and guide the analysis of its potential impacts on various stakeholders and the environment.

This report also examines the potential tension between ethical values and profit motives in the development of cultured meat and seafood (CM/CSF). While the motivation for developing CM/CSF technologies has often stemmed from ethical goals such as sustainability and animal welfare, their further development is largely driven by private investment and market interests.

We present a value-profit matrix with four zones:

- Investment zone: high ethical focus, early stage of development.
- Win-win-win zone: alignment of ethics, environment and profit.
- Exploitation zone: profit-driven shortcuts that harm people or the planet.
- Crash zone: public backlash and loss of trust due to unethical practices.

The great challenge and task of technology ethics is to show the way from the investment zone to the win-win-win zone and to prevent the drift into the exploitation and the crash zone. To achieve trustworthy innovations and business models, the complex ethical dimensions must be taken into account from the outset and throughout the development to the market. Transparency, stakeholder engagement and value-based design can help CM/CSF companies avoid ethical pitfalls and build long-term trust and success.

The Ethical Impact Assessment of CM/CSF highlights the significant potential of these technologies to contribute to a more sustainable, humane, and equitable food system. However, realising these benefits requires careful consideration of the identified core values and proactive management of associated risks. By addressing the challenges and leveraging the positive impacts, CM/CSF can play a crucial role in transforming food production for the better.

Introduction

The main objective of this report is to provide as comprehensive and unbiased an overview as possible of the ethical opportunities and risks associated with cultured meat and seafood (CM/CSF). It is intended to serve as a basis for a fruitful dialogue in which no interest group feels excluded. The report attempts to comprehensively address the potential ethical implications of CM/CSF and draw initial conclusions. Further conclusions and recommendations will be presented in the second report (month 36).

The report primarily addresses the potential ethical implications of CM/CSF, which must, however, be assessed in the context of conventional meat and other alternative protein sources, such as plant proteins.

The report is structured in such a way as to enable a differentiated and multi-layered examination of the ethical promises and risks of CM/CSF.

It consists of the following main sections:

In the methodology section we describe the procedure applied and the steps taken, which are largely inspired by the IEEE 7000 standard (value-based engineering). In the next step, we examine the contextual factors and stakeholder groups that would be affected by the production and consumption of CM/CSF. This forms the basis for the core of this EIA, the value analysis: this section shows which core values are influenced by CM/CSF and which value qualities are relevant. In the next section, we describe how the data was collected through literature research, workshops and interviews.

The discussion section examines the relationship between the main drivers and additional core values, the problem of CM/CSF as a technical solution, values and market dynamics. In the conclusion section, we summarise the results and provide (very) preliminary recommendations. In the outlook section, we provide a preliminary outlook on the next steps and phases of the EIA. The appendices contain detailed value tables from workshops, literature reviews and interviews, as well as further supplementary information.

Our objective was to present a thorough and balanced examination of the ethical dimensions of CM/CSF, thereby providing a solid foundation for informed, nuanced reflection and dialogue.

In fact, there is a very controversial debate underway about the production and consumption of CM/CSF. Polarising views clash with each other, we briefly outline a few of them:

Many people consider meat production and consumption to be a major factor in climate change, environmental pollution and the destruction of ecosystems. At the same time, factory farming, long transport routes and slaughter cause enormous suffering to sentient animals[1,2,3]. According to the appeal, a rapid change in current food systems is necessary.

In addition to plant proteins, the production of CM/CSF is considered a promising alternative for ensuring food security and drastically reducing environmental pollution and animal suffering in conventional meat/seafood production. This is partly because cell cultivation in bioreactors requires far less water and land than conventional animal husbandry, and partly because mass slaughter is not necessary. In fact, early proponents of CM/CSF promoted the idea for ethical rather than economic reasons. The spread of CM/CSF would probably make us realise how barbaric it was to slaughter animals for our consumption and pleasure[4]. In terms of taste and composition, CM/CSF is more similar to conventional meat/seafood than other alternative proteins such as plant-based proteins and therefore has the potential for greater consumer acceptance.

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[1] Neus González et al., 'Meat Consumption: Which Are the Current Global Risks? A Review of Recent (2010–2020) Evidences', *Food Research International* 137 (November 2020): 109341, https://doi.org/10.1016/j.foodres.2020.109341.

[2] Catherine C. Ivanovich et al., 'Future Warming from Global Food Consumption', *Nature Climate Change* 13, no. 3 (March 2023): 297–302, https://doi.org/10.1038/s41558-023-01605-8.

[3] Halil Simdi and Ayberk Seker, 'A Change Is Gonna Come: Will Traditional Meat Production End?', *Environmental Science and Pollution Research* 29, no. 20 (1 April 2022): 30470–85, https://doi.org/10.1007/s11356-021-17829-0.

[4] Cor Van Der Weele and Clemens Driessen, 'Emerging Profiles for Cultured Meat; Ethics through and as Design', *Animals* 3, no. 3 (26 July 2013): 653, https://doi.org/10.3390/ani3030647.

But there are, of course, opposing views: For many, as we will see in the next pages, the idea of CM/CSF also raises major ethical concerns. Would CM/CSF not be much more of a tech-fix that distracts from the need for fundamental changes in our way of life[5]? Would the widespread use of CM/CSF lead to the disappearance of farmed animals and further diminish our contact with nature? Is the idea of CM/CSF rather not a hubris of Western civilisation, which wants to extend its control over non-human nature even further[6]? Would the only winner not be big industry, which displaces small farmers and perpetuates unjust food distribution?

We get to the bottom of such questions in this EIA, namely, we will examine what the *ethically* relevant effects of a large-scale introduction of CM/CSF would be.

But what exactly is ethics? Ethics is a branch of philosophy that deals with the question 'What should we do?' and attempts to answer this. It is a process of reflection in which people's decisions are guided by values, principles and goals, rather than by instinctive habits or social conventions. Values and principles provide a sense of what is good, right and meaningful in life. They act as a compass in choosing between the alternatives available to us. Ethics is therefore a kind of toolbox with a methodology for making choices that make the world worth living in. It addresses existential questions such as: 'What is the right thing to do?', 'What counts as a good life?', 'What does justice mean?' or 'What is the value of human and animal life?'

With the increasing impact of modern technologies and industry on all aspects of society, the ethical dimension is becoming ever more important. The faster the technological progress advances and the more powerful technologies become, the more important it is to design them in accordance with ethical values and principles. The ethics of technology therefore raises questions such as 'Does a particular technology work well?', 'Who benefits from it and who might it harm?', 'Could it threaten human and fundamental rights?', 'How can technology be designed to enhance values rather than compromise them?'.

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[5] C. Salzani and Z. Weisberg, 'The Ethics and Politics of Cultured Meat: Food Transition, Big Business, "Humanewashing"', in *Transforming Food Systems: Ethics, Innovation and Responsibility* (EurSafe 2022, Edinburgh, United Kingdom: Wageningen Academic Publishers, 2022), 428–33, https://doi.org/10.3920/978-90-8686-939-8_67.

[6] Lee, 'Meat-Ing Demand', 25-26.

With Hans Jonas and his philosophical reflections in the book 'Das Prinzip Verantwortung'[7], it became clear that ethical questions about the good life do not only relate to our fellow human beings, but also to our fellow creatures and nature as a whole.

FEASTS is a project funded by the European Commission to promote the *Farm to Fork Strategy*[8]. The aim of this strategy is to foster fair, healthy and environmentally friendly food systems for the provision of safe alternative proteins. The food system should be more sustainable, greener and healthier, with a positive impact on biodiversity and the circular economy. At the same time, it should reduce food poverty and also enable successful businesses[9].

These are all ethical objectives.

The question now arises as to what technical, social, organisational and political measures can be taken to achieve such ambitious goals? CM/CSF is one possible way forward, and the aim of this report is to assess the opportunities and risks as comprehensively as possible in order to derive recommendations in a next step. This work thus fits in with the mission of FEASTS:

'FEASTS is a groundbreaking, collaborative research programme with the goal to deliver a comprehensive, unbiased knowledge base about cultured meat and seafood (CM/CSF), and their place in the food system. Through advanced research, interdisciplinary collaboration, and stakeholder engagement we employ a food-systems thinking approach to help understand the role cultured meat and seafood might play in a resilient, equitable and sustainable food system.'[10]

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[7] Hans Jonas, *Das Prinzip Verantwortung* (Frankfurt am Main: Suhrkamp Taschenbuch, 1979). Original work in German. For the English version see: *The Imperative of Responsibility* (translated by The University Chicago Press).

[8] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. – A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system, COM/2020/381 final.

[9] European Commission Decision C(2024), 'HORIZON-CL6-2023-FARM2FORK-01-13: Cultured meat and cultured seafood – current status and future prospects in the EU', 17 April 2024, 170.

[10] The mission statement of FEASTS. See FEASTS homepage under: https://feasts-innovation.eu/.

Ethical Impacts identified

Methodology used

The work to capture the ethical dimensions of CM/CSF for this assessment was largely inspired by the so-called Value-Based Engineering method. This (VBE) is a new, deeply visionary and wellbeing-driven method for the ethical alignment of innovations. It starts as early as possible in the system definition phase with the mission and intended goals of innovation projects and guides innovation teams through various processes toward defining the system requirements. At the core of this process is the world's first standard addressing ethical issues in system design, IEEE 7000, published together with ISO as ISO/IEC/IEEE 24748-7000. The standard was developed over a period of five years (2016-2021) with the help of more than 35 members of the standardisation working group and reviewed by 95 international experts. The working group has responded to more than 1,000 suggestions for improvement from these experts. As a result of this inclusive and open collaboration, many of the best approaches to value-based system design have been incorporated, including stakeholder engagement, conceptualisation of values and risk-based design[11].

Three Phases of VBE

A VBE process consists of three main building blocks (Figure 1), namely:

1. Concept and context exploration
2. Ethical values elicitation and prioritisation
3. Ethically aligned design

The current EIA primarily addresses modules 1 and 2 and provides an initial, very preliminary outlook on phase 3. In the final EIA (due in month 36), steps 1 and 2 will be supplemented and revised as necessary, and module 3 will be added.

[11] Sarah Spiekermann, *Value-Based Engineering: A Guide to Building Ethical Technology for Humanity* (De Gruyter, 2023), https://doi.org/10.1515/9783110793383.

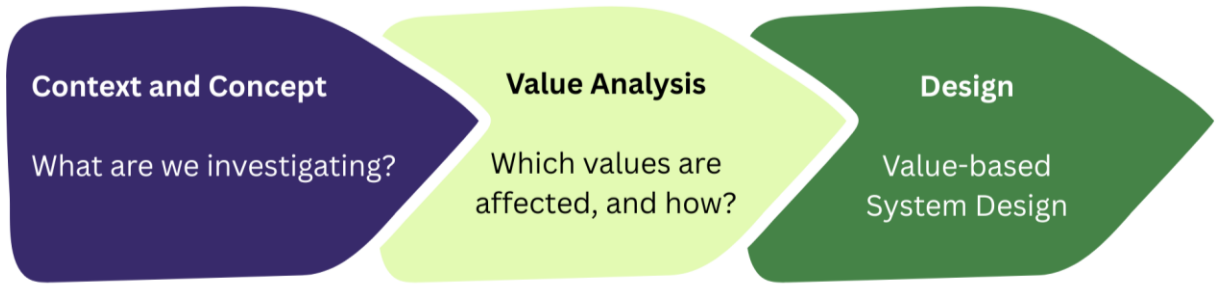

Figure 1: The 3 phases of Value-Based Engineering

Phase 1: Concept and context exploration

The purpose of the concept and context investigation is to define how a system might function from the perspective of the stakeholders and its potential for ethical benefit or harm. It creates an initial rough outline identifying the essential actors, processes and 'material flows'.

Challenges

The contextual study of CM/CSF is particularly challenging for several reasons:

1) We are not looking at a specific product developed and manufactured by a single manufacturer with clearly defined relationships with third parties such as suppliers and distributors, but rather a widely ramified value chain consisting of countless individual players with varying degrees of independence, from the farmer who breeds the cell donor animals to the final consumer.

2) Conventional meat and fish production must be included in the ethical assessment in order to be able to evaluate the ethical implications comparatively (example: CM production requires less water than conventional beef production).

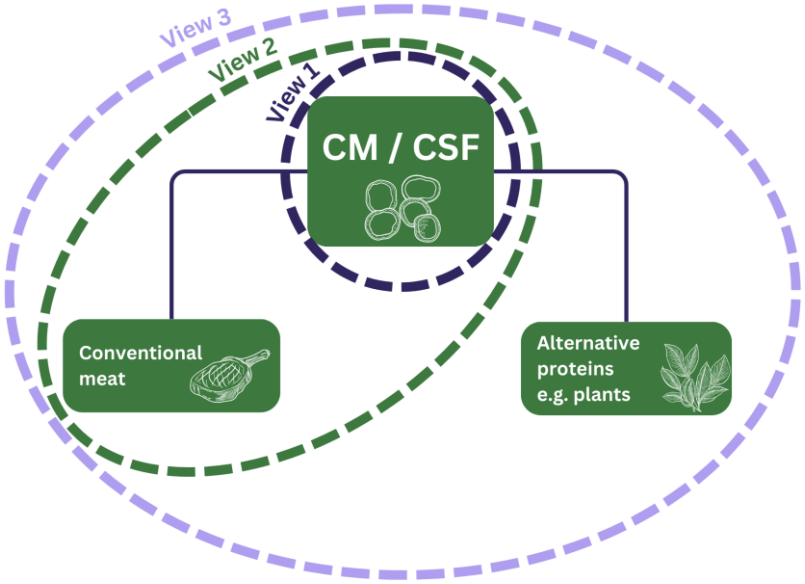

Figure 2: Setting out boundaries in ethical evaluation

3) Further alternative protein products must also be taken into account, as they are also subject to an 'ethical comparison' (Figure 2). For example, if you claim that protein supply with CM/CSF is better than the alternative from an ecological point of view, you must clarify what you are using as an alternative. Is it protein from conventional meat production or plant-based or other protein alternatives (insects, algae etc.)? Although this analysis mainly compares CM/CSF with conventional meat production, it is important to bear in mind that other alternative proteins are also available and are being developed.

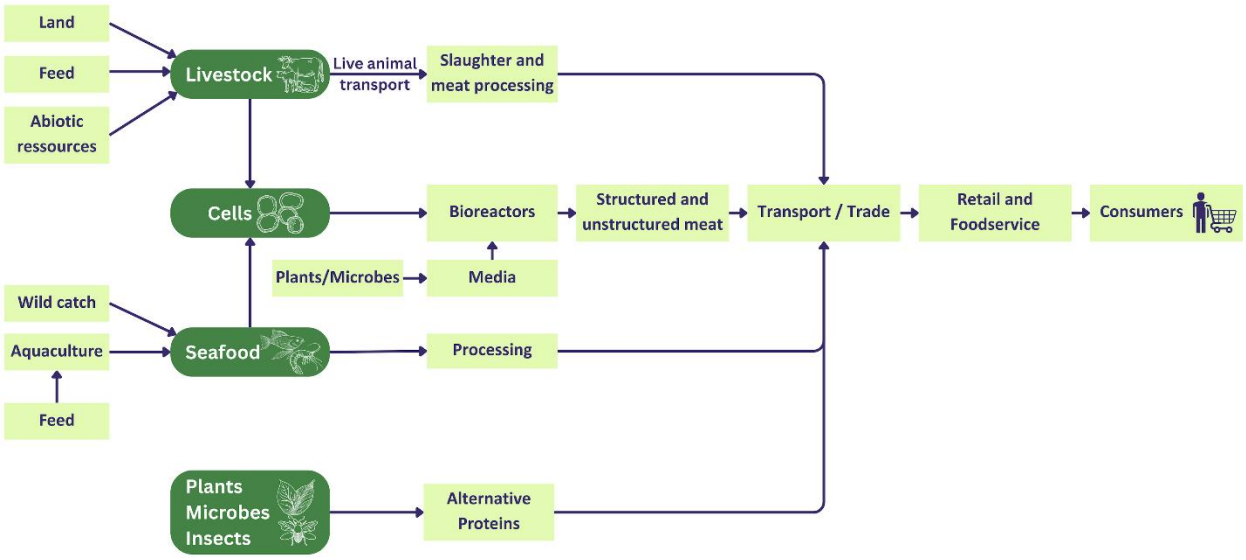

Figure 3: A simple contextual diagram of CM/CSF production and distribution (and alternatives)

4) The CM/CSF value chain and its position in the food system are still evolving. In Europe, there are no products approved for human consumption on the market yet, and worldwide there are only a few with very limited experience. The ethical implications must be assessed to the best of our knowledge at this stage but can only be based in part on facts. This will change over time. The final EIA report at the end of the FEASTS project will also have a different starting point than the present one.

5) The most likely scenario for the medium term is that the European market will also see a mix of conventional meat and seafood, CM/CSF and other alternative proteins. We are not aware of any uniform forecasts as to how the various protein segments might divide up the market, but some assumptions must be made. For an ethical analysis of CM/CSF, it is important to imagine that CM/CSF will occupy a large market share (without specifying this in more detail) in order to have a clearer picture of the potential opportunities and risks. We therefore ran through these scenarios in our workshops without knowing what the market share will actually look like in the future.

The results presented in this report must therefore be viewed against the background that both the authors we cite in the study and the workshop participants may have had different reference systems in mind when describing the possible ethical implications of CM/CSF.

Stakeholders

The working group for Task 4.1 mapped the relevant stakeholder groups for CM/CSF. An overview is provided in Figure 4.

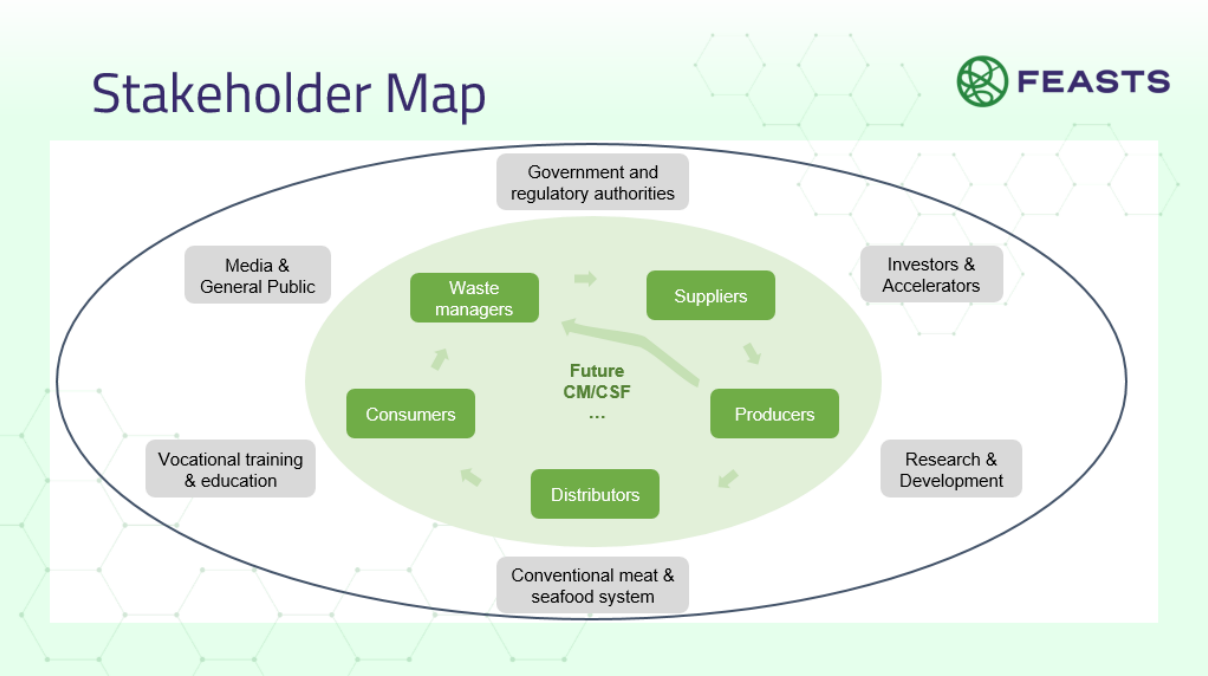

Figure 4: Stakeholder mapping for CM/CSF

From the perspective of the ethical implications of CM/CSF, all of these groups are relevant, but play a subordinate role in the classification. For example, the question of whether CM/CSF is healthy is relevant for all consumers, regardless of whether they work in the media or in vocational training. Furthermore, the ethical analysis must address those groups of people who, for whatever reason, will not consume CM/CSF. Finally, the natural environment including animals and plants must also be considered among those affected.

Figure 5 provides an overview of the relevant stakeholders from an ethical perspective. The individual groups listed can be further categorised, as we have done in the value tables (see Annexes).

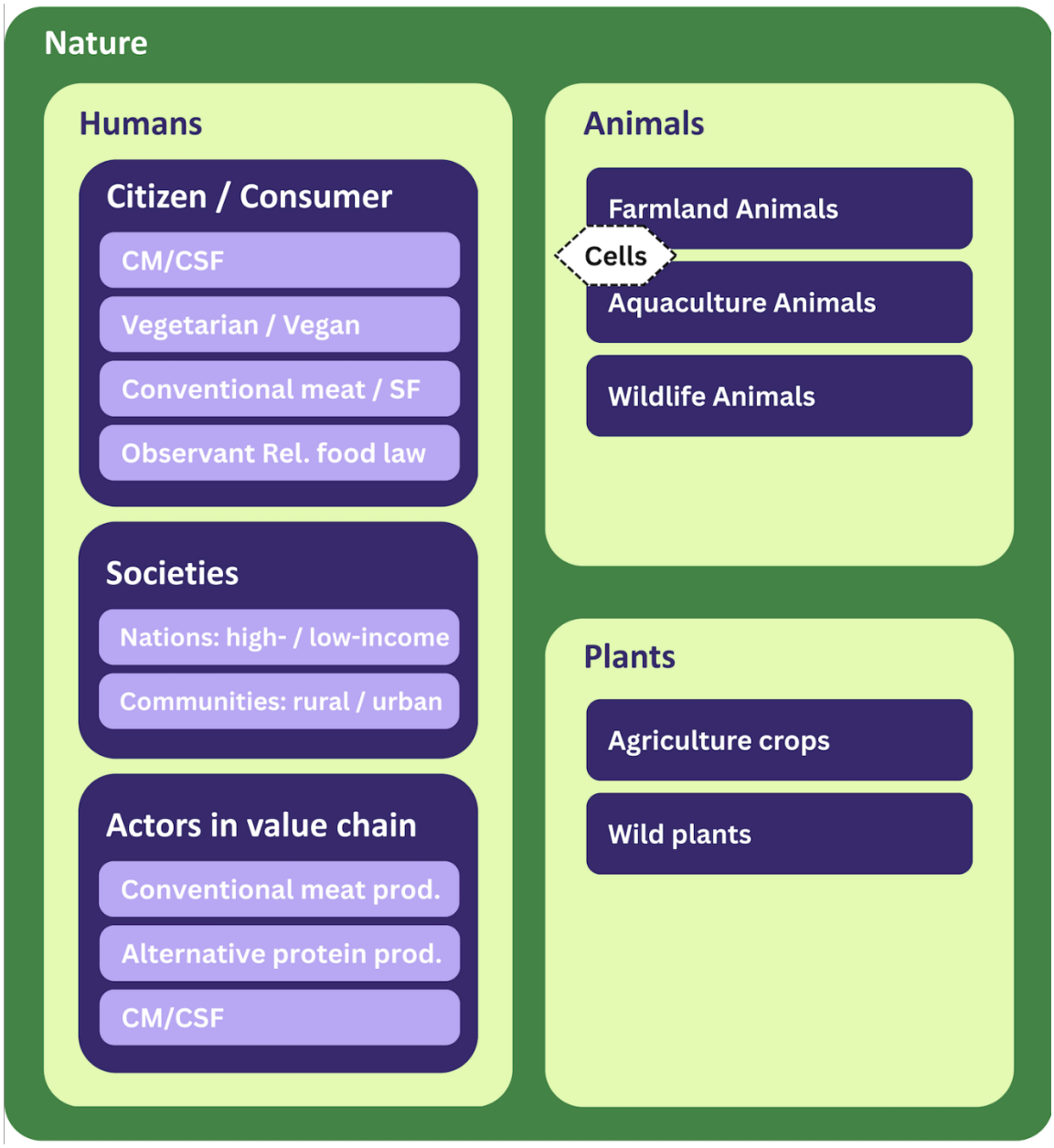

Figure 5: Stakeholders of ethical impacts of CM/CSF at different levels

Phase 2: Value exploration

The aim of the second phase of the EIA is to examine the positive and negative value potentials of CM/CSF. Based on the contextual factors and stakeholders identified in phase 1, this step identifies and discusses the positive values that CM/CSF could bring to the world in order to create value for stakeholders and protect nature. In addition, possible negative values that could arise from the introduction and dissemination of CM/CSF and should be avoided are also considered.

It is important to examine the ethical implications of CM/CSF assuming that CM/CSF would be available on the market on a large scale, i.e. with significant impacts on the target stakeholders and markets. In this context, the EIA also takes a long-term perspective (approximately 10 to 20 years) in order to be able to assume a representative market share of CM/CSF.

Value Ontology

VBE proposes a three-level value ontology to bridge the gap between the more abstract level of values and the functionalities of the specific technology under investigation. We follow this terminology in this EIA as it helps to provide clarity and structure for the subsequent steps.

The levels are designated as follows:

Core Values

are values that are identified as central essences of the technology of interest. Core values are always positive and intrinsic in nature. Examples of core values are trust, equality, freedom, truth, preservation of nature, etc. These core values are usually those to which we generally refer when we talk about value phenomena. Core values are, for example, those that we consider so important that they are protected as fundamental rights by the EU Charter.

Value Qualities (value demonstrator in IEEE 7000 terminology)

are manifestations of a core value that can be tangibly observed. A value quality can be positive or negative and thus realise or damage the core value in reality[12].

Value Dispositions

are the capacity, characteristics or properties 'in' an object[13]. Value dispositions are what auditors can, indeed, tangibly find in an inspected system.

To illustrate the concept of the three-layered value ontology, let us take a look at the value of animal protection (Figure 6). The **core value** is *animal welfare*. The well-being of the animals is reflected in various dimensions of **value qualities**. Positive value qualities can refer to the *health* of the animals, *wholesome feed* and sufficient liquid intake, *species-appropriate accommodation*, sufficient space for *movement* and much more. On the other hand, insufficient space for an animal is a negative value quality in relation to the core value of animal welfare. The **value disposition** is the very specific characteristic of value quality in a specific situation, i.e. something that animal protection auditors or inspectors can actually monitor and measure. For an animal-friendly stable (value quality), for example, measurable value dispositions are the type of *floor*, the *square metres* per animal, the *temperature* and *humidity*, etc. In summary, to comprehend a certain value, (e.g. animal welfare through technology) it is necessary to understand how this value is expressed in value qualities and how these value qualities can be specifically verified through value dispositions.

[12] Spiekermann, *Value-Based Engineering*.
[13] Value disposition can also be 'in' a person.

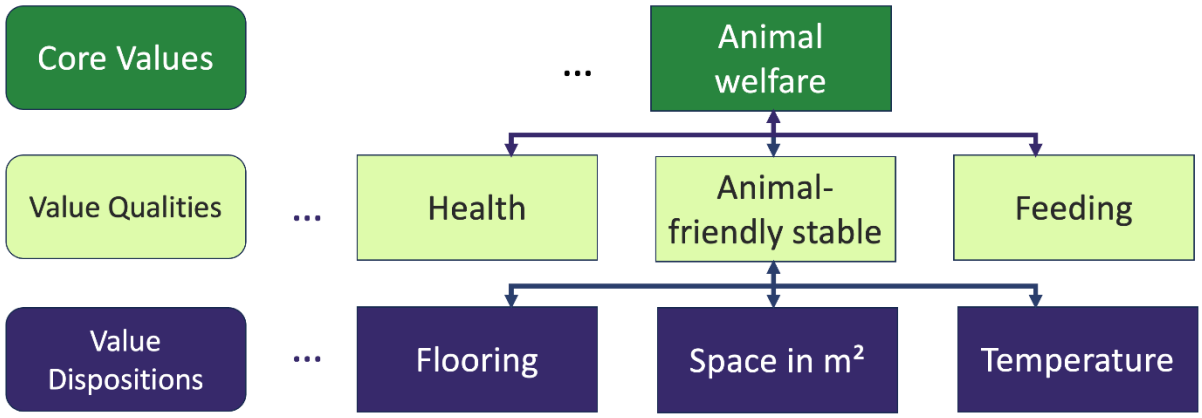

Figure 6: The three-layered value ontology using the example of animal welfare

We can summarise the dynamics between positive core values and positive/negative value qualities as follows:

- fostering a positive value quality in a system constitutes a positive value
- harming a positive value quality in a system constitutes a negative value
- fostering a negative value quality in a system constitutes a negative value
- harming (or prohibiting) a negative value quality in a system constitutes a positive value

The aim of ethically oriented technology design is to shape all value dispositions in such a way that positive value qualities are realised on the one hand and negative value qualities are excluded as far as possible on the other.

