FEASTS
Fostering European Cellular Agriculture for Sustainable Transition Solutions

Business models in European agri- and aquaculture and engagement strategies for farmers and aquafarmers

Deliverable 4.4

Work Package 4: Multi-stakeholder, Socio-economic and Ethics

Task 4.5: Capacitating the farmer and aquafarmer industry for a just transition

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Executive Summary

This work assesses the current state of European farmers and aquafarmers business models, challenges, and strategic opportunities to explore how future innovations - farm-based cultured meat (CM) and cultured seafood (CSF) production- could be meaningfully integrated within existing sector realities. Exploring this integration is essential given the mounting economic, environmental, and regulatory pressures facing both sectors, and the need to understand whether CM and CSF could offer realistic pathways to diversification and resilience for European primary producers.

For farmers, the research conducted within FEASTS builds on prior explorative feasibility work carried out by RespectFarms. As part of FEASTS, 41 semi-structured interviews were conducted across eight countries, continuing an established trajectory while deepening insights into business model patterns and strategic drivers. The findings from this work will directly inform the upcoming FEASTS Deliverable D4.7, which will present a blueprint for a CM farm.

For aquafarmers, S2AQUA conducted the first structured investigation within FEASTS. Consequently, methodological depth differs: Aquaculture research represents an exploratory baseline. A total of 26 interviews were conducted in seven countries, covering Northern and Southern Europe, to establish sector structure, operational realities, and strategic orientations. The smaller sample size of aquafarmers reflects the structure of the European aquaculture, where the number of operating companies is significantly lower and more concentrated than in livestock farming, resulting in fewer accessible interview participants.

Among farmers, clear strategic trajectories are observable: there is a strong shift toward diversification of business models, autonomy, and risk management, with roughly two-thirds already hybridizing multiple streams of revenue within their business. Nine business model typologies and five farmer personas were identified. A small, younger, market-facing, and entrepreneurial cluster shows early openness to innovations such as CM when positioned as a business enabler rather than a replacement. Among aquafarmers, structural differences are pronounced across regions and scales, but most emphasize sustainable growth, product quality, and environmental responsibility as key drivers of future competitiveness. Northern enterprises demonstrate strong technological and investment capacity, while Southern small-scale producers prioritize operational stability. Six company profiles were identified, reflecting diverse challenges, opportunities, orientations, and innovation levels. An innovation-driven segment, mainly Northern and capital-intensive, is best positioned to lead CSF integration, while Southern and small-scale actors are more likely to engage indirectly through partnerships or shared infrastructure.

For farmers, adoption drivers align CM with existing strategies: economic diversification, labor automation, regulatory compliance opportunities, reputation enhancement, infrastructure adaptability, premium market access, innovation appetite, and policy support alignment. Barriers include high debt, technical complexity, infrastructure requirements, regulatory and market uncertainty, cultural identity concerns, and supply chain adjustments. Future CM adoption should focus on the high-potential profiles and models, co-developed with them, avoiding broad communication without demonstration.

For aquafarmers, persistent sector constraints could be partly mitigated through CSF adoption, while existing aquaculture strengths provide leverage. Key opportunities include growing demand for sustainable seafood, R&D investment, academic partnerships, production diversification, value-added products, and access to renewable energy and improved resource efficiency. Barriers - mainly affecting small and micro-producers with limited resources or tertiary education - include technical complexity, infrastructure needs, and constrained structural capacity. Adoption will not follow a single pathway: readiness depends on structural capacity and innovation level rather than attitudes, and engagement strategies must reflect sector asymmetry.

Critical to success for both sectors are enabling factors: regulatory frameworks must facilitate participation; technological and economic constraints should be addressed case by case; and industry partnerships must foster genuine collaboration, supporting smaller, coastal, and rural producers. Without supportive policies, appropriate technology, and business model design, CM and CSF risks could concentrate on industrial facilities, further marginalizing the family farms that underpin Europe's decentralized food system and food sovereignty.

Both sectors now require evidence-based pilots to validate financial and regulatory feasibility before broader strategic positioning. Regulatory classification will be decisive in determining whether on-farm and -aquafarm participation is viable. Engagement must remain sector-specific: language, incentives, and expectations suitable for farmers cannot be transferred directly to aquaculture without contextual adaptation. Future CM and CSF exploration must remain anchored in the sector realities mapped in this research, not in abstract innovation narratives.

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Introduction

Agriculture and aquaculture pressures and the development of cellular agriculture

European agriculture stands at a crossroads. Livestock farmers across the continent face increasing pressures from unstable markets, changing environmental regulations[1], labour shortages[2], and shifting consumer expectations[3]. These dynamics are challenging the economic stability and long-term sustainability of traditional farming systems. Aquaculture - the world's fastest-growing food sector - continues expanding and modernizing to meet rising global demand for seafood[4]. However, while often positioned as a sustainable alternative to capture fisheries, the sector faces its own set of environmental, regulatory, and economic challenges[5,6]. These include managing nutrient discharges and other ecological impacts, reducing reliance on fishmeal and fish oil, ensuring biosecurity and product safety, and navigating complex legislative frameworks that constrain growth, innovation, and competitiveness. The European Green Deal and its Farm to Fork Strategy[7], together with the Strategic Guidelines for Sustainable and Competitive EU Aquaculture[8], provide a comprehensive policy framework addressing these pressures. These strategies aim to reduce environmental impacts while enhancing competitiveness, social inclusion, and resilience across rural and coastal regions. By situating agriculture and aquaculture within this policy agenda, Europe seeks to reconcile environmental, economic, and social objectives while supporting long-term sustainability.

Amid these pressures and policy frameworks, cellular agriculture – the production of meat and seafood through cell culture rather than conventional animal farming – has emerged as a potential technological pathway that could contribute to more sustainable protein production, considering environmental, economic, and social dimensions, as well as animal

[1] Finger, R., Fabry, A., Kammer, M. H., Candel, J. J. L., Dalhaus, T. P. F., & Meemken, E.-M. (2024). Farmer Protests in Europe 2023–2024. *EuroChoices*. https://doi.org/10.1111/1746-692X.12452

[2] OECD, 2023 – OECD Food, Agriculture and Fisheries Paper 189 (2023). Labour and Skills Shortages in the Agro-Food Sector. https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/01/labour-and-skills-shortages-in-the-agro-food-sector_c9915f4e/ed758aab-en.pdf

[3] EC (2023), EU agricultural outlook for markets, 2023-2035. European Commission, DG Agriculture and Rural Development, Brussels.

[4] FAO, 2024 - Food and Agriculture Organization of the United Nations. (2024). *The state of world fisheries and aquaculture 2024: Blue transformation in action. Rome.* https://doi.org/10.4060/cd0683en

[5] Martínez-Porchas, M., & Martínez-Córdova, L. R. (2012). World aquaculture: Environmental impacts and troubleshooting alternatives. The Scientific World Journal, 2012, 389623. https://doi.org/10.1100/2012/389623

[6] Cappell, R., Huntington, T., Guélé, M. E., Macfadyen, G., & Caillart, B. (2024). The EU oceans and fisheries policy: Latest developments and future challenges. Directorate-General for Internal Policies of the Union – European Parliament. https://aquaculture.ec.europa.eu/knowledge-base/reports/eu-oceans-and-fisheries-policy-latest-developments-and-future-challenges

[7] Farm to Fork Strategy. (z.d.-b). Food Safety. https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en?

[8] European Commission (2021) Strategic guidelines for a more sustainable and competitive EU aquaculture for the period 2021 to 2030. Brussels, Belgium, European Commission, 17pp. DOI: 10.25607/OBP-

welfare[9,10]. However, its development has so far been driven mainly by research and industrial actors, with limited participation from farmers and aquafarmers. This limited engagement highlights a critical knowledge and participation gap regarding how cultured meat (CM) and culture seafood (CSF) could complement existing agricultural and aquaculture systems and contribute to the resilience of rural and coastal communities. The timing of these developments is critical. CM and CSF are transitioning from laboratory concepts to early commercialization, with regulatory approvals already granted in Singapore, the United States, Israel, and Australia. Europe therefore faces a strategic window to shape how these technologies evolve within its food systems and regulatory frameworks. Without proactive inclusion and policy alignment, cellular agriculture could centralize production in urban or industrial facilities, potentially bypassing traditional farmers and aquafarmers. Conversely, co-development approaches that actively involve primary producers could diversify rural and coastal economies, enhance supply chain resilience, and strengthen Europe's global leadership in sustainable and ethical protein production.

Relevance to FEASTS and alignment with EU Policy goals

This deliverable contributes directly to the objectives of FEASTS, which aims to identify and assess pathways for the sustainable and socially acceptable integration of cellular agriculture into existing European food systems.

Building on the EU's broader sustainability agenda outlined in the first section, this work also supports the implementation of policies that promote innovation, diversification, and fair transitions for primary producers. It is particularly consistent with the objectives of the Common Agricultural Policy (CAP), the Common Fisheries Policy (CFP), and Horizon Europe's agenda for food system transformation, all of which aim to ensure that sustainability transitions are inclusive and equitable.

Within this policy landscape, FEASTS provides empirical evidence of the opportunities that cellular agriculture has the potential to bring farmers and aquafarmers, as well as the barriers that require addressing in order to bridge the two sectors. The initiative also identifies ways to position this subject among different stakeholders, in order to ensure that the potential of cellular agriculture on the socio-economic foundations of European food systems is realized, contributing to a just and regionally balanced transition across rural and coastal communities.

Research context and sectoral maturity

[9] Rubio, N., Datar, I., Stachura, D., Kaplan, D., & Krueger, K. (2019). Cell-based fish: a novel approach to seafood production and an opportunity for cellular agriculture. Frontiers in Sustainable Food Systems, 3, 43. https://doi.org/10.3389/fsufs.2019.00043

[10] Riquelme-Guzmán, C., Stout, A. J., Kaplan, D. L., & Flack, J. E. (2024). Unlocking the potential of cultivated meat through cell line engineering. iScience, 27(10), 110877. https://doi.org/10.1016/j.isci.2024.110877

This study, jointly developed by RespectFarms – a startup serving as a system integrator and offering CM technology solutions to farmers – and S2AQUA, a collaborative research laboratory dedicated to aquaculture research and development, focuses on livestock farms and aquafarms as potential future sites for CM and CSF production, and investigates how cellular agriculture can be integrated into European agriculture and aquaculture systems. The analysis builds on RespectFarms' previous explorative feasibility work and on current understanding of CM technology maturity and the practical possibilities for on-farm CM production. It examines business models, operational realities, and engagement pathways to support an inclusive transition toward CM and CSF production.

A total of 67 in-depth interviews were conducted, including 41 with livestock farmers and 26 with aquafarmers. The research captured first-hand insights into production structures, innovation dynamics, and perceptions regarding diversification and technological adoption.
The two sectors differ in their research maturity and prior engagement with cellular agriculture:

- Knowledge of the interaction between cellular agriculture and livestock farming builds upon an existing body of research; RespectFarms and other European initiatives have previously explored farmers' perceptions, feasibility, and early interest in on-farm CM production[11,12,13,14]. On the one hand, such studies demonstrated that roughly 1 in 10 of farmers in the Netherlands respond positively to the idea of CM farming. On the other, a number of farmers perceives cellular agriculture as a threat[15] to their livelihood and influence[16], however, they also demonstrate an overwhelming lack of awareness of their potential involvement in the CM value chain. The current study extends this work by examining how CM could complement conventional livestock systems, as well as identifying likely early adopters.
- Aquaculture, in contrast, remains largely unexplored in terms of its potential interaction with CSF production, with no prior systematic research examining aquafarmers' perspectives on possible integration.

[11]Bock, A.K., Krzysztofowicz, M., Rudkin, J. and Winthagen, V. Farmers of the Future. EUR 30464 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-26332-6, doi:10.2760/680650, JRC122308

[12] MacMillan, T. C., Lewis, K., Dooley, J. J., Morgans, L. C., Sexton, A. E., Ali, M., Allan, S., Argyle, I., Dunsford, I., Goodman, M. K., Lynch, J., Manning, L., Ranawana, V., Rose, D. C., Rothman, R., Sibly, W., Vasilopoulos, A., & Wylie, A. (2024). *Culture Clash? What cultured meat could mean for UK farming*. Royal Agricultural University.

[13] RespectFarms. https://www.respectfarms.com/blog/the-feasibility-of-cultivated-meat-from-the-farm

[14] Tacken, G; Polet, I; Splinter, G (2023). *De perceptie van kweekvlees door actoren in de vleesketen en hun eigen rol in the eiwittransitie*. Wageningen University & Research.

[15] Coldiretti Giovani Impresa, 'Consumi: le 5 bugie della carne Frankenstein' (18 November 2021)

[16] Manning L, Dooley JJ, Dunsford I, Goodman MK, MacMillan TC, Morgans LC, Rose DC and Sexton AE (2023) Threat or opportunity? An analysis of perceptions of cultured meat in the UK farming sector. Front. Sustain. Food Syst. 7:1277511. doi: 10.3389/fsufs.2023.1277511

This asymmetry shapes both the scope and analytical depth of the study: the livestock component extends a maturing research stream, while the aquaculture component establishes the first empirical baseline for this sector within the FEASTS framework.

Overall study aim

FEASTS Task 4.5 focuses on livestock farms and aquafarms as potential future sites for cultured meat and seafood production. The analysis builds on RespectFarms' previous feasibility work and on current understanding of CM technology maturity and the practical possibilities for on-farm CM production The central objective of this study is to assess how CM and CSF could interact with Europe's existing food production systems, and to understand the conditions under which farmers and aquafarmers could engage with these emerging technologies. This includes mapping current business models, identifying opportunities and constraints, and developing an evidence base for designing inclusive and realistic engagement strategies across both sectors. In both sectors, CM and CSF were not part of the interview guide. They only appeared when interviewees themselves raised these topics in relation to their future vision or the broader context of the FEASTS consortium.

Given the different trajectories and levels of maturity of agriculture and aquaculture in relation to cellular agriculture, the research is structured into two parallel streams – one focusing on livestock farmers and one on aquafarmers. Each stream follows its own set of specific objectives, analytical approaches, and sectoral boundaries. The detailed objectives for each sector are presented within the corresponding sections (A-Farmers and B-Aquafarmers) of the report.

Together, these two research streams form the first cross-sectoral assessment of how cellular agriculture could interact with Europe's traditional food production systems. By capturing both convergences and sector-specific dynamics, the analysis provides a scientific basis for evidence-based policymaking and the design of inclusive engagement strategies.

This integrated approach supports FEASTS' broader mission to ensure that cellular agriculture evolves as a complementary and participatory innovation pathway, strengthening rather than displacing Europe's rural and coastal livelihoods while contributing to the sustainability, resilience, and diversification of its food systems.

A – FARMERS

Courtesy: Buro Proost 2022

Part 1 – Interview process and analysis

1. Study objective

This analysis builds on RespectFarms' previous feasibility work and on current understanding of CM technology maturity and the practical possibilities for on-farm CM production. The objective of this study is to generate practical, actionable insights into farmers' business models, decision-making logic, and operational constraints and to identify key drivers and barriers that influence their willingness to adopt or integrate farm-based CM systems. These insights will directly inform the development of the CM Farm Blueprint (FEASTS Deliverable 4.7), ensuring that the blueprint reflects real farmer needs, constraints, and expectations. This work also lays the foundations for an effective farmer engagement strategy and supports stakeholder involvement in blueprint validation and the development of future pilot farms.

Research with livestock farmers focuses on five main goals, designed to understand pathways and identify early adopters of on-farm CM production within European livestock systems:

- Map and classify existing livestock farming business models across Europe.
- Develop representative farmer profile clusters based on their visions, motivations, and strategic orientations.
- Analyze key barriers and enablers shaping CM adoption.
- Identify likely innovators and early adopters using the Technology Adoption Curve framework.
- Design targeted engagement strategies to collaborate with early adopters in developing and testing on-farm CM prototypes.

This component represents a mature stage of inquiry, expanding upon RespectFarms' prior empirical work and translating earlier feasibility insights into actionable engagement approaches, policy guidance, and pilot design recommendations.

2. Study context

Livestock farming is a foundation of European agriculture, encompassing the breeding, rearing and management of farm animals for meat, milk, eggs, and other animal products. It represents a vital socio-economic and cultural component of rural Europe and is deeply intertwined with local land use, food systems and regional traditions[17]. The livestock sector is also at the heart of contemporary sustainability challenges, as it faces increasing pressure to reduce nitrate, phosphorous and greenhouse gases emissions[18], improve animal welfare, and adapt to dietary trends and regulatory frameworks.

[17] Alessandrini, M., Alblas, E., Batten, L., & Bothé, S. (2024). Smallholder farms in the sustainable food transition: A critical examination of the new Common Agricultural Policy. *Review of European, Comparative & International Environmental Law*, *33*(1), 124–135. https://doi.org/10.1111/reel.12539

[18] Kyriazakis, I., Arndt, C., Aubry, A., Charlier, J., Ezenwa, V. O., Godber, O. F., Krogh, M., Mostert, P. F., Orsel, K., Robinson, M. W., Ryan, F. S., Skuce, P. J., Takahashi, T., van Middelaar, C. E., Vigors, S., & Morgan, E. R.

Across Europe, livestock production is diverse and heterogeneous, characterized by agro-ecological conditions, economic potential, production intensity, and environmental and social situations[19]. Production systems range from extensive pasture-based and mixed crop-livestock farms to intensive landless operations. Cattle (beef and dairy), pigs, and poultry constitute the largest segments of the sector, completed by smaller, locally significant systems for sheep, goat and specialty meat.

Eurostat indicates there are over 9 million farms in the European Union, with 93% being family-run[20]. Farm numbers are declining as operations become larger and more specialized. Succession is a concern, most of the 9.1 million farm managers are at least 55 years old and only 12% are under 40[21], posing challenges for the future of European agriculture.

About 4 million European farms keep livestock. In 2024, Animal products represent over 40% of the EU agricultural output of 532 billion EUR[22]. Milk pig farming produced over 21 million tons of meat, with Spain, Germany, Denmark, France, the Netherlands, Poland, and Italy leading production. Poultry farms produced more than 14 million tons, mostly in Poland, Spain, France, Germany, and Italy. The cattle sector, covering beef and veal, contributed over 6.5 million tons, with major producers including France, Germany, Ireland, Spain, Poland, Italy, and the Netherlands.

(2024). Improve animal health to reduce livestock emissions: quantifying an open goal. Proceedings of the Royal Society B: Biological Sciences, 291(2024.0675). https://edepot.wur.nl/671482

[19] Meyer, R. (2014). Diversity of European Farming Systems and Pathways to Sustainable Intensification. TATuP - Zeitschrift für Technikfolgenabschätzung in Theorie und Praxis, 23(3), 11–21. https://doi.org/10.14512/tatup.23.3.11

[20] Agriculture statistics - family farming in the EU**;** European Commission (2022) https://ec.europa.eu/eurostat/statisticsexplained/index.php?title=Farms_and_farmland_in_the_European_Union_-_statistics

[21] Sajn, N. (2025) Generational renewal in EU agriculture, European Parliament Research Service Briefing. https://www.europarl.europa.eu/RegData/etudes/BRIE/2025/772876/EPRS_BRI(2025)772876_EN.pdf

[22] European Parliament (2025), EU agriculture policy in numbers (infographics) https://www.europarl.europa.eu/pdfs/news/expert/2021/11/story/20211118STO17609/20211118STO17609_en.pdf

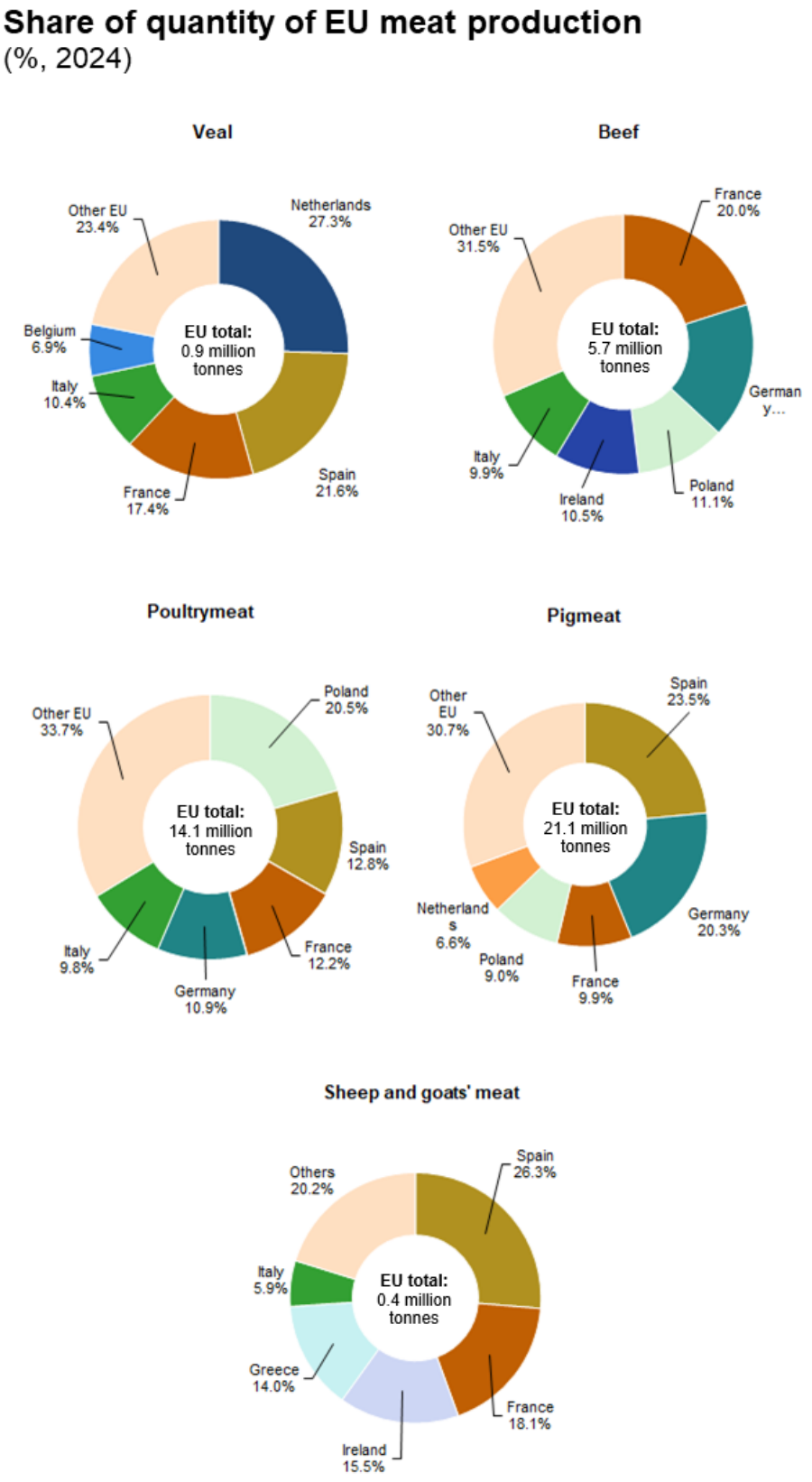


Figure A- 1 Share of quantity of EU meat production (%, 2024).
Source: Eurostat (online data code: apro_mt_pann)

Along with the heterogeneity in species, geographical distribution and business ownership, European farms also differ in the business models they employ. Recent research on agricultural business operations has identified several broad categories that these businesses could be sorted into, including sustainable, technology-based, and cooperative[23]. Additionally, broader archetypes for circular and sustainable business models, as well as nine types of sustainable food systems, have been proposed[24]. Building on this top-down literature-based work, our study takes an empirical, bottom-up approach, better reflecting the farmers' own rationales for employing their chosen strategies.

3. Participants selection criteria and contacts

The sample covered various production systems (mixed crop-livestock, grazing, landless, agroecology, and organic) and included all types of specializations such as fattening, breeder, full-cycle, and dairy farms.

To focus on those more likely to adopt new innovations, larger farms were prioritized over the EU average, thereby excluding subsistence-level farms, which are primarily engaged in agricultural activities to produce food mainly for household consumption, and are thus less likely to be involved in commercial on-farm CM production[25]. Additionally, the interviews concentrated on younger-than-average farmers, providing valuable insights into long-term sector visions[26].

The gender distribution of interview participants in this study largely reflected the wider demographic reality of European farming, where the majority of farm managers are male[27], rather than being a result of intentional selection bias[28]. Out of the 41 participants, 3 farm owners/co-owners were female; female partners of 2 participants also took part in the interviews.

Sampling was conducted by requesting support from consortium members, RespectFarms networks, and farming organizations, reviewing profiles online, and contacting potential participants by phone, online, or in person to reach the necessary number of participants.

[23] Miranda, F. Javier & García-Gallego, José & Valero, Víctor & Rubio, Sergio & Chamorro-Mera, Antonio. (2023). A systematic review of the literature on agri-food business models: critical review and research agenda. British Food Journal. 125. 10.1108/BFJ-12-2022-1102.

[24] Donner M and de Vries H (2023) Business models for sustainable food systems: a typology based on a literature review. Front. Sustain. Food Syst. 7:1160097. doi: 10.3389/fsufs.2023.1160097

[25] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Subsistence_farming

[26] Sajn, N. (2025) Generational renewal in EU agriculture, European Parliament Research Service Briefing. https://www.europarl.europa.eu/RegData/etudes/BRIE/2025/772876/EPRS_BRI(2025)772876_EN.pdf

[27] Bock, A.K., Krzysztofowicz, M., Rudkin, J. and Winthagen, V. Farmers of the Future. EUR 30464 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-26332-6, doi:10.2760/680650, JRC122308

3.1. Interview scope & geographical coverage

Forty-one livestock farmers were interviewed for the purpose of the study. This covered cattle, dairy, pig, poultry, and mixed farms, in order to introduce a degree of diversity within the sample. Farmers were interviewed in eight countries leading in livestock and poultry production volumes in 2024: Belgium, Denmark, Germany, France, Italy, Netherlands, Poland, and Spain. The emphasis was placed on regions with high livestock density to capture a diverse range of operational realities. Details of the participants can be found in ANNEX-1.