Core Values identified

We have identified eight key values that can be directly influenced by the introduction and application of CM/CSF. We describe the exact method used to identify these values in the section 'How was the data collected? Four of the core values are those that are regularly cited as ethical goals of CM/CSF. We therefore refer to them as **ethical drivers**, which are (Figure 7):

- Animal Welfare[14,15,16,17,18]
- Ecological Sustainability[19,20,21,22,23]
- Human Health[24,25,26,27,28]
- Food Security / Food Justice[29,30,31,32,33,34]

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[14] Van Der Weele and Driessen, 'Emerging Profiles for Cultured Meat; Ethics through and as Design'.
[15] Nicolas Treich, 'Cultured Meat: Promises and Challenges', *Environmental and Resource Economics* 79, no. 1 (May 2021): 33–61, https://doi.org/10.1007/s10640-021-00551-3.
[16] Nisansala Chandimali et al., 'Not Seafood but Seafood: A Review on Cell-Based Cultured Seafood in Lieu of Conventional Seafood', *Food Control* 162 (August 2024): 110472, https://doi.org/10.1016/j.foodcont.2024.110472.
[17] Cristian Moyano-Fernández, 'The Moral Pitfalls of Cultivated Meat: Complementing Utilitarian Perspective with Eco-Republican Justice Approach', *Journal of Agricultural and Environmental Ethics* 36, no. 1 (March 2023): 23, https://doi.org/10.1007/s10806-022-09896-1.
[18] Lee, 'Meat-Ing Demand'.
[19] A. Janet Tomiyama et al., 'Bridging the Gap between the Science of Cultured Meat and Public Perceptions', *Trends in Food Science & Technology* 104 (October 2020): 144–52, https://doi.org/10.1016/j.tifs.2020.07.019.
[20] Lucie Pilařová et al., 'Exploring Ethical, Ecological, and Health Factors Influencing the Acceptance of Cultured Meat among Generation Y and Generation Z', *Nutrients* 15, no. 13 (28 June 2023): 2935, https://doi.org/10.3390/nu15132935.
[21] Chriki and Hocquette, 'The Myth of Cultured Meat'.
[22] Luca Lo Sapio, 'The Ethics of Cultivated Meat: Hypes and Hopes of a New Challenging Technology', *International Journal of Applied Philosophy* 36, no. 1 (2022): 27–39, https://doi.org/10.5840/ijap2023210173.
[23] Richard Helliwell and Rob J. F. Burton, 'The Promised Land? Exploring the Future Visions and Narrative Silences of Cellular Agriculture in News and Industry Media', *Journal of Rural Studies* 84 (1 May 2021): 180–91, https://doi.org/10.1016/j.jrurstud.2021.04.002.
[24] Tomiyama et al., 'Bridging the Gap between the Science of Cultured Meat and Public Perceptions'.
[25] Fabio Bacchini and Elena Bossini, 'The Ethics of Imitation in Meat Alternatives', *Food Ethics* 8, no. 2 (October 2023): 24, https://doi.org/10.1007/s41055-023-00134-6.
[26] Chandimali et al., 'Not Seafood but Seafood'.
[27] Pilařová et al., 'Exploring Ethical, Ecological, and Health Factors Influencing the Acceptance of Cultured Meat among Generation Y and Generation Z'.
[28] Chriki and Hocquette, 'The Myth of Cultured Meat'.
[29] Treich, 'Cultured Meat'.
[30] Salzani and Weisberg, '67. The Ethics and Politics of Cultured Meat'.
[31] Moyano-Fernández, 'The Moral Pitfalls of Cultivated Meat'.
[32] Hanna L. Tuomisto, 'Vertical Farming and Cultured Meat: Immature Technologies for Urgent Problems', *One Earth* 1, no. 3 (November 2019): 275–77, https://doi.org/10.1016/j.oneear.2019.10.024.
[33] Lee, 'Meat-Ing Demand'.
[34] Martin Krøyer Rasmussen et al., 'Critical Review of Cultivated Meat from a Nordic Perspective', *Trends in Food Science & Technology* 144 (February 2024): 104336, https://doi.org/10.1016/j.tifs.2024.104336.

At the same time, for a well-founded value analysis, it is important to consider as much of the entire value space as possible that could be positively or negatively influenced by a technology. Based on our literature research, interviews and workshops, four additional core values have emerged, which we refer to as **additional core values**[35], namely (Figure 7):

- Economic security[36,37,38,39,40,41]
- Social cohesion[42,43,44,45,46]
- Trust[47,48,49,50,51]
- Integrity[52,53,54,55,56]

[35] According to the VBE method, economic security would be more of a value quality that realises a core value such as freedom or well-being. It would therefore not count as a core value. However, as the possible effects of CM/CSF on the labour market are very frequently discussed and mentioned, we have assigned economic security as a core value.
[36] Tomiyama et al., 'Bridging the Gap between the Science of Cultured Meat and Public Perceptions'.
[37] Treich, 'Cultured Meat'.
[38] Lee, 'Meat-Ing Demand'.
[39] Chriki and Hocquette, 'The Myth of Cultured Meat'.
[40] Lo Sapio, 'The Ethics of Cultivated Meat'.
[41] Rasmussen et al., 'Critical Review of Cultivated Meat from a Nordic Perspective'.
[42] Van Der Weele and Driessen, 'Emerging Profiles for Cultured Meat; Ethics through and as Design'.
[43] Bacchini and Bossini, 'The Ethics of Imitation in Meat Alternatives'.
[44] Moyano-Fernández, 'The Moral Pitfalls of Cultivated Meat'.
[45] Chriki and Hocquette, 'The Myth of Cultured Meat'.
[46] Helliwell and Burton, 'The Promised Land?'
[47] Tomiyama et al., 'Bridging the Gap between the Science of Cultured Meat and Public Perceptions'.
[48] Van Der Weele and Driessen, 'Emerging Profiles for Cultured Meat; Ethics through and as Design'.
[49] Salzani and Weisberg, '67. The Ethics and Politics of Cultured Meat'.
[50] Lee, 'Meat-Ing Demand'.
[51] Rasmussen et al., 'Critical Review of Cultivated Meat from a Nordic Perspective'.
[52] Van Der Weele and Driessen, 'Emerging Profiles for Cultured Meat; Ethics through and as Design'.
[53] Bacchini and Bossini, 'The Ethics of Imitation in Meat Alternatives'.
[54] Salzani and Weisberg, '67. The Ethics and Politics of Cultured Meat'.
[55] Lee, 'Meat-Ing Demand'.
[56] Rasmussen et al., 'Critical Review of Cultivated Meat from a Nordic Perspective'.

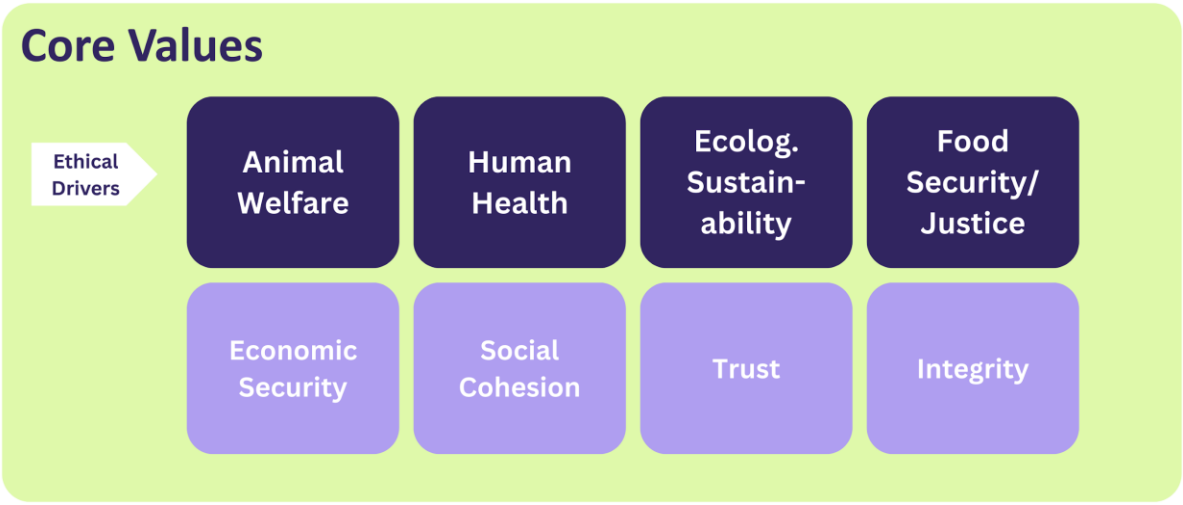

Figure 7: The eight core values impacted by CM/CSF

In this EIA, the eight core values are not weighted, i.e. no assessment is made as to whether one value is more important than another. In the VBE methodology, this is done in steps known as 'Core Value Prioritisation' and 'Conceptual Value Analysis'. However, it must be examined whether these steps can be applied in the context of CM/CSF or whether they need to be adapted. We will address this question in the final EIA (month 36 of the FEASTS project).

When considering the individual core values, it is important to understand that these are not self-contained entities but rather should be viewed as interacting factors. For example, reducing the use of antibiotics in animal husbandry (by offering CM/CSF products) would simultaneously have a positive impact on the core values of animal welfare, environmental sustainability and human health.

Value Qualities identified

In discussions about the opportunities and risks of technologies, values, value qualities and technical characteristics (value dispositions) are often mixed together and not clearly distinguished from one another. This easily leads to misunderstandings and mutual recriminations, which can be avoided by using clear terminology. It is as if apples and oranges are being mixed together in the debate, further heating up the discussion. Mutual accusations resulting from imprecise wording could be avoided if clear value terminology were used. That is why it is so

important to identify which facets of core values could be positively or negatively influenced by CM/CSF. These are the value qualities.

By differentiating the individual value qualities of a particular core value, it also becomes apparent that the same value could potentially be influenced positively or negatively. For example, the core value of health could be promoted by CM/CSF if CM/CSF is healthier than conventional meat, but also vice versa if CM/CSF is less healthy. Or the core value of economic security could be at risk for farmers, but at the same time other jobs could be created. It is therefore very important to look closely at this and identify the value qualities that influence the core values in each case.

The following section therefore examines which value qualities are relevant to each of the core values of CM/CSF. Section 'How data had been collected' describes in more detail how we identified the individual value qualities. Here is a brief summary: the starting point is always a description of a possible ethical impact of CM/CSF (from the literature or from workshop participants). The core value is usually easy to identify. A 'description of effect' could be, for example, 'The introduction of CM/CSF requires less water than conventional animal husbandry'. This 'effect description' obviously relates to the core value of ecological sustainability. How does the core value manifest itself in this context: through 'less waste of resources'. This is therefore the value quality for this effect that contributes to ecological sustainability.

The following section briefly describes the eight core values and the associated value qualities that are relevant in the context of CM/CSF. A distinction can be made between positive value qualities, which promote the core value, and negative value qualities, which detract from the core value.

In order to make the process of characterisation of value qualities more comprehensible, we use some examples for each core value to describe how we came to the value qualities from the 'descriptions of effect'. It is important to note that the value qualities presented in the examples do not represent a prioritisation but are merely illustrative. It is also important to note that the description of the effects does not necessarily reflect our view but is taken from the literature or from our workshop participants and reproduced here.

Table of data reference

The following coding is used for reference of data (see also Annexes):

X	Either a workshop participant or an interviewed partner
Y	ID number for a description of effect of CM/CSF
WS1_Y	Description of effect from first workshop
UX.Y	Description of effect from second workshop (utilitarian ethics perspective)
VX.Y	Description of effect from second workshop (virtue ethics perspective)
DX.Y	Description of effect from second workshop (duty ethics perspective)
LY	Description of effect from literature
IX.Y	Description of effect from interviews

As an example: 'U1.1.' means that this is the first effect of CM/CSF, viewed from a utilitarian ethics standpoint, described by the first participant from the second workshop.

Animal Welfare

In the context of this EIA, we consider animal welfare to be the well-being of farmed animals. Measures and standards of animal welfare vary according to context. Animal welfare science uses measures such as longevity, disease, immunosuppression, behaviour, physiology and reproduction, among others. According to Fraser, 'The relief of suffering is obviously the chief objective in animal welfare practice.'[57]. We can also define animal welfare according to the decades-old 'Five Freedoms' formulated in the 1990s or more recent paradigms[58],

[57] A.F. Fraser, 'Animal Welfare Practice: Primary Factors and Objectives', *Applied Animal Behaviour Science* 22, no. 2 (1 February 1989): 159, https://doi.org/10.1016/0168-1591(89)90052-X.
[58] David J. Mellor, 'Updating Animal Welfare Thinking: Moving beyond the "Five Freedoms" towards "A Life Worth Living"', *Animals: An Open Access Journal from MDPI* 6, no. 3 (14 March 2016): 2, https://doi.org/10.3390/ani6030021.

which are:

1. Freedom from hunger and thirst
2. Freedom from discomfort
3. Freedom from pain, injury or disease
4. Freedom to express normal behaviour
5. Freedom from fear and distress

This conceptualisation does not automatically mean a ban on slaughter[59], but promotes what Fraser calls 'humane slaughter', which aims to minimise suffering by 'rendering the subject insensitive and unconscious as quickly as possible'[60]. Several animal welfare organisations are campaigning at the United Nations for a Universal Declaration on Animal Welfare (UDAW) to recognise animals as sentient beings capable of experiencing pain and suffering, and to recognise animal welfare as an important issue in the context of the social development of nations worldwide. The 2019 UN Sustainable Development Report identified animal welfare as one of several key missing issues in the 2030 Agenda for Sustainable Development[61].

An important question in the consideration of animal welfare is how widespread production and consumption of CM/CSF would affect farm animals still being kept. On the one hand, the animals needed for cell donation, and on the other hand, the animals kept for conventional meat production. Would the conditions for farm animals improve because less mass production would be necessary?

Value Qualities identified

Positive value qualities:

- Reduced diseases
- Reduced stress and pain
- Reduced harsh conditions
- Respect for animals

[59] Heather Browning and Walter Veit, 'Is Humane Slaughter Possible?', *Animals* 10, no. 5 (5 May 2020): 3, https://doi.org/10.3390/ani10050799.
[60] Fraser, 'Animal Welfare Practice', 163–64.
[61] SDSN Secretariat and Bertelsmann Stiftung, 'Sustainable Development Report 2019'.

Negative value quality:

- Increased stress and pain

Examples to illustrate

Description of effect: A) CM/CSF could lessen the pain for farm animals caused by factory farming and transport to slaughterhouses (WS1_5, WS1_6, L37, L38). B) Stress on wildlife could also be decreased (WS1_11). The value quality that results from these impact descriptions is '**reduced stress and pain**'.

Description of effect: CM/CSF could have lasting positive effects for farm animals with improved farming conditions. Although similar to the former value quality, here, more general effects are meant with this, such as A) a higher quality of life (WS1_2) with B) a loosened concentration of farm animals in tight spaces (WS1_3). C) The act of exploitation could diminish (WS1_1). D) Provided that in certain cases economically viable production is maintained (U9.2). The value quality that results from these impact descriptions is '**reduced harsh conditions**'.

Description of effect: CM/CSF could foster the respect for animals. A) Meat/seafood consumers would be more exposed to this alternative protein supply, making it harder to rationalise one's own animal consumption (V3.1). B) Social awareness of animals being at the origin of food would be raised (V5.1), C) so more people would care about animals (WS1_14), D) which further strengthens animal's rights (WS1_12) to E) life, freedom and physical integrity (D8.1). The value quality that results from these impact descriptions is '**respect for animals**'.

Ecological Sustainability

We define ecological sustainability as the ability of ecosystems to maintain their essential functions and processes over the long term, ensuring the resilience and health of the natural environment[62]. It involves the responsible use of natural resources to meet current human needs while preserving the environment for future

[62] David Hernandez, 'Ecological Sustainability: Definition and Importance Explained', 28.6.2024, https://www.lythouse.com/blog/what-is-ecological-sustainability.

generations[63]. It also involves maintaining biological diversity, maintaining soil fertility and combating environmental pollution[64].

The relationship between traditional agriculture and biodiversity is a complex one, as intensive livestock farming can pose a threat to biodiversity, but biodiversity-friendly systems are also possible. It should also be noted that cattle (due to their non-selective grazing behaviour) are 'effective at controlling highly competitive plant species' in grazing systems and thus promote flower diversity[65]. In fact, various authors agree that certain forms of grazing are beneficial for the preservation of biodiversity[66], e.g. for species living in meadows with low productivity[67] and for birds on arable land[68].

Value Qualities identified

Positive value qualities:

- Protection / regeneration of biodiversity
- Reduced pollution
- Less waste of resources
- Less waste
- Climate balance
- Respect for nature
- Moderation
- Soil health

[63] Hernandez.
[64] Hernandez.
[65] M.D. Fraser, H.E. Vallin, and B.P. Roberts, 'Animal Board Invited Review: Grassland-Based Livestock Farming and Biodiversity', *Animal* 16, no. 12 (1 December 2022): 5, https://doi.org/10.1016/j.animal.2022.100671.
[66] Hanna L Tuomisto, 'The Eco-friendly Burger', *EMBO Reports* 20, no. 1 (January 2019): 4, https://doi.org/10.15252/embr.201847395.
[67] Lorenzo Marini et al., 'Response of Orthopteran Diversity to Abandonment of Semi-Natural Meadows', *Agriculture, Ecosystems & Environment* 132, no. 3–4 (August 2009): 232–36, https://doi.org/10.1016/j.agee.2009.04.003.
[68] J D Wilson, A D Evans, and P V Grice, 'Bird Conservation and Agriculture: A Pivotal Moment?', *IBIS* (2010): https://doi.org/10.1111/j.1474-919X.2009.00992.x.

Negative value qualities:

- Loss of biodiversity
- More waste of resources
- More waste

Examples to illustrate

Description of effect: The consumption of CM/CSF could foster the protection and regeneration of biodiversity, by A) lowering the demand for plant protein production used to feed farm animals, thus freeing up more land for natural habitats (WS1_47), by B) easing the pressure on marine ecosystems through reduced overfishing (W1_49) and by C) contributing to the preservation of endangered aquatic species (L40). D) Moreover, the reduced need for extensive agricultural and fishing activities opens up opportunities for the re-naturalisation of large areas, supporting the recovery of diverse ecosystems (U4.9, U7.2). The value quality resulting from these impact descriptions is '**protection and regeneration of biodiversity**'.

Description of effect: The consumption of CM/CSF could contribute to a reduction in the waste of resources, A) through reduced farmland and water usage (WS1_30, WS1_31, L81, L82), B) additionally by producing CM/CSF products locally, close to where it is consumed, which cuts transportational resource use and lowers environmental burdens (WS1_40). And C) by producing meat with less use of resources, like water, thereby maintaining resources for coming generations (U8.7). The value quality resulting from these impact descriptions is '**less waste of resources**'.

Description of effect: The consumption of CM/CSF could lead to a reduction in pollution, through A) reduced air pollution, B) reduced usage of toxic chemicals, and C) overall lower emissions as well as D) less soil and water pollution compared to conventional livestock farming (U10.5, U1.7, L83, L84). E) However, the consumption of CM/CSF could also result in increased air and water pollution near production facilities (WS1_57). The value quality resulting from these impact descriptions is '**reduced pollution**'.

Human Health

The term 'health' has a variety of definitions that have been used for different purposes over time. In general, it refers to physical and mental well-being, particularly in relation to the normal functioning of the human body, without disease, pain (including psychological pain) or injury. Health can be promoted by encouraging healthy activities, such as regular healthy diet, physical activity and adequate sleep, and by reducing or avoiding unhealthy activities or situations, such as smoking or excessive stress.

Value Qualities identified

Positive value qualities:

- Reduced contaminants
- Reduced pathogens
- More nutritional meat
- Healthier meat
- Healthier seafood
- Physical safety

Negative value qualities:

- Increased contaminants
- Increased pathogens
- Less nutritional meat
- Unhealthier meat
- Unhealthier seafood

Examples to illustrate

Description of effect: CM/CSF could have less contaminants or be less contaminated by compositional materials that are harmful for the human body and health, mainly due to better control conditions within the bioreactors. A) Chemicals such as prooxidants or dioxides can be left out in the cell-proliferation stage with precision (U6.2). B) Since no slaughter is involved, faecal contamination would disappear (L35). On the side of CSF intake, it is also significant to point out that it becomes highly

unlikely to get contaminated by C) heavy metals, micro plastics (L71), D) nuclear waste (L72). The value quality that results from these impact descriptions is '**reduced contaminants**'.

Description of effect: CM/CSF could have more contaminants or be more contaminated by compositional materials that are harmful for the human body and health. Two kinds of risky effects can happen here: A) unintentional and unwanted side-effects, B) intentional misuse and wanted side-effects. A) The first due to the lack of human oversight, such as generally more contamination due to more mechanical processing (WS1_70). B) While under the second category individual producers decide to add substances which make consumers addicted to their products (I2.10). The value quality that results from these impact descriptions is '**increased contaminants**'.

Description of effect: The only impact category for human health that is not related to the intake and digestion of CM/CSF but concerns the indirect effect that with long-term re-wilding strategies of converting pasturelands into spaces that regenerate biodiversity, the number of wild animals would increase. If among these wild species there are venomous or large predatory animals, then this endangers human safety (WS1_71). The value quality that results from this impact description is '**physical safety**'.

Food Security / Food justice

The Rome Declaration defines food security as follows: '*Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.*'[69].

Food justice addresses deeply rooted inequalities within food systems. These include injustices in the way food is grown, distributed and accessed, particularly for marginalised communities. The goal of food justice is to break down barriers that prevent fair access to nutritious food.

[69] FAO, 'Rome Declaration on World Food Security' (Food and Agriculture Organisation, 17.11.1996), https://www.fao.org/4/w3613e/w3613e00.htm.

Food security and food justice are not identical, but since they have large areas of overlap, we treat them as one core value in the context of this EIA.

Value Qualities identified

Positive value qualities:

- Availability
- Accessibility
- Affordability

Negative value qualities:

- Social inequality
- Dependence on technology

Examples to illustrate

Description of effect: The production and distribution of CM/CSF could make food more available for consumers. A) Enhancing food supply for the global population with a growing trend towards animal-based products (L33). B) Production sites could be located where the demand is higher or where food emergencies happen (WS1_72). C) The production is furthermore less dependent on weather conditions (L98). The value quality that results from these impact descriptions is availability of food, simply '**availability**'.

Description of effect: The production and distribution of CM/CSF could A) make food more accessible for humans (WS1_66). B) However, a monopolistic centralisation of CM/CSF production would make it harder for consumers to access certain products (WS1_75). C) While allergy causing substances could be edited out, making it possible for allergy sufferers to access meat/seafood products which once were impossible for them to do so (U11.4). The value quality that results from these impact descriptions is accessibility to food, simply '**accessibility**'.

Description of effect: The price of CM/CSF is dependent on market dynamics; material costs, percentage of shares, scaling etc., which in turn determines its affordability relative to every consumer's financial situation. A) Cheap protein sources are more

affordable for consumers (U6.4), B) higher recycling efficiency could lower its cost (I1.12), C) in particular, this could benefit poorer countries (U11.1). D) However, with a small number of suppliers, a potential blackmailing of the population with regard to supply can happen (U12.7). E) High investment and production costs are likely to hinder the use of CM/CSF in low-income regions (L59). The value quality that results from these impact descriptions is affordability of food, simply '**affordability**'.

Economic Security

Economic or financial security means having a stable income or other resources to meet one's needs consistently, to support a certain standard of living now and in the foreseeable future[70]. This includes sustained solvency, predictability of future cash flow of a person or other economic unit, such as a farm, employment security or job security.

Value Qualities identified

Positive value qualities:

- Income security
- Job attractiveness
- Product availability
- Income generation

Negative value quality:

- Income insecurity

Examples to illustrate

Description of effect: CM/CSF could create or exacerbate existing income insecurity for different groups of workers within the agricultural system, throughout the supply chain. Three categories of labour are particularly vulnerable in a transition to CM/CSF: A) conventional meat/seafood production, B) animal-care service, C) indirect work

[70] Daniel Thomas Mollenkamp, 'Economic Security: Meaning, History in the US, FAQs', *Economic Security: Meaning, History in the US, FAQs*, 22 November 2022, https://www.investopedia.com/economic-security-5213404.

linked with these two categories. For A) includes slaughterers and butchers (I5.2, while B) includes breeders, veterinarians, feed producers, farmers (I1.2-4). Finally, in C), more mediately affected jobs are included, such as secondary livestock products- and tourism providers (L53, L54). The value quality that results from these impact descriptions is '**income insecurity**'.

Description of effect: CM/CSF could create novel kinds of work with better working conditions or make existing jobs more attractive, throughout a growing market and supply chain. A) Offering new opportunities with higher pay (L52), also B) attracting creative work personnel (U8.2). C) Furthermore, since '[t]he conventional meat industry has […] a reputation for being dirty and dangerous, as well as a long history of exploiting immigrants and vulnerable workers', it may be the case that with CM/CSF, the quality of work to produce meat and seafood improves, lowering the exploitation of these workers (L113, D2.3).

The value quality that results from these impact descriptions is '**job attractiveness**'.

Description of effect: CM/CSF could harm the availability of those products gained with the conventional meat/seafood supply chain, i.e. products of secondary nature, such as A) biogenic substances (U7.7), B) leather, pharmaceuticals (L77) and/or C) the prices of animals used for farming could go up (I1.10). This would make economic conditions harder for downstream buyers of these products. The value quality that results from these impact descriptions is '**product availability**'.

Social Cohesion

Social cohesion is characterised by a set of attitudes and behaviours that include mutual trust, an integrative identity, a sense of belonging and working together for the common good[71].

Value Qualities identified

Positive value qualities:

[71] Louis Moustakas, 'Social Cohesion: Definitions, Causes and Consequences', *Encyclopedia* 3, no. 3 (29 August 2023): 1029, https://doi.org/10.3390/encyclopedia3030075.

- Regional identity
- Cultural heritage
- Inclusion
- Freedom of Choice
- Resilient society

Negative value quality:

- Social tension

Examples to illustrate

Description of effect: The consumption of CM/CSF could lead to further increases in social tensions, A) between those who can afford it and those who cannot (WS1_78), B) between older people who do not want to get used to it and younger people (WS1_98), C) between those who consume CM and feel more virtuous than those who consume conventional meat (V7.1, V8.6). D) However, the consumption of CM/CSF could also lead to a reduction in the current tensions between vegetarians (vegans) and meat/seafood consumers (WS1_88). The value quality resulting from these impact descriptions is '**social tension'**.

Description of effect: The consumption of CM/CSF could foster greater freedom of choice, by offering a larger choice of products on supermarket shelves (U9.1), by enabling vegetarians who are open to CM/CSF to have a more diverse nutritional intake (U11.3), and by opening up a broad field for the invention of individual characteristics in meat and seafood (U12.2). Furthermore, it would free up more land that has previously been used for conventional meat production, to grow other 'interesting' diverse crops (WS1_80). The value quality resulting from these impact descriptions is '**freedom of choice'**.