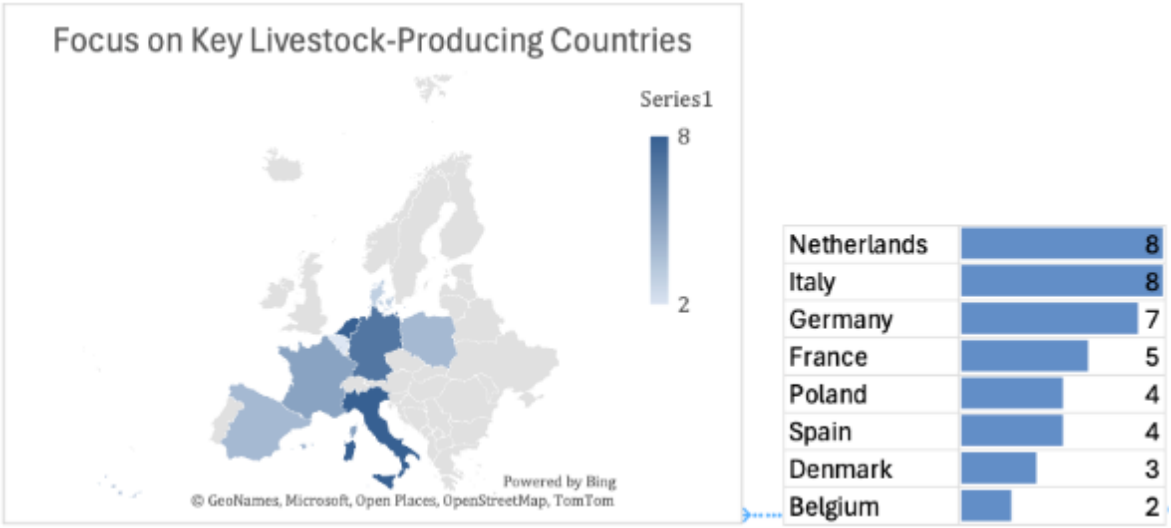


Figure A- 2. Number of farms interviewed and geographical location.

While the findings and insights stated throughout the report are representative of the interviewed pool, we also acknowledge that this only provides a first indication of the general state of European agriculture due to the inherent limitations of the sample size. In order to yield more quantitatively sound and general conclusions, more datapoints will be added to the present database as RespectFarms continues its farmer engagement endeavors.

4. Interview design and implementation

RespectFarms applied explorative, business-oriented qualitative research methods to generate actionable insights for FEASTS, rather than conducting a purely academic study. The interview concept was based on Design Thinking[29], a human-centric, iterative problem-solving model that aims to uncover user needs, identify patterns, and inform innovation processes. In particular, the interviews aligned with the core step of Design Thinking "Empathize", whereas the data analysis aligned with "Define", and engagement strategy drafting with "Ideate". Together with a semi-structured interview approach, these means were chosen to produce practical insights on business models, innovation readiness, and potential pathways for CM adoption.

[29] An Introduction to Design Thinking, Process Guide. Hasso Platner Institute of Design at Stanford. https://web.stanford.edu/~mshanks/MichaelShanks/files/509554.pdf

Interview design and planning:
The interview guide was structured to explore farmers lived realities and long-term ambitions, with question blocks covering farm operations, strategic drivers, pain points, business model characteristics, and sector outlooks. Semi-structured interviews (see ANNEX-4) ensured consistency while allowing farmers to expand on the topics most relevant to them. Farmers were selected to represent a diverse range of species, production systems, and business models across eight countries.

Interviews were conducted on-site following qualitative fieldwork best practices. Each session lasted around 120 minutes, enabling in-depth discussions and direct observation of the farm context. Interviews were not recorded; instead, detailed notes were taken to encourage a conversational atmosphere and support open sharing. All interviews complied with EU data protection rules. Participants were informed, provided consent, and all personal data was anonymized for use within FEASTS.

5. Key research areas explored

The interviews examined several dimensions of livestock farming, organized around three major points:

- Business Models: Farmers described how their operations are structured and have evolved, providing insights into scale, scope, market orientation, and operational strategies.
- Pain Points and Opportunities: Participants identified challenges and opportunities in the sector, helping to anticipate drivers and barriers for future CM adoption.
- Vision on Future Business Directions: Farmers shared their long-term plans and expectations for sector evolution.

While the topic of cellular agriculture was not included in the interview questionnaire, spontaneous comments on cellular agriculture knowledge and perception of cellular agriculture were recorded, providing initial signals on awareness and attitudes.

6. Interview data analysis

Interview analysis followed a multi-method qualitative analysis framework, combining thematic analysis, business modeling logic, and innovation adoption theory to evaluate CM integration potential.

- Interview insights were mapped onto Business Model, Persona, and Environment Canvases (see **ANNEX-6**), and documented in an Excel database.
- Responses were grouped based on recurring themes (challenges, opportunities, and future visions) to identify key drivers and barriers for potential on-farm CM production.

- The AI tool Claude.ai was used to support the clustering of farms into business model profiles and farmers into farmer personas. Business model clustering was based on organizational characteristics, operational strategies, and market orientation. Similarly, farmer personas were developed from the sum of observed motivations, ambitions, and risk attitudes. All AI-generated outputs were cross-checked against raw notes for accuracy. The respective prompts provided to the AI model were as follows:
    - "Using this dataset, identify the primary business models employed by farmers along with their key characteristics. Support your findings with data from the interviews so that they can be verified and interpreted accordingly."
    - "Develop persona profiles for farmers based on their future outlook. Using the attached dataset, create realistic profiles that encompass their motivations, pain points, and vision. Ensure that the persona profiles are comprehensive, capturing insights from the transcripts while blending multiple sources to maintain anonymity."
- To assess readiness for CM adoption, both business models and personas were mapped onto the Technology Adoption Curve[30], a sociological framework originally developed in agricultural innovation research. The likelihood of adoption was predicted by creating a ranking system for business models and personas. This system used qualitative scores, categorized as "Early market," "Mainstream market," and "Sceptics," which were assigned to each option as described below:
    - Business model assessment: Each business model was evaluated using five qualitative criteria (scale and scope, innovation appetite, risk tolerance, resource flexibility, market orientation) derived from interview insights and field observations. Drivers and barriers were identified for each model and synthesized into adoption scenarios. These informed long-term hypotheses about evolving farm roles towards 2040 and allowed business models to be positioned along the Technology Adoption Curve.
    - Persona assessment: Personas were positioned along the Technology Adoption Curve based on their defining traits, motivations, and attitude towards innovation.
    - This process enabled the identification of which business models and personas align with each stage of innovation adoption and what engagement strategies are most appropriate.
- The findings inform FEASTS' and Task 4.5 priorities for engagements with the sector, early co-creation, pilot development, and strategic resource allocation during and beyond FEASTS, and clarifies which segments may require market maturity or remain skeptical of CM integration.
- These assumptions will be further tested during the implementation of Deliverable 4.7, the CM Farm Blueprint, and subsequently after FEASTS.

[30] Rogers, E. Diffusion of Innovations, 5th ed.; Free Press: New York, NY, USA, 2003. https://www.taylorfrancis.com/chapters/edit/10.4324/9780203887011-36/diffusion-innovations-everett-rogers-arvind-singhal-margaret-quinlan

Part 2 – Findings from farmers interviews

Previous research has identified that European farmers see significant opportunities in digitalization, sustainable practices, and climate-friendly agriculture[31]. Further, it has been shown that farmers increasingly cite concerns about policy uncertainty, financial pressure, and succession as the main threats to their business[32][33].

However, while such studies largely focused on literature reviews, structured surveys, and scenario analyses, the present study relies on a more conversational and person-centric fieldwork approach to qualitative evidence gathering. This, in turn, allowed for the probing of not only the characteristics of the farmers' businesses, but also their personalities and attitudes.

In the interviews, farmers shared their experiences, concerns, and aspirations. Full lists of challenges and opportunities, as well as their frequency of occurrence and corresponding example quotes, are available in ANNEX-7 and ANNEX-8, respectively. These conversations revealed:

- Existing opportunities for the sector
- Common operational challenges
- Current trends in farm transformation
- Varied levels of awareness and interest in CM technologies.

1. Key opportunities identified

European livestock farmers see potential opportunities in their businesses and industry. **Across all regions and types of farms, these are the five most frequently mentioned opportunities:**

- **Diversification**: Farmers see opportunities in diversifying their business models and sources of income to build resilience. This includes multifunctional agriculture (environmental, social services, agrotourism) as well as mixed agricultural businesses that combine primary production with other business activities (farm shops, on-farm processing).

[31] Bock, A.K., Krzysztofowicz, M., Rudkin, J. and Winthagen, V. Farmers of the Future. EUR 30464 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-26332-6, doi:10.2760/680650, JRC122308

[32] World Economic Forum. Transforming Food Systems with Farmers: A Pathway for the EU, 2022

[33] Uittenbogaart. Different Future Visions for Farming: An In-Depth Exploration of the Future Visions of Dutch Farmers (Master's thesis, Chair Group Rural Sociology, Wageningen University, the Netherlands), 2021, https://edepot.wur.nl/558516

- **Technology Adoption**: Technologies such as automation and precision agriculture are perceived as means to improve operational efficiency and animal welfare, but they require investments that are challenging for small farms.
- **Access to Premium Markets**: Certifications, quality labels, and participation in short or local supply chains are seen as strategies for farmers to compete through product differentiation and premium pricing.
- **Direct Sales**: Farmers increasingly consider direct sales to consumers to improve margins, control production standards and branding, and strengthen relationships with consumers and their surrounding community.
- **Policy Support**: With ongoing CAP reforms and EU environmental and rural development initiatives, farmers increasingly consider incentives and grants that promote innovation, environmental services and conservation.

Other opportunities include:

- **Sustainability**: More farmers are recognizing that green investments can open new markets opportunities and create additional sources of income.
- **Meeting new standards**: Some farmers see opportunities in complying with or exceeding new standards as a way to strengthen their competitiveness and future proof their farm, whether they plan to continue operations or eventually exit.

2. Main challenges European livestock farmers are facing

European livestock farming faces several challenges that threaten its competitiveness and long-term prospects. **The top five concerns found across different regions and types of farms are:**

- **Regulatory Challenges**: Complex and changing policies create uncertainty, making it hard for farms, especially small and medium sized ones, to invest or hand over to the next generation.
- **Financial Pressure**: With margins shrinking, increasing costs, and fluctuating prices, farmers face significant challenges to survival, especially since their operations depend on long-term investments and debt support. Large processors dominate the market, further squeezing farmer profits.
- **Labor Shortage & Succession Issues**: Low wages, poor returns and tough working conditions discourage workers and newcomers, leading to staff shortages and succession challenges across Europe.
- **Public Image**: Farmers feel unfairly criticized by the media and society, especially regarding environmental impact (emissions, pollution, biodiversity loss) and animal welfare (intensive systems, confinement, antibiotics), and less respected in their communities compared to previous generations. This has a negative effect on their morale.

- **Market Control**: The processor and retailer sectors are highly concentrated, resulting in product commoditization and less autonomy for farmers.

Other important challenges include:

- **Infrastructure & Growth**: Farm expansion and modernization are increasingly costly, and land prices have soared. In addition, opposition from local stakeholders often deters new investments from being made.
- **Biosecurity**: Disease outbreaks can eradicate entire herds, causing major financial losses and impacting morale
- **Lifestyle**: Poor work-life balance and constant financial stress impact farm owners and make recruitment and succession difficult.
- **Survival**: A number of farms face survival challenges. Integration into larger farms often appears to be the only viable option.
- **Environmental Challenges**: Changes in the weather, soil problems, and the regulatory pressure resulting therefrom add more risks for farmers.

For additional details on challenges and opportunities, refer to ANNEX-7 and ANNEX-8.

3. Their vision of the future

The visions shared by our sample reveal a sector in transition. They show farmers balancing tradition with innovation as they adapt to economic, regulatory, and consumer changes. **Farmers employ diverse strategies to manage these shifts**.

- **Diversification as Risk Management:** More farmers respond to challenges by diversifying their income sources (e.g.: processing products, producing renewable energy, offering services, engaging in agritourism activities). The goal is to reduce vulnerability to market and regulatory changes and increase revenue.
- **Practical Technology Adoption**: Technology is now viewed as essential for efficiency and chosen for its problem-solving ability, including automation (e.g., robot milking), precision farming tools, or digital platforms. Focus is given on ease of use, ROI, and tangible benefits, rather than only modernization.
- **Sustainability as Strategy**: Environmentally friendly practices that reduce ecological burdens, circular use of resources, and regenerative farming, are becoming increasingly more mainstream. They are driven by regulatory agendas, consumer demand, subsidies, and new revenue opportunities. Farmers are aiming to implement more sustainable business models and increasingly adopting these practices as part of their strategic positioning.
- **Direct-to-Consumer Sales**: More farmers sell directly to customers through farm shops and online. This allows them to achieve better margins, closer customer relationships, and have less reliance on intermediaries.

- **Work-Life Balance**: Some farmers decide to prioritize manageable workloads, reduced stress, family participation, and personal fulfilment, especially in mid-career. This is often done through simplification and automation.
- **Planning**: Farmers' demographics and situations influence whether they invest to expand operations, plan for succession, or pursue exit strategies like retirement or sale.
- **Adapting to Policy**: Farmers align their operations with EU policies to maximize subsidies and ensure compliance. Some are involved in influencing policy through farmers' unions or industry groups.
- **Innovation Exploration and Future Positioning**: Some farmers explore new opportunities, such as cellular agriculture, advanced technology, and new business models, in order to stay competitive and prepare for future changes.

4. Different levels of awareness and interest in cultured meat technologies

Our efforts to connect with farmer unions, cooperatives, and chambers of agriculture on the theme of Cellular Agriculture often faced silence or bureaucracy. However, direct conversations with individual farmers showed real curiosity and openness. Two main insights were observed:

- **Awareness Gap:** Farmers generally demonstrate limited awareness of cellular agriculture although exceptions exist. In Italy, for instance, the farmers' union Coldiretti has taken an active stance against CM, resulting in predominantly negative sentiment. Also, in the Netherlands, several factors have contributed to higher levels of awareness. These include government openness, the presence of CM startups, national discussions concerning the nitrogen crisis, and a culture of agricultural innovation. Outside these specific contexts, most farmers remain unfamiliar with the concepts of cellular agriculture and CM.

- **Untapped Interest:** Farmers whose interviews touched upon cellular agriculture were generally unaware of their possible roles in the development of CM. After receiving information about these opportunities, their responses varied from rejection or indifference to curiosity or enthusiasm. The main highlight was that most had not previously been informed of possible involvement.

- **Early signs of interest**: Although not the primary focus of this stage of the research, discussions around cellular agriculture and RespectFarms' mission arose organically during conversations with farmers. In a minority of cases, these interactions moved beyond curiosity and developed into active engagement. Among 41 farmers interviewed, 5 actively followed up to further explore cellular agriculture. In addition, one industrial player reported current involvement in research and development

activities. This group of farmers showed several shared traits. They had a proactive and entrepreneurial attitude, reflected in their diversified farm business, and strong connections with both industry groups and consumers. Most are aged 30-50, environmentally and socially conscious, and have an advanced education in fields such as veterinary sciences, business or agriculture.

Part 3 - Analysis of the data and clustering of the sample

To gain insights into the currents EU livestock systems, we analyzed the sample through both the operational attributes of the farms and personal characteristics of their owners. The data collected from interviews was systematically reviewed to identify patterns.

- Farmers have been categorized into nine distinct business models, each characterized by specific operational features.
- Five farmer persona profiles have been defined according to their motivations and long-term visions.
- Key drivers and barriers influencing farmers' innovative behaviors were identified.

1. Nine business models of European livestock farming

Following our interviews with livestock farmers, we have identified nine distinct business models. These typologies are based on farmers' strategies for creating value, managing risks and positioning within the value chain. They are not tied to specific sectors like dairy or pig farming. Hybridization, when farms combine multiple business models, has become common and reflects the increasing complexity and entrepreneurship in agriculture.

As indicated before, our work extends the existing literature on agricultural business models[34] [35] through a fieldwork approach that more closely reflects how the farmers position themselves to strategically combine value creation, risk management, and value-chain positioning in practice. In addition, our research records a widespread hybridization of strategies across models, leading to more complex and mutually connected categories.

Nevertheless, some of the models identified in the study correlate with the previously defined types. These represent more specific subcategories of the existing typology, for example, “Independent Intensive Livestock Specialist,” “Multi-site Agribusiness Entrepreneur,” and “Industrial Scale Farming Business,” all pursue scale, efficiency and low unit costs, and thus reflect cost leadership. “Cooperative Integrated Farmer” and “Contract Faring Specialist” both exhibit participation in external business model schemes. “Diversified-Multi-Stream Business

[34] Miranda, F. Javier & García-Gallego, José & Valero, Víctor & Rubio, Sergio & Chamorro-Mera, Antonio. (2023). A systematic review of the literature on agri-food business models: critical review and research agenda. British Food Journal. 125. 10.1108/BFJ-12-2022-1102.

[35] Donner M and de Vries H (2023) Business models for sustainable food systems: a typology based on a literature review. Front. Sustain. Food Syst. 7:1160097. doi: 10.3389/fsufs.2023.1160097

Farmer" and in part, "Agroecological Farmer" and "Traditional Farmer" fall under multifunctional farms, where on-farm processing, ecosystem services, and cultural continuity are employed.

1.1. Independent Intensive Livestock Specialist

These farms aim for large scale and efficiency and use modern technology. Owners operate independently, typically raise a single livestock type. They sell to processors or industrial buyers at market prices without contracts. These farms are profitable and technologically advanced, but they are exposed to market volatility and face societal pressures regarding sustainability and animal welfare. Due to their size and openness to technology, these farms often lead the way in adopting new innovations that fit their business requirements.

Table A- 1. The Business Model Elements of Independent Intensive Livestock Specialists.

Business Model Element	Details
Customer Segments	Regional processors, local traders, auction market, slaughterhouse
Value Propositions	Efficient production, flexibility, autonomy
Channels	Direct processor sales, auctions, spot or contract market
Customer Relationships	Reputation-based, negotiated terms
Revenue Streams	Contract/spot sales of livestock, by-products, subsidies
Key Activities	Intensive feeding, breeding, maintenance, financial management
Key Resources	Land, buildings, equipment, family labor, expertise
Key Partners	Feed suppliers, vets, banks, equipment dealers, transporters
Costs	High feed & energy costs, veterinary, depreciation, family labor cost

1.2. Cooperative Integrated Farmer

Cooperative Integration is common among small and medium-sized family farms. Members run their own businesses but collaborate for input purchasing, processing, distribution, and/or marketing. This collective approach offers economic stability and risk-sharing while preserving owners' everyday autonomy. Cooperatives do limit opportunities for individual innovation or branding, but they have capacity for integrating technologies thanks to their established shared resources and distribution networks.

Table A- 2. The Business Model Elements of Cooperative Integrated Famers.

Business Model Element	Details
Customer Segments	Cooperative entity as the guaranteed volume buyer (serving processors, retailers, exporters)
Value Propositions	Consistent quality, standardized volume delivery of livestock
Channels	Cooperative delivery or processing centers
Customer Relationships	Membership agreement, voice in governance (voting rights), trust-based relationship with fellow members and management
Revenue Streams	Sales via coop, fair payment for products, coop dividends, coop premiums, members-only subsidies

Key Activities	Production, compliance, delivery, participation in governance
Key Resources	land and personal assets, shared resources of the coop (technical infrastructure, knowledge, bargaining power)
Key Partners	Cooperative members and management, technical advisors, banks
Costs	Annual memberships, capital contributions, cost of production

1.3. Diversified-Multi-Stream Business Farmer

These farms combine traditional agriculture with other activities such as food processing, agritourism, renewable energy, or direct sales. Diversification helps farms manage risks, stay resilient, and increase profitability. It is increasingly adopted among the farmers we met because it provides safety against unpredictable conditions. Farmers who choose to diversify show entrepreneurial adaptability, which helps them to add new activities and create extra income, especially in targeting niche or premium markets.

Table A- 3. The Business Model Elements of Multi-stream Business Famers.

Business Model Element	Details
Customer Segments	Local artisans and consumers, tourists, niche retailers, neighboring farmers, energy buyers
Value Propositions	Differentiated, local/artisanal products, on-farm experiences, energy production, farm services
Channels	Farm shops, local markets, online, tourism platforms, short channels
Customer Relationships	Personal, trust-based, storytelling
Revenue Streams	Products sales, agrotourism, processing, energy sales, service fees, grants
Key Activities	Direct sales, product innovation, hosting visitors, energy production, farm services, marketing
Key Resources	Land, processing equipment, tourism & energy infrastructure, skills, brand, network
Key Partners	Local network, tourism partners, cooperatives, energy companies
Costs	High labor, marketing, certification, tourism/energy infrastructure

1.4. Vertically Integrated Farmer

Vertically integrated farms manage various components of the value chain, from animal husbandry to processing, packaging, distributing and/or direct sales. This approach allows farmers to earn higher margins and build stronger relationships with their customers. However, it requires investing more capital and managing additional operations. These farms are well-positioned to integrate new processes into their value chains, potentially developing more product lines.

Table A- 4. The Business Model Elements of Vertically Integrated Farmers.

Business Model Element	Details
Customer Segments	Depending on scale: End-consumers, supermarkets, food service, exporters
Value Propositions	Full traceability, quality control, competitive pricing, brand reliability
Channels	Own brand, direct sales or delivery, B2B contracts
Customer Relationships	Brand loyalty, long-term contracts
Revenue Streams	Product sales, branded goods, margin from processing

Key Activities	Production, processing, branding, distribution, compliance
Key Resources	Infrastructure, capital, brand, logistics system, labor
Key Partners	Retailers, distributors, logistics, packaging, banks
Costs	High capital investment, maintenance, compliance, marketing, distribution

1.5. Agroecological Farmer

These farms focus on sustainability, animal welfare, and ecosystem health, often earning organic or agroecological certifications. They serve premium markets and rely on public subsidies. They are smaller in scale and output but obtain higher margins from livestock sales, as well as revenues from ecosystem services. The philosophical alignment with sustainability makes CM both attractive and controversial: some see it as a complement to ecological values, while others view it as divergent from natural farming traditions.

Table A- 5. The Business Model Elements of Agroecological Farmers.

Business Model Element	Details
Customer Segments	Ethical consumers, niche markets, organic buyers, local community
Value Propositions	Environmental stewardship, biodiversity, animal welfare, chemical-free, circularity
Channels	Farmers' shops, cooperatives, online, organic stores
Customer Relationships	Strong community ties, transparency, education
Revenue Streams	Premium pricing, agri-environmental subsidies, ecosystem services fees, carbon payments
Key Activities	Rotational grazing, low-input farming, biodiversity monitoring, education
Key Resources	Biodiverse land, ecological knowledge, reputation, ecosystem services, certifications, heritage breeds
Key Partners	NGOs, local governments, research orgs, certification bodies
Costs	Low inputs, labor-intensive, longer cycles, lower density, certification costs

1.6. Contract Farming Specialist

These farms work under contract for integrators or processors. They benefit from market security and technical support but have restricted autonomy. They must follow set rules and aim for high performance. Any new production depends on what the contracting company wants.

Table A- 6. The Business Model Elements of Contract Farming Specialists.

Business Model Element	Details
Customer Segments	Integrator as sole buyer
Value Propositions	Guaranteed supply, volumes, timing, and standardized quality
Channels	Direct line with integrator
Customer Relationships	Secure and long-term contract, performance-monitored
Revenue Streams	Livestock sales under contract, performance-based
Key Activities	Animal care, protocol compliance, performance monitoring
Key Resources	Dedicated, specialized facilities, labor, contract agreements

Key Partners	Integrator who dictates input supply and protocols
Costs	Debt, energy, maintenance, dependency risk

1.7. Traditional Farmer

These small-to-medium family farms are built on long-standing traditions. They focus on quality, local distribution, and keeping their culture alive. They are slow to adopt new technology and mainly sell traditional products to customers who value authenticity.

Table A- 7. The Business Model Elements of Traditional Farmers.

Business Model Element	Details
Customer Segments	Local traders, auction market, slaughterhouse, small coops
Value Propositions	Local breeds, community ties, authenticity, cultural continuity
Channels	Local retailers, small cooperatives, neighbors
Customer Relationships	Personal, informal, trust-based
Revenue Streams	Livestock sales, small subsidies
Key Activities	Small-scale and low-input husbandry, multi-product production, seasonal breeding
Key Resources	Small land, family labor, traditional knowledge, local heritage breeds
Key Partners	Local coops, neighbors, local vets, family networks
Costs	Low investment, low margin, family labor, vet

1.8. Multi-site Agribusiness Entrepreneur

These are medium-to-large-scale businesses structured across several production sites, managed via centralized systems. They coordinate production at local or regional scale, mixing ownership and partnership models. Technology adoption, risk management, and professional management are common.

Table A- 8. The Business Model Elements of Multi-site Agribusiness Entrepreneurs.

Business Model Element	Details
Customer Segments	Large processors, integrated companies or coops, exporters
Value Propositions	Scale efficiency, consistent supply
Channels	Processors, B2B contracts
Customer Relationships	Corporate B2B
Revenue Streams	Livestock bulk sales, economies of scale
Key Activities	Multi-site production coordination, monitoring, optimization
Key Resources	Multiple locations, IT/analytics, capital, workforce, management team
Key Partners	Feed suppliers, pharma/vet services, financial institutions, contractors, logistics suppliers
Costs	Site acquisition, management overhead, logistics, IT systems, cost of production (feed, energy, vet/pharma)

1.9. Industrial Scale Farming Business

Industrial scale models are owned or managed by corporations. They are highly mechanized and oriented towards commodity markets and maximum production. They are technology-driven leaders and potentially well-positioned for new technology adoption, provided return on investment is favorable.

Table A- 9. The Business Model Elements of Industrial Scale Farming Businesses.

Business Model Element	Details
Customer Segments	Major processors, large retailers, exporters
Value Propositions	Large volume, standardized quality, reliability, efficiency, price competitiveness
Channels	Long-term supply contracts, direct to retailers, export
Customer Relationships	Transactional, volume-based, specifications-driven
Revenue Streams	High volumes of sales, co-products, subsidies
Key Activities	Intensive feeding, genetic selection, health management, logistics
Key Resources	Capital, infrastructure, automation, labor, feed, genetics, data systems
Key Partners	Feed suppliers, pharma/vet services, processors, banks
Costs	High feed (60-70%), energy, labor, maintenance, compliance, depreciation

1.10. Hybridization and model diversity

Among the 41 farmers in our sample, the most prevalent business models are Intensive Independent (10 farmers), Cooperative Integration (7), and Diversification (7). However, approximately two-thirds of the sample have integrated elements from multiple business models within their operations.

Each farmer is linked to a primary Business Model profile (Figure A-3). However, while assigning farmers to profiles, some were also found to correspond to a secondary profile. Figure A-4 presents the total number of farmers per Business Model, distinguishing between primary and secondary profiles.

This high adoption of mixed business models reflects a strong trend among the sample interviewed towards adaptability and resilience, in a context of growing uncertainty.

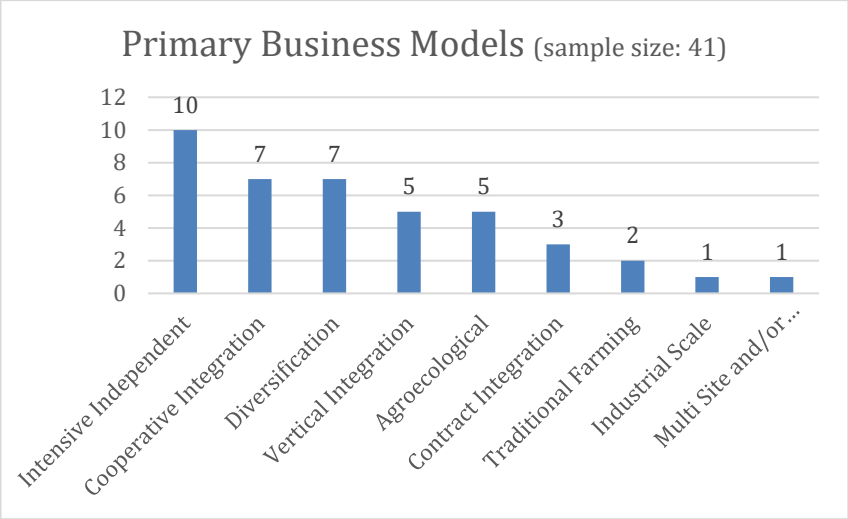


Figure A- 3. The total number of farmers per primary business model profile.