Description of effect: But the consumption of CM/CSF could also harm regional identities, as food production carried out primarily by industries could lead to a lost connection with local meat and seafood, as well as with places traditionally linked to food (WS1_93). A reduction in livestock grazing could radically change cultural landscapes and ecological systems, while CM could also result in the loss of local cultural practices and traditions associated with eating meat (U12.6, L49). Many

cultural landscapes that are important to regional identities and heritage are upheld through livestock farming and might disappear due to the shift towards CM (L62, L102). However, local production of CM/CSF could also create new regional food cultures that did not exist before (WS1_81). The value quality resulting from these impact descriptions is '**regional identity**'.

Trust

Trust is the firm belief in the integrity or character of a person, an organisation and, in a broader sense, a technology, that it is safe and reliable and will not harm you. You believe that someone is good and honest and will not harm you, or that something is safe and reliable[72].

Value Qualities identified

Positive value qualities:

- Transparent communication
- Truthfulness
- Accessibility of technology

Negative value qualities:

- Loss of control
- Uncertainty

Examples to illustrate

Description of effect: The consumption of CM/CSF could harm the accessibility of technology, as the market could get dominated and misused by large corporations, creating a dependency on a few players due to the high capital expenditure associated with the technology (U1.1, U2.6). Big disruptions in the market could require large amounts of resources, especially financial ones, posing the danger that small businesses might get squeezed out by larger corporations (U3.2). This could strengthen the overall dependency on large corporations (V4.2, V5.4). The value quality resulting from these impact descriptions is '**accessibility of technology**'.

[72] Cambridge Dictionary Entry of 'Trust', https://dictionary.cambridge.org/dictionary/english/trust.

Description of effect: The consumption of CM/CSF could harm transparent communication, if CM/CSF becomes so widely distributed that consumers can no longer comprehend in which products it is contained (U11.7). To address this, clear labelling standards should be developed and implemented, to ensure that consumers can easily identify when and where CM/CSF is used (I5.1). There is also the risk of CM/CSF falling under 'ethical washing', leading to contradictions and confusion among consumers and the general public (L17). Furthermore, branding CM/CSF as 'natural' could jeopardise the integrity of CM/CSF producers and risks losing the trust of consumers (L18). The value quality resulting from these impact descriptions is '**transparent communication**'.

Integrity

Integrity means remaining true to your own values and acting honestly and fairly. A person with integrity has clear moral principles and lives by them: decently, sincerely, righteously, reliably and trustworthily. The term 'integrity' comes from the Latin 'integritas', which means something like 'complete', 'undivided' or 'unbroken'. A person of integrity therefore acts in an undivided and holistic manner.

Value Qualities identified

Positive value qualities:

- Cognitive consonance
- Reflection
- Respect for life
- Non-violent society
- Mindfulness

Negative value qualities:

- Cognitive dissonance
- Alienation

Examples to illustrate

Description of effect: The consumption of CM/CSF could foster the cognitive consonance of consumers, for those who enjoy eating meat but want to pay more

attention to animal welfare (U3.3). The animal as a living being, not a means to food, could move back into focus, removing the need to repress the aspect of violence (V5.7). It could encourage more conscious reflection of consumers, such as questioning when it is truly important to eat conventional meat and when CM is sufficient (V7.3). Overall, it could support a greater consistency between social values, morals, and modes of action (D4.3). Furthermore, CM could alleviate personal guilt associated with participation in the mass meat industry (L93). The value quality resulting from these impact descriptions is '**cognitive consonance**'.

Description of effect: But the consumption of CM/CSF could also foster cognitive dissonance, by resulting in an 'artificial food culture' (WS1_96) and encouraging a reduced sense of responsibility for maintaining a conscious, self-determined diet (V10.3). The commodification of animals into food could cause internal contradictions for the consumer, as animals are seen both as living beings and as products, and this problematic separation could be further intensified by CM/CSF, negatively affecting both animals and humans (L19). The value quality resulting from these impact descriptions is '**cognitive dissonance**'.

Description of effect: The consumption of CM/CSF could foster the alienation from nature, traditions and knowledge about food production, through a low connection to the manufacturing method due to its complexity (U2.7), and by replacing or leading to the loss of traditional understandings of the environment and relationship systems (U12.8). Dealing with 'death' could become even more unnatural (V11.2), and the over-complication of food supply chains could lead to further alienation from food sources and food systems (L34). The value quality resulting from these impact descriptions is '**alienation**'.

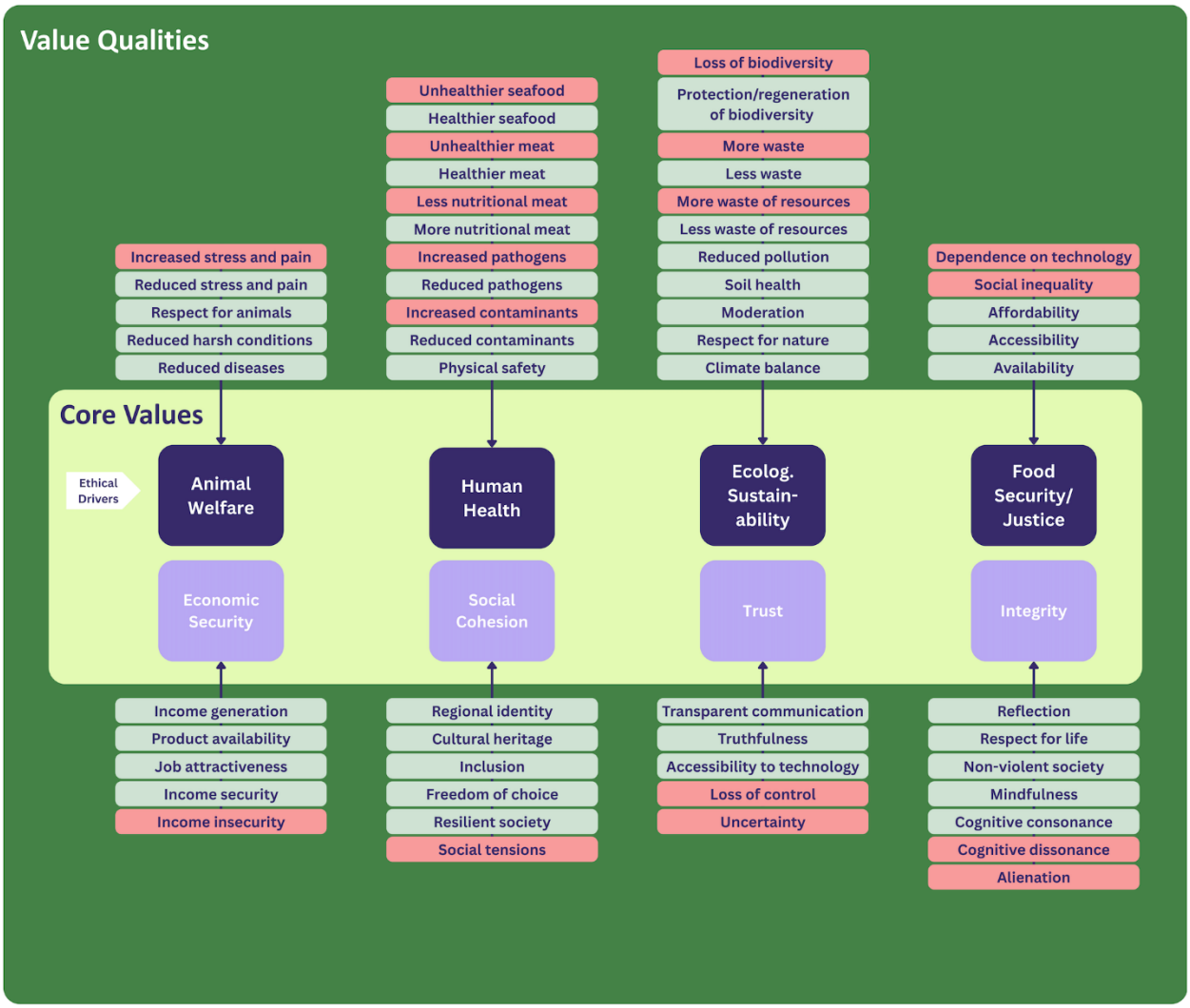

Figure 8: Overview of the identified value qualities that manifest the core values (positive value qualities in light green, negative value qualities in light red)

Value Dispositions

Core values manifest themselves in value qualities, which in turn can be measured by value dispositions. Value dispositions are therefore the very specific characteristics and functionalities of a technology that can be examined and tested. How a technology affects values ultimately depends on the totality of the value dispositions associated with that technology. For all the value qualities we identified in the previous section, the relevant value dispositions must therefore be determined in order to make the ethical impact concretely measurable.

For the value qualities example, we used the assumption that CM consumes less water than conventional beef from cattle farming. We labelled this value quality as 'less waste of resources'. The corresponding value disposition would then be the exact determination of how many litres of water are needed for 1 kg of CM (as opposed to 1 kg of conventional beef).

As CM/CSF technology is still under development and not yet available on the European market, the value dispositions for a number of core values are still evolving. This naturally poses an additional challenge for the ethical assessment of CM/CSF. The multidisciplinary composition of the FEASTS project with its various work packages (Figure 9) provides an excellent basis for tracking the development of the relevant value dispositions and incorporating these into the value analysis. The results and findings of the individual work packages are therefore key indicators for assessing how CM/CSF will actually affect value qualities and core values (see Figure 10).

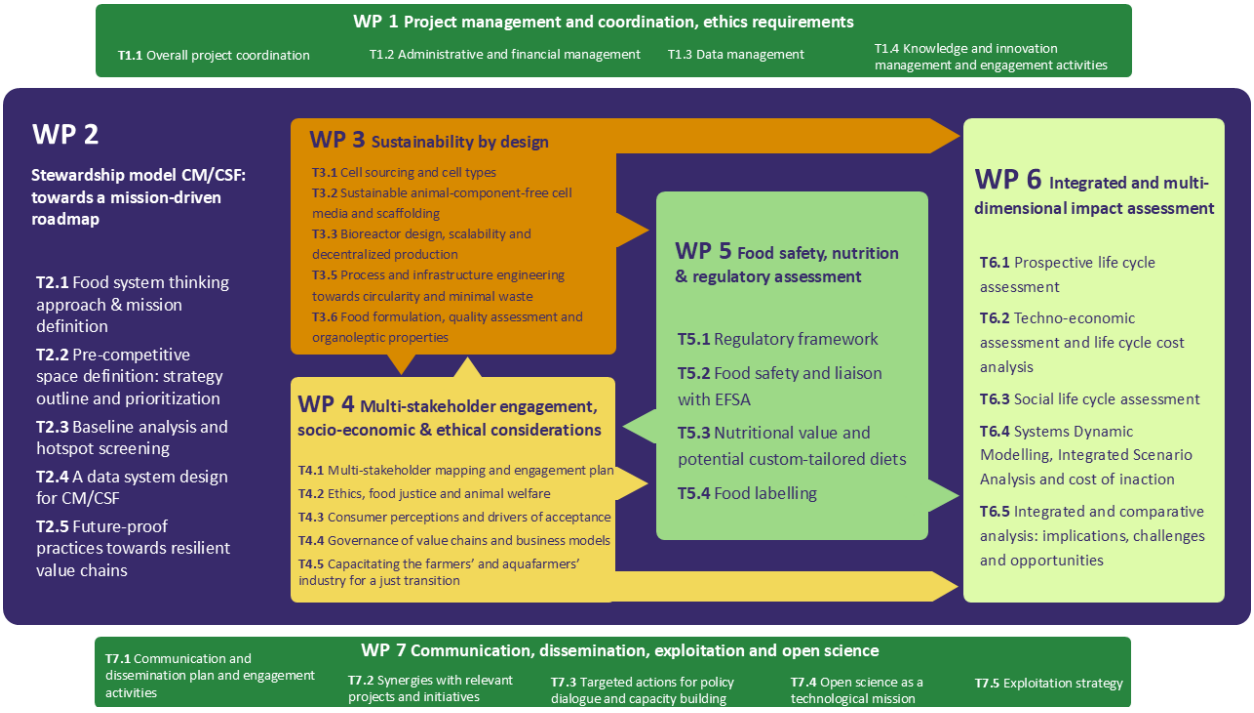

Figure 9: All Work Packages and tasks within the project FEASTS

The relationship between the individual core values and the various fields of work within FEASTS is shown in Figure 10:

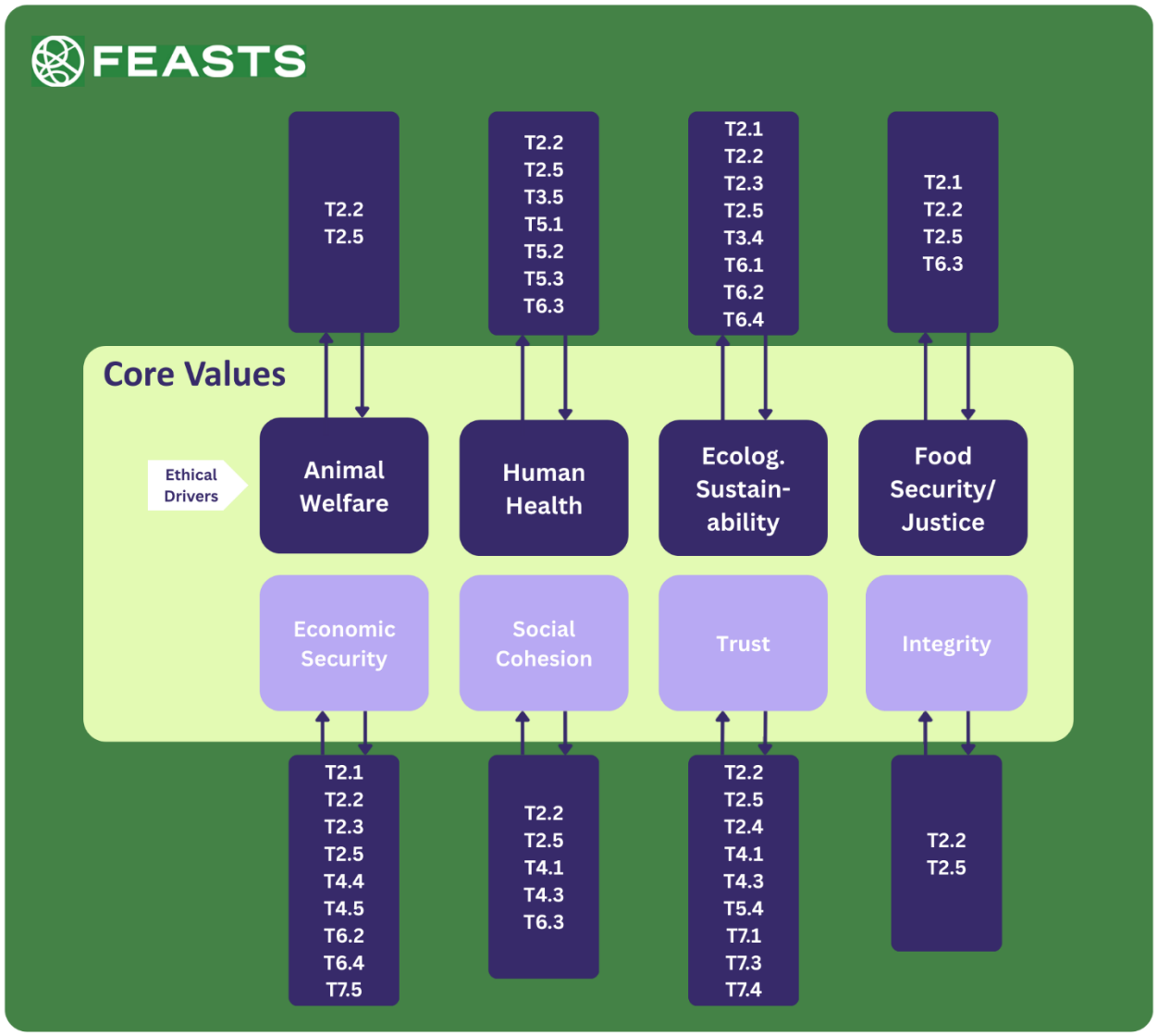

Figure 10: The connection between the individual tasks within FEASTS and the core values (Task 4.2, which carried out this EIA, is naturally related to all core values, but is not shown separately)

Data collection

The aim of the EIA is to identify as comprehensively as possible the potential ethical consequences of introducing (or not introducing) CM/CSF. The starting point for our analyses was always the anticipation of possible ethical implications arising from the introduction and application of CM/CSF. In order to capture these 'descriptions of effects' as comprehensively as possible, we used three different sources: literature, workshops and bilateral interviews.

Although the chapter is entitled 'Data collection', it does not deal with data in the strict sense which can be measured, rather with ethically relevant views held by people from different backgrounds. But that is precisely the point, because values cannot be measured and should instead be outlined conceptually.

Literature

After screening more than 40 published scientific articles, we selected 15 that deal sufficiently centrally with the ethical implications of CM/CSF and are suitable for our analyses (parts of the remaining articles will be considered for the next steps). We went through the selected works sentence by sentence and highlighted 'description of effect'. We deliberately did not use AI tools for this task in order to a) not overlook anything, b) not be subject to algorithmic misinterpretations, and c) above all, to engage sufficiently with the topic ourselves.

A total of 72 'description of effects' were extracted. These were listed in a table and then had to be assigned to the relevant stakeholders, core values and value qualities. The stakeholders affected by the 'description of effect' are usually clear. In most cases, it was also obvious which ethical driver (core value) the impact descriptions corresponded to. For the other core values, especially social cohesion, trust and integrity, this is not always so clear. The value qualities can also be clearly derived from the text or must be interpreted from the context. In the case of disputed assignments, the point was discussed by at least two of us, with one or more person trained as a *Value Lead* according to IEEE 7000.

The aim of the EIA is to obtain a picture that is as comprehensive as possible of the ethical impact dimensions of CM/CSF, in order to provide clarity, facilitate serious debate and develop possible measures to strengthen positive ethical effects and reduce negative risks. This requires a robust and clear structure in terminology, as presented here in the form of a value ontology: impact description, core values, value qualities and value dispositions.

At the same time, we are aware that with this type of structuring, individual lines of argumentation by the authors may be lost, because: A) It is not possible to transfer all arguments presented in well-thought-out scientific papers into value tables. The selection always remains subjective to a certain extent. B) When an argument is extracted from a paper, it may be taken out of context (unintentionally) and thus no longer categorised correctly. C) The authors may have weighted (hierarchised) the arguments, which is no longer apparent in the overview table.

In any case, this work must be carried out with care, i.e. to the best of one's knowledge and belief. We have tried very hard and now assume that we have extracted essential arguments for or against CM/CSF from an ethical perspective.

After several revisions of the structure of the core values and the associated value qualities, a table of values was finally developed, as shown in the Annex.

Workshops

A total of five ethics workshops are planned for the duration of the FEASTS project. We have conducted two of these for the present mid-term EIA report, and the remaining three will take place in the second phase of the project.

Workshop 1

In consultation with FEASTS management, partners from the FEASTS project were invited to participate in the first workshop. The workshop took place on 19 September 2024, with 16 participants, and lasted two hours.

Participant Number	Occupation
P01.	Scientific Coordinator, Expert in Life-Cycle Assessment
P02.	Research Assistant for Management
P03.	Associate Professor for Agricultural and Food Sciences
P04.	Post Doctoral Researcher in Biomedical Science
P05.	Senior Project Manager, Expert in International Development
P06.	Scientific Coordinator, Biochemist
P07.	PhD Student in Agricultural and Food Sciences
P08.	Senior Project Manager, Expert in Management of Climate Change
P09.	Project Coordinator, Associate Professor for Bioengineering
P10.	PhD Student in Sustainable Development and Climate Change
P11.	Scientific Manager, Cellular Agriculture Scientist
P12.	Molecular Biologist, Cellular Agriculture Scientist
P13.	PhD Candidate in Cellular Agriculture
P14.	Biotechnologist, Cellular Agriculture Scientist
P15.	Institution Director, Molecular Biologist
P16.	Post Doctoral Researcher in Inorganic Chemistry

First, questions were posed that each participant could answer using an online questionnaire. The answers were then made available to all participants by screen sharing. Questions about individual points of view could be asked and discussed together. This led to lively and fruitful discussions (so much so that we had to postpone some of the topics we had originally planned to cover to a later workshop). We then presented a selection of topics that we had prepared for the various questions.

The questions discussed during the workshop were:

1) How could CM/CSF have a positive impact on animal welfare (opportunities)?

2) How could CM/CSF have a negative impact on animal welfare (risks)?

3) What principle should society follow in relation to animal welfare?

4) How could CM/CSF have a positive impact on environmental sustainability (opportunities)?

5) How could CM/CSF have a negative impact on environmental sustainability (risks)?

6) How could CM/CSF have a positive impact on food culture (opportunities)?

7) How could CM/CSF have a negative impact on food culture (risks)?

The answers to the individual questions and the subsequent discussions were recorded and transcribed.

In a subsequent step, the contributions were documented in a structured manner according to thematic and sub-thematic areas (Annex 1.1).

These results of this workshop were used in further reflection steps to develop the value tables for Workshop 1 (Annex 1.2).

Workshop 2

The second workshop took place on 23 March 2025 with participants physically present on site and lasted the whole day (from 9:00 a.m. to 5:00 p.m.). Stakeholders with different professional backgrounds and world views were invited. Of the 14 people who had registered, 12 attended. The following groups of stakeholders participated:

Stakeholder Group (Diverse Input and Multistakeholder Feedback Group = DIMSFG)
Consumer
Business Development Biotech
CM and ethics expert
Editor in chief life science magazine
Innovation expert
Technology Assessment expert
Forum Ernährung Heute https://www.forum-ernaehrung.at/ *(Competence Centre for Nutrition, Health and Lifestyle)*
Vegane Gesellschaft Österreich https://www.vegan.at/ *(Vegan Society Austria)*
Verein Gegen Tierfabriken https://vgt.at/ *(Association Against Animal Factories)*
Vier Pfoten https://www.vier-pfoten.at/ *(Animal protection organisation for animals under direct human influence)*
Proteinvielfalt in Österreich https://www.proteinvielfalt.at/ *(Association for sustainable food and innovative, alternative protein sources)*
Proteinvielfalt in Österreich / Arkeon https://www.proteinvielfalt.at/

Due to the time available for this workshop, we were able to follow the didactic recommendations of the VBE methodology (IEEE 7000) for conducting such a workshop. After a round of introductions and a brief introduction to the CM/CSF technology, we introduced the concepts of ethics, focusing on the concept of values and their role in moral reasoning. In particular, three main ethical frameworks were introduced to the participants with examples: utilitarian ethics, virtue ethics and duty ethics.

Why is this important?

These workshops focus on the question of how a technology can help to realise or threaten values. We use the three moral philosophies above (and other spiritual/religious traditions as appropriate) to identify values and value qualities that might be affected. The values assessment proposed by VBE is not limited to asking stakeholders about their preferences. It is not a simple brainstorming exercise on pros and cons. Rather, it is based on established ethical frameworks. When people think in terms of values, it greatly enhances creativity in terms of potential value impacts (Figure 7).

Utilitarian Ethics

First, the potential advantages and disadvantages for stakeholders (including livestock and the environment) that could result from a comprehensive introduction of the system are assessed. This is a utilitarian perspective that offers a very broad view of all possible consequences of the system.

Utilitarian ethics is a branch of moral philosophy that was founded in 18th-century England by the philosophers Jeremy Bentham (1748-1832) and John Stuart Mill (1806-1873). They argued that decision-makers should weigh the consequences of their decisions by 'balancing' the positive and negative outcomes against each other.

Virtue Ethics

Secondly, the impact on the virtues of human users or consumers is examined. Virtues describe the habitual character traits of a person that make them a good and moral member of the community and a good decision-maker. Or, to put it more simply, a virtue is the positive value of human behaviour. Examples include modesty, moderation, friendliness, attentiveness, reliability, etc.

One of its most famous proponents is Aristotle (384 BC - 322 BC) who can be considered its founder in the western hemisphere. He emphasised above all the concept of the 'golden mean' of virtues. In other cultures, Confucius (551 BC - 479 BC) is particularly noteworthy, who emphasised virtues such as ren (benevolence). A

modern proponent of virtue ethics is Alasdair MacIntyre (1929-2025), who revived it with his work in the 20th century.

Duty Ethics

Thirdly, the question arises as to whether there are principles of duty ethics that are relevant to CM/CSF and that should be given special consideration in the future design of the system. Duty ethics is a moral theory that emphasises duties and rules. According to this view, actions are morally right or wrong depending on whether they comply with certain moral principles or duties – regardless of the consequences.

A well-known proponent is Immanuel Kant (1724–1804). He is a central figure in deontological ethics. He argued that moral actions must follow a universal moral law, which he formulated in his categorical imperative: 'Act only according to maxims that you can at the same time want as universal laws.' W. D. Ross (1877–1971), another proponent developed a pluralistic version of deontology. In this, he emphasised prima facie duties – such as loyalty, justice and charity – that must be weighed up in moral decisions.

Each of these three moral philosophies has its strengths and weaknesses, which is why they are combined in a holistic view of values (Figure 11).

Figure 11: Value analysis based on three major moral philosophies

After a brief introduction to the respective moral philosophy, pre-prepared tables were distributed, which the participants filled out individually and in silence for about 20 minutes.

Then a discussion round was opened: everyone could ask questions or mention one or more important points that came to mind. A lively exchange followed. As moderators, we made sure that everyone could express their opinions freely, but that the discussion did not become confrontational. After the discussion round, everyone could continue filling out their tables in peace.

The table asks for a description of the impact, value, impacted stakeholders and also possible measures (to strengthen opportunities and mitigate risks). A deliberate decision was made not to distinguish between value and value quality in the tables in order to keep things simple. The more precise classification was left to us in the further processing.

Question for utilitarian ethics table:

What could be possible positive and negative consequences of cultivated meat and seafood for direct and indirect stakeholders if it were produced and consumed on a large scale?

Name (optional):					
UTILITARIAN ANALYSIS					
#	STAKEHOLDER	DESCRIPTION OF EFFECT	VALUE	+/-	SUGGESTION FOR MEASURE (optional)
#1					
#2					
#3					

Question for virtue ethics table:

What impact could cultivated meat and seafood have on the character and/or personality of people if it were produced and consumed on a large scale? On the relationship between the individual and society, animals, and themselves?

Name (optional):					
VIRTUE ETHICS ANALYSIS					
#	STAKEHOLDER	DESCRIPTION OF EFFECT	VIRTUE (harmed) / VICE (fostered)	+/-	SUGGESTION FOR MEASURE (optional)
#1					
#2					
#3					

Question for duty ethics table:

Which maxim in the context of nutrition, especially cultivated meat and seafood, do you consider important?

Name (optional):					
DEONTOLOGICAL ANALYSIS					
#	STAKEHOLDER	DESCRIPTION OF EFFECT	VALUE / MAXIM	+/-	SUGGESTION FOR MEASURE (optional)
#1					
#2					
#3					

These exercises opened up space for lively discussions within the group. Participants exchanged their views and reflected together on the ethical aspects from different perspectives. The atmosphere throughout the day was open and engaging, and the group approached the discussions with curiosity and a strong interest in the topic.

After the workshop, we reviewed all handwritten tables and transferred the information to the final value tables.

Interviews

In addition to the literature review and the results of the workshops, a total of six interviews were conducted. These served primarily to explore certain aspects in greater depth and clarify them with experts. The interviews lasted approximately 45 minutes and were conducted in a semi-structured format. Four interviews were recorded and subsequently transcribed, while two interviews were recorded by hand.

Following the interviews, evaluation tables were created in the same way as those from the literature and workshop work.

Interview	Background	Country
1	Professor of moral philosophy specialising in bioethics and CM	Italy
2	Scientist in a start-up company providing services for the emerging CM industry	Switzerland
3	Professor for Functional foods	Denmark
4	Cultivated Meat Consultant	Germany
5	Cultivated Meat Consultant	Netherlands
6	Livestock farmer	Italy

Summary of data

In summary (literature, workshops and interviews), the following data emerges:

	Number
Description of effects	379
Value qualities	55
Core Values	8

After several rounds of revision, we ended up with a value table from the literature, two value tables from the workshops, and one value table from the interviews. The obvious next step was to merge all of the value tables and create a consolidated table. However, since the methodology used to determine the results for the value tables was very different, we left the four value tables separate for better traceability.