As shown in figure A-4, diversification emerges as the leading secondary strategy adopted by 10 farmers to mitigate risk and expand income streams. In total, 17 farmers utilize diversification, making it the most widely implemented strategy overall.

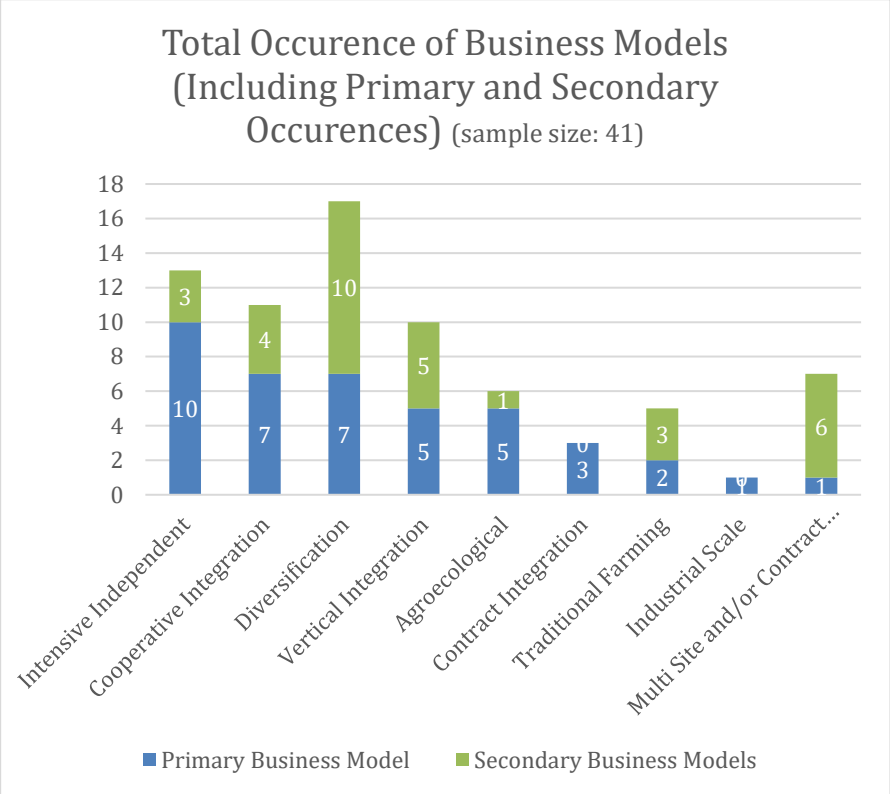


Figure A- 4. The total number of farmers per business model, distinguish between primary and secondary profiles.

2. Five strategic Personas

In addition to analyzing various business models, we have created five distinct profiles. These personas are developed based on the visions that farmers articulated regarding the future of their operations and their expectations for the next three to five years. The profiles represent a range of attitudes and motivations that shape how farmers plan for and perceive their future.

Teun de Jongh

Teun, a young farmer from the Netherlands, sees opportunity in every challenge. His vision centers on diversification, transforming a traditional dairy operation into a multifaceted hub that includes energy production, agritourism, and a local food shop. Teun is motivated by a desire for financial resilience and a life outside the constraints of commodity markets. With an entrepreneurial mindset, he actively seeks out new partnerships and innovative ventures, believing that risk can be managed through varied income streams. His farm thrives on adaptability and a dynamic approach to evolving market demands.

Source: Image generated by Google's generative AI model (Gemini) in response to a user prompt

2.1. The Independent Resilient Farmer

These farmers seek **autonomy, resilience and freedom** from external dependencies. They take steps to eliminate intermediaries and **diversify revenue** sources to **gain better control** over their future.

Core Vision	Autonomy, resilience, freedom from dependencies
Representative Quote	R001: "Cut intermediaries; diversify revenue; control our destiny"
Demographics	30-45, university-educated, entrepreneurial
Key Motivations	Independence and self-sufficiency
Strategic Initiatives	Direct sales & processing Energy production (solar, biogas, wind) Farm services (equipment rental, contracting) Brand development and premium product positioning Technology adoption for efficiency
Main Challenges	Limited bargaining power with processors and intermediaries Debt from diversification Complex operations across multiple lines Time management pressures
Technology Adoption	Open but cautious of dependencies

Source: Image generated by Google's generative AI model (Gemini) in response to a user prompt

Marco Russo

Marco operates a rapidly scaling farm in Italy, embracing the efficiencies of modern technology and a drive for growth. His vision centers on expanding herd size, automating operations, and integrating advanced data analytics to boost productivity. Regulatory compliance and cost control are constant priorities. Marco is motivated by competition and the pursuit of market leadership. He invests heavily in infrastructure, robotics, and precision agriculture, always searching for ways to streamline and scale. For Marco, the future of farming lies in smart management and technological innovation.

2.2. The Strategic Consolidator

These farmers aim to **expand and modernize** their operations for **higher efficiency and output**. Treating farming as a scalable business, they pursue operational advantages through investment and technology, growing via acquisitions or multi-site development for lasting market presence.

Core Vision	Growth through calculated consolidation, modernization and operational excellence. They want to expand, increase herd for economies of scale, possibly acquire other farms.
Representative Quotes	R007: "Optimize costs, buy more land" R008: "Expand to economies of scale; maybe a second farm" R039: "Acquisitions, reaching 10.000 sows"
Demographics	Business-focused, strong financial management
Key Motivations	Competitive advantage through size and efficiency
Strategic Initiatives	Expansion through land/farm acquisition Development of multi-site operations Advanced automation and tech adoption (e.g.: AI, data analysis) Circular systems for resource efficiency Cost optimization and economies of scale
Main Challenges	High capital requirements and debt management Operational complexity at scale Risk of concentration in a single product type Potential disconnection from society expectations
Technology Adoption	Early adopter, efficiency-focused

Source: Image generated by Google's generative AI model (Gemini) in response to a user prompt

Maria Sokół

Maria manages a mid-sized farm in Poland, deeply rooted in principles of environmental stewardship. Her vision is to nurture the land through regenerative agriculture, creating a model that can influence broader farming practices. Maria emphasizes soil health, biodiversity, and community engagement, aiming for products that tell a story of sustainability and authenticity. She actively promotes breed conservation and is developing a regional brand that reflects her commitment to the environment. Maria's outlook is optimistic: She believes agriculture can be both profitable and restorative to the earth.

2.3. The Organic/Regenerative Steward

This profile regards **farming as both an environmental and social responsibility**. They focus on long-term ecological health and wish to influence sustainable practices across the sector. These individuals are motivated by sustainability, often lead in environmental initiatives and certifications, and align closely with the growing demand for eco-friendly products.

Core Vision	Environmental stewardship combining sustainability with economic viability. Aim to take care of soil and animals, reduce CO2 emissions, and impact society.
Representative Quotes	R017: "Regenerative farming; natural reserve; Better Leven certification 3 stars" R040: "Organic; Reduce CO2 by 30%; impact society locally and nationally"
Demographics	Values-driven, systems thinkers
Key Motivations	Long-term ecological sustainability
Strategic Initiatives	Organic /regenerative practices Reduced-input systems Breed conservation Carbon sequestration Premium positioning
Main Challenges	Transition costs Market development complexity Balancing ideals with economics
Technology Adoption	Selective, must align with values

Daniel Jensen

Daniel, a Danish farmer, reimagines agriculture as a path to a balanced and fulfilling life. His vision is to optimize operations not just for profit, but for personal well-being and team morale. Daniel limits expansion, automates labor-intensive processes, and cultivates a culture of care on the farm. He views farming as a vocation that should enrich daily life, creating space for family, creativity, and health. Driven by the belief that quality of life is integral to farm sustainability, Daniel plans a future where work and happiness coexist harmoniously.

2.4. The Lifestyle Optimizer

This profile focuses on **achieving a balanced lifestyle and maintaining financial stability and well-being**. They favor operational simplification over business growth.

Core Vision	Work-life balance with operational sustainability
Representative Quotes	R013: "Better lifestyle; less operations; more free time; no growth" R021: "No more growth; consolidate; remain independent"
Demographics	Approaching retirement or succession
Key Motivations	Personal well-being over expansion
Strategic Initiatives	Technology for reduction of extensive physical labor and timesaving Avoid debts, minimize financial risks Operational consolidation rather than expansion Succession planning Focus on stability
Main Challenges	Succession uncertainty Balancing lifestyle goals with business viability
Technology Adoption	For simplification only

Source: Image generated by Google's generative AI model (Gemini) in response to a user prompt

Louise Moreau

Louise is a multi-generational farmer in France, deeply committed to preserving the heritage of the family farm. Her vision prioritizes continuity: maintaining a viable operation for future generations, passing down knowledge, and honoring time-honored practices. Louise is wary of risky investments, preferring incremental improvements that sustain the farm's health and community ties. Succession planning is central: Louise seeks to ensure the next generation is prepared for stewardship. For her, farming is as much a way of life as a business, rooted in tradition and stability.

2.5. The Heritage Custodian

This profile is characterized by **a strong dedication to maintaining farming traditions**, family continuity, and local identity.

Core Vision	Preserving agricultural heritage and family legacy
Representative Quotes	R012: "To go forward we must look backward; family; tradition" R015: "Breed conservation; DOP niche" R030: "No growth and no debts, keep small family farm"
Demographics	Traditionalists, deep community roots
Key Motivations	Continuity of heritage and cultural practices
Strategic Initiatives	Traditional methods Integrated operations Community engagement Quality over quantity Heritage breed conservation
Main Challenges	Pressure from efficient competitors Finding committed workers and successors Balancing heritage with adaptation Limited economies of scale
Technology Adoption	Traditional methods preferred

3. Adoption drivers and barriers for farm-based cultured meat

Our research identified patterns in what could motivate or discourage farmers from considering CM adoption. There are existing barriers, but the drivers align well with current farmer challenges and future goals.

3.1. Key adoption drivers

European livestock farmers face various challenges; some of the challenges could present a basis for alignment with the opportunities that CM has the potential to provide. The research identified eight primary drivers that could motivate farm-based adoption:

Table A- 10. The Key Adoption Drivers for Farm-Based Cultured Meat.

Opportunity Area	Predicted Impact of CM on Farmers	Key Details/Driver
Economic Stability Through Diversification	Provides additional revenue streams and economic stability.	Farmers struggle with low margins and price volatility. CM could become an extension for existing multi-activity businesses fitting risk managements strategies.
Labor Shortages and Automation	Offers a solution to workforce issues due to compatibility with automation.	Farmers find it hard to recruit qualified workers. The technological process may also attract younger, skilled workers to rural areas.
Regulatory Opportunities	Can provide an option to reduce farm's environmental impact and comply with regulations (GHG, nitrogen, animal welfare).	Farmers worry about excessive environmental pressure and prohibitive regulations. Integrating CM production may allow to maintain agricultural activity while complying with minimal changes.
Farmers Reputation Enhancement	Helps position farmers as environmental innovators and tech leaders.	Farmers are concerned about declining social status and negative public perception (e.g., being unfairly targeted as animal oppressors). Joining CM initiatives counters this.
Infrastructure Adaptability	Option to repurpose existing buildings and infrastructure for CM production.	Many farms have infrastructures needing modernization. Repurposing reduces barriers to entry compared to building entirely new facilities.
Market Access and Premium Positioning	Creates an opportunity to differentiate products and potentially achieve premium pricing.	Farmers engaged in direct-to-consumer or premium markets could see "farm-grown cultured meat" as strengthening customer relationships and enabling premium positioning.
Innovation Appetite	Appeals to younger, educated, and entrepreneurial farmers who seek competitive advantages.	A segment of farmers (mainly 30-45 years old) already engaged in diversification views new technologies as opportunities rather than threats.
Policy Support Alignment	Creates opportunities for grant funding, modernization support, and subsidies.	CM aligns with existing EU policy priorities around innovation, sustainability, and rural development.

3.2. Key adoption barriers

Despite the driving factors, farmers also face issues that could negatively affect their participation in this emerging sector. The study determined seven potential barriers that would require addressing in order to ensure farmers' inclusion in CM production:

Table A- 11. The Key Adoption Barriers for Farm-Based Cultured Meat.

Challenge Area	Specific Concern for Farmers	Key Details/Implication
Financial and Investment Challenges	High levels of existing debt create financial barriers.	Farmers are concerned about the necessary investments required for CM production and the uncertain nature of the returns.
Skills Gap and Technical Complexity	Lack of required biotechnology expertise and new skill sets.	Farmers would need to understand "cell culture techniques" and manage sterile production environments. Current agricultural education systems do not yet provide relevant training.
Infrastructure Requirements	Concerns over biosecurity risks and contamination controls.	Farms currently lack the precise environmental control needed. Some existing buildings may be modified but new infrastructure may also need to be built.
Regulatory Uncertainty	Hesitancy to face more regulatory complexity without clear guidelines.	Current regulations do not allow the commercialization of CM. Farmers are already burdened by administrative tasks.
Cultural and Identity Concerns	Resistance due to a perceived inconsistency with the identity of traditional food producers.	Farmers focused on heritage and "natural processes" may resist CM technology, viewing it as artificial or industrial.
Market and Consumer Acceptance	Uncertainty about how consumers will react to CM products.	Farmers question market development and consumer acceptance of cultured products sold alongside traditional offerings.
Supply Chain Adjustments	Need for adjusted supply chains (e.g., growth media, technical support).	Rural areas often lack access to specialized suppliers and technical services, which may create operational challenges.