Three core values that we describe (animal welfare, human health, ecological sustainability) as ethical drivers became clear relatively quickly after an initial review of the literature. However, the combined core value of 'food security/food justice' was not as clear-cut as the other three ethical drivers. We thought about this a lot and talked it over, including with the FEASTS Ethics Board, to see if we should call it an

ethical driver or not. In the end, we decided to include it. The question was not whether 'food security/food justice' is an ethical goal (of course it is), but whether it's realistic to aim for it with CM/CSF. This is particularly true because CM/CSF is still very expensive to produce and is therefore unlikely to be a realistic food alternative for low-income people for some time to come. However, as price dynamics can change relatively quickly, we have nevertheless included it as an ethical driver.

Among the other core drivers, economic security was very quickly identified as something that needed to be included. Critics of CM/CSF often argue that its introduction could lead to massive job losses in agriculture and related sectors.

The three remaining core values – social cohesion, trust and integrity – required several rounds of reviewing the results from literature, workshops and interviews before we could agree on them. In principle, they could also be named or structured slightly differently, but it is important that the value qualities they encompass are sufficiently taken into account in the reflection on the ethical implications of CM/CSF.

Values and aspects we did not include

We have deliberately excluded some aspects of CM/CSF that are often mentioned in the context of ethical considerations for the following reasons:

Naturalness

In our literature research, unnaturalness is often discussed as a reason to reject CM[73]. Thus, although the term 'unnaturalness' is very prominent in the question of whether CM/CSF is desirable or not, we did not include 'unnaturalness' as a value (or value quality) in our value analysis for the following reasons:

1) It is unclear what exactly is meant by the term 'unnatural'.

[73] Matti Wilks, Charlie R. Crimston, and Matthew J. Hornsey, 'Meat and Morality: The Moral Foundation of Purity, but Not Harm, Predicts Attitudes toward Cultured Meat', *Appetite* 197 (June 2024): 6, https://doi.org/10.1016/j.appet.2024.107297. See also: Rasmussen et al., 'Critical Review of Cultivated Meat from a Nordic Perspective', 9.

'Unnatural' is a very vague term that is also understood very differently by different people. This also makes the boundary between natural and unnatural very fluid. Does everything 'natural' become 'unnatural' when humans intervene in natural processes? Strictly speaking, agriculture, a sweater made of sheep's wool or brewing beer would then also be unnatural. Indeed, every form of civilisation is unnatural in this strict sense. Ultimately, this would mean that humans themselves are an unnatural part of the cosmos.

Is the line to be drawn so that every organic and living thing is natural while every mechanical and dead thing is artificial? If this was the line, then technologies such as CM/CSF, which are produced from living cells, would further blur the boundaries.

2) Does 'natural' imply morally good?

The 'natural' does not translate to being the ethically desirable thing. (Philosophers have put it this way: one cannot carelessly conclude 'ought' from 'is'). If, for example, a praying mantis bites the head off the male after mating, this is natural, but it is not a guideline for ethically correct behaviour on a human level. But even on a purely biological level, not everything that is 'natural' is good for us. A wild belladonna plant in the forest is 'natural', but not suitable for human consumption. In short, 'naturalness' tells nothing about whether something is ethically desirable or not.

3) Is factory farming more 'natural' than CM?

The question of the naturalness of CM also raises the question of how 'natural' conventionally produced meat is. Animals in factory farms are fed with antibiotics and hormones, as to make them grow faster and larger than they would in nature. The processing of the meat gained after slaughter is also a highly technological process that is not very 'natural'.

Our criticism of the term 'unnatural' does not mean that the concerns associated with it should not be taken seriously. On the contrary, we have tried to understand what the actual concern is and what value quality it is actually supposed to address. For example, we have assigned the value quality 'alienation' from the core value of integrity to the concern that CM/CSF technology could further alienate us from nature.

Technological progress

Technical progress is not an intrinsic core value in itself. It can be described as an extrinsic value, i.e. as a means to possibly realise a core value. For example, a new technology can be used to ensure that fewer resources are consumed in a particular process, thus strengthening the core value of environmental sustainability. But the opposite can also happen, for example, that due to the rapid innovation cycles for smartphones, more and more rare earths are extracted from the earth and then thrown away. Technical change does not automatically have a positive impact on society and nature, but rather it is necessary to examine how it affects the value space overall.

Religious food laws and values

A number of religions prescribe certain dietary laws for their followers. In Judaism, for example, food must be kosher; in Islam, it must be halal. Some Buddhist schools generally prohibit the consumption of meat. It is therefore an interesting question as to how CM/CSF is viewed by adherents of these religions. So far, there is no consistent view on this, but rather different positions. For future consumers of CM/CSF who belong to a religion with dietary rules, how CM/CSF is classified is naturally of great relevance. We have therefore addressed these issues in our research. However, since the respective assessment of CM/CSF is very religion-specific, we have not included it as a value or value quality, but have subsumed it under social cohesion, value quality: inclusion.

Organoleptic properties

Organoleptic properties are the aspects of a food that can be perceived with the senses, including taste, appearance, smell and touch. For consumer acceptance, these properties are crucial in determining whether a new food will be accepted and desired. If it does not taste good and does not feel good, it wo not be consumed, even if a range of ethical values speak in its favour. On the other hand, a food with organoleptic properties that are very attractive can be perceived as such, even though it is unhealthy in reality. Just because something tastes good does not make it good. The question of whether CM/CSF has healthier nutritional properties than

conventional meat falls under the core value of 'human health', but is not an organoleptic property. Therefore, we did not include organoleptic properties in our considerations.

Cultured Human Meat

As CM/CSF technologies continue to develop, at some point interest may be sparked in applying these technologies to the production of human flesh. However, when potential consumers are confronted with the idea of eating cultured human flesh, their reactions will range from pure disgust to indifference to enthusiasm. There is a risk that we will either embrace this option out of enthusiasm or ban it without convincing reasons. Addressing the possible ethical implications of consuming human cells requires a specific and in-depth discussion well into the ontological questions of what these cells actually are. We therefore plan to hold a separate workshop on this topic and feed the results into the final EIA (Ethical Impact Assessment) at the conclusion of the FEASTS project.

Discussion

The EIA does not present a simple solution. It highlights the ethical dimensions of a technology, as far as they can be assessed, including the ethical dilemmas it contains. The EIA thus provides a basis for informed reflection and a joint search for the best solutions to the challenges. Based on our findings regarding core values and value qualities, in this section we explore the following questions:

1. How could the pursuit of ethical goals influence the other core values?

2. Can CM/CSF really achieve the ethical goals, or is it more of a technical solution that does not address the real problems?

3. How could the emerging pursuit of profit influence the ethical goals?

The following passages do not represent a complete and conclusive analysis of the issues raised, but rather initial considerations for examining these issues and stimulating further open discourse.

The relationship between key drivers and additional core values

In the next section, we will explore how the pursuit of each of the four core ethical drivers of CM/CSF (considered individually) might affect the other core values we have identified. So, what is the relationship between the driver core values and the other core values? Although these values may be pursued jointly, here we analyse what might be involved in favouring one over the other in formulating policies concerning CM/CSF. To be sure, this is not to say that the direction that promotes the most values is also the most desirable, as other considerations must be considered, including the priority given to certain values over others.

If we consider CM/CSF as a means to pursue a particular value, we must also consider how the large-scale production and consumption of CM/CSF would:

a) affect other values of CM/CSF consumers, and

b) take into account existing activities, processes and actors related to conventional meat production and consumption.

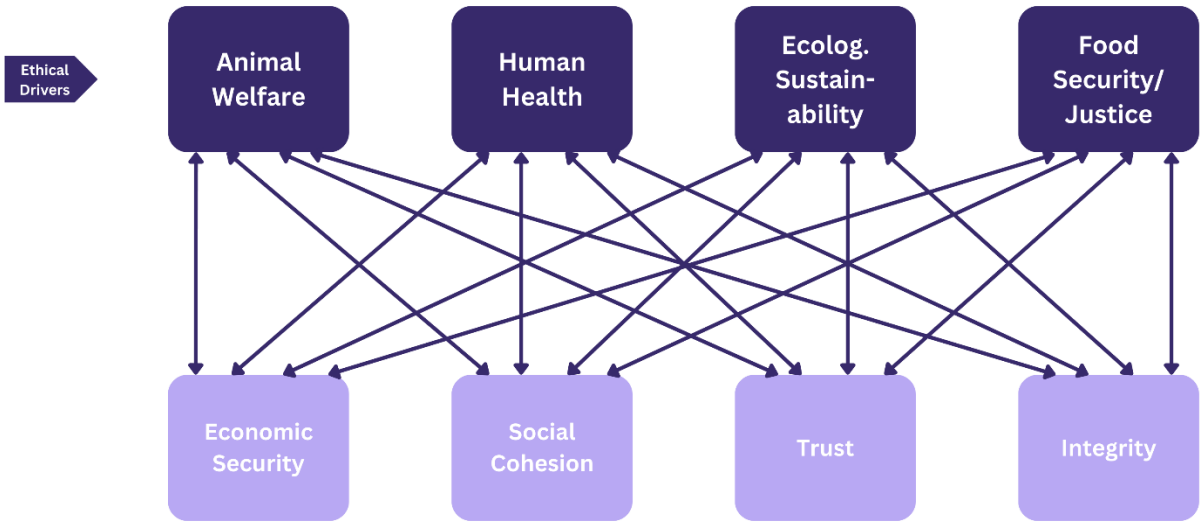

Figure 12: Interdependence of the pursuit of the individual ethical drivers of CM/CSF with additional core values

Animal Welfare

Possible impacts on the core value **social cohesion**

Widespread use of CM/CSF could influence current understanding of animal welfare. If it were possible to meet meat demand without killing animals, slaughter could be seen as unnecessary cruelty to animals. At the same time, there are also voices, such as Mellor, who see a healthy human-animal relationship as beneficial to animal welfare[74]. The promotion and preservation of small-scale, extensive animal husbandry, where a relationship with the animals can be cultivated ('farm holidays'), would still require slaughter, but could be seen as a positive alternative to intensive animal husbandry, where a close human-animal relationship can only be achieved to a very limited extent.

If we consider the avoidance of animal killing to be a very high principle, even moderate traditional agricultural practices or cultural activities that deviate from this precept

[74] Mellor, 'Updating Animal Welfare Thinking', 16.

(such as hunting) must be avoided. Furthermore, many cultural landscapes that have emerged from livestock farming and are important for regional identity and heritage – such as the Pyrenees National Park in France/Spain, the Burren in Ireland, the Lake District National Park in the United Kingdom and the Massif Central in France – were created by livestock farming, and their survival may depend on it[75].

The ready availability of CM/CSF could also enable people who care about animal welfare to consume 'traditional' meat dishes (value quality: inclusion).

Possible impacts on the core value **economic security**

Higher animal welfare standards and stricter monitoring and enforcement of these standards could jeopardise farmers' incomes and affect the existence of traditional smallholdings in rural areas. This could have further negative consequences in the form of job losses. However, this will also depend heavily on how the introduction of CM/CSF affects the value placed on 'animal welfare'. Will the slaughter of animals that are no longer needed for meat production be considered incompatible with animal welfare? Would animal husbandry that allows for sufficient human-animal interaction and includes 'painless' slaughter be considered unethical? If so, for which animal species? Could this lead to the stigmatisation of conventional farms, even if they currently meet animal welfare standards?

Furthermore, for the same reasons, the production of secondary products from conventional meat production (such as leather or dairy products) could be compromised. The production of CM/CSF for the promotion of animal welfare could also endanger this aspect of the economy around conventional meat.

Possible impacts on the core value **integrity**

On the one hand, the replacement of many cultural activities in which animals play a role with CM/CSF can lead to further alienation of animals and food sources. On the other hand, the appreciation of animal welfare in the production of CM/CSF could reduce feelings of guilt about meat consumption.

[75] Helliwell and Burton, 'The Promised Land?'

Ecological Sustainability

Possible impacts on the core value **economic security**

The market introduction of resource-efficient CM/CSF products could well lead to job losses in conventional meat production; this will of course depend heavily on demand and market share, and also on whether farmers themselves can/want to become CM/CSF producers (value quality: **income security**).

The stability of the supply of meat by-products could also be at risk, which could lead to critical side effects on the market: Lee points out that the production of synthetic substitutes for other animal products would be less efficient and more harmful to the environment than conventional production[76]. Promoting environmental sustainability could therefore also mean defending the importance of maintaining this type of supply (value quality: **product availability**).

Possible impacts on the core value **social cohesion**

The goal of environmental sustainability, especially resource efficiency, can conflict with traditional agriculture, which requires a lot of land and water. Traditional practices involving animals that are at least partly at odds with animal welfare goals, such as hunting or bullfighting, are acceptable from a planetary health perspective. Sustainable hunting practices are entirely possible[77]. Depending on the type of hunting, it may conflict with biodiversity, but within the framework of 'sustainable' hunting, it can be a valuable tool for promoting biodiversity. With regard to tourist attractions, it should be noted that some traditional livestock farming practices are also linked to tourism and that some cultural landscapes are also dependent on small-scale livestock farming (value quality: **cultural heritage)**.

CM/CSF can be read as a more sustainable alternative to conventional meat production, without giving up the cultural aspects of meat consumption. From this perspective, CM/CSF could make it possible for environmentally conscious people to

[76] Lee, 'Meat-Ing Demand', 15.

[77] Rolf D. Baldus, ed., *Best Practices in Sustainable Hunting: A Guide to Best Practices from around the World*, CIC Technical Series Publication 1 (2008).

eat 'traditional' meat dishes, thus making them involved in the cultural and social practices associated with them (value quality: **inclusion)**.

Environmental sustainability and biodiversity can be goals in which rural and regional areas play a particularly active role. Therefore, their promotion can be compatible with the preservation of regional identity and those productive activities benefiting them, such as those forms of livestock farming that are positive for biodiversity conservation[78] (value quality: **regional identity**).

Possible impacts on the core value **integrity**

Maintaining a dual orientation of meat production (conventional and CM/CSF) could reduce this alienation, especially if a link to conventional meat production is maintained for more symbolically relevant cultural practices. Furthermore, promoting activities that focus on biodiversity and sustainability can support this value at multiple levels (value quality: **alienation**).

It is not easy to determine the impact of this aspect. Framing the dual (conventional and CM/CSF) orientation of meat production in terms of safeguarding broader planetary health, whether in terms of biodiversity or resource use, may alleviate feelings of guilt connected to animal slaughter. However, some aspects of cognitive dissonance might remain intact, as animal killing practices would not be totally ruled out in the pursuit of this key driver (value quality: **cognitive dissonance**).

Human Health

Possible impacts on the core value **economic security**

If conventional meat production were to be considered less healthy than CM/CSF, and this caused a corresponding change in regulations or public perception, this could undermine the viability of the respective production sector (value quality: **income security**).

[78] Fraser, Vallin, and Roberts, 'Animal Board Invited Review'.

It should be noted that other types of edible by-products, such as milk, are also not immune to traces of antibiotics[79]. Other non-edible by-products, e.g. leather, would not be incompatible with this type of value, but it would need to be understood to what extent production devoted exclusively to this type of product is economically viable (value quality: **product availability**).

If health is the top priority, traditional practices such as hunting could also be viewed critically from this perspective[80]. At the same time, hunters often have a high level of expertise in minimising the risk of infection and disease from 'wild game meat'[81]. A widespread introduction of CM/CSF could further fuel a critical attitude towards hunting (value quality: **cultural heritage)**.

Possible impacts on the core value **integrity**

Replacing many of those cultural activities where the animal is involved with CM/CSF can lead to further alienation from animals and sources of food (value quality: **alienation**).

Reducing animal slaughtering, although for health concerns, could reduce the feeling of guilt in meat consumption (value quality: **cognitive consonance**).

Food Security / Food Justice

Possible impacts on the core value **economic security**

Ensuring the resilience of supply chains does not directly involve limitations in food production and loss of sovereignty in rural areas. As in the case of the pursuit of 'resource efficiency' in the framework of ecological sustainability, this value is compatible with the maintenance of conventional meat production. Jobs in

[79] Sabbya Sachi et al., 'Antibiotic Residues in Milk: Past, Present, and Future', *Journal of Advanced Veterinary and Animal Research* 6, no. 3 (11 July 2019): 315–332, https://doi.org/10.5455/javar.2019.f350.

[80] Katarzyna Niewiadomska et al., 'Perception of the Health Threats Related to the Consumption of Wild Animal Meat—Is Eating Game Risky?', *Foods* 10, no. 7 (4 July 2021): 1544, https://doi.org/10.3390/foods10071544.

[81] Germana Giuggioli et al., 'The Hygiene-Sanitary Control in the Wild Game Meats', *Italian Journal of Food Safety* 6, no. 4 (26 February 2018): 222, https://doi.org/10.4081/ijfs.2017.6875.

conventional meat production could be retained, but the addition of a competitive, high-efficiency product on the market could still lead to a loss of jobs. Much depends on the growth in demand (value quality: **income security**).

Possible impacts on the core value **social cohesion**

As in the case of the efficient use of resources, food security does not exclude the use of conventional and traditional paths for food production (for goals A and B). This would help preserve traditions linked to animal slaughtering and meat consumption. See 'ecological sustainability' for an argument concerning the preservation of cultural landscapes through livestock farming (value quality: **cultural heritage**).

Rural areas can maintain their conventional importance due to their role in ensuring food security, at least as part of the supply chain (value quality: **inclusion**).

Maintaining a dual direction in meat and seafood production (by keeping some forms of conventional meat production intact) could help preserve a feeling of inter-connectedness, especially when a link to conventional meat production is retained for more symbolically relevant cultural practices. However, reducing the food system to its productive dimension, and animals to a 'standing reserve', would not promote other dimensions of this value (value quality: **regional identity**).

Possible impacts on the core value **integrity**

Compared to the pursuit of 'ecological sustainability', the preservation of conventional meat production for the sake of Food security/Food justice would not be connected to the broader planetary health. In this case, instead, animals would be seen merely as a means for our needs (value quality: **cognitive consonance**).

How would pursuing the four ethical drivers through CM/CSF affect conventional meat production?

Promoting CM/CSF primarily for:

Animal Welfare may oppose conventional livestock farming, although some forms of it may coherently remain in place. Public sensitivity towards animal suffering may increase if meat production no longer requires slaughter, leading to a shift in

understanding of animal welfare. At the same time, the role of farming in maintaining human-animal relationships remains an open question. While small-scale farms may be considered compatible with animal welfare under certain conditions, large-scale operations do not usually meet these standards.

Ecological sustainability is compatible with some forms of conventional agriculture and traditional meat production, which can be involved in the promotion of resource efficiency, sustainability and biodiversity. The issue of biodiversity is more complex: intensive agriculture is a recognised threat, but certain livestock systems and meat production practices can help maintain biodiversity.

Human Health also tends to oppose conventional livestock farming, either for extensive use of antibiotics in intensive ones, or for difficulty in controlling the sanitary measures of small-scale farming practices. Generally speaking, practices involving animal slaughter may come under scrutiny if perceived as harmful to public health, which could lead to increasing restrictions.

Food Security does not necessarily require abandoning conventional farming and justifies its continuation, also allowing intensive livestock farming to remain in place. This is true despite the importance of implementing CM/CSF production for ensuring protein supply in a growing population. From this perspective, small-scale production practices are only valued to the extent that they enable widespread availability of food. Unlike animal welfare, food security does not introduce moral considerations regarding animals but focuses on ensuring a stable and sufficient food supply from a human-centred perspective.

The problem of CM/CSF as techno-fix

A common criticism is that CM/CSF does not really solve problems but is a surface-level techno-fix[82]. This means that these technologies are not capable of triggering the social change that would be necessary to solve the pressing problems of sustainability, nutritional wealth, etc. For example, criticism is levelled at the fact that

[82] In the literature, there is a clear distinction between the terms 'techno-fix' and 'techno-solutionism', which was developed by Sætra and Selinger, see: Sætra and Selinger (2024). However, it is not necessary to elaborate on this distinction in the context of this EIA.

CM/CSF would solidify meat consumption and an 'instrumental approach to animals', instead of 'any substantive and lasting change to occur, we will have to abandon our fixation with meat altogether, and devote ourselves instead to developing a global, ecologically sustainable plant-based food system'[83]. CM/CSF technologies, the critics say, not only fail to achieve the purpose of effectively replacing a significant portion of conventional meat production but also hinder the necessary social change. These technologies 'run counter to the goal of transforming the values and beliefs that underpin exploitation'[84].

The opposing view is that it is very difficult to change people's moral attitudes and that it is therefore important to strive for technical solutions. Otherwise, according to Sætra and Selinger, we tend 'to ignore real challenges related to changing human behaviour rapidly and downplay the positive potential of new technological breakthroughs'[85].

In reflection of these two different perspectives, Lo Sapio proposes to balance the techno-optimism of CM/CSF proponents with the critical approach of the techno-fix critique by adopting a 'techno-realism' stance[86]. This refers to a critical-realistic attitude towards the development and use of new technologies that sees both the extraordinary potentials and the criticism and potential risks. In this way, a more responsible technology governance can emerge from a 'golden mean' between tech enthusiasm and hostility towards technology. We agree with Lee that in evaluating the potential of CM/CSF, 'careful attention must be paid to the broader social, ethical, and ecological systems that stand to be affected, lest we—as the adage goes—miss the forest for the trees'[87]. This is why it is so important to reckon with all the values affected by CM/CSF, as we have done in this EIA. The aim is to find a way to design and use technologies in such a way that essential values are not compromised and that no attempt is made to favour one stakeholder group over others.

[83] Salzani and Weisberg, '67. The Ethics and Politics of Cultured Meat', 432.
[84] Lee, 'Meat-Ing Demand', 27.
[85] Sætra and Selinger (2024)
[86] Lo Sapio, 'The Ethics of Cultivated Meat', 35–36.
[87] Lee, 'Meat-Ing Demand', 16.

Values and market dynamics

Innovations are not usually driven primarily by ethical considerations, but rather by profit motives. Even if the origins of CM/CSF are deeply rooted in ethical goals, commercial and entrepreneurial goals come into play at the latest when the interests of investors and venture capitalists in start-ups need to be satisfied. In addition to the question of what is desirable for society in ethical terms, companies are confronted with the fact that financial interests need to be satisfied quickly.

It is therefore important to ask how the impact of CM/CSF on values is influenced by market interests. Much of the research and development in CM/CSF relies on private companies and private investment[88], which is growing 'almost entirely independently of public research initiatives aimed at sustainability in food and agriculture'[89]. In the CM/CSF sector, start-ups are leading the way by securing funds from venture capitalists[90].

The narrative with which these technology investors are presented is adapted to the imaginative worlds that permeate technological innovation in the high-tech sector[91]. In fact, many of the 'promising narratives' guiding the development of CM/CSF innovations 'have been fabricated […] to appeal to a set of private investors and financiers'[92]. In this section, we will therefore explore how ethical value promises and market interests influence each other and influence ongoing research in the field.

Innovation processes always involve risks that we can roughly divide into two classes:

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[88] See: Alexandra E Sexton, Tara Garnett, and Jamie Lorimer, 'Framing the Future of Food: The Contested Promises of Alternative Proteins', *Environment and Planning. E, Nature and Space* 2, no. 1 (March 2019): 48, https://doi.org/10.1177/2514848619827009.

[89] Richard Helliwell, Erik Bjørnerud, and Tonje Nerby, *Cultured Meat and Responsible Research When the Future Is an Illusion for Financial Speculation*, *93-98* (Brill, 2024), 94, https://doi.org/10.3920/978-90-0471-550-9_12.

[90] Neil Stephens et al., 'Bringing Cultured Meat to Market: Technical, Socio-Political, and Regulatory Challenges in Cellular Agriculture', *Trends in Food Science & Technology* 78 (1 August 2018): 163, https://doi.org/10.1016/j.tifs.2018.04.010.

[91] Alexandra E. Sexton, 'Food as Software: Place, Protein, and Feeding the World Silicon Valley–Style', *Economic Geography* 96, no. 5 (19 October 2020): 450–52, https://doi.org/10.1080/00130095.2020.1834382.

[92] Helliwell, Bjørnerud, and Nerby, *Cultured Meat and Responsible Research When the Future Is an Illusion for Financial Speculation*, 95.

a) the desired goals and values are not realised.

b) the desired goals and effects are accompanied by undesirable side effects.

However, Investors often do not want to hear complex presentations, but simple solutions that can quickly succeed in the market. In such over-simplified investor-oriented narratives, which are intended to promote the further development of CM/CSF, we can distinguish between two approaches, which we will call 'unambiguous' and 'conflict-free'.

Unambiguous narrative

To sufficiently arouse the interest of investors in emerging technologies that have yet to be developed, it is common practice to paint a glowing picture of the hoped-for goals (both economic and social-ethical in nature), but to gloss over the possible difficulties in actually achieving the goals. For example, it may be kept quiet that slaughterhouse waste or FBS may still be used in CM/CSF, or the ecological advantages of CM/CSF are convincingly presented without pointing out that a great deal of progress is still needed to achieve this goal. Furthermore, the potential harmful risks to human health may be 'ignored and downplayed', and doubts about the actual scalability of production may be dismissed by making 'rhetorical promises of large and cheap reactors'[93].

Conflict-free narrative

At the same time, actors in this field promote 'conflict-free' narratives that ignore or deliberately disregard dilemmas between different values and the possibility of negative impacts of this technology on certain values. For example, Helliwell and Burton (2021) point to 'narrative omissions' in 'mainstream news and industry media' regarding the potentially destructive impacts of this innovation on rural communities, the cultural landscape, and certain aspects of biodiversity[94]. This is coupled with a 'cherry-picking' of the values promoted by the technology, selecting those that best fit the current capabilities of CM/CSF technologies. For example, consider how the

[93] Dwayne Holmes et al., 'Cultured Meat Needs a Race to Mission Not a Race to Market', *Nature Food* 3, no. 10 (October 2022): 786, https://doi.org/10.1038/s43016-022-00586-9.
[94] Helliwell and Burton, 'The Promised Land?', 182.

technical limitations of reproducing beef cell lines at scale have led the CM/CSF industry to focus on cultured chicken meat, and how this led to a change in narrative. Indeed, since conventional chicken production has a higher degree of material efficiency compared to conventional beef production, the narrative promises sustaining CM/CSF development have moved away from promoting environmental sustainability and favoured a discourse on animal welfare[95].

In both cases, the main reason behind this type of narrative is the need to show investors that CM/CSF technologies are close to their final stages and almost ready to access a large-scale market[96]. This is a central aspect in the for-profit, high-tech environments where many CM/CSF companies operate and compete, especially the many start-ups developing these technologies. For these teams, it is crucial to offer a clear answer to the question concerning how long investors have to wait before having a profitable product[97]. The availability of a 'clear answer', however, could be precluded by the need for further technical improvements to align with the expectations held by consumers (e.g. a sustainable and slaughter-free meat alternative), by governments (e.g. compliance with health measures), and by investors themselves (e.g. scalable production). The uncertainties associated with the search for technical improvements, including the difficulty of proving that solutions can be found in a short time, are, in fact, obstacles to this approach, as is the possibility that they bring with them further compromises and shortcomings.

We believe that transparency is essential in these points: on the one hand, to have clarity about the state of technological development, and on the other hand, to be able to correctly classify the possible positive and negative effects of CM/CSF, so that appropriate measures can also be taken. This will in turn also have an impact on the core value of *Trust* and by that on public acceptance.

An honest and continuous effort to realise values in the innovation process can lead to unforeseen solutions to technical challenges, which can increase competitiveness

[95] Helliwell, Bjørnerud, and Nerby, *Cultured Meat and Responsible Research When the Future Is an Illusion for Financial Speculation*, 96.
[96] Holmes et al., 'Cultured Meat Needs a Race to Mission Not a Race to Market', 785.
[97] Sexton, 'Food as Software', 460.

of companies, as, for example, the value of 'beauty' has established the resounding success of Apple products[98].

Deliberately and strategically aligning with the values of stakeholders can yield unforeseen solutions. This may provide an element of increased competitiveness for individual companies or, in the phase of mission-driven collective progress as advocated by Holmes *et al.*, form a new, higher common ground from which a subsequent 'race to mission' can be initiated[99].

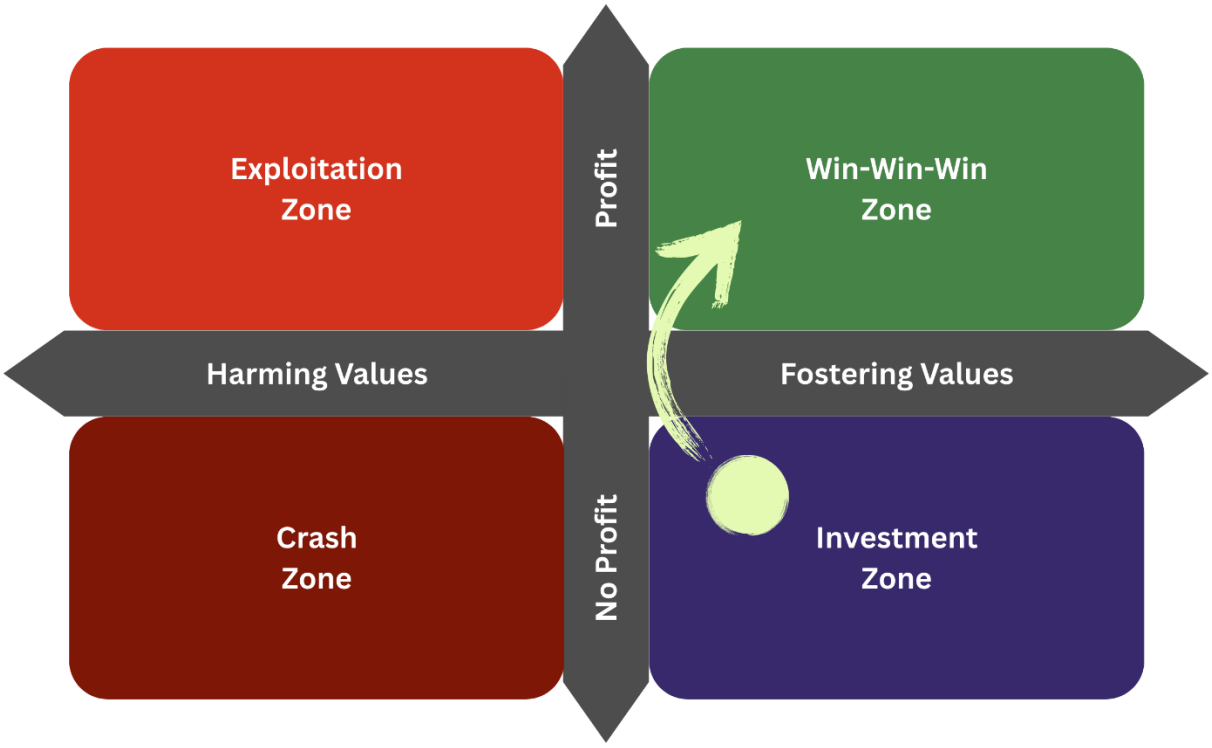

Figure 13: The value-profit matrix

If we superimpose the two relevant axes,

a) ethical goals (values), and

b) profitable goals (corporate success),

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[98] Charles H. Noble and Minu Kumar, 'Using Product Design Strategically to Create Deeper Consumer Connections', *Business Horizons* 51, no. 5 (October 2008): 441–450, https://doi.org/10.1016/j.bushor.2008.03.006.

[99] Holmes et al., 'Cultured Meat Needs a Race to Mission Not a Race to Market', 787.

we get a matrix of four sectors that are relevant for all companies that operate innovatively.

Investment Zone

Before money can be made from technical innovations, they have to be invented and developed, which requires significant investment. The high pressure to quickly enter the market often shifts the focus from ethical goals. Dealing with fundamental ethical values, as presented in this EIA, is essential and must be an integral part of the development process from the outset in order to be sufficiently effective. From an economic point of view, an early examination of the meaning and value of new products is also relevant because it leads to a high level of motivation among employees, as it gives their own work more meaning. Furthermore, it is much more cost-effective for entrepreneurs to address the question of value at an early stage, since the costs of making changes to products that have already been developed are significantly higher. Technological change is truly synonymous with societal progress only if it is designed to realise fundamental values and minimise risks. The development of trustworthy new solutions for our protein needs can only be achieved through an integrative approach that combines technical knowledge, legal requirements, and ethical competence.

Win-Win-Win Zone

The modern era is characterised by a deep-rooted belief in the possibilities of technological innovation for the well-being and development of humanity. Entrepreneurship and free markets are excellent tools for improving people's lives and meeting their needs. The solutions to the challenges of our time often lie in human inventiveness, unleashed by the market economy, i.e. in the development and provision of goods and services that people and society need for a good and fulfilled life. Economic activity is particularly well suited to meeting the needs of a larger world. After all, the centre of every business model contains what is called a 'value proposition'.

If the process of developing alternative protein products from CM/CSF is designed to be cautious, wise and ethical, a Win-Win-Win situation could indeed arise, namely:

good products for consumers, good effects on the environment and animal welfare, and good for the companies that make money from them.

Exploitation zone

The problem is that free markets and their actors also reflect human nature. Exceptional creativity and innovation, which can do a great deal of good, go hand in hand with greed and arrogance. The time pressure to get to market quickly, coupled with profit maximisation strategies as the sole goal of new product management, can easily lead to risks and harm for consumers, wider society and also the environment. For example, it is conceivable that industry players might seek to increase their sales targets by adding addictive ingredients to CM/CSF products. Disruptive engineering (not infrequently inspired by bad management theory and practice) can lead to a destruction of the environment or a disruption of social structures. Technology is then called upon anew to help fix the negative value issues observed. This has happened a lot in the past 200 years – and in an accelerated form in the last 20 years. One may take as an example, the oft-criticised logistics operations of Amazon. As of 2021, the company has undoubtedly excelled in terms of classical process management values, which are cost, rapidity, flexibility and quality. However, the technological workflows used to create these process management values are only instrumental to financial gain. At the same time, they have a lot of negative value externalities that the stakeholders impacted by the technology complain about. For example, when Amazon's warehouse employees reported that they would not have enough time to go to the bathroom and are therefore forced to pee into empty bottles to ensure the rapidity of process flow, then their dignity is hurt[100].

Crash zone

Crash zone means that a company's exploitative behaviour becomes sufficiently public and thus its reputation among customers and the population rapidly declines. Trust is a central asset for long-term customer loyalty and takes many years to build but can be destroyed in a very short time. It is a recurring phenomenon that

[100] Shannon Liao, 'Amazon Warehouse Workers Skip Bathroom Breaks to Keep Their Jobs, Says Report', 16 April 2018, https://www.theverge.com/2018/4/16/17243026/amazon-warehouse-jobs-worker-conditions-bathroom-breaks.

companies that have made good profits collapse very quickly when a scandal reveals that their business model is based on exploitation or even fraud.

Furthermore, it is essential that well-thought-out laws adequately protect citizens, and, in the context of our study, animals and the environment. In this way, companies that act ethically are rewarded and those that abuse their market power at the expense of values are penalised. If the positive motivation is not enough to strengthen the relevant values with one's own products, at least the fear of losing customer trust and facing heavy fines helps to avoid the crash zone.

The great challenge and task of technology ethics is to show the way from the investment zone to the win-win-win zone and to prevent the drift into the exploitation and the crash zone. To achieve this, the complex ethical dimensions must be taken into account from the outset.

Conclusions

The following conclusions and recommendations are very preliminary for at least three reasons and should therefore not be considered final.

1) The EIA report is designed in such a way that a significant part (in VBE terminology: ethics-oriented design) is still pending and the results will be included in the final report. This includes three further workshops, literature research and further interviews:

2) As explained in the report, the value dispositions are still being developed and therefore the results of other working groups within FEASTS must be awaited before concrete conclusions can be drawn.

3) The values of animal welfare and integrity are not addressed in detail by other working groups within FEASTS and must therefore be further investigated by us.

Preliminary conclusions

The 'Ethical Impact Assessment of Cultured Meat and Seafood' provides a comprehensive analysis of the ethical implications associated with the development and implementation of CM/CSF technologies.

Here are some of preliminary key conclusions which can be drawn from the report:

1. Animal Welfare

- **Positive Impact**: CM/CSF has the potential to significantly reduce animal suffering by eliminating the need for conventional livestock farming and slaughter. This aligns with the core value of animal welfare, promoting a more humane approach to meat production.
- **Challenges**: Ethical concerns remain regarding the treatment of cell-donor animals and the use of fetal bovine serum (FBS) and other animal-derived components. Addressing these issues is crucial to fully realizing the animal welfare benefits of CM/CSF.

2. Ecological Sustainability

- **Positive Impact**: CM/CSF can contribute to ecological sustainability by reducing land and water use, lowering greenhouse gas emissions, and decreasing pollution. This supports the goal of creating a more environmentally friendly food system.
- **Challenges**: The energy consumption of CM/CSF production and the risk of monocultures need careful management to ensure that the ecological benefits are not offset by new environmental issues.

3. Human Health

- **Positive Impact**: CM/CSF offers the potential for safer and more nutritious meat alternatives. The controlled production environment can reduce contaminants and pathogens, improving food safety and public health.
- **Challenges**: Long-term health effects of consuming CM/CSF require further study. Ensuring that CM/CSF products are free from harmful additives and contaminants is essential for consumer trust and health.

4. Food Security / Food Justice

- **Positive Impact**: CM/CSF can enhance food security by providing a stable and scalable source of protein. This can help address global food shortages and improve access to nutritious food.
- **Challenges**: Ensuring affordability and accessibility of CM/CSF is critical to avoid exacerbating existing inequalities in food systems. Policies and subsidies may be needed to make CM/CSF accessible to all socioeconomic groups.

5. Economic Security

- **Positive Impact**: The development of CM/CSF can create new job opportunities and support economic growth in emerging sectors. This can help transition workers from traditional farming to new roles in the CM/CSF industry.
- **Challenges**: The shift to CM/CSF could disrupt traditional farming economies, leading to job losses and economic displacement. Support for affected workers and communities is necessary to mitigate these impacts.

6. Social Cohesion

- **Positive Impact**: CM/CSF can promote inclusivity and preserve cultural practices by providing diverse dietary options that align with various ethical and cultural values.
- **Challenges**: The introduction of CM/CSF may create social tensions between different consumer groups. Efforts to foster dialogue and understanding are important to maintain social cohesion.

7. Trust

- **Positive Impact**: Building public trust in CM/CSF requires transparent communication about production processes, safety standards, and ethical considerations. Clear labelling and independent oversight can enhance consumer confidence.
- **Challenges**: Dependence on large corporations and potential uncertainties about the safety and origins of CM/CSF products need to be addressed to maintain trust.

8. Integrity

- **Positive Impact**: CM/CSF can help align personal values with dietary choices, reducing cognitive dissonance and promoting ethical reflection. This supports the core value of integrity in food production.
- **Challenges**: Ensuring that CM/CSF production practices uphold ethical standards and do not lead to new forms of alienation or cognitive dissonance is essential.

Overall preliminary conclusion

The Ethical Impact Assessment of CM/CSF highlights the significant potential of these technologies to contribute to a more sustainable, humane, and equitable food system. However, realising these benefits requires careful consideration of the identified core values and proactive management of associated risks. By addressing the challenges and leveraging the positive impacts, CM/CSF can play a crucial role in transforming food production for the better.

Preliminary recommendations

The following conclusions are taken from the workshop contributions. They do not necessarily reflect our opinion and have not yet undergone the VBE's process for developing 'ethical value requirements'. They should therefore be regarded as provisional.

Animal Welfare

To support animal welfare, it is important to communicate clearly and transparently if and when CM/CSF consumption demonstrably reduces negative impacts on animals, for example by lowering the need for slaughter or by reducing stress, pain and exposure to disease. Where such benefits are supported by evidence, they should be made accessible to the public in a comprehensible and balanced manner. At the same time, in order to maintain a respectful relationship with animals, existing cultural practices could be adapted rather than abandoned. For instance, conventional farms could be transformed into sanctuaries or places for non-exploitative animal encounters, such as farm tourism or educational petting farms. These approaches may help preserve the symbolic role animals play in regional identities while affirming their intrinsic value.

Human Health

Ensuring the safety and healthiness of CM/CSF products must be a core priority. This includes the promotion of strict monitoring and pre-testing of CM/CSF to safeguard against contaminants, pathogens, or nutritional deficiencies. Investments should be directed toward research that enables tailored nutritional profiles, ensuring healthier meat and seafood alternatives for all population groups, including people with food intolerances. Public communication should clearly present the potential health benefits, and nutrient labelling standards should be developed to help consumers make informed choices. Research initiatives should also explore how CM/CSF can become part of healthier diets. Within the FEASTS project, this topic is explored in greater depth by working groups T3.5, T5.1, T5.2, T5.3, and T6.3, whose focus lies specifically on the health-related aspects of CM/CSF.

Ecological Sustainability

If and where ecological advantages of CM/CSF, such as the possible protection of biodiversity, reduced pollution, and lower use of farmland and water, can be clearly verified, these aspects must be at the heart of public communication strategies. Measures such as rewilding or afforestation of former pasturelands should be publicly supported to enhance biodiversity regeneration. Agricultural subsidies could be redirected toward renaturation and the creation of more forested areas. Promoting renewable energy for CM/CSF production facilities is also essential to strengthen the environmental integrity of these technologies and support climate balance. Communicating these ecological benefits effectively can help build acceptance and legitimacy for the shift in food systems.

Food Security / Food Justice

To enhance food justice, affordability and accessibility of CM/CSF should be ensured through targeted public subsidies and funding strategies. State support for open-source research can reduce reliance on large corporations and help create fairer access to production technologies. Smaller reactor models and local production sites should be encouraged to avoid centralised control and maintain a more democratic food system. At the same time, educational initiatives and simplified, inclusive public information campaigns can help make this technology accessible to all, regardless of socioeconomic background. This is particularly important to address social inequality and to ensure a just transition.

Economic Security

To avoid economic displacement, strategies must be put in place to support farmers and workers affected by any decline of conventional livestock production. This includes creating new job opportunities in CM/CSF-related sectors, and offering training programs to help farmers shift to new roles, such as operators of CM/CSF facilities, or as stewards of restored landscapes. Attractiveness and security of these new jobs must be part of policy discussions. Furthermore, CM/CSF research and development should be publicly supported to strengthen local product availability and

stimulate regional income generation, especially in rural areas facing structural change.

Social Cohesion

To preserve social cohesion, policy must address tensions that may arise between those who accept CM/CSF and those who do not. Public education should aim to foster understanding, rather than deepen divides between different consumer groups. At the same time, farmers should be included in the transformation process, not only through financial support, but also via public recognition and involvement in planning processes. Regional identity and cultural heritage should be preserved by rethinking the role of animals and rural spaces in a post-livestock era. Strategies that foster individual freedom of choice, e.g. by increasing product variety and allowing consumers to make conscious dietary decisions, can further support an inclusive and resilient society.

Trust

Transparent communication is crucial to building public trust. This includes clarity about how CM/CSF is produced, what it contains, and how safety is ensured including information campaigns in easy language, understandable for everyone. Production standards and labelling requirements should be implemented to make it clear where CM/CSF is present, similar to the existing standards for genetically modified food. Education efforts should not only focus on benefits, but also on the reasons why CM/CSF is being developed in the first place, including environmental, ethical, and health motivations. Open-source approaches to production and strong public funding can help reduce uncertainty, counterbalance corporate dominance, and ensure equitable access to knowledge and technology.

Integrity

Finally, CM/CSF should be developed and communicated in ways that foster cognitive consonance and ethical reflection. Public discourse should encourage individuals to reconcile their values, such as compassion for animals, with their dietary choices. CM/CSF offers a way to reduce personal guilt associated with participation in the industrial meat industry, without requiring a full departure from familiar food habits. At

the same time, care must be taken to avoid creating new contradictions, for example, by branding CM as 'natural' or by alienating people from food systems through overly complex technologies. Mindful integration of CM/CSF into society requires space for reflection, respectful communication, and long-term ethical engagement.

Outlook

This report is the first part of the ethical reflections within the FEASTS project.

The methods used in this report enable a comprehensive and structured approach to assessing the ethical impact of farmed meat and farmed fish. The aim is to provide a tool that ensures that the desired core values are realised both before and after the potential market introduction of CM/CSF and that negative impacts are reduced.

The second part of the EIA (completed in month 36) will also serve this purpose, focusing in particular on the development of 'Ethical Value Requirements' (as defined in IEEE 7000™). These are organisational (in our context also political) and technical requirements identified by stakeholders to ensure that technical innovations actually realise values and reduce negative value impacts.

In this context, we will conduct three further workshops and interviews with various stakeholders and work closely with partners within FEASTS whose work addresses the core values described in this report.

Ultimately, the goal is to create a robust tool that can be used to assess whether the desired target values are being achieved, how side effects can be dealt with, and how possible misuse of the technology can be counteracted.

Annex 1 – Workshop 1

1.1 Structured contributions from participants from Workshop 1

In the workshop we explored the potential benefits and risks of shifting away from conventional animal agriculture toward CM/CSF. We looked at chances and risks for animal welfare, ecological sustainability, and food culture.

Participants identified a wide range of opportunities for improving animal welfare, including the reduction of animal suffering, less intensive farming, and decreased need for animal slaughter. These changes could also lead to ecological sustainability, such as more land for biodiversity, reduced antibiotic use, and lower risk of zoonotic diseases.

However, the discussion also highlighted ethical and practical concerns, such as the potential exploitation of animals for cell extraction, loss of meaningful human-animal relationships, and uncertainties around the treatment of animals still used in the production process. There were also concerns about economic and ecological trade-offs, such as increased monoculture for bioreactor feed. The ontological status of cells used in cultured meat was discussed too.

Below, we have sorted the participants' contributions according to opportunities and risks and divided these into thematic subgroups. The points that were emphasised in the workshop are marked by [discussion] before the respective answer[101].

[101] The text within square brackets '[]' indicate either a correction of spelling or a comment by us. Round brackets '()' are given by participants themselves.

Animal Welfare

Chances

Reduction of animal exploitation.

Reduced animal suffering: anxiety, stress.

Reduction of intensive farms.

Less intensive farming is needed, so more room for organic farming and for farmed animals to have a higher quality of life.

Less farmed animals might lead to improved animal welfare within farms.

Reducing intensive livestock farming and its negative effects on animals.

Reduction of the required surface of farmland that produces feed for livestock (more space for rewilding nature) and its negative effects. [→ ecological sustainability]

Less animal suffering.

Less animal suffering.

No animal suffering.

Less stress for animals.

Happier animals due to reduced stress.

Animals for cell selection are treated better than animals for conventional meat production.

Decreased ecological stress on wildlife.

More room for biodiversity, so expansion of wild animals and proliferation of species if policies to restore ecosystems are in place. [→ ecological sustainability]

Less, to no, slaughtering of animals

Reduce animal slaughter.

Reduction in animal slaughter.

Less farmed animals in the world, less slaughtered animals.

Animals do not need to be killed, and thus their life conditions will be improved.

Less animals have to be killed for meat/seafood production.

Animals that are still slaughtered can live on few farms where they can live in groups and have a more decent life than today. Additionally: there will be more biodiversity, as animal farming and slaughtering is one of the main reasons why land for wild animals is destroyed. [To our knowledge, slaughter is not a major cause for land loss. While animal farming is.]

Less, to no, overfishing

No overfishing with [CSF]

Better animal farming standards with lower density of farm animals: e.g. hygiene, less infectious diseases (better health).

Reduction [i]n the number of animals used - less intensive farming.

Less animals in mass production systems.

Fewer animals on farms, reduction in disease transmission.

Reducing the risks of zoonotic diseases that arise from livestock farming. [→ human health]

Less animal feeding issues.

Reduced use of antibiotics.

Less animals have to be kept in small confinement/ fed with antibiotics etc. (less stress for animals).

Less waste from animal rearing. [→ ecological sustainability]

A more animal-friendly life.

New and more diverse relations with farm animals: e.g. as 'neighbours'.

Raised social awareness on the value of the life of farmed animals.

More respect for animals.

Farm animals are respected as living beings and are free to live in a cooperative environment with humans on farms.

Promotion of animal rights (beyond food for humans). [→ principles of animal welfare]

Wild animal hunting is reduced and that protects biodiversity. [→ ecological sustainability]

Less area for plant protein production → more biodiversity. [→ ecological sustainability]

More free land for more interesting crops. [→ impact on food culture]

Higher prices for traditional meat. [Why exactly?]

Traditional factory farming could 'die out' because the cheapest meat comes from [CM]. [Why is this a chance for animal welfare?]

Risks

Violation of animal rights, e.g.: inviolability of a being's body (bodily integrity).

Potential use of waste streams that harm animals (e.g.: toxic chemicals, plants that harm the environment of animals).

Livestock production will stay in a smaller part and their condition will worsen [due] to decrease price.

What happens to the animals that will then not be needed anymore for meat/seafood production? Is killing off animals that are not needed anymore possible. [Not clear why farmers would kill off their animals when these no longer have an economic use.]

New possible and unforeseen ways to exploit animals, such as repetitive biopsies.

Few animals will still be held for biopsy.

Possible discomfort/suffering from cell extraction.

Some (baby) animals still might die for CM/CSF (depending on production method).

[Discussion:] The (economic) need for constant biopsies goes against being vegan.

The dignity of animals is not respected anymore as their body is seen as an object for human pleasure as humans are able to recreate their body.

Nothing changes in the slaughter system, because [CM] remains a niche product.

[Discussion:] What are the CM cells? Do they have an ontological connection to the animal?

Which rules will apply to the animals that provide the cells? Factory farming for animals that provide the cells?

Genetic modifications of animals for cell selection (e.g.: a chicken without a head[102], a goat that gives silk). [Discussion: Several participants have stated that this aspect could also be used for positive aspects, such as for dogs that are more resilient to certain diseases. No definite conclusion was reached.]

No economic alternative for foetal bovine serum (FBS) found.

Potential reliance on animal-derived products (e.g.: culture medium components).

Simulation of immoral acts can lead to real immoral acts: e.g. foster the desire to taste conventional meat.

Less, to no, meaningful relations with farm animals.

Animal population control (number of individuals). [Neutral statement, unclear why this is a risk.]

Less diversity in farmed animals due to lower numbers.

Less research will go into animal health/fewer investments into veterinary as animals are not so important for food security any longer (animals lose importance in general).

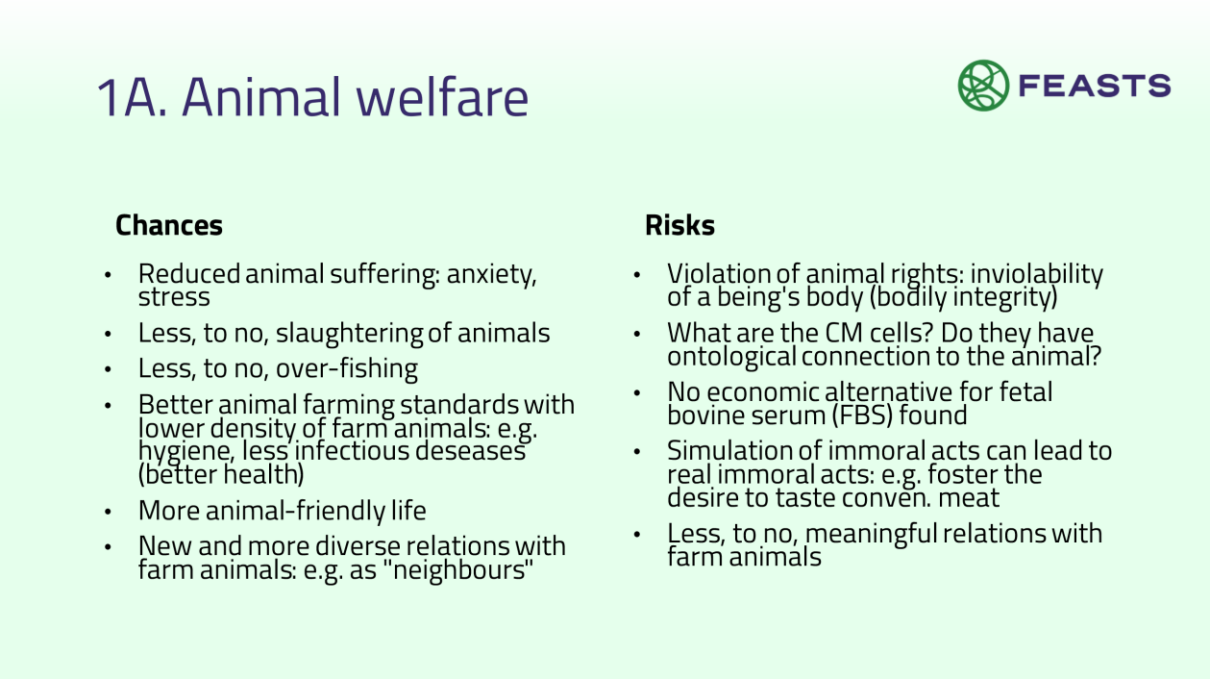
Increase of wild animals that might create problems in the surroundings of cities/villages.

[102] See also: Mike the headless Chicken.

[Increased demand] to use more territory to plant crops needed to feed bioreactors and then more monoculture that destroys room for wildlife. [→ ecological sustainability]

Resources used. [→ ecological sustainability]

Economic impact on traditional farming. [→ food security]



Principles of Animal Welfare

Positively: Do foster Freedom for animals (of movement, of sociality, of body).

Freedom to walk and move.

Ensure adequate living conditions to all living beings.

Animal welfare is an important issue because right now, there are animals of class A and animals of class B. I think we need to understand that if we talk about animal welfare, we need to ensure a minimum level of welfare for all animals. Unfortunately, this is usually not the case. [Discussion:] e.g. Pigs in intensive farms live with dead bodies vs. Home-owned dogs being treated well.

Value of life.

[Discussion:] Humans have a hierarchy for the animal kingdom, in certain (legal) cases, different animals are treated differently by us, which is justifiable (the value of one fly vs. of a human baby). It is, however, not about justifying our own dominating position at the top of the species hierarchical level (somewhat unjustifiable due to our own cruelty towards animals). Further, many animals interact with many other animals, constituting part of a larger (eco-)system, it is hard to isolate one kind out.

Quality of life (living conditions).

Animal-specific rearing conditions.

Life duration.

Negatively: Do not violate the Freedom of animals.

Society should follow *less harm* principle, towards any form of life.

Non-violence against others.

Animals should not be subject to cruelty.

Do not harm / eat animals.

Do not harm / eat sentient animals.

Sentientism.

Do not cause harm to animals in any way unless absolutely necessary.

Reduce animal suffering as much as possible, while still ensuring food security for humans.

No breeding of harmful features.

Do not kill animals.

Do not kill sentient animals.

Species-appropriate killing.

Rearing animals in good condition but can be killed for meat. [We note and point at this interesting contradiction.]

Positively: Do have meaningful, respectful relations with animals.

Humans have responsibility to care and protect.

Live among animals and not isolated - provide means for animals to live sustainably (water, landscape, etc).

Respect for every living being.

Society should recreate society and living space to create environment to respect animal lives.

Available to society in general (awareness and cost). [Discussion:] Awareness of CM and its potentials, both positive and negative ones, such as animal welfare issues and being affordable not just for a particular group but for everybody.

When working for scientific purposes, [d]o follow the 3Rs recommendations: replacement by using in vitro alternatives, reducing the number of animals needed for a given experiment and refinement by reducing to the maximum [minimum] the pain. [Either this person meant to say 'by reducing the pain maximally', or 'by reducing the pain to a minimum']

Negatively: Do not reduce animals to purely utilitarian functions.

Animals are not object to recreate for human pleasure. Society should respect animals as living beings with the same right to live and not be used [for] humans. (Instead, there should be a balanced relationship).

One health principle - is based on the interrelations between human, animal, ecological health. (Strive for balance between all three, especially because animals do kill each other.).