3.3. Regional and demographic patterns

The research revealed distinct patterns in adoption readiness:

- **Geographic Variations**: Northern European farmers showed greater openness to CM. This is particularly true in the Netherlands and Germany. This likely reflects higher agricultural innovation rates, more developed biotechnology sectors, and different regulatory environments.

- **Age and Education**: Farmers aged 30-45 with university education demonstrated highest interest levels. This demographic combines sufficient farm experience with openness to innovation. They also have longer planning horizons.

Part 4 – On-Farm cultured meat integration: adoption framework

1. Next steps: from listening to action

While farmers could engage in CM in multiple roles[36], for example, as input (e.g.: cells, ingredients for growth media) or ingredient suppliers for CM products, the focus here is specifically on on-farm integration, which falls within the scope of the CM Farm Blueprint (D4.7). Because on-farm CM production has never been implemented before, a structured process, from engagement and co-development to demonstration and eventual replication, is required to generate the practical, technical, and economic insights needed for informed adoption.

The path from transition to action therefore requires the dialogue to progress into a practical pilot project. Our aim is to create a pathway for on-farm CM integration that supports farmers and is driven by them. Our approach is guided by the previous farmer engagement and research experience, as well as the Design Thinking guidelines. It relies on several key steps:

- Engage with farmers to unveil their needs
- Co-develop solutions, making them drive innovation and influence their peers.
- Demonstrate technical and economic feasibility through demonstration farms.
- Provide policy makers with unbiased information to help build supportive policy frameworks.
- Prepare industry collaboration models for mainstream adoption.

Over the next years, this strategy requires moving beyond assumptions and theoretical models. Developments should take on-farm CM integration from farmers' workshops, functional blueprints and prototypes to tested models that are ready for broad implementation. Constant farmers' engagement will be necessary to provide robust technical, economic and regulatory models.

1.1. Framework: The Technology Adoption Curve

Our engagement strategy is built on the Technology Adoption Curve. It is a well-established framework by Everett Rogers explaining how new technologies spread through populations.

[36] MacMillan, T.C., Lewis, K., Dooley, J.J., Morgans, L.C., Sexton, A.E., Ali, M., Allan, S., Argyle, I., Dunsford, I., Goodman, M.K., Lynch, J., Manning, L., Ranawana, V., Rose, D.C., Rothman, R., Sibly, W., Vasilopoulos, A., Wylie, A. (2024). Culture Clash? What cultured meat could mean for UK farming. Transforming UK Food Production. July 2024

This model recognizes that different groups adopt innovations at different rates, based on their tolerance to risk, resources and values[37].

The Five Adopter Categories include:

- **Innovators (2-3%):** They are the risk-takers and technology enthusiasts who embrace new ideas first, often before they are fully proven. Innovators are willing to experiment and can tolerate initial failures.
- **Early Adopters (10-15%):** They are opinion leaders who adopt innovations early but are more careful than innovators. Their success stories influence others and make technology socially acceptable.
- **Early Majority (25—35%):** In the context of farming, they are the pragmatic farmers who adopt innovations once they see clear evidence of success. They need proof before committing resources but are open to change if it makes sense for their business.
- **Late Majority (30-40%):** In our context, they are the conservative farmers who adopt innovation when it becomes mainstream and social pressure mounts. Late majority requires extensive evidence and prefers to minimize risk.
- **Laggards (15-20%):** These are the traditional farmers who resist change, due to philosophical beliefs, age, or satisfaction with current methods. They may never adopt or only do it if absolutely necessary.

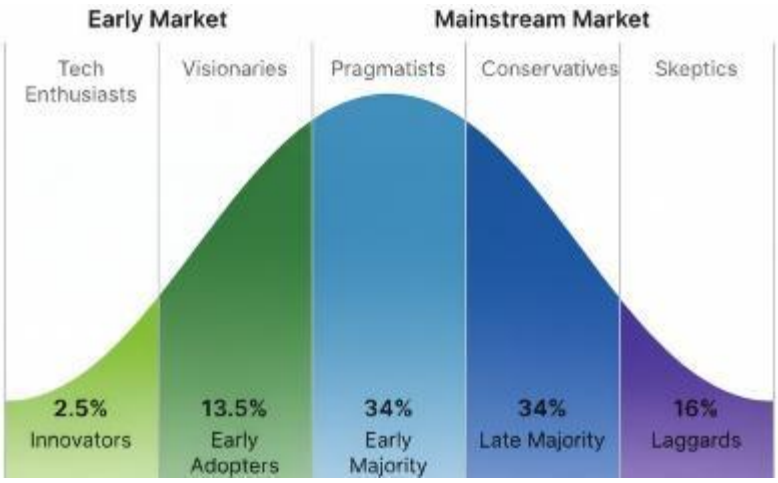


Figure A- 5. The technology adoption curve.

Understanding these adoption patterns is important for on-farm CM integration. Building momentum should be done strategically. Engagement should take place with the right profiles of farmers at the right time, and with appropriate messaging and support. This helps

[37] Rogers, E. Diffusion of Innovations, 5th ed.; Free Press: New York, NY, USA, 2003. https://www.taylorfrancis.com/chapters/edit/10.4324/9780203887011-36/diffusion-innovations-everett-rogers-arvind-singhal-margaret-quinlan

to avoid wasting resources by trying to convert those who are not yet ready. This model also highlights the importance of leveraging peer influence when early adopters start demonstrating success to the early majority.

1.2. Adoption pathways

Integrating CM production on farms depends on recognizing that different farmers have different capabilities, motivations and timelines for transformation and innovation. In adapting CM integration for European farming, we analyzed business models and farmer personas to target high-potential groups: Innovators and Early Adopters.

1.2.1. Business models analysis

We assessed various business models to determine how they can adjust to integrating CM. We assume that integration potential depends on factors such as operational flexibility, capital, infrastructure, philosophy, and market position. Our analysis highlights business models that are best suited for early engagements versus mainstream adopters needing market maturity, and finally to the late majority facing philosophical or structural barriers. This approach provides a roadmap for strategic engagement and resource allocation.

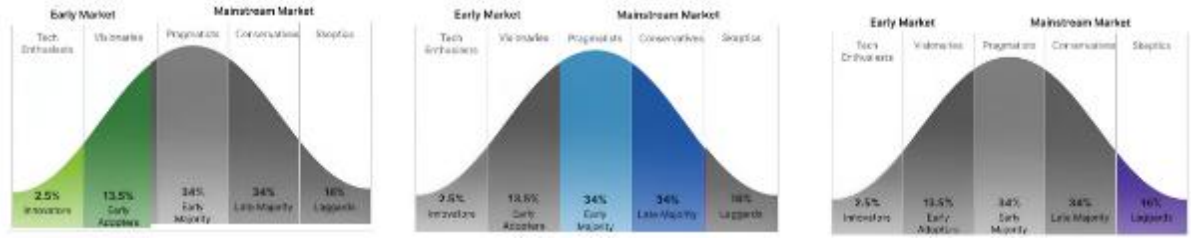


Figure A- 6. Different adopter groups.

<u>High potential business models for early market and early engagements:</u>

Based on the interviewed sample, we have identified that diversified farming, vertically integrated operations, and progressive agroecological farms could present potential early adopters of CM integration.

- ✓ **Diversified Farming** shows the strongest early potential for CM integration through entrepreneurial approach and multiple income sources (livestock, tourism, energy, DTC). These medium-scale farms are adaptable and open to innovation. Their niche market and direct-to-consumer channels provide entry points for premium CM products, requiring minimum operational change.

  <u>Positioning</u>**:** Target for small-scale bioreactor operations. Positioning should emphasize low additional investment, compatibility with existing diversification strategy and access to premium niche markets where CM is likely to obtain higher margins.

- ✓ **Vertically Integration** brings operational advantages as farmers control processing, distribution or retail channels. These operations can add CM as a premium product line within existing infrastructures, though investment costs in current facilities may limit adoption to specific product lines. We assume adoption is likely to occur among small or medium scale structures.
  Positioning**:** Frame CM as another integration opportunity. Focus should be on adding CM as a premium product line within the controlled value chain. Farmers will be able to leverage their existing processing and retail infrastructure for CM operations.

- ✓ **Agroecological Farming (Progressive)** aligns philosophically with CM's environmental benefits. Expertise in premium markets and sustainability communications positions these farmers to market CM as a resource-efficient alternative for environmentally conscious consumers.
  Positioning: Highlight environmental and sustainability benefits (reduced land use, lower emissions, resource efficiency) that are aligned with the agroecological values of the farmer and their consumers.

Business models likely requiring market maturity:

Our sample indicates that other models may find better opportunities for integration at a later stage. These types of businesses are likely to adopt CM after the technology has been validated, efficiency proven, and markets show acceptance. This approach fits their large operational scale and can help CM achieve mainstream adoption.

- ✓ **Industrial Scale Farming** operations are technology leaders, but they will likely adopt CM production when the market is ready to consume larger volumes. At this stage they could potentially equip several production facilities with CM production.

- ✓ **Cooperative Integration** relies on members consensus. This makes cooperatives adopters of mature technologies rather than pure innovators. Their strength is in collectively investing to scale proven technologies through shared infrastructure and established distribution networks.

- ✓ **Multi-site Agribusiness** may enable experimental CM integration at selected sites while maintaining traditional operations elsewhere. Professional management and site specialization are strong basis.

- ✓ **Independent Intensive Farming** shows variable potential depending on circumstances. Financial pressures and efforts to increase efficiency may both promote or hinder innovation and CM integration. These farmers will likely invest once technology is proven and scale advantages are ensured.

- ✓ **Contract Integration** depends on integrators' strategies. If integrators implement CM production within their networks and assume technology and market risks, contracted farmers could transition to bioreactor operation roles, creating rapid mainstream scale without individual adoption barriers.

Business Models with philosophical or structural barriers:

Other models have low potential for CM integration due to financial and philosophical barriers.

- ✓ **Traditional/Heritage Farming** has limited integration potential due to restricted financial resources and a focus on continuity and authenticity. For them, CM creates opportunities to position traditional products as heritage ones.
- ✓ **Agroecological Farming (Traditional)** shows philosophical resistance viewing CM as inconsistent with natural systems principles despite its orientation towards sustainability. We should recognize the incompatibility with these models, keep a respectful distance, and ensure they have access to accurate information.

1.2.2. Farmers Personas Analysis and Assumptions

This analysis ranks farmer personas by their likelihood to adopt CM technology, considering motivations and future outlooks. Farmers are clustered from high-potential innovators to traditional sceptics, providing a base for phased engagement.

High potential adoption Persona:

- ✓ **Independent Resilient Farmers** represent the highest potential for CM adoption due to their openness to diversification, entrepreneurial mindset, risk tolerance, desire for autonomous revenue streams and pragmatic approach to innovation. Their existing operations could potentially support new technologies with minimal adaptation.
  Positioning**:** Primary target for active co-development and early adoption pilots. CM production should be positioned as partnerships that brings further independence through economic advantages and further autonomous revenue opportunities.

- ✓ **Organic/Regenerative Stewards** can show interest through environmental benefits narrative (e.g.: reduced land use and emissions, integration with circular farming systems), research partnerships for sustainable methods, but also premium market development and alignment with carbon credits and environmental subsidies.
  Positioning**:** Environmental stewardship, highlighting ecological resilience, integration with regenerative practices, premium opportunities for conscious consumers.

Farmers Personas for mainstream adoption:

- ✓ **Strategic Consolidators** offer potential thanks to their access to capital for investment in infrastructure. Their business-focused mindset, long-term planning and focus on economies of scale are aligned with on-farm commercial scale CM production facilities.

- ✓ **Lifestyle Optimizers** require specific positioning around highly automated and minimal management systems, or passive income models to integrate with their goals of lifestyle simplification.
  Positioning**:** Reach when able to deliver low-maintenance solutions with automation and minimal day-to-day management.

Farmer Personas requiring respectful distance:

- ✓ **Heritage Custodians** require careful approaches emphasizing preservation of the family farm viability through additional income, minimal disruption to traditional operations, or economic necessity for generational transfer. Positioning**:** At later stage consider tradition-compatible approaches

2. Engagement strategy

2.1. Insights

Institutional vs. Individual engagement: Our research revealed a contrast in attitudes: agricultural institutions and unions remained largely closed to CM discussions, while individual farmers demonstrated openness and curiosity when presented with opportunities relevant to their farms. The finding suggests that engagement should prioritize direct contact with farmers, at least during early engagement phases. Rather than seeking validation from agricultural organizations, the strategy focuses on building farmer-to-farmer networks and demonstrate practical value through pilot projects.

Early Adopter profile and co-creation opportunities: Approximately 10-15% of interviewed farmers showed active follow-up interest. These farmers tend to be younger (aged 30-45), university-educated, entrepreneurial, and already engaged in diversification strategies. Most importantly, they view CM as a possible revenue opportunity. Their combination of skills, willingness to take risks, and innovation mindset positions them to provide good insights into challenges and practical solutions.

Farmer diversity requires segmented strategies: The nine business model typologies and five persona profiles identified in our research demonstrate considerable farmers heterogeneity. This diversity demands segmented approaches to each group's motivations, capabilities and readiness level.

2.2. Recommended engagement by innovation segments

The engagement strategy for on-farm CM adoption targets distinct farmer groups.