Prioritising health of ecosystem over individual ones. [→ ecological sustainability]

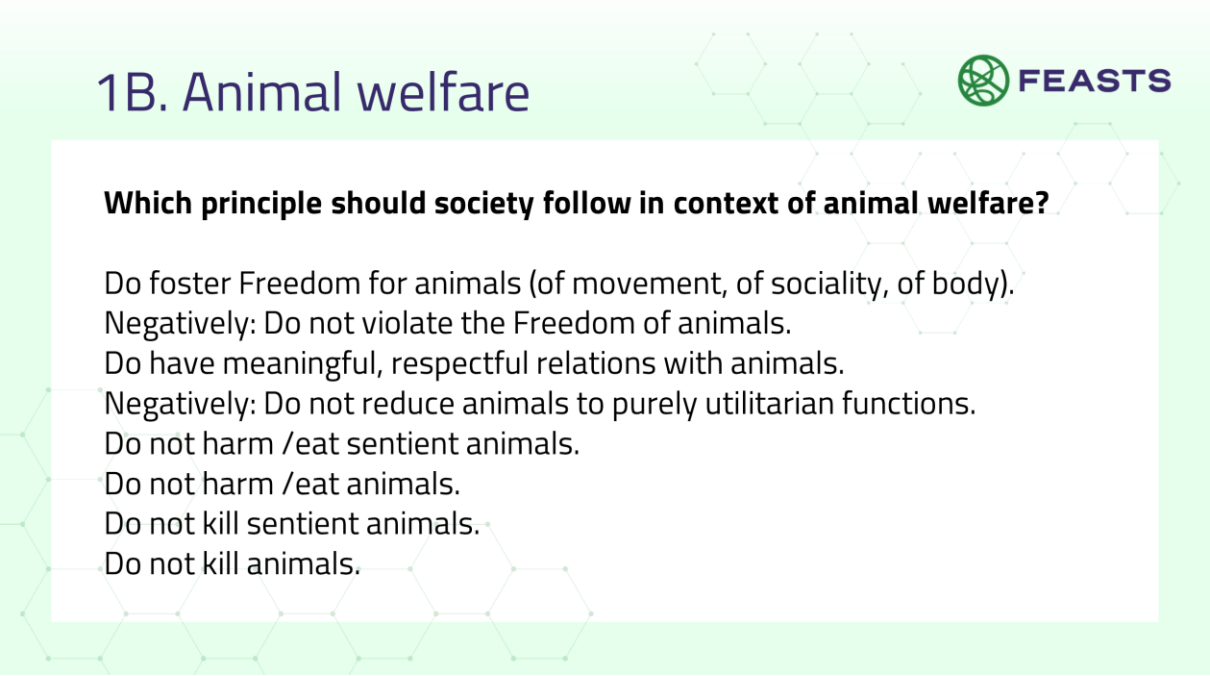
If I can rely on plants fully for nutrition (e.g.: living in a European city) [then why kill animals?]. [Should this be possible for everyone?]

Utilitarianism. [Unclear, probably meant as pleasant lives for the greatest number of animals.]

Assume that humans have the right to eat meat. We are omnivorous. Assume that the food chain exists, and humans are part of it.

[Discussion:] Humans have an ancestral and emotional relationship to animals – both domesticated and wild – making it part of a long and complex tradition which should not be oversimplified by CM. Not all relations are negative, many are worth conserving.

[Discussion:] Animals kill other animals – this seems to be part of nature and not unethical. Emphasising the interlinkage between various kinds of animals.



Ecological Sustainability

Chances

Lower resource intensity: less usage of land, water, chemicals, antibiotics, animal feed.

Reduced resources for manufacturing.

Less land and water use.

Reduced land use.

Reduce land usage.

Reduce land use.

No need to expand land use for livestock.

Reduce water use.

May reduce water usage.

Less use of antibiotics, normally used in livestock.

Less ecological burdens: reduced pollution of air (CO_2 etc.), soil and waterway

Potential lower ecological impact on all levels.

Reduced pressures on several ecological media, in particular on air pollution, water pollution, and biotic and abiotic resources (both for animal breeding and for meat/fish processing).

We will produce protein within the secondary sector, rather than in the primary sector. In case it is more efficient, this can bring overall global lower ecological impact.

Increasing the variety and nutritional value of products can further reduce the production of other food production systems with a high impact.

Reduce all negative ecological impacts of factory farming.

Reduced land use, GHG emissions and water.

Less GHG emissions.

Decrease of CO_2 emissions.

Reduce CO_2 emission (e.g. from cattle farming).

Reduction of gas emissions due to livestock farming.

IF/WHEN cellular agriculture is scalable, it will have a lower ecological footprint in terms of land use, greenhouse gas emissions, and recycling of materials + can be produced within cities where consumed (reduced transport).

On-site production → no transportation.

Reduced microplastics and harmful waste in the ocean

Increased land and maritime biodiversity

Improved biodiversity.

Less land use for farm animals and more biodiversity.

Use of less land, water, resources will drive more room for biodiversity.

Decrease land use for livestock rearing and leave more land [for] plant production and wildlife.

Potential for increased biodiversity, due to the improvements of ecological conditions on several media.

Reduced over-fishing.

CSF may help to reduce overfishing - protection of biodiversity.

More stability for eco-systems

Resilient to climate change.

Circular production systems.

Space to improve the circular economy on meat production - zero waste concept.

Risks

Higher energy consumption.

Energy intensive process.

High use of energy for cell meat production.

High-energy demand if greener energy is not used to power [CM] factories, for instance.

Jevon's Paradox: simpler production leads to higher consumption

Higher energy demand/costs?

Rebound effect: Increased production.

More ecological burdens.

Could be less sustainable than hoped for.

Wrong assumption in LCAs, negative impact on environment.

Amount of fresh water and energy needed. (Still unknown.)

CM/CSF production waste might have negative impact on environment.

Ingredients needed to create CM/CSF might have ecological risks.

Unknown impact of waste products.

Water and air pollution near the production facilities.

Water source pollution through waste product accumulation.

CO_2 emissions.

Higher CO_2 footprint.

Material sourcing - e.g. plastic pollution from single-use plastic in R&D.

Positive ecological impact hijacked by business and financial interests.

Land not needed for cattle farming might be turned into industrial zones (or more generally might be used in an ecological-unfriendly way).

Less power to the farmers and more power to the industry, which has implications for land management.

Need for finite raw materials sources competition for resources (e.g. renewable energy sources, water for urban and residential use).

Farmers/aquafarmers who feel responsible for taking good care of their land/soils might give up this responsibility if they don't need the land any longer.

Dismissing other alternatives for conventional meat (such as plant-based proteins).

Still higher ecological impact compared to full plant-based diets.

Scale of the process. [→ food security]

Centralisation makes food less accessible. [→ food security]

Compliance with regulatory frameworks. [→ food security]

Consumer acceptance. [→ impact on food culture]

Extinction of cultural heritage. [→ impact on food culture]

Need for dedicated crops. [→ food security, what has this to do with CM?]

2. Sustainability

Chances

- Lower resource intensity: less usage of land, water, chemicals, antibiotics, animal feed
- Less enviromental burdens: reduced pollution of air (CO2 etc.), soil and waterway
- Reduced microplastics and harmful waste in the ocean
- Increased land and maritime biodiversity
- Reduced over-fishing
- More stability for eco-systems

Risks

- Higher energy consumption
- Jevon's Paradox: simpler production leads to higher consumption
- Positive ecological impact highjacked by business and financial interests
- Dismissing other alternatives for conventional meat (such as plant based proteins)

Impact on Food Culture

Chances

More locally produced foods

Local production.

To support food emergency situations. [→ food security]

Increase food security - dependent on broad distribution and costs (long-term). [→ food security]

Easier access to healthier products → [an] improve[-ment] in global health and social wellness. [→ human health]

More diverse, exotic meat/fish products (e.g.: potential to eat endangered species without further endangering them).

Broadening the option for food sources.

[CM] could replace traditional meat if the same 'pieces' are produced and could increase the supply of products with low availability (e.g. wild animals, or especially endangered ones).

Reduction in disease transmission through eating meat. [→ human health]

New gastronomic experiences: menus, dishes.

New products.

To use novel food ingredients to re-create traditional cuisine, and do novel cuisine inspired on previous culture.

New possible flavours and ingredients could lead to new traditional foods.

New foods could be developed - opportunities for new dishes and new traditions.

Consumer has the chance to choose food free from animal suffering. [→ animal welfare]

Healthier alternatives? [→ human health]

Healthier products. [→ human health]

To support balanced nutrition. [→ human health]

New traditions for growing meat together.

Evolution of culinary tradition - new products could lead to new tradition and way of eating and sharing food.

Ability to keep eating traditional foods that might have less ecological pressure, antibiotics, and potentially [more] nutritional benefits.

For high meat-eating countries, it might mean an opportunity to adopt a sustainable approach towards meat consumption without having to give it up.

Vegan versions of traditional foods, more inclusive and still traditional food.

Veg vs. non-veg food habits currently co-exist in many countries. CM/CSF could break up this divide, so that e.g. at a barbecue or a family breakfast table everybody choses to eat meat (in the form of CM) again.

More focus on older recipes with less meat in it and more traditional ingredients such as legumes. [Does this still have to do with CM?]

Risks

Less locally produced foods.

Food standardisation and loss of local specialties, loss of identity.

Food production only by industries → lost connection with food and lost connection in places related to food (positive experience of shopping at local markets and bonding experience with food producer).

Could be deemed as Western ideology by non-Westerners.

May result i[n] problems in developing world since people have to rely on meat from companies rather than from own farm.

Loss of gastronomic experiences: night-market, fish-market, remote restaurants.

Reduced product range.

The availability of certain delicacies could be reduced (especially for other organs - not muscle tissue, e.g. liver, heart, tail, ...).

Failing specific flavours as conventional ingredients are not available.

Loss of cultural practices associated with farming/fishing: living on a farm/boat, fishing trips, Hispanic Corrida, ceremonies of killing certain animals.

Loss of culinary tradition.

The idea what meat is changes along with the feeling/atmosphere about eating a traditional meat dish together (e.g. special meat eaten for Christmas).

Loss of cultural heritage on food issues (can also be a positive point if we consider the increase on product diversity).

Artificial food culture.

Necessary to change also the approach to food in general, not only the cuisine.

Consumers' resistance to change.

[F]or high meat-eating countries, it might be difficult to embrace [CM/CSF] given central role in socialisation (e.g. holidays) these products might play.

Senior citizens more resistant to include it in their diets.

Disruption of balanced diets - built over longer traditions - e.g. med. [→ human health]

Nutrient deficiencies if CM is different from meat. [→ human health]

Unhealthier products due to more processing and contamination from manufacturing process. [→ human health]

Divide between who can afford it and who can't (if CM costs more). [→ food security]

5. Bonus: Impact on food culture

Chances

- More diverse, exotic meat/fish products (potential to eat endangered species without further endangering them)
- New gastronomical experiences: menus, dishes
- New traditions for growing meat together

Risks

- Less locally produced foods
- Could be deemed as Western ideology by non-Westerners
- Loss of gastronomical experiences: nightmarket, fishmarket, remote restuarants
- Loss of cultural practises associtated with farming/fishing: living on a farm/boat, fishing trips, Hispanic Corrida, ceremonies of killing certain animals

The following topics were prepared but then not covered during the workshop due to a lack of time:

3. Food security

Chances

- Stabilised CM/CSF supply: more resilience of production against climate change, harsh weather conditions
- Increased efficiency for CM/CSF supply
- (CM/CSF supply for space travel and planetary settlements)
- (Decentralised CM/CSF supply: more local, less monopolistic, lower transportational costs?)

Risks

- Increased dependence on technology: more volatile to power shortages, cyber attacks
- Increased political & economic dependence on „big industry“
- Higher skill- and knowledge bar to enter meat/fish production
- Less farmers: farming knowledge
- Remains too costly for poor countries and working class of rich countries

4. Human health

Chances

- More nutritious: improved intake of rich proteins
- Less, to no, intake of undesired food parts: fat
- Less, to no, contamination: antibiotics
- No microplastics
- Less, to no, viral jumps of pathogens from farm animals to humans

Risks

- Unkown bodily side-effects: e.g. problems with metabolism
- Harmful residuals in the end-product
- For the sake of profit, the manufacturing industry could introduce substances that are bad for health (e.g. addictive).
- Failures in handling the cell proliferation process
- Unknown effects of edited cells

6. Bonus: Human character

Highly speculative

„Virtues“

- **Compassion**: concern for others
- - for animals
- - for less privileged (food justice)
- **Flexibility**: skillful adaption to change

„Vices“

- **Hubris**: People believe that they can overcome all difficulties with technical solutions and do not need to change their behaviour.
- **Insolence**: Production and consumption of cells of human origin (‘eating celebrities’)
- **Excessiveness**: you can eat as much meat as you want

1.2 Value table from Workshop 1

We summarise the dynamics between positive core values and positive/negative value qualities as follows:

- f: Fostering positive value quality in a system constitutes a positive value
- h: Harming a positive value quality in a system constitutes a negative value
- f: Fostering a negative value quality in a system constitutes a negative value
- h: Harming (or prohibiting) a negative value quality in a system constitutes a positive value

Core Value: Animal Welfare

Value quality	f/h	Description of effect	Stakeholder	ID
Reduced diseases	f	Reduced risk of diseases transmitting to other animals with lower farming density.	Farm animals	WS1_9
Reduced diseases	f	Reduced usage of antibiotics.	Farm animals	WS1_10
Reduced stress and pain	f	Less to no stress and pain for grown farm animals.	Farm animals (mature)	WS1_3
Reduced stress and pain	f	Less animals killed for meat production.	Farm animals	WS1_5
Reduced stress and pain	f	Less animals killed for seafood production.	Aquafarm animals	WS1_6
Reduced stress and pain	f	Decreased ecological stress on wildlife.	Wildlife	WS1_11
Reduced stress and pain	f	CM would increase prices for conventional meat, thereby fostering animal welfare because lesser consumers buy it.	Farm animals	WS1_15
Increased stress and pain	f	CM factories could create wasteful streams that harm nearby farm and/or wild animals.	Farm animals and wildlife (land)	WS1_18
Increased stress and pain	f	Discomfort, stress, and suffering might happen while extracting cells.	Cell-donor animals	WS1_21

Increased stress and pain	f	CM could disrespect the dignity of source animal as its body becomes an object of human manipulation and perverse enjoyment.	Cell-donor animals	WS1_23
Increased stress and pain	f	With more natural living space, wild animals would increase, putting themselves in closer contact with industrial areas, cities, villages, which would harm them.	Wildlife (land)	WS1_29
Reduced harsh conditions	f	Less exploitation of farm animals due to milder and more relaxed farming practices.	Farm animals	WS1_1
Reduced harsh conditions	f	Higher quality of life for farm animals due to milder and more relaxed farming practices.	Farm animals	WS1_2
Reduced harsh conditions	f	The animals selected for CM production are treated better than conventional farm animals.	Cell-donor animals	WS1_4
Reduced harsh conditions	f	With CSF, the demand to overfish diminishes.	Wildlife (aquatic)	WS1_7
Reduced harsh conditions	f	Overall lower intensity of animals in mass production systems and small confinement.	Farm animals	WS1_8
Reduced harsh conditions	f	CM would become the cheapest meat source, thereby pushing conventional factory farming to 'die out' and helping farm animals.	Farm animals	WS1_16
Reduced harsh conditions	h	Remaining livestock could face worsened farming conditions due to cutting costs.	Farm animals	WS1_19
Reduced harsh conditions	h	New forms of exploitation could emerge, such as repetitive biopsies performed on the same source animal over a short period, breaking biological limits; exhaustion, pain.	Cell-donor animals	WS1_20

Reduced harsh conditions	h	Depending on production methods, in some cases the source animal would die.	Cell-donor animals	WS1_22
Reduced harsh conditions	h	No effective changes in the food system are brought about if CM/CSF remain a niche product.	Farm animals	WS1_24
Reduced harsh conditions	h	Genetic modification could be used on animals for cell selection, creating new kinds of animals that might be questionable, such as a chicken without a head or a goat which gives silk instead of milk.	Cell-donor animals	WS1_25
Reduced harsh conditions	h	Potential over-reliance on animal-derived products (e.g. culture medium components), forgoing other animal-free alternatives and risking further exploitation of the source animal.	Cell-donor animals	WS1_26
Reduced harsh conditions	h	Lower diversity of farm animals due to overall lower numbers of livestock.	Farm animals	WS1_27
Respect for animals	f	CM/CSF would promote animal rights.	Farm animals	WS1_12
Respect for animals	f	CM/CSF would increase respect for animals.	Farm animals	WS1_13
Respect for animals	f	CM/CSF would raise social awareness to care more about the lives of farm animals.	Farm animals	WS1_14
Respect for animals	h	Animals lose importance; less resources for animal health and veterinary.	Farm animals and wildlife (land)	WS1_28

Core Value: Ecological Sustainability

Value quality	f/h	Description of effect	Stakeholder	ID
Protection / regeneration of biodiversity	f	Decrease land use for livestock rearing and leave more land to plant production and wildlife.	Wildlife (land)	WS1_45
Protection / regeneration of biodiversity	f	Overall reduced usages of farmland and water leads to more room for biodiversity.	Wildlife (land)	WS1_46
Protection / regeneration of biodiversity	f	Lower demand for plant protein production used to feed farm animals frees up more space for biodiversity.	Wildlife (land)	WS1_47
Protection / regeneration of biodiversity	f	Wild (game) hunting for meat could be reduced, protecting biodiversity.	Wildlife (land)	WS1_48
Protection / regeneration of biodiversity	f	CSF would ease the demand to overfish, protecting marine biodiversity.	Wildlife (aquatic)	WS1_49
Loss of biodiversity	f	Higher crops demand for bioreactors would lead to monoculture, destroying plant diversity.	Wildlife (land; plants)	WS1_63
Reduced pollution	f	Reduced air pollution; GHG, CO_2 emissions.	Nature	WS1_34
Reduced pollution	f	Reduced water pollution.	Nature	WS1_35
Reduced pollution	f	Increased variety and nutritional value of products could further lower demand for other food products with heavy environmental impact.	Nature	WS1_38
Reduced pollution	h	Still harmful when non-renewable energy sources are used for production.	Nature	WS1_52
Reduced pollution	h	Overall higher CO_2 output.	Nature	WS1_54

Reduced pollution	h	Ingredients needed to create CM/CSF might have ecological risks.	Nature	WS1_55
Reduced pollution	h	Air- and water pollution near the production facilities.	Nature	WS1_57
Reduced pollution	h	Material sourcing pollution from single-use plastic in R&D.	Nature	WS1_58
Reduced pollution	h	Water source pollution through waste product accumulation.	Nature	WS1_83
Less waste of resources	f	Reduced farmland usage.	Nature	WS1_30
Less waste of resources	f	Reduced water usage.	Nature	WS1_31
Less waste of resources	f	Reduced antibiotics usage.	Nature	WS1_32
Less waste of resources	f	Reduced manufacturing resources usage.	Nature	WS1_33
Less waste of resources	f	Reduced usages of abiotic and biotic resources.	Nature	WS1_36
Less waste of resources	f	Reallocation of meat/seafood production from primary (agricultural) sector to secondary (industrial) sector, done efficiently, would decrease global ecological impact.	Nature	WS1_37
Less waste of resources	f	On-site production and consumption cuts transportational resource, lowers environmental burdens.	Nature	WS1_40
Less waste of resources	f	Improved (waste) material recycling efficiency.	Nature	WS1_41
More waste of resources	f	More energy intensive.	Nature	WS1_50
More waste of resources	f	Rebound effect of lower energy costs leading to more demand, ultimately	Nature	WS1_51

		increasing energy levels (Jevon's paradox).		
More waste of resources	f	More water intensive.	Nature	WS1_53
More waste of resources	f	Land freed up from cattle farming might be used in an ecological-unfriendly way (e.g. turned into industrial zones).	Nature	WS1_59
More waste of resources	f	Still higher ecological impact compared to full plant-based diets.	Nature	WS1_61
Less waste	f	Reduced ecological impacts of factory farming.	Nature	WS1_39
Less waste	f	Less waste from farm animal rearing.	Nature	WS1_43
More waste	f	CM/CSF waste could have negative impacts on environment.	Nature	WS1_56
More waste	f	Unknown impact of waste products.	Nature	WS1_77
Climate balance	f	CM would be integrated into a circular production system, making meat production more stable and sustainable.	Nature	WS1_42
Climate balance	f	More stable and resilient ecosystems against climate change.	Nature	WS1_44
Respect for nature	h	Aquafarmers who feel responsible for taking good care of their waterway might give up this responsibility if the incentives are gone.	Nature (waterway)	WS1_99
Soil health	h	Farmers who feel responsible for taking good care of their land and soil might give up this responsibility if they do not need the space any longer.	Nature (soil)	WS1_62

Core Value: Human Health

Value quality	f/h	Description of effect	Stakeholder	ID
Increased contaminants	f	Unhealthier products due to more processing and contamination from manufacturing.	CM/CSF consumers	WS1_70
Reduced pathogens	f	Reduced risk of zoonotic diseases jumping to humans.	CM consumers	WS1_64
Reduced pathogens	f	Reduced risk of disease transmission through eating meat.	CM consumers	WS1_65
More nutritious meat	f	More balanced out diet.	CM consumers	WS1_67
Less nutritious meat	f	Less balanced out diet.	CM consumers	WS1_68
Less nutritious meat	f	Nutrient deficiencies.	CM consumers	WS1_69
Physical safety	h	With more natural living space, wild animals would increase, putting themselves in closer contact with industrial areas, cities, villages, some of which might be dangerous for humans, risking human safety and health.	Public citizens	WS1_71

Core Value: Food Security / Food Justice

Value quality	f/h	Description of effect	Stakeholder	ID
Availability	f	To support food emergency situations.	CM/CSF consumers	WS1_72
Availability	f	Increased food security.	CM/CSF consumers	WS1_73
Availability	h	Scale of production might have issues.	CM/CSF consumers	WS1_74

Availability	h	Scarcity of finite raw materials leads to competition for resources (e.g. renewable energy sources, water for urban and residential use), endangering food security for all.	CM/CSF consumers	WS1_76
Availability	f	Broadening the option for food sources.	CM/CSF consumers	WS1_82
Availability	f	Vegan versions of traditional foods, more inclusive and still traditional food.	Vegans	WS1_85
Availability	h	Reduced product range: The availability of certain delicacies could be reduced (especially for non-muscle tissues, e.g. feet, liver, heart, tail,...).	CM/CSF consumers	WS1_95
Accessibility	f	Easier access to healthier products improves global health and social wellness.	CM/CSF consumers	WS1_66
Accessibility	h	Centralisation makes food less accessible.	CM/CSF consumers	WS1_75
Social inequality	f	May cause problems in developing countries, since people have to rely on meat from international companies rather than from local farms.	Developing nations	WS1_94

Core Value: Economic Security

Value quality	f/h	Description of effect	Stakeholder	ID
Income insecurity	f	Economic impact destabilises traditional farming.	Farmers	WS1_79

Core Value: Social Cohesion

Value quality	f/h	Description of effect	Stakeholder	ID
Social tensions	f	Gap, social division, between who can afford it and who cannot (if CM costs more).	CM consumers	WS1_78
Social tensions	h	CM/CSF could break up the divide between veg. vs. non-veg. food habits currently co-existing in many countries. Which are sometimes in conflict with each other.	CM/CSF consumers	WS1_88
Social tensions	f	Senior citizens would be more resistant to include CM/CSF in their diets.	Public citizens (seniors)	WS1_98
Regional identity	f	Local production fosters local food culture.	(Local) Communities	WS1_81
Regional identity	h	Food standardisation and loss of local specialties, loss of identity.	(Local) Communities	WS1_92
Regional identity	h	Food production only done by industries leads to lost connections with local meat and seafood. Further losing connection to places related with food.	(Local) Communities	WS1_93
Cultural heritage	f	To use novel food ingredients to re-create traditional cuisine, and do novel cuisine inspired on previous food culture.	CM/CSF consumers	WS1_84
Cultural heritage	f	Ability to keep eating traditional foods that might have less ecological pressure, antibiotics, and potentially more nutritional benefits.	CM/CSF consumers	WS1_87
Cultural heritage	h	Extinction of certain cultural heritage.	Communities	WS1_90
Cultural heritage	h	Loss of culinary tradition.	Communities	WS1_91

Cultural heritage	h	Failing specific flavours as conventional ingredients are not available.	CM/CSF consumers	WS1_97
Freedom of choice	f	More space to grow other 'interesting' diverse crops.	Vegans	WS1_80
Freedom of choice	f	New products could lead to new ways of eating and sharing food.	CM/CSF consumers	WS1_86
Freedom of choice	h	Certain consumer groups will be more rejective of CM/CSF.	CM/CSF consumers	WS1_89

Core Value: Trust

Value quality	f/h	Description of effect	Stakeholder	ID
Loss of control	f	Less power to the farmers and more power to the industry, which has implications for land management and the environment.	Farmers and nature	WS1_60

Core Value: Integrity

Value quality	f/h	Description of effect	Stakeholder	ID
Cognitive dissonance	f	Results in an 'artificial food culture'.	CM/CSF consumers	WS1_96
Non-violent society	f	Consumers, for the first time, have the ability to choose meat free from animal suffering.	Humans and animals	WS1_17

Annex 2 – Workshop 2

Figure 14: Participants at workshop 2 filling out value tables (all persons agreed for publishing the photo)

Feedback quotes from participants (the persons agreed that their name is mentioned)

Tanja Sinozic-Martinez, Expert in technology impact assessment:

'Attending innovethic's workshop on ethical innovation was invaluable to me! Lukas' skilful combination of ethics with the highly complex innovation of [CM] was both impressive and incredibly helpful for my own work in the field of value-based engineering. Thanks to him and his team, I was able to quickly contribute my most important points to the discussion and follow the many clever comments from the participants with ease and full of energy. Lukas has an extraordinary talent for constructively and confidently guiding the dialogue between participants – a skill that

is especially crucial when emotions run high on controversial topics. And when don't they! Thank you, Lukas!'

Stefan Hupe, innovation expert:

'The innovethic workshop on CM/CSF was an exceptionally enriching experience for me. Using a value-based approach, the workshop developed well-founded criteria for the ethical assessment of these products. I was particularly impressed by how innovethic brought together a diverse group of experts through its extensive network. The moderation was purposeful, clear and at the same time open to different perspectives – this way, valuable insights could be gained. A thoroughly inspiring format for anyone who wants to look at complex future issues from different angles.'

Christian Busse, CM and Ethics expert:

'I had the pleasure of attending a CM/CSF ethics workshop. The content and topics were presented in a tangible and pragmatic way. I was able to understand a lot in a short time and channel it into practical thought processes.'

Value table from Workshop 2

We summarise the dynamics between positive core values and positive/negative value qualities as follows:

- f: Fostering positive value quality in a system constitutes a positive value
- h: Harming a positive value quality in a system constitutes a negative value
- f: Fostering a negative value quality in a system constitutes a negative value
- h: Harming (or prohibiting) a negative value quality in a system constitutes a positive value

Core Value: Animal Welfare

Value quality	f/h	Description of effect	Stakeholder	ID
Reduced stress and pain	f	Less slaughter, less pain for animals, under the condition that the cell-giver animals are being stressed, utilised as least as possible.	Farm animals	U3.4

Reduced stress and pain	f	Reduced number of the affected individuals.	Farm animals	U4.1
Reduced stress and pain	f	No animal production / still meat.	Farm animals	U5.2
Reduced stress and pain	f	If less animals are farmed, [then] the number of animal suffering is reduced, also more space available for animals.	Farm animals	U10.1
Reduced stress and pain	f	Fewer animals get slaughtered and live longer.	Farm animals	U11.2
Reduced stress and pain	f	To live in a way that causes as little suffering as possible (animals, exploitation of other countries, slaughterhouse employees, feeding etc., own health if meat consumption is too high).	Animals	D2.3
Reduced stress and pain	f	To cause as little animal suffering as possible. → Replace conventional meat with [CM] if meat consumption cannot be given up	Farm animals	D2.4
Reduced stress and pain	f	Reducing the suffering & pain of the animals (donor animals).	Cell-donor animals	D3.2
Reduced stress and pain	f	Maximum avoidance of suffering.	Animals	D4.2
Reduced stress and pain	f	You should not do to others what you would not want done to yourself. Especially if they would suffer or wish to suffer.	Animals	D8.2
Reduced stress and pain	f	Reverence for life. You shall not kill, not even an animal.	Animals	D10.1
Reduced harsh conditions	f	Lower dependency on animal agriculture.	Farm animals	U2.3

Reduced harsh conditions	f	Possibility of lower livestock density, provided that economically sensible production is maintained.	Agriculture	U9.2
Respect for animals	h	Many animals whose welfare is now being taken care of will not exist at all, less happily animals.	Farm animals (already with species-appropriate farming)	U8.5
Respect for animals	f	No rationalisation of one's own animal consumption anymore.	Farm animals	V3.1
Respect for animals	f	New human-meat relationship because traditional meat no longer 'real' animal meat.	Humans and animals	V4.1
Respect for animals	f	Increased awareness of the 'origin' of food → animal as a living being.	Animals	V5.1
Respect for animals	f	Engaging more deeply with animal husbandry → empathy.	Humans	V6.2
Respect for animals	f	A more relaxed attitude toward farm animals, as they could be treated better.	Animals	V7.2
Respect for animals	f	I let animals live and grant them freedom (reintroduction into wilderness).	Animals	V10.4
Respect for animals	f	Every animal can live for the sake of living and no longer serves a 'purpose'.	Animals	V11.3
Respect for animals	f	All people respect the lives of other living beings and try to make them as pleasant as possible.	Humans	D1.4
Respect for animals	f	Minimisation/avoidance of the use of animals in the production process.	CM/CSF producers	D4.4
Respect for animals	f	Animals have fundamental rights to life, freedom, and physical integrity.	Animals	D8.1
Respect for animals	f	You shall not interfere with an animal's freedom.	Animals	D10.4

Core Value: Ecological Sustainability

Value quality	f/h	Description of effect	Stakeholder	ID
Protection / regeneration of biodiversity	f	Re-naturalisation potential for large areas.	Nature	U4.9
Protection / regeneration of biodiversity	f	Way more wilderness possible.	Wildlife (land and sea)	U5.3
Protection / regeneration of biodiversity	f	Reduced pressure onto forest areas.	Wildlife (land)	U6.1
Protection / regeneration of biodiversity	f	Reduced germs and diseases in the seas, easing species extinction.	Aquaculture	U6.5
Protection / regeneration of biodiversity	f	More natural space, because pastureland could get re-natured → better environment and health.	Society	U7.2
Protection / regeneration of biodiversity	f	Rededication or re-naturalisation of agricultural land, more land for plant-based production.	Nature	U9.7
Protection / regeneration of biodiversity	f	Concentration of animal husbandry on areas which have no other utility.	Nature	U9.9
Protection / regeneration of biodiversity	f	More open spaces that are not cultivated for livestock or with livestock.	Wildlife (land)	U12.9
Protection / regeneration of biodiversity	f	Land becomes used more for recreation area instead of working area.	Nature	V4.3
Loss of biodiversity	f	Loss of biodiversity through the loss of pastures.	Nature	U1.5

Loss of biodiversity	h	Less exploitation of natural resources / biodiversity.	Nature	U2.5
Reduced pollution	f	Lower emissions from livestock farming.	Nature	U1.7
Reduced pollution	f	Lower emissions, soil pollution, water pollution etc. compared to conventional livestock farming.	Nature	U10.5
Less waste of resources	f	Less waste of resources with meat production maintains resources for coming generations.	Future generations	U8.7
Less waste of resources	f	Reflected use of limited resources.	Nature	V8.2
Less waste of resources	f	Maximum efficiency in the use of natural resources.	CM/CSF producers	D4.1
Less waste of resources	f	Should be producible in a resource-efficient way (energy, water, etc.).	Nature	D5.4
Climate balance	h	Large-technologically produced leads to sustainable potentials being questionable [sustainability with massive involvement of technology is questionable].	Nature	U2.9
Climate balance	f	Less greenhouse gases, more resource conservation.	Nature	U5.4
Climate balance	f	To live as sustainably as possible. → [CM] better balance for the climate.	CM consumer	D2.1
Respect for nature	f	Technology should help humans become eco-centric again.	Humans	D9.3
Moderation	h	No longer paying attention to the amount of meat consumed, since [CM] is cheaply available – even though plant-based remains the healthiest and most sustainable option.	CM consumers	V6.4

Moderation	f	You shall practice moderation and give nature its space (→ humans in a reserve).	Nature	D10.3
Soil health	h	Origin of fertiliser for farm animals gets lost, leading to more use of artificial fertilisers.	Nature	U1.6
Soil health	h	Higher usage of synthetic fertilisers with a lack of animals.	Nature	U6.3

Core Value: Human Health

Value quality	f/h	Description of effect	Stakeholder	ID
Reduced contaminants	f	Reduced burden upon the immune system through targeted omitting of prooxidants (ingredients of medication).	CM/CSF consumers	U6.2
Reduced contaminants	f	Food must continue to be safe for human consumption.	Humans	D1.6
Reduced pathogens	f	Antibiotics in livestock farming are no longer needed, leading to lower resistance.	CM/CSF consumers	U1.8
Reduced pathogens	f	Reduced danger of zoonoses and antibiotics resistance.	Society	U4.2
Reduced pathogens	f	Lower risk of zoonosis through less intensive animal husbandry.	CM/CSF consumers	U10.4
Reduced pathogens	f	Should not lead to the emergence and spread of (new) diseases and epidemics.	Humans	D5.5
More nutritional meat	f	Humans clearly eat too much meat which harms health, environment, animals. Nutritional profile and CM can be adjusted (e.g. Cholesterol).	CM consumers	U10.3

More nutritional meat	f	Should serve the well-being of people and be affordable for them (e.g., nutritional value, safety).	Humans	D5.1
More nutritional meat	f	You shall ensure that you and others stay healthy through sufficient and appropriate food.	Humans	D10.5
Less nutritional meat / seafood	f	One-sided diet.	CM/CSF consumers	U12.1
Healthier meat	f	Engaging with one's diet (meat consumption), with regard to health.	Humans	V6.1
Unhealthier meat / seafood	f	Could be unhealthy.	CM/CSF consumers	U1.2

Core Value: Food Security / Food Justice

Value quality	f/h	Description of effect	Stakeholder	ID
Availability	f	Positive effects for progress in the area cell-bio as well as in overlapping areas with other technologies.	CM/CSF researchers	U4.5
Availability	f	Nutrients of animal products available.	Vegans	U5.1
Availability	f	Long-term food security at a more favourable price. → fight hunger → justice / poverty.	CM/CSF consumers	U7.3
Availability	f	Mostly do without meat for animal welfare reasons, not for reasons of flavour, would offer an alternative to conventional meat.	Vegetarians / Vegans	U10.6
Availability	f	Together, we ensure sufficient food for everyone on the planet.	Humans	V10.5
Availability	f	It should promote food and nutritional security.	Society	D6.5

Availability	f	You shall prepare for difficult times (food reserves, e.g. reduction of arable land due to environmental disasters or wars, disruption of supply chains).	Humans	D10.6
Accessibility	h	Further isolation of rural areas because technology is still only located in urban centres.	Rural communities	U9.8
Accessibility	f	The humans that could not eat meat / seafood due to food intolerance, can do so now.	Humans (with allergies)	U11.4
Accessibility	f	individuals finally have the feeling that they have products of equal value without regard for farm form.	Humans	V2.4
Accessibility	f	It should be accessible to the general population, regardless of social status or geographic conditions.	Society	D6.6
Accessibility	f	Others should have the same access as I do.	Society	D9.2
Affordability	h	At the end of the day, who can afford CM and profit from it? Low-income earners, if they can afford it, tend to buy meat that is not pro-animal welfare (cheaper). Can these [persons] make use of this [CM] alternative at all?	Poor humans	U3.1
Affordability	f	Cheap, high-efficient sources for protein.	CM/CSF consumers	U6.4
Affordability	f	If CM/CSF are cheaper than meat and seafood, then poor nations can consume more nutritious food easier.	CM/CSF consumers (in poor countries)	U11.1
Affordability	h	Expansion of market power through monopolisation.	Society	U12.3
Affordability	h	Dependence on a small number of suppliers, making it possible to blackmail the population with regard to supply.	Democracy (Public citizens)	U12.7

Social inequality	f	CM/CSF becomes cheap in such a way that the majority who consume it are poor people, and they bear the dangers of its consumption alone.	Society	U11.8
Social inequality	f	'Real' meat becomes expensive so that only rich people can consume it.	Poor humans	U11.9
Social inequality	h	It could lead to fairer conditions regarding global nutrition (animal farming exploits other countries).	Rich humans	V6.5
Social inequality	h	Creating a sense of belonging for all sections of the population -> food justice.	Society	D3.3
Social inequality	h	Use of [CM] for the benefit of all, avoidance of monopolisation.	Society	D4.6
Social inequality	h	You should reflect on your own survival and enable others to survive too (through food).	Society	D10.2
Dependence on technology	f	Greater dependence, as society becomes even more important for obtaining food.	CM/CSF consumers	V10.2

Core Value: Economic Security

Value quality	f/h	Description of effect	Stakeholder	ID
Income security	f	Foster local economic sites / shaping a more resilient supply-chain.	Communities	U4.6
Income security	f	There should be transition support for agriculture towards plant-based production.	Agriculture	D7.3
Income insecurity	f	Value creation shifts from agriculture to industry.	Farmers	U1.3
Income insecurity	f	Farmers die out through less demand for meat.	Farmers	U1.4

Income insecurity	f	Work-positions are cancelled, or work-fields are changed.	Farmers	U4.3
Income insecurity	f	Displacement of work-positions and business purposes.	Agriculture	U4.8
Income insecurity	f	Substitution of animal husbandry with synthetic meat leads to economic loss and poverty.	Breeders / Farmers / Slaughterers	U7.1
Income insecurity	f	Less exports leads to trade deficit and poverty.	Society (politics)	U7.6
Income insecurity	f	Lose a large part of their sales market.	Farmers	U8.4
Income insecurity	f	Necessary re-orientation for some businesses; no 'simple going on as usual'.	Agriculture	U9.3
Income insecurity	f	Reduction of agricultural subsidies, possibly redistribution or higher expenditure/more budget for R&D.	Farmers	U9.5
Income insecurity	f	Feel left-out, their existence endangered / [should have] more pleasant time at profession, (they are often) not satisfied (with their own husbandry), but due to economic reasons often not possible otherwise.	Farmers	U10.2
Income insecurity	f	Farmers selling meat / seafood must take into account that they could lose their business.	Farmers	U11.5
Income insecurity	f	The farmer loses self-esteem because he becomes unemployed.	Farmers	V1.7
Job attractiveness	f	Growing market which attracts creative work personal.	CM/CSF producers	U8.2
Product availability	h	Animal production not only produces meat, but also other biogenic substances that are needed in other areas of the economy. → scarcity → high prices → economic crisis.	Consumers of secondary livestock products	U7.7

Income generation	f	Profits dramatically from low-vice alternatives in animal cell culture.	Pharmaceutical industry	U2.2
Income generation	f	Expanded business field.	Agriculture	U2.4
Income generation	f	Profit from cheaper drugs (e.g. antibodies) for medical improvement.	Society	U12.5

Core Value: Social Cohesion

Value quality	f/h	Description of effect	Stakeholder	ID
Social tensions	f	The acceptance of [CM] could fall short within the sceptical part of the population, due to the anxiety of gene manipulation or negative health effects or anxiety before something new.	CM consumers	U3.5
Social tensions	f	Loss of power leads to anxieties [and potential further opposition by them].	Farmer-guilds	U7.9
Social tensions	f	Arrogance over those who want to eat natural diets.	Naturalists	V2.2
Social tensions	f	Judging others who eat conventional meat, based on the belief that [CM] solve all problems.	Society	V6.3
Social tensions	f	It could further contribute to a division between 'good' and 'bad' meat — consumption might be seen as a mark of virtue.	Society	V7.1
Social tensions	f	Divergence of groups who still eat conventional meat and those who stop doing so.	Society	V8.6
Social tensions	h	Potential for less polarising groups of people; less dispute over principles & therefore more togetherness.	Society	V9.4

Regional identity	h	Regional traditions, possibilities for tourism gets lost.	Rural communities	U8.6
Regional identity	h	Reduction in livestock grazing, thereby radical change of cultural landscape and ecological systems.	Farmers	U12.6
Cultural heritage	h	Concerns over the 'devaluation' of conventionally manufactured animal products.	Agriculture	U9.4
Inclusion	f	New evaluation of cultural aspects (Halal yes/no?; is this vegan yes/no? etc.).	Society	U2.10
Inclusion	h	Feels impaired in the principle of belief that humans intervene in creation → unrest, social rejection.	Religions	U7.8
Inclusion	h	A social divide between those who can afford meat and those who cannot.	Society	V11.1
Inclusion	f	All people, regardless of their socio-demographic status, have the opportunity to eat a balanced diet (according to Austrian nutritional recommendations).	Humans	D1.2
Freedom of choice	f	More options / freedom.	CM/CSF consumers	U2.1
Freedom of choice	f	On the other side, many humans could 'hop on the train' (e.g. trends) due to the novelty and their curiosity.	CM/CSF consumers	U3.6
Freedom of choice	f	New diet patterns; new wishes.	CM/CSF consumers	U4.4
Freedom of choice	f	Larger choice of products on supermarket shelves.	CM/CSF consumers	U9.1
Freedom of choice	f	Vegetarians who are more open to CM/CSF could have more diverse nutrition in-take.	Vegetarians	U11.3

Freedom of choice	f	Broad field for invention of individual characteristics.	CM/CSF researchers	U12.2
Resilient society	h	Capability for subsistence gets lost.	Society	U5.6
Resilient society	f	Less dependence on 'evil' foreign countries → Self-sufficiency.	Society (politics)	U7.4
Resilient society	h	Less dependence on 'evil' foreign countries → Self-sufficiency. → Lower threshold to wage a war.	Society (politics)	U7.5
Resilient society	f	Humans finally have the feeling that they are contributing effectively, e.g. sustainability.	Public citizens	V2.3

Core Value: Trust

Value quality	f/h	Description of effect	Stakeholder	ID
Transparent communication	f	Could answer many questions within accompanying research to the emerging economic sector.	CM/CSF researchers	U8.3
Transparent communication	h	Consumers of CM/CSF could develop food intolerance which would be hard to trace back to. CM/CSF production is a 'black box'.	CM/CSF consumers	U11.6
Transparent communication	h	CM/CSF becomes widely distributed so that one cannot comprehend in which products it is contained.	CM/CSF consumers (opponents of CM/CSF)	U11.7
Transparent communication	f	Everyone has the opportunity to find out how the meat on their plate was created and how to eat a balanced diet.	Humans	D1.3
Transparent communication	f	Society must be educated about the consequences, possibilities, advantages, and disadvantages.	Society	D9.1

Truthfulness	f	Decisions are to be made based on proven facts.	Society	D1.5
Truthfulness	f	Consideration of scientific facts.	Society	D4.5
Accessibility of technology	h	Market could get dominated and misused by large corporations.	Society	U1.1
Accessibility to technology	h	Dependency upon a few large corporations → High capital expenditure technology.	Society	U2.6
Accessibility to technology	h	Big upheavals can require large amounts of resources (among other things, of financial nature). Here stands the danger of small businesses getting squeezed out by larger ones.	Agriculture	U3.2
Accessibility to technology	f	A farmer used to breed animals learns how to manufacture artificial meat.	Farmers	V1.6
Accessibility to technology	h	Dependency upon large corporations.	Society	V4.2
Accessibility to technology	h	Feeling of dependence on large corporations.	Society	V5.4
Accessibility to technology	f	Knowledge about production methods should be accessible to all people. → Market and technological possibilities must not be abused.	Humans	D10.7
Loss of control	f	Loss of control due to technologically produced food / sense of uncertainty.	CM/CSF consumers	V5.6
Uncertainty	f	Anxiety / concerns over one's diet being 'healthier/unhealthier' due to one's eating of 'better' or 'worse' meat.	CM/CSF consumers	U9.6

Uncertainty	f	Due to the yet unknown health consequences of CM consumption, consumers become uncertain.	CM consumers	V1.4
Uncertainty	f	The fear of uncertainty may be intensified by the resulting 'overabundance' and by a lack of knowledge about the technical means and processes.	CM/CSF consumers	V9.5

Core Value: Integrity

Value quality	f/h	Description of effect	Stakeholder	ID
Cognitive consonance	f	Added value for all those who enjoy eating meat but want to pay more attention to animal welfare → would be a softer entry without big renunciation.	CM consumers	U3.3
Cognitive consonance	f	Eating meat without animal suffering.	CM consumers	U5.5
Cognitive consonance	f	Animal welfare activists would be empowered in their justice through CM becoming mainstream.	Animal welfare activists	V1.3
Cognitive consonance	f	The consumer of CM becomes more self-confident because no animals have to die directly for his meal.	CM consumers	V1.5
Cognitive consonance	f	The animal as a living being moves back into focus; one no longer has to shut oneself off from this to avoid confronting the aspect of violence.	Animals	V5.7
Cognitive consonance	f	More conscious reflection: when is it truly important for me to eat conventional meat, and when is [CM] 'enough'?	CM consumers	V7.3
Cognitive consonance	f	Bringing one's personal claim of avoiding harm into alignment with one's actions.	CM/CSF consumers	V8.4

Cognitive consonance	f	It could have a positive impact on the sense of self-efficacy by giving the individual facilitating opportunities to act in the name of animal welfare.	CM/CSF consumers	V9.2
Cognitive consonance	f	Consistency of social values/morals and modes of action.	Society	D4.3
Cognitive dissonance	h	Resolution of one's own cognitive dissonance between self-image and the violence exercised (toward animals, slaughterhouse workers).	CM/CSF consumers	V8.1
Cognitive dissonance	f	I take less responsibility for a conscious, self-determined diet.	CM/CSF consumers	V10.3
Reflection	h	Replacement product; production reduces the needed engagement with one's nutrition.	Society	U2.8
Reflection	f	Conventional agriculture could increasingly be questioned critically.	Meat industry (individual)	V2.1
Reflection	f	Enables a life according to one's own morality (not using animals).	CM/CSF consumers	V3.2
Reflection	f	All people are aware of the side effects of their decisions.	Humans	D1.1
Respect for life	f	The consumer of CM/CSF acts justly / feels his sense of justice empowered because he protects animal lives through the consumption [of CM/CSF].	CM/CSF consumers	V1.1
Respect for life	f	It could positively impact one's feeling of acting justly by minimising animal suffering.	CM/CSF consumers	V9.1
Respect for life	f	Should contribute to 'killing' being viewed critically.	Humans	D5.3
Alienation	f	Low connection to manufacturing method (complexity).	Society	U2.7
Alienation	f	Traditional understanding of the environment and relationship	Public citizens	U12.8

		systems would be replaced by technocracy.		
Alienation	f	'Technical nutrition' – loss of connection (to food and its origin).	Society	V5.2
Alienation	f	Greater distance from the animal reduces its 'value' and causes it to fade from awareness (similar to 'electricity comes from the socket') – alienation.	Humans and animals	V10.1
Alienation	f	Dealing with 'death' becomes (even) more unnatural.	CM/CSF consumers	V11.2
Non-violent society	f	A stop to the normalisation of cruelties against animals.	Society	U4.7
Non-violent society	f	Meat could be consumed without concerns over not species-appropriate husbandry or the killing of animals.	CM consumers	U8.1
Non-violent society	f	Transformation toward a less violent society.	Society	V8.3
Non-violent society	f	Fulfilment of the striving for the avoidance of suffering, freedom from negative experiences.	Humans and animals	V8.5
Mindfulness	f	Living in a resource- and climate-friendly way.	Society	V3.3
Mindfulness	h	Loss of the feeling of what had to be 'sacrificed' to produce something → 'everything can be produced anyway'.	CM/CSF consumers	V9.3
Mindfulness	f	I have more time/resources as I need to worry less about obtaining food, which I can use for personal growth.	CM/CSF consumers	V10.6

Annex 3 – Literature review

Value table from Literature

We summarise the dynamics between positive core values and positive/negative value qualities as follows:

- f: Fostering positive value quality in a system constitutes a positive value
- h: Harming a positive value quality in a system constitutes a negative value
- f: Fostering a negative value quality in a system constitutes a negative value
- h: Harming (or prohibiting) a negative value quality in a system constitutes a positive value

Core Value: Animal Welfare

Value quality	f/h	Description of effect	Stakeholder	ID
Reduced diseases	f	Reduced risk of infectious diseases among farm animals themselves[103].	Farm animals	L32
Reduced diseases	f	CSF would reduce the risk of wild fishes being infected by diseases carried by domestic fishes[104].	Wildlife (aquatic; fish)	L36
Reduced stress and pain	f	Reduced stress and pain by reducing transport to slaughterhouses[105].	Farm animals	L37
Reduced stress and pain	f	The necessity of slaughter for meat production falls away[106].	Farm animals	L38
Reduced stress and pain	f	Reduced stress and pain by reducing factory farming[107].	Farm animals (mature)	L39

[103] Treich, 'Cultured Meat', 34.
[104] Chandimali et al., 'Not Seafood but Seafood', 4.
[105] Treich, 'Cultured Meat', 51–52.
[106] Treich, 33.
[107] See: Sghaier Chriki and Jean-François Hocquette, 'The Myth of Cultured Meat: A Review', Frontiers in Nutrition 7 (February 2020): 6, https://doi.org/10.3389/fnut.2020.00007. As well as: Rasmussen et al., 'Critical Review of Cultivated Meat from a Nordic Perspective', 8.

Increased stress and pain	f	The best medium to grow CM contains foetal bovine serum (FBS) made from dead calves, which is contradictory for that CM aims to be slaughter-free[108].	Farm calves	L41

Core Value: Ecological Sustainability

Value quality	f/h	Description of effect	Stakeholder	ID
Protection / regeneration of biodiversity	f	CSF would reduce the need for extensive fishing, thereby aid the preservation of endangered aquatic species[109].	Wildlife (aquatic)	L40
Protection / regeneration of biodiversity	f	CSF could reduce ghost fishing and the subsequent harm for various aquatic species caused by this practice[110].	Wildlife (aquatic)	L42
Protection / regeneration of biodiversity	f	Pastureland could become biodiversity-promoting areas[111].	Wildlife (land)	L43
Protection / regeneration of biodiversity	f	Restore the ocean biodiversity lost due to overfishing[112].	Wildlife (aquatic)	L44
Protection / regeneration of biodiversity	f	With fewer farm animals, fewer resources will also be needed to feed farm animals[113].	Nature	L90

[108] The authors state that replacement to FBS has already been found (2020). See: Chriki and Hocquette, 2.
[109] Chandimali et al., 'Not Seafood but Seafood', 4.
[110] Chandimali et al., 4.
[111] Bacchini and Bossini, 'The Ethics of Imitation in Meat Alternatives', 10.
[112] Chandimali et al., 'Not Seafood but Seafood', 4.
[113] Rasmussen et al., 'Critical Review of Cultivated Meat from a Nordic Perspective', 9.

Protection / regeneration of biodiversity	f	CSF would reduce the amount of undesired captures or leftover parts of fishes being thrown back into the ocean[114].	Wildlife (aquatic)	L91
Protection / regeneration of biodiversity	f	CM could foster the revival of currently marginal breeds[115].	Farm animals	L121
Loss of biodiversity	f	It is still unclear whether CM would reduce or increase greenhouse gases (GHG)[116].	Nature	L80
Loss of biodiversity	f	Certain forms of farming practices (e.g. low-productivity meadows) are good for species biodiversity (e.g. farmland birds), with a complete take-over of CM, this will be lost[117].	Wildlife (land; birds)	L119
Loss of biodiversity	f	CM could continue and exacerbate the ongoing extinction of agricultural breeds[118].	Farm animals	L120
Loss of biodiversity	f	CSF could lessen the control measures of invasive species, such as for the Arctic red king crab (Paralithodes camtschaticus) in Nordic countries[119].	Nature	L122
Reduced pollution	f	Reduced air pollution[120].	Nature	L83
Reduced pollution	f	Reduced usage of toxic chemicals[121].	Nature	L84

[114] Chandimali et al., 4–5.
[115] Helliwell and Burton, 'The Promised Land?', 187.
[116] Chriki and Hocquette, 'The Myth of Cultured Meat', 3.
[117] Helliwell and Burton, 'The Promised Land?', 186.
[118] Helliwell and Burton, 187.
[119] Helliwell and Burton, 187.
[120] The comparison is with conventional beef, see: Lo Sapio, 'The Ethics of Cultivated Meat', 28–29.
[121] The comparison is with conventional beef: Lo Sapio, 28–29.

Less waste of resources	f	Reduced water usage[122].	Nature	L81
Less waste of resources	f	Reduced land usage[123].	Nature	L82
More waste of resources	f	CM could have the effect that many consumers do not change to a vegetarian / vegan lifestyle, although plant-based alternative food products are more environmental-friendly[124].	Nature	L20
More waste of resources	f	Stimulating resource efficiency by CM could lead to greater consumption, thereby cancelling out environmental savings (Jevon's paradox)[125].	Nature	L78
More waste of resources	f	CM overshadows other potential solutions for climate change, such as the reduction of meat consumption with plant-based alternatives[126].	Nature	L89

Core Value: Human Health

Value quality	f/h	Description of effect	Stakeholder	ID
Reduced contaminants	f	Reduced faecal contamination within slaughterhouses[127].	CM consumers	L35

[122] The comparison is with con. beef: Lo Sapio, 28–29. For a discussion of an initial life-cycle analysis (LCA) comparing CM with con. European meat, see: Treich, 47.
[123] The comparison is with con. beef: Lo Sapio, 28–29. For a discussion of an initial life-cycle analysis (LCA) comparing CM with con. European meat, see: Treich, 47.
[124] Lee, 'Meat-Ing Demand', 26–27.
[125] Moyano-Fernández, 'The Moral Pitfalls of Cultivated Meat', 5–6.
[126] Lee, 26–27.
[127] Treich, 'Cultured Meat', 50.

Reduced contaminants	f	Reduced risk of eating micro plastics and heavy metals[128].	CSF consumers	L71
Reduced contaminants	f	Virtually eliminating the possibility of eating seafood contaminated by nuclear power[129].	CSF consumers	L72
Increased contaminants	f	Within the European Union, hormone growth promoters are prohibited in farming systems for conventional meat production, CM also uses these growth factors, which conflicts with EU law[130].	CM consumers	L9
Reduced pathogens	f	Condensed factory farming makes viral jumps among species easier, leading to the spread of viruses harmful to humans, would be lessened with CM[131].	CM consumers	L66
Reduced pathogens	f	CM could be healthier than conv. meat as the production is overall more controllable, sterile, hygienic[132].	CM consumers	L67
Reduced pathogens	f	Approximately no chances of pathogenic contamination with the harvesting of CM inside a laboratory[133].	CM consumers	L68
Reduced pathogens	f	If the production of CM does not involve antibiotics, then antibiotic resistance of a human body used to consume conventional meat could be eliminated by switching to CM[134].	CM consumers	L69

[128] Chandimali et al., 'Not Seafood but Seafood', 5.
[129] Chandimali et al., 5.
[130] Chriki and Hocquette, 'The Myth of Cultured Meat', 2.
[131] Food-borne pathogens include: Salmonella, Campylobacter and Escherichia coli. Treich, 'Cultured Meat', 35 and 50 respectively. See also: Chriki and Hocquette, 'The Myth of Cultured Meat', 3.
[132] Tomiyama et al., 'Bridging the Gap between the Science of Cultured Meat and Public Perceptions', 149.
[133] Such as influenza. See: Chriki and Hocquette, 'The Myth of Cultured Meat', 3.
[134] Chriki and Hocquette, 4.