For the period 2025–2028, strategic efforts should prioritize innovators and early adopters through active co-creation during the early stages.

These younger and educated entrepreneurial farmers are already engaged in diversification and sustainability initiatives. They represent natural first partners for CM co-creation and pilot projects. They demonstrate the characteristics identified in our research (age 30-45, higher education, entrepreneurial mindset, existing diversification experience, and moderate financial stability). Engagement Approach: Deep co-creation and active partnership. Key activities include design thinking workshops, technical training programs, advisory panel participation, pilot project implementation, peer champion development.

Table A- 12. Strategic Target and Goals 2025-2028, Prioritizing Innovators & Early Adopters.

Innovation Segment	Engagement Stage / Goal	Target Farmer Personas & Business Models	Engagement Activities	Expected Roles & Outcomes	Timeline
Innovators & Early Adopters (2–15%)	**Active Co-Creation – Early Stage**	**Business Models:** - Adaptive/Diversifying Farmers - Agroecological Farmers - Vertically Integrated (small-medium scale) **Personas:** **- Independent Resilient Farmers** (age 30–45, higher education, entrepreneurial, diversification experience, moderate financial stability) **- Organic/Regenerative Stewards** (environmentally motivated, circular system mindset)	- Design thinking workshops - Technical training programs - Advisory panel participation - Pilot project implementation - Peer champion development - Blueprint co-creation sessions	**Most important partners at early stage**: blueprint co-creators, technology validators, farmer ambassadors influencing broader adoption, and proven operational models.	**2025–2028**

The **early majority** will participate after 2028, when pilot successes, requiring proof, learning opportunities, and risk assessment.

Table A- 13. Strategic Target and Goals After 2028 Regarding the Early Majority.

Innovation Segment	Engagement Stage / Goal	Target Farmer Personas & Business Models	Engagement Activities	Expected Roles & Outcomes	Timeline

Early Majority (~34%)	**Participation upon Pilots Completion**	**Business Models:** - Cooperative Farmers - Corporate/Integrator Farmers - Vertically Integrated - Industrial/Intensive Farmers (cost-sensitive adopters) - Multi-site Agribusiness Operators **Personas:** - **Strategic Consolidators** (pragmatic, business-focused, capital-strong, connected) - **Lifestyle Optimizers** (seek automation and low-maintenance income)	- Study tours to pilot farms - Business case dissemination - Technology demonstrations - Learning workshops - Peer network access - Risk-benefit analysis sessions - Financing options presentation - Regulatory clarity briefings	**Evidence-based participation:** informed and investment-ready farmer base, expanded network of potential adopters, and feedback on scalability and financing requirements.	**2028+**

The **late majority**, more cautious, will be informed through trusted channels to develop understanding and reduce resistance.

Table A- 14. Strategic Target and Goals After 2028 Regarding the Late Majority.

Innovation Segment	Engagement Stage / Goal	Target Farmer Personas & Business Models	Engagement Activities	Expected Roles & Outcomes	Timeline
Late Majority (~34%)	**Build Awareness and Acceptance**	**Business Models:** - Traditional Family Farms - Cooperative Farmers (risk-averse participants) - Agroecological Farmers (traditional) **Personas:** - **Lifestyle Optimizers** (conservative group, prefer proven simplicity) - **Heritage Custodians** (tradition-oriented, open to complementary income)	- Agricultural publication features - Cooperative meeting presentations - Industry conference sessions - Factual information campaigns - Concern-addressing forums - Open dialogue channels - No-pressure information sharing	**Largest segment:** reduced resistance to CM development, informed farmer base capable of future adoption decisions, maintained social license for innovation.	**2028+**

Laggards, unlikely to adopt, will be engaged respectfully with minimal direct contact, focusing on information access and support for their traditional role, ensuring coexistence and agricultural diversity from 2030 onwards.

Table A- 15. Strategic Target and Goals After 2030 Regarding Laggards.

Innovation Segment	Engagement Stage / Goal	Target Farmer Personas & Business Models	Engagement Activities	Expected Roles & Outcomes	Timeline
Laggards (~16%)	**Respectful Distance and Coexistence**	**Business Models:** - Traditional Family Farms (heritage-oriented) - Industrial/Contract Farmers (locked into existing value chains)	- Minimal direct engagement - Accurate information access - Respectful dialogue maintenance - Acknowledgment of	**Respect for diversity:** reduced active opposition, recognition of the right to non-adoption, coexistence	**2030+**

	Personas: - **Heritage Custodians** (deeply traditional, value stability, protect family legacy)	traditional agriculture role - Support for non-adoption rights - Coexistence framework communication	between traditional and innovative farmers, preservation of agricultural diversity.

3. Implementation by Respect Farms

3.1. FEASTS project scope and activities (2024-2026)

Within the FEASTS project timeline, the immediate objective focuses on co-creating a CM farm overview with innovators and disseminating findings to wider audiences of farmers, policy makers, and industry stakeholders.

Phase 1: CM Farm overview development (Q3 2024-Q2 2026)

Objective	Develop functional models for integration of CM production into existing farm operations through collaborative design with farmer innovators.
Key Activities	**Prototype Infrastructure Planning (Q3 2024–Q4 2025):** Technical feasibility assessment, infrastructure, and equipment requirements mapping with the engineering team and consultants. **Co-creation Workshops (Q4 2025–Q1 2026):** Design thinking workshops, business model canvas exercises, and collaborative blueprint development with farmer innovators. **Participants**: 15 Farmers Total: Five farmers who expressed interest, plus 10 additional innovation-oriented farmers identified through the RespectFarms or FEASTS extended network.
Deliverable	**Farm-based** CM **overview document** (subject to agreement with the team).

Phase 2: Knowledge dissemination (Q3 2026 onwards)

Target Audiences	Agricultural researchers, policymakers, industry stakeholders, cellular agriculture industry, farmers, and broader farming community across Europe.
Communication Formats	**Policymakers and farmer-friendly materials**: Online resources, reports, infographics ensuring accessibility to diverse audiences with varying technical backgrounds.
Distribution Channels	Website page, industry conferences, policy briefings.

3.2. RespectFarms activities beyond FEASTS (2025-2028)

As a system integrator, RespectFarms' role extends beyond FEASTS research scope to translate insights into operational pilots and scalable implementation models.

Phase 3: Pilot implementation (2025-2028)

Farm development program

Objective	Create real-world demonstrations of farm-based CM production that validate technical feasibility and business viability.

Implementation	RespectFarms is partnering with one committed farmer from the innovation segment to establish the first pilot facility. RespectFarms will provide technical support, coordinate with technology providers, facilitate financing arrangements, and document lessons learned for broader application.

Farmer advisory panel

Objective	Engage with advisory groups aligned with different business model types identified in research to test pilot adaptability across diverse farming contexts.
Implementation	Technical visits to existing CM facility. Collaborative workshops with farmer innovators focusing on business model development, financial models and ROI, regulatory compliance, risk assessments and infrastructure planning.

Phase 4: Network expansion (2027 onwards)

Workshops series with early adopters

Objective	Expand engagement beyond initial innovators to build broader network of potential adopters and refine implementation models
Participants	Pilot farmers, potential adopters, technology providers, researchers, policy representatives
Implementation	**Focus on practical problem-solving, peer learning, and continuous improvement of farm-based models**: Technical challenges and solutions Business model refinement Market development strategies Regulatory navigation Financing mechanisms Consumer communication

Farmer community development

Objective	Build community that shares experiences, build trust in CM adoption, and develops organic influence networks within agricultural communities
Participants	Pilot farmers, potential adopters
Implementation	Online knowledge-sharing platforms Study tours Regional sub-groups Mentorship programs connecting pilot farmers with potential adopters

4. Conclusion: from dialogue to demonstration

This strategy recognizes that on-farm CM adoption will not happen uniformly across European agriculture. By focusing initially on innovators, building tailored engagement strategies for different farmer segments, and creating visible proof-of-concept projects, we aim to establish

solid foundations for farmer-driven adoption that enable those ready for innovation to co-develop and lead the way.

Within the FEASTS project, the intended result is a functional overview of the CM farm, which informs various groups of stakeholders (farmers, policy makers, industry actors, researchers) of the real possibilities and practical considerations of on-farm CM production. This overview will provide the knowledge foundation necessary for informed decision-making across Europe's agricultural and policymaking landscapes.

By the end of the decade, the goal is to be an operational pilot CM farm that demonstrates how this technology can support rather than marginalize farming communities. Through this demonstration model, on-farm CM technology will be known, tested and ready for adoption by more farmers who see alignment with their business models, values and aspirations across Europe.

This progression from dialogue to demonstration and replication must ensure that CM developments understand the reality of farming and create genuine opportunities for those farmers ready to innovate and ultimately contributing to a more sustainable and resilient European food system.

Part 5 – Implications for implementation

We expect the integration of CM production on farms to follow a Technology Adoption Curve, with 10 to 15% of entrepreneurial farmers who are likely to act as early adopters. These innovators may serve as demonstration sites and may encourage broader acceptance among the livestock sectors.

However, the drivers and barriers cited earlier in the report indicate that success will depend on several factors. First, financial uncertainty must be reduced, and this requires innovative financing solutions and risk-sharing models. Policy support, especially for infrastructure investment will be essential. Second, technical capacity among livestock farmers must be built. This can be done by developing training programs and encouraging transfers of knowledge among farmers. Conversely, technology needs to adapt to farmers' needs and the farm-specific infrastructure prior to being integrated. Developing robust, easily operated and maintained bioreactors and accompanying equipment, which address the farmers' needs and capacities, is essential. Third, regulatory certainty and clear guidelines for on-farm CM production must be provided by the European Union. Finally, CM markets must be developed, which will require consumer education initiatives.

1. Implications for EU policymakers

Farm-based CM is an opportunity for policymakers to achieve several policy objectives simultaneously. By enabling farmer participation in this emerging sector, policymakers can strengthen food security and sovereignty while potentially meeting climate targets. Farmers are the backbone of European food systems and rural economies; they must remain central to food production and innovation. This will ensure Europe can both maintain control over food production capacity and develop rural economic capabilities.

Regulation can support or restrict farm-based cultured meat: The integration of CM into farming is feasible, but success will depend on supportive EU policy frameworks. Without helpful policies, CM is likely to concentrate on industrial facilities controlled by large corporations and farmers will be left out. This would weaken Europe's decentralized food production system and reduce food security. Policymakers must proactively create clear and accessible ways for farmers to participate and ensure that the benefits of this technology are not monopolized by large corporations to the detriment of rural communities.

Economic Drivers: Farmers are under pressures with low profits, unstable prices, powerful buyers, regulatory costs, and labor shortages. These pressures threaten the viability of family farms which are the foundation of EU food security. CM can address some of these challenges. It can offer new revenue streams and decrease animal disease risks, while relying on technology that can reduce the extent of imposing physical labor often essential to small farms. However, integrating CM production is a risky investment in a context where many farmers already carry heavy debt. Success will depend on innovative financing models and risk sharing mechanisms involving both policymakers and industry partners. Supporting farmers in this transition helps protect Europe food sovereignty and production capacity.

Policy Integration Opportunity: Farm-based CM production has a strong potential alignment with EU priorities. Not only can it support the Green Deal emission reduction goals and the Farm to Fork sustainability agenda, but also the rural innovation strategies. This technology can help reinforce food security and sovereignty by keeping farmers at the center of food production and innovation. However, for CM to have real impact, it should be included in rural development and climate transition policies rather than isolated in a biotechnology regulatory framework, separate from farming and food systems.

Recommendations for policymakers

1. **Design Farmer-Friendly Regulatory Pathways:** Establish clear regulatory frameworks for on-farm CM production that recognize farms as potential novel food production facilities. Create "regulatory sandboxes" allowing pilot projects to operate under experimental permits while maintaining safety oversight. Ensure proportional requirements that do not exclude smaller-scale or cooperative ventures.

2. **Expand Financial Support Mechanisms**: Create a fair and level-playing field where farmers adopting CM production are not excluded from agricultural subsidies. Redesign Common Agricultural Policy to classify CM infrastructure as eligible modernization investments. Extend Rural Development Programmed funding to cover CM farm construction and equipment. Create specific innovation grants for farmer-led cellular agriculture projects and develop risk-sharing financial instruments that can combine EU funds with private investment. Finally, ensure that farmers who integrate CM production can retain access to existing agricultural support schemes as they should not be penalized for innovation.

3. **Build Education and Fund Farmers Training**: Fund farmers training to develop necessary technical competencies in biotechnology, automation and clean production. Integrate cellular agriculture into agricultural education at all levels such as university programs as well as education for practicing farmers. Support farmer knowledge transfer initiatives such as peer networks and demonstration farms.

2. Implications for industry stakeholders

For CM startups, established processors, and technology providers, partnering with farmers offers many advantages. Farmers bring production capacity, infrastructure, consumer trust, and local market access across Europe. They provide social legitimacy and authentic storytelling that industrial players cannot match. The “farm-grown” narrative helps differentiating products in premium markets and building consumer acceptance in ways that “lab-grown” products can’t achieve. In the future, industry will need farmers to produce at scale and farmers will need industry to access technology and markets. The early stage is an opportunity to create collaborative models that benefit both sides.

From Supply Chain to Partnership Models: Farmers currently lack the skills, technology, and financial flexibility to transition to CM on their own. Adoption of this new technology will depend on building trusted partnerships that share both risk and reward. Therefore, the industry (both upstream and downstream) must move beyond the traditional procurement approaches and engage farmers as co-developers in these new value chains.