Reduced pathogens	f	The need for antibiotics and fungicides in CM production is no longer necessary, leading to 'healthier' products for the consumers[135].	CM consumers	L100
Increased pathogens	f	The containment issue of pathogens within CM production could be higher than in the research labs (when scaled up industrially)[136].	CM consumers	L21
More nutritional meat	f	CM could be more nutritional as the composition of micronutrients can be designed (and are less determined by the source animal)[137].	CM consumers	L22
Less nutritional meat	f	CM could be less nutritional if the growth medium is less nutritious[138].	CM consumers	L106
Healthier meat	f	Reduced health risks typically associated with traditional red meat, such as cardiovascular disease, cancer, obesity[139].	CM consumers	L70
Unhealthier meat	f	CM could have negative side effects on consumers health (not yet known), such as effects on metabolism or muscle structures[140].	CM consumers	L101
Healthier seafood	f	CSF would aid in managing diabetes and obesity[141].	CSF consumers	L108

[135] Chriki and Hocquette, 2.
[136] Chriki and Hocquette, 4.
[137] E.g.: Omega-3 fatty acids and iron. Chriki and Hocquette, 3.
[138] The authors state that they 'cannot exclude a reduction in the health benefits of micronutrients due to the culture medium, depending on its composition.' Chriki and Hocquette, 3.
[139] Tomiyama et al., 'Bridging the Gap between the Science of Cultured Meat and Public Perceptions' , 149. And Salzani and Weisberg, '67. The Ethics and Politics of Cultured Meat', 430.
[140] Chriki and Hocquette, 3.
[141] Chandimali et al., 'Not Seafood but Seafood', 5.

Core Value: Food Security / Food Justice

Value quality	f/h	Description of effect	Stakeholder	ID
Availability	f	CM would be a solution for the growing global population and the increasing trend for animal-based diets[142].	Developing nations	L33
Availability	f	CM could be used to support outer space exploration and the settlement of other celestial bodies[143].	Space explores / settlers	L63
Availability	f	CM could increase food security as it is less dependent on instable weather conditions[144].	CM consumers	L98
Accessibility	h	CM raises the bar for food production, further making meat consumption more dependent on techniques and equipment[145].	CM consumers (who want to live without much technology)	L2
Accessibility	h	CM is a high-tech product and could exclude traditional actors in the food production chain[146].	Farmers	L64
Accessibility	h	Even without global monopoly, multinational companies could highjack and concentrate CM productions, making it unjust by setting high access bars[147].	CM producers (small-middle)	L110
Accessibility	h	The initial development of CM is being funded by billionaires and philanthropists, which is dangerous if not balanced out by state and/or diverse investor groups[148].	Public citizens	L111

[142] Chriki and Hocquette, 'The Myth of Cultured Meat', 1. See also: Pilařová et al., 'Exploring Ethical, Ecological, and Health Factors Influencing the Acceptance of Cultured Meat among Generation Y and Generation Z', 3.
[143] Lo Sapio, 'The Ethics of Cultivated Meat', 28.
[144] Treich, 'Cultured Meat', 45.
[145] Moyano-Fernández, 'The Moral Pitfalls of Cultivated Meat', 7.
[146] Moyano-Fernández, 7.
[147] Treich, 'Cultured Meat', 45.
[148] Treich, 46.

Affordability	h	High investment and productions costs are likely to hinder the use of CM in low-income regions[149].	CM consumers (in poor countries)	L59
Social inequality	f	CM could further entrench the unjust ideology underlying industrial economies and thereby exacerbating the hunger problem[150].	Developing nations	L60

Core Value: Economic Security

Value quality	f/h	Description of effect	Stakeholder	ID
Income security	f	CM could become an integrated part of local production processes, and by that securing further income[151].	Farmers	L96
Income insecurity	f	If CM is scaled up to industrial production levels, then livestock farmers will likely be one of the most negatively impacted stakeholder groups[152].	Farmers	L24
Income insecurity	f	CM would diminish the production of secondary livestock products, such as cosmetics, leather, pharmaceuticals and thus leading to job losses[153].	Producer of secondary livestock products	L53
Income insecurity	f	CM could lead to job losses for the workers providing tourist services such as transhumance[154].	Rural communities	L54

[149] Tuomisto, 'Vertical Farming and Cultured Meat', 277.
[150] Lee, 'Meat-Ing Demand', 18-19.
[151] Rasmussen et al., 'Critical Review of Cultivated Meat from a Nordic Perspective', 12.
[152] Rasmussen et al., 10. See as well: Pilařová et al., 'Exploring Ethical, Ecological, and Health Factors Influencing the Acceptance of Cultured Meat among Generation Y and Generation Z', 3. And: Lo Sapio, 'The Ethics of Cultivated Meat', 36. These authors all highlight the potential destabilisation for (industrial) farmers.
[153] Lee, 'Meat-Ing Demand', 15.
[154] Chriki and Hocquette, 'The Myth of Cultured Meat', 4.

Income insecurity	f	The conventional livestock system provides income for people living in rural areas, CM could diminish their income and marginalise them[155].	Rural communities	L97
Job attractiveness	f	Creation of new jobs and employment opportunities[156].	CM producers	L52
Job attractiveness	f	CM might counter the exploitative conditions of meat workers by making work less physically exhausting[157].	CM workers (slaughterhouse workers, scientists, bioreactor maintainers)	L113
Product availability	h	CM would diminish the production of secondary livestock products, such as cosmetics, leather, pharmaceuticals[158].	Consumers of secondary livestock products	L77

Core Value: Social Cohesion

Value quality	f/h	Description of effect	Stakeholder	ID
Social tensions	f	CM could result in similar adverse reactions of activists, as it were with the introduction of GMO[159].	CM consumers	L15
Social tensions	f	CM risks becoming a monopoly by one or few companies, potentially	Public citizens	L109

[155] Moyano-Fernández, 'The Moral Pitfalls of Cultivated Meat', 7.
[156] In most cases likely with higher skill-bar but also with higher payout. See: Tomiyama et al., 'Bridging the Gap between the Science of Cultured Meat and Public Perceptions', 149.
[157] The definition of worker exploitation matters here. Just because work becomes less physically exhausting and more psychologically demanding, does not necessarily mean that exploitation disappears. In his paper, Nicolas Treich does not define it either, simply highlighting that the conventional meat industry has a long history of exploiting meat workers (especially immigrants). See: Treich, 'Cultured Meat', 47.
[158] Lee, 'Meat-Ing Demand', 15.
[159] Rasmussen et al., 'Critical Review of Cultivated Meat from a Nordic Perspective', 10.

		generating social divisions within society[160].		
Regional identity	h	CM could lead to the loss of local cultural practices and traditions associated with eating meat[161].	Public citizens	L49
Regional identity	h	Land abandonment through less farms, deserted towns and infrastructure[162].	Rural communities	L62
Regional identity	h	Many cultural landscapes important to regional identities and heritage are upheld through livestock farming, these might be lost due to CM[163].	Rural communities	L102
Cultural heritage	h	Traditional farming carries certain cultural heritage with it, which is valuable not only for farmers but for the public as large, this might be lost with transitioning to CM[164].	Public citizens	L50
Cultural heritage	h	CM could lead to lesser tourist attractions such as transhumance[165].	Public citizens	L51
Cultural heritage	h	Traditional knowledge about farmland might be lost, losing e.g. the ability to how to grow food while keeping the soil healthy[166].	Farmers	L107
Cultural heritage	h	CM could diminish recreational services in rural communities (other than transhumance; leisure activities in rural places)[167].	Rural communities	L117

[160] Treich, 'Cultured Meat', 44–45.
[161] Bacchini and Bossini, 'The Ethics of Imitation in Meat Alternatives', 8–9.
[162] Helliwell and Burton, 'The Promised Land?', 186.
[163] Helliwell and Burton, 186.
[164] Bacchini and Bossini, 8.
[165] Chriki and Hocquette, 'The Myth of Cultured Meat', 4.
[166] Moyano-Fernández, 'The Moral Pitfalls of Cultivated Meat', 7.
[167] Helliwell and Burton, 'The Promised Land?', 186.

Core Value: Trust

Value quality	f/h	Description of effect	Stakeholder	ID
Transparent communication	h	Symbolic identification of CM is still an issue for consumer acceptance because the naming affects the perception of it[168].	CM consumers	L16
Transparent communication	h	CM risks falling under an 'ethical washing', leading to contradictions and confusions for consumers and the general public[169].	Public citizens	L17
Transparent communication	h	Branding CM as 'natural' risks losing the integrity of CM producers and trust to consumers[170].	CM producers	L18

Core Value: Integrity

Value quality	f/h	Description of effect	Stakeholder	ID
Cognitive consonance	f	CM could alleviate personal guilt of participating within the mass meat industry[171].	CM consumers	L93
Cognitive dissonance	f	The commodification of animals into food can cause cognitive dissonance for the consuming subject. That is, internal contradictions between animals qua animals and animals qua food, treating both as unrelated. This problematic separation is further intensified by CM and affects both animals and humans negatively[172].	CM consumers and farm animals	L19

[168] Chriki and Hocquette, 'The Myth of Cultured Meat', 5-6.
[169] Salzani and Weisberg, '67. The Ethics and Politics of Cultured Meat', 430-431.
[170] Rasmussen et al., 'Critical Review of Cultivated Meat from a Nordic Perspective', 9.
[171] Cor Van Der Weele and Clemens Driessen, 'Emerging Profiles for Cultured Meat; Ethics through and as Design', Animals 3, no. 3 (July 2013): 650, https://doi.org/10.3390/ani3030647.
[172] Lee, 'Meat-Ing Demand', 22–23.

Cognitive dissonance	f	The 'simulated' object of meat might not be fully separable from the original immoral aspects, primarily the killing of an animal[173].	CM consumers	L94
Alienation	f	Further alienation away from food sources and food systems through over-complication of food supply-chains[174].	CM consumers	L34

[173] Bacchini and Bossini, 'The Ethics of Imitation in Meat Alternatives', 15–16.

[174] Cor Van Der Weele, 'How to Save Cultured Meat from Ecomodernism? Selective Attention and the Art of Dealing with Ambivalence', in *Animals in Our Midst: The Challenges of Co-Existing with Animals in the Anthropocene*, ed. Bernice Bovenkerk and Jozef Keulartz, vol. 33, The International Library of Environmental, Agricultural and Food Ethics (Cham: Springer International Publishing, 2021), 553–554, https://doi.org/10.1007/978-3-030-63523-7_30.

Annex 4 – Interviews

Value table from Interviews

We summarise the dynamics between positive core values and positive/negative value qualities as follows:

- f: Fostering positive value quality in a system constitutes a positive value
- h: Harming a positive value quality in a system constitutes a negative value
- f: Fostering a negative value quality in a system constitutes a negative value
- h: Harming (or prohibiting) a negative value quality in a system constitutes a positive value

Core Value: Animal Welfare

Value quality	f/h	Description of effect	Stakeholder	ID
Reduced stress and pain	f	CM could be produced without animal-based sources, thereby diminishing animal suffering.	Farm animals	I1.6
Reduced stress and pain	f	If more efficient and affordable, CM would no longer harm farm animals.	Farm animals	I2.2
Increased stress and pain	f	CM could maintain the maximal extraction of young calves' blood - a form of animal exploitation.	Farm calves	I1.11
Increased stress and pain	f	If FBS is replaced by regular blood, this can still be harmful for farm animals.	Farm calves / cows	I2.1

Core Value: Ecological Sustainability

Value quality	f/h	Description of effect	Stakeholder	ID
Loss of biodiversity	f	CM could be produced without animal-based sources, thereby risking a monoculture of plants used for amino acid in CM production.	Wildlife (land; plants)	I1.5

Less waste of resources	f	The production of CM has the advantage of being able to recycle most of the medium used to grow meat, making the whole process less wasteful and more sustainable.	Nature	I1.15
Less waste of resources	f	Reduced land usage.	Nature	I2.6
Less waste of resources	f	Reduced water usage.	Nature	I2.7
More waste of resources	f	CM production would require more energy.	Nature	I3.4
Less waste	f	If more recycling efficient, CM would produce less waste.	Nature	I2.3

Core Value: Human Health

Value quality	f/h	Description of effect	Stakeholder	ID
Reduced contaminants	f	A CM reactor has the design option to have lower pathogenic risks, and lower (possibly zero) contamination rates by chemicals (dioxides) used in conventional agricultural farming practices and found concentrated in animals.	CM consumers	I1.9
Increased contaminants	f	Making cell-lines immortal entails the risk of sporadic and uncontrollable cell proliferation, i.e. cancer cells, their effects on health are not clear yet.	CM consumers	I1.7
Increased contaminants	f	Addictive ingredients being added by CM companies to generate more profit harms consumer's health.	CM consumers	I1.8
Increased contaminants	f	Unethical producers could add addictive substances into CM, making it addictive.	CM consumers	I2.10

Reduced pathogens	f	CM does not need antibiotics, lowering antibiotic resistance.	CM consumers	I1.13
More nutritional meat	f	Increased overall health benefits due to controllability of nutrition.	CM consumers	I2.8
Unhealthier meat	f	Due to the nature of capitalistic competition for maximising profits, producers are incentivised to cut costs, leaving out necessary steps for safety.	CM consumers	I2.9

Core Value: Food Security / Food Justice

Value quality	f/h	Description of effect	Stakeholder	ID
Availability	f	The prime need for CM comes from space missions, for it is highly implausible to farm animals in space.	Space explores / settlers	I2.5
Affordability	f	With more parts recycled, CM production could be more sustainable and therefore less costly for consumers overall.	CM consumers	I1.12
Affordability	h	A big risk is that the price of farm animals could go up (due to shortages thereof) with long term and mass availability of CM, harming con. meat consumers.	Meat consumers	I1.14

Core Value: Economic Security

Value quality	f/h	Description of effect	Stakeholder	ID
Income insecurity	f	CM could lead to job losses for the workers providing meat distribution services.	Meat distributors	I1.1

Income insecurity	f	CM could lead to job losses for the workers providing animal care services.	Breeders	I1.2
Income insecurity	f	CM could lead to job losses for the workers providing animal care services.	Farmers	I1.3
Income insecurity	f	CM could lead to job losses for the workers providing animal care services.	Feed manufacturers	I1.4
Income insecurity	f	Potential negative effects for agricultural workers, not simply only for farmers.	Butchers	I5.2
Income insecurity	f	CM could lead to job losses for the workers providing animal care services.	Veterinarians	I5.3
Income insecurity	f	Potential negative effects for tractor suppliers.	Producers of secondary livestock products	I5.4
Product availability	h	A big risk is that the price of farm animals could go up (due to shortages thereof) with long term and mass availability of CM, harming con. farmers with increased costs.	Farmers	I1.10

Core Value: Social Cohesion

Value quality	f/h	Description of effect	Stakeholder	ID
Social tension	f	CM carries the dystopian potential of becoming monopolised by a few big industry players and them unfairly disadvantaging competitors.	Public citizens	I2.11
Freedom of choice	f	Possible personalisation for one's diet due to controllability.	CM consumers	I2.4

Core Value: Trust

Value quality	f/h	Description of effect	Stakeholder	ID
Transparent communication	h	If the origin and composition of the product remain uncertain, so does its accountability, particularly, if ingredients or additives come from external sources.	CM consumers	I5.1

Literature

Bacchini, Fabio, and Elena Bossini. 'The Ethics of Imitation in Meat Alternatives'. *Food Ethics* 8, no. 2 (October 2023): 1-21. https://doi.org/10.1007/s41055-023-00134-6.

Baldus, Rolf D., ed. *Best Practices in Sustainable Hunting: A Guide to Best Practices from around the World*. CIC Technical Series Publication 1. Budakeszi: CIC [u.a.], 2008.

Browning, Heather, and Walter Veit. 'Is Humane Slaughter Possible?' *Animals* 10, no. 5 (5 May 2020):1-11. https://doi.org/10.3390/ani10050799.

Cambridge Dictionary Entry of 'Trust'. https://dictionary.cambridge.org/dictionary/english/trust.

Chandimali, Nisansala, Eun Hyun Park, Seon-Gyeong Bak, Yeong-Seon Won, Hyung-Jin Lim, and Seung-Jae Lee. 'Not Seafood but Seafood: A Review on Cell-Based Cultured Seafood in Lieu of Conventional Seafood'. *Food Control* 162 (August 2024): 1-8. https://doi.org/10.1016/j.foodcont.2024.110472.

Chriki, Sghaier, and Jean-François Hocquette. 'The Myth of Cultured Meat: A Review'. *Frontiers in Nutrition* 7 (7 February 2020): 1-9. https://doi.org/10.3389/fnut.2020.00007.

EU Commission. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. – A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system, COM/2020/381 final.

EU Commission. 'Food, Bioeconomy, Natural Resources, Agriculture and Environment', 17 April 2024, 170.

FAO. 'Rome Declaration on World Food Security'. Food and Agriculture Organisation (UNO), 17.11 1996. https://www.fao.org/4/w3613e/w3613e00.htm.

Fraser, A.F. 'Animal Welfare Practice: Primary Factors and Objectives'. *Applied Animal Behaviour Science* 22, no. 2 (1 February 1989): 159–76. https://doi.org/10.1016/0168-1591(89)90052-X.

Fraser, M.D., H.E. Vallin, and B.P. Roberts. 'Animal Board Invited Review: Grassland-Based Livestock Farming and Biodiversity'. *Animal* 16, no. 12 (1 December 2022): 1-12. https://doi.org/10.1016/j.animal.2022.100671.

Friedman, Batya, and David Hendry. *Value Sensitive Design: Shaping Technology with Moral Imagination*. Cambridge, Massachusetts: MIT Press, 2019.

Giuggioli, Germana, Alberto Olivastri, Luca Pennisi, Domenico Paludi, Adriana Ianieri, and Alberto Vergara. 'The Hygiene-Sanitary Control in the Wild Game Meats'. *Italian Journal of Food Safety* 6, no. 4 (26 February 2018): 222-224. https://doi.org/10.4081/ijfs.2017.6875.

González, Neus, Montse Marquès, Martí Nadal, and José L. Domingo. 'Meat Consumption: Which Are the Current Global Risks? A Review of Recent (2010–2020) Evidences'. *Food Research International* 137 (November 2020): 1-6. https://doi.org/10.1016/j.foodres.2020.109341.

Hartmann, Nicolai. *Ethics*. London: George Allen & Unwin, 1932.

Helliwell, Richard, Erik Bjørnerud, and Tonje Nerby. *Cultured Meat and Responsible Research When the Future Is an Illusion for Financial Speculation*. *93-98*. Brill, 2024. https://doi.org/10.1163/9789004715509_015.

Helliwell, Richard, and Rob J. F. Burton. 'The Promised Land? Exploring the Future Visions and Narrative Silences of Cellular Agriculture in News and Industry Media'. *Journal of Rural Studies* 84 (1 May 2021): 180–91. https://doi.org/10.1016/j.jrurstud.2021.04.002.

Hernandez, David. 'Ecological Sustainability: Definition and Importance Explained', 28 June 2024. https://www.lythouse.com/blog/what-is-ecological-sustainability.

Holmes, Dwayne, David Humbird, Jan Dutkiewicz, Yadira Tejeda-Saldana, Breanna Duffy, and Isha Datar. 'Cultured Meat Needs a Race to Mission Not a Race to Market'. *Nature Food* 3, no. 10 (October 2022): 785–87. https://doi.org/10.1038/s43016-022-00586-9.

IEEE, 'IEEE Standard Model Process for Addressing Ethical Concerns during System Design'. *IEEE Std 7000-2021* (15 September 2021) . https://doi: 10.1109/IEEESTD.2021.9536679.

Ivanovich, Catherine C., Tianyi Sun, Doria R. Gordon, and Ilissa B. Ocko. 'Future Warming from Global Food Consumption'. *Nature Climate Change* 13, no. 3 (March 2023): 297–302. https://doi.org/10.1038/s41558-023-01605-8.

Jonas, Hans. *Das Prinzip Verantwortung [The Imperative of Responsibility]*. Frankfurt am Main: Suhrkamp Taschenbuch, 1979.

Klenk, Michael. 'How Do Technological Artefacts Embody Moral Values?' *Philosophy & Technology* 34, no. 3 (September 2021): 525–44. https://doi.org/10.1007/s13347-020-00401-y.

Kluckhohn, Clyde. *Values and Value-Orientations in the Theory of Action: An Exploration in Definition and Classification*. Cambridge, Massachusetts: Transaction Publishers, 1962.

Kudina, Olya, and Ibo Van De Poel. 'A Sociotechnical System Perspective on AI'. *Minds and Machines* 34, no. 3 (12 June 2024): 1-9. https://doi.org/10.1007/s11023-024-09680-2.

Lee, Angela. 'Meat-Ing Demand: Is *In Vitro* Meat a Pragmatic, Problematic, or Paradoxical Solution?' *Canadian Journal of Women and the Law* 30, no. 1 (March 2018): 1–41. https://doi.org/10.3138/cjwl.30.1.1.

Liao, Shannon. 'Amazon Warehouse Workers Skip Bathroom Breaks to Keep Their Jobs, Says Report', 16 April 2018. https://www.theverge.com/2018/4/16/17243026/amazon-warehouse-jobs-worker-conditions-bathroom-breaks.

Lo Sapio, Luca. 'The Ethics of Cultivated Meat: Hypes and Hopes of a New Challenging Technology'. *International Journal of Applied Philosophy* 36, no. 1 (2022): 27–39. https://doi.org/10.5840/ijap2023210173.

Marini, Lorenzo, Paolo Fontana, Andrea Battisti, and Kevin J. Gaston. 'Response of Orthopteran Diversity to Abandonment of Semi-Natural Meadows'. *Agriculture, Ecosystems & Environment* 132, no. 3–4 (August 2009): 232–36. https://doi.org/10.1016/j.agee.2009.04.003.

Mellor, David J. 'Updating Animal Welfare Thinking: Moving beyond the "Five Freedoms" towards "A Life Worth Living"'. *Animals: An Open Access Journal from MDPI* 6, no. 3 (14 March 2016): 1-20. https://doi.org/10.3390/ani6030021.

Mollenkamp, Daniel Thomas. 'Economic Security: Meaning, History in the US, FAQs'. *Economic Security: Meaning, History in the US, FAQs* (blog), 22 November 2022. https://www.investopedia.com/economic-security-5213404.

Moustakas, Louis. 'Social Cohesion: Definitions, Causes and Consequences'. *Encyclopedia* 3, no. 3 (29 August 2023): 1028–37. https://doi.org/10.3390/encyclopedia3030075.

Moyano-Fernández, Cristian. 'The Moral Pitfalls of Cultivated Meat: Complementing Utilitarian Perspective with Eco-Republican Justice Approach'. *Journal of Agricultural and Environmental Ethics* 36, no. 1 (March 2023): 1-17. https://doi.org/10.1007/s10806-022-09896-1.

Niewiadomska, Katarzyna, Małgorzata Kosicka-Gębska, Jerzy Gębski, Marzena Jeżewska-Zychowicz, and Marianna Sułek. 'Perception of the Health Threats Related to the Consumption of Wild Animal Meat—Is Eating Game Risky?' *Foods* 10, no. 7 (4 July 2021): 1-14. https://doi.org/10.3390/foods10071544.

Noble, Charles H., and Minu Kumar. 'Using Product Design Strategically to Create Deeper Consumer Connections'. *Business Horizons* 51, no. 5 (October 2008): 441–50. https://doi.org/10.1016/j.bushor.2008.03.006.

Pilařová, Lucie, Tereza Balcarová, Ladislav Pilař, Lucie Kvasničková Stanislavská, Joanna Rosak-Szyrocka, Jana Pitrová, Pavel Moulis, and Roman Kvasnička. 'Exploring Ethical, Ecological, and Health Factors Influencing the Acceptance of Cultured Meat among Generation Y and Generation Z'. *Nutrients* 15, no. 13 (28 June 2023): 1-14. https://doi.org/10.3390/nu15132935.

Rasmussen, Martin Krøyer, Julie Gold, Matthias W. Kaiser, Jana Moritz, Niko Räty, Sissel Beate Rønning, Toni Ryynänen, et al. 'Critical Review of Cultivated Meat

from a Nordic Perspective'. *Trends in Food Science & Technology* 144 (February 2024): 1-16. https://doi.org/10.1016/j.tifs.2024.104336.

Sachi, Sabbya, Jannatul Ferdous, Mahmudul Hasan Sikder, and S M Azizul Karim Hussani. 'Antibiotic Residues in Milk: Past, Present, and Future'. *Journal of Advanced Veterinary and Animal Research* 6, no. 3 (11 July 2019): 315–32. https://doi.org/10.5455/javar.2019.f350.

Salzani, C., and Z. Weisberg. 'The Ethics and Politics of Cultured Meat: Food Transition, Big Business, "Humanewashing"'. In *Transforming Food Systems: Ethics, Innovation and Responsibility*, 428–33. Edinburgh, United Kingdom: Wageningen Academic Publishers, 2022. https://doi.org/10.3920/978-90-8686-939-8_67.

Scheler, Max. *Der Formalismus in Der Ethik Und Die Materiale Wertethik - Neuer Versuch Der Grundlegung Eines Ethischen Personalismus*. Max Niemeyer, 1921.

SDSN Secretariat, and Bertelsmann Stiftung. 'Sustainable Development Report 2019', 19 June 2019.

Sexton, Alexandra E. 'Food as Software: Place, Protein, and Feeding the World Silicon Valley–Style'. *Economic Geography* 96, no. 5 (19 October 2020): 449–69. https://doi.org/10.1080/00130095.2020.1834382.

Sexton, Alexandra E, Tara Garnett, and Jamie Lorimer. 'Framing the Future of Food: The Contested Promises of Alternative Proteins'. *Environment and Planning. E, Nature and Space* 2, no. 1 (March 2019): 47–72. https://doi.org/10.1177/2514848619827009.

Simdi, Halil, and Ayberk Seker. 'A Change Is Gonna Come: Will Traditional Meat Production End?' *Environmental Science and Pollution Research* 29, no. 20 (1 April 2022): 30470–85. https://doi.org/10.1007/s11356-021-17829-0.

Spiekermann, Sarah. *Value-Based Engineering: A Guide to Building Ethical Technology for Humanity*. De Gruyter, 2023. https://doi.org/10.1515/9783110793383.

Stephens, Neil, Lucio Di Silvio, Illtud Dunsford, Marianne Ellis, Abigail Glencross, and Alexandra Sexton. 'Bringing Cultured Meat to Market: Technical, Socio-Political, and Regulatory Challenges in Cellular Agriculture'. *Trends in Food Science & Technology* 78 (1 August 2018): 155–66. https://doi.org/10.1016/j.tifs.2018.04.010.

Tomiyama, A. Janet, N. Stephanie Kawecki, Daniel L. Rosenfeld, Jennifer A. Jay, Deepak Rajagopal, and Amy C. Rowat. 'Bridging the Gap between the Science of Cultured Meat and Public Perceptions'. *Trends in Food Science & Technology* 104 (October 2020): 144–52. https://doi.org/10.1016/j.tifs.2020.07.019.

Treich, Nicolas. 'Cultured Meat: Promises and Challenges'. *Environmental and Resource Economics* 79, no. 1 (May 2021): 33–61. https://doi.org/10.1007/s10640-021-00551-3.

Tuomisto, Hanna L. 'The Eco-friendly Burger'. *EMBO Reports* 20, no. 1 (January 2019): 1-6. https://doi.org/10.15252/embr.201847395.

Tuomisto, Hanna L. 'Vertical Farming and Cultured Meat: Immature Technologies for Urgent Problems'. *One Earth* 1, no. 3 (November 2019): 275–77. https://doi.org/10.1016/j.oneear.2019.10.024.

Van Der Weele, Cor. 'How to Save Cultured Meat from Ecomodernism? Selective Attention and the Art of Dealing with Ambivalence'. In *Animals in Our Midst: The Challenges of Co-Existing with Animals in the Anthropocene*, edited by Bernice Bovenkerk and Jozef Keulartz, 545–57. The International Library of Environmental, Agricultural and Food Ethics. Cham: Springer International Publishing, 2021. https://doi.org/10.1007/978-3-030-63523-7_30.

Van Der Weele, Cor, and Clemens Driessen. 'Emerging Profiles for Cultured Meat; Ethics through and as Design'. *Animals* 3, no. 3 (26 July 2013): 647–62. https://doi.org/10.3390/ani3030647.

Wilks, Matti, Charlie R. Crimston, and Matthew J. Hornsey. 'Meat and Morality: The Moral Foundation of Purity, but Not Harm, Predicts Attitudes toward Cultured Meat'. *Appetite* 197 (June 2024): 1-9. https://doi.org/10.1016/j.appet.2024.107297.

Wilson, Jeremy D., Andrew D. Evans, and Philip V. Grice. 'Bird Conservation and Agriculture: A Pivotal Moment?' *IBIS* 152 (8 December 2009). https://onlinelibrary.wiley.com/doi/10.1111/j.1474-919X.2009.00992.x.

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