Infrastructure and Technical Support Requirements: Infrastructure represents a challenge but not in way many assume. Farms do not need sterile, pharmaceutical-grade cleanrooms for CM production. Success will depend on practical solutions that are suited to agricultural settings: modular bioreactor systems designed for farm environment, cooperative-owned facilities, or regional hubs providing shared production or transformation capacity.

Farmers also need technical support. This includes maintenance services, biotechnology training, transformation and logistics solutions. Industry must develop turnkey approaches that minimize complexity while ensuring production quality and safety standards.

Market Development Through Authentic Storytelling: Farmers see opportunities to strengthen their reputation through participation in sustainability-focused innovations. Industry should leverage farmer authenticity in market development, positioning products as "farm-grown CM " rather than "lab-grown" alternatives.
This framing builds consumer trust while providing farmers with premium market access and enhanced social positioning. Most importantly, it differentiates farm-based products from industrial commodity CM, allowing higher prices and stronger consumer loyalty.

Recommendations for industry

1. **Design Farmer-Appropriate Technology Solutions**: Develop robust, easy-to-maintain bioreactor systems specifically for agricultural environments. Create turnkey solutions integrating with existing farm management systems and practices. Focus on modular approaches allowing incremental adoption rather than complete operational transformation.

2. **Lower Barrier-to-Entry**: Technology must be accessible and affordable. If upfront costs are too high, most farmers will be excluded. Industry should prioritize reducing total system costs through standardization, shared infrastructure, and scalable designs that work for different farm sizes.

3. **Create Premium Market Positioning**: Partner with locally focused retailers and high-end restaurants to develop premium market segments. This positions farm-grown CM against industrial commodities. Premium positioning protects margins for both farmers and industry partners. Leverage farmer credibility and authenticity in marketing campaigns. Create transparency initiatives connecting consumers directly with producing farms. Emphasize environmental and welfare benefits. The farm connection is the competitive advantage.

4. **Build trust, don’t overpromise, stay realistic**: Farmers have long memories of industry partnerships that promised much and delivered little. Building credibility requires honest communication about timelines, challenges, and expected outcomes. Industry must be transparent about what is proven and what is still uncertain and share risks openly. Overpromising destroys trust and closes doors to entire farming communities.

3. Essential points

The transition to farm-based CM presents numerous opportunities for European livestock farmers, with its trajectory shaped by regulatory, economic, and social factors that influence the sector's development. To ensure that broader engagement and acceptance are achieved, it should be positioned as a step in the evolution of agriculture, rather than its disruption. This principle should guide all stakeholder actions on consortium, policy, and industry levels.

Policymakers and industry stakeholders play a crucial role in establishing frameworks that support farmer engagement, such as enabling regulations and collaborative business models that lower entry barriers and share potential benefits. If managed inclusively, the successful integration of CM into farming systems could contribute to rural economic diversification and sustainability, while also addressing environmental concerns associated with traditional livestock production.

However, without collaborative strategies, there is a risk that farmers may face exclusion or diminished viability, which could impact the resilience and decentralization of European food systems. Conversely, without farmer involvement, CM risks lacking social legitimacy. It is thus essential to foster trust by leveraging farmers' participation and aligning innovation with broader agricultural and sustainability goals.

The next steps should focus on implementing practical pilot projects with early adopters to demonstrate feasibility, build confidence, and lay the groundwork for wider adoption through transparent and collaborative approaches.

Source: Image generated by Google's generative AI model (Gemini) in response to a user prompt

B – AQUAFARMERS

Part 1 – Interview process and analysis

1. Study objectives

Aquaculture represents a highly diverse and rapidly evolving food production sector in Europe, yet its potential interaction with CSF has not received attention yet. Unlike livestock farming, where preliminary work on farmer perspectives and CM integration already exists, the aquaculture sector has not previously been studied in relation to its readiness, interest, or capacity to engage with cellular aquaculture. This creates a significant knowledge gap at a time when technological innovation, environmental pressures, and changing market expectations are reshaping the future of seafood production.

To address this gap, the aquaculture component of the study aims to build a foundational understanding of how aquaculture businesses operate, how they differ across regions and scales, and what conditions may shape their future engagement with CSF. The research was designed to capture the structural, economic, and strategic diversity of European aquaculture, providing the basis for meaningful dialogue and practical integration pathways.

Research with aquafarmers is structured around four main goals:

1) Map and characterize aquafarmers' business models across Europe;
2) Develop representative profiles of aquaculture enterprises by region and operational type;
3) Design engagement plans to foster dialogue and collaboration with cellular aquaculture actors;
4) Provide recommendations for applying these plans in future research, policy, and industry contexts.

Together, these objectives establish the first empirical baseline for understanding how the aquaculture sector might interact with emerging CSF technologies. This foundational work highlights knowledge gaps, identifies areas with high potential for collaboration, and supports FEASTS' broader mission of ensuring that cellular agriculture evolves in a way that is compatible with Europe's aquaculture communities.

2. Study context

Aquaculture is the controlled breeding, rearing, and harvesting of aquatic organisms, including fish, shellfish, and algae, in freshwater, brackish, and marine environments. It is a major global food production sector and, for the first time, surpassed capture fisheries in total aquatic animal production volume in 2022[38]. Production systems exhibit a high degree of variability and include open-water net cages, land-based recirculating aquaculture systems

[38] FAO, 2024 - Food and Agriculture Organization of the United Nations. (2024). *The state of world fisheries and aquaculture 2024: Blue transformation in action. Rome.* https://doi.org/10.4060/cd0683en

(RAS), flow-through systems (FTS), and pond systems for fish production, suspended and bottom culture for bivalves production. A wide range of species are farmed worldwide, but key ones include Atlantic salmon, trout, carp, tilapia, oysters, mussels, and clams.

In Europe, including both EU and non-EU countries such as Norway, Turkey, and the United Kingdom, aquaculture production was estimated at 2.87 million tones in 2023. Norway alone accounted for about 55% of this volume, almost entirely from Atlantic salmon farming. The European Union, although the largest global seafood market, produced only about 1.1 million tones[39]. Within the EU, Spain had the highest production, followed by France, Greece, and Italy (Fig.B-1).

In Europe, aquaculture production is divided into fish (85%) and mollusks (15%). The fish sector operates through distinct regional systems. In Northern Europe, including Norway, salmon and trout are the main marine cold-water species, produced mainly through intensive farming in open-water net cages in fjords, representing 67% of total European fish production. In Southern Europe, seabream and seabass are the main marine Mediterranean species, farmed offshore in open-water net cages, and, at a smaller scale, in pond systems installed in coastal waters, accounting for 19% of production. In Central and Eastern Europe, carp and rainbow trout are the main freshwater species, primarily farmed in pond systems and FTS, accounting for 14% of production[25]. Mollusks, mainly mussels from Spain and oysters from France, are produced in non-fed systems including long-line, rack, and bottom culture.

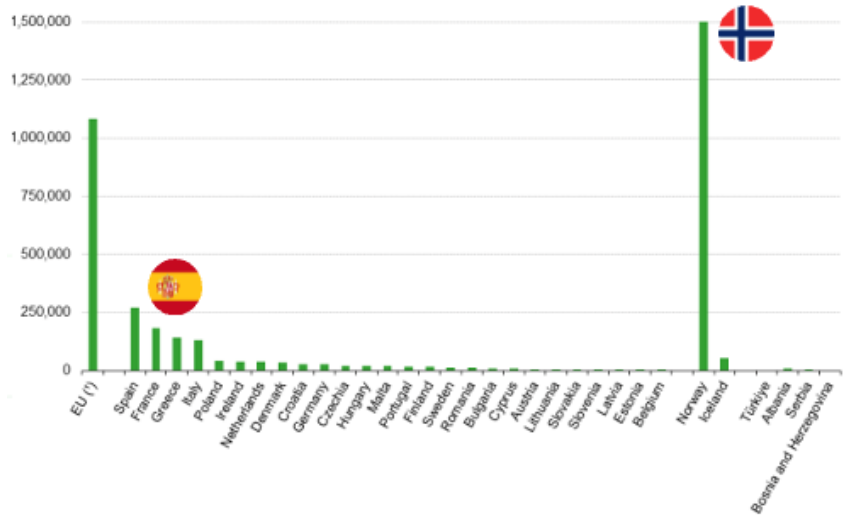


Figure B- 1. Aquaculture production in Europe in 2023 (tonnes of live weight).
Figure adapted from EUROSTAT (online data code: fish_aq2a)

[39] FEAP, 2024 - Federation of European Aquaculture Producers. (2024). FEAP production report 2017–2023. Retrieved from https://feap.info/data-home/data/

This distribution reflects two main operational models: large-scale, cold-water farming in Northern Europe and smaller-scale, coastal farming of warmer water fish and shellfish in Southern Europe[40].

3. Participants selection criteria and contacts

The sample selection was designed to provide comprehensive coverage of practices and conditions in European aquaculture and to be representative of the various production systems, species, and scales. Production systems covered open-water cages and land-based RAS, FTS, and pond systems for fish, and suspended/ bottom culture for bivalves. The sample also reflected species diversity, covering fish including salmon, trout, seriola, turbot, sole, seabass, seabream, as well as bivalves such as mussels, oysters, and clams. Companies of varying sizes were included, ranging from micro enterprises with fewer than 10 employees to large corporations employing over 250 employees. The sample further incorporated both centralized and multiple-site enterprises, as well as producer associations. Geographically, interviews covered producers from both Northern and Southern Europe, with a target of at least 24 interviews in total.

For the selection of candidates, a database of companies in the aquaculture sector was created. The contacts were obtained from S2AQUA's network, project consortium members, and online search. In total, 92 aquafarm companies were identified and contacted via email, followed by phone calls to non-responders. Contacts were divided into the South region—targeting Portugal (12 contacts), Spain (17 contacts), Italy (28 contacts), and France (4 contacts) – and the North region, which included Norway (18 contacts), Denmark (8 contacts), and the Netherlands (5 contacts). To boost participation, we also reached out to five aquaculture producer organizations: (1) the Aquafarmers Portuguese Association – APA; (2) the Technological Centre of the Aquaculture Cluster – CETGA; (3) the Dutch Association of Fish Farmers – NeVeVi; (4) the Italian Fish Farmers Association – API; and (5) the Federation of European Aquaculture Producers – FEAP. Out of all efforts, we secured 26 positive responses from companies willing to be interviewed (Fig. B-2). Specific details about these participating companies can be found in ANNEX-2.

[40] Altmeyer, 2024 - Altmayer, A. (2024). EU aquaculture: State of play (Briefing No. PE 762.336). European Parliament, European Parliamentary Research Service (EPRS). https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/762336/EPRS_BRI(2024)762336_EN.pdf

Figure B- 2. Number of aquaculture companies contacted and geographical location (North vs South Europe) of those that agreed to participate.

4. Interview design and implementation

The interviews were carried out to understand the different aquafarmers' business models, their environment, hopes, challenges, goals, and their vision for the future of aquafarming. The interviews were anonymized ensuring that all personally identifiable information was removed, making it impossible to trace the data back to individual participants. Prior to the interview, each participant was provided with this information through a consent form, which they were asked to read and sign before proceeding.

Each interview lasted approximately 90 minutes and was conducted in person – either at the companies' production sites or in their administrative offices located off-site – by Joana Rosa and Renata Gonçalves, both researchers at S2AQUA and active participants in Work Package 4, Task 4.5 of FEASTS project. In several instances, the interviews were complemented by guided visits to the production facilities, which provided additional insights into the

companies' operational contexts. No recording devices were used during the interviews, all records were taken in the form of notes. The interviews were held in English or Portuguese, depending on the context. The interviews followed a semi-structured format, using guided conversations rather than a fixed questionnaire. Discussions were organized around selected focus topics (ANNEX-3) and supported by an interview guide outlining core questions (ANNEX-5).

5. Key research areas explored

As for farmers, the interview content was examined using the following research tools:

- Business Model Canvas (BMC): a tool that provided a framework to map aquafarmers companies' business models, enabling understanding of their strategies and identifying common and divergent points among them.
- Persona Canvas (PC): a tool that aided in capturing the diverse profiles, motivations, and challenges encountered by interview participants.
- Context Map Canvas (CMC): a tool used to identify the influence of external factors on decision-making and operational realities of each aquaculture company.

The three canvas – BMC, PC, CMC – were populated with the information collected during each interview resulting in three canvas per participant company. In total, 78 canvas were produced and analyzed. Each canvas template is available for consultation in ANNEX-6.

Although discussing CSF was not an interview objective at this stage, several participants were already aware of the topic. This is because, prior to each interview, aquafarmers received an invitation describing briefly the FEASTS project and were provided with the project website, and they also received an informed consent form outlining the project's broader focus on emerging protein production systems, including CSF. As a result, some interviewees raised the topic spontaneously, offering initial views on opportunities and concerns. Notes were taken when CSF emerged naturally in the conversation, and these insights were used to inform the development of recommendations for the engagement strategies (Part 4). This topic will be addressed in depth during the roundtable implementation (Part 5).

6. Interview data analysis

Information collected from the canvases was first organized into a structured database, ensuring consistency in the treatment of qualitative and quantitative variables and facilitating subsequent analysis.

An initial exploratory analysis was then conducted to examine regional demographic and business characteristics. Descriptive statistics and graphical representations were used to compare broad trends between Northern and Southern Europe. Variables considered in this stage included the number of employees, employees' education level, company production

volume, and initial investment. These descriptive analyses served to highlight structural differences rather than to produce representative estimates.

To further explore inter-company patterns, particularly in relation to perceived opportunities and challenges, a binary-coded dataset was developed. For each participant, every opportunity or challenge was coded as 1 (mentioned) or 0 (not mentioned), resulting in two matrices (one for opportunities and one for challenges), each with one row per company and one column per category.

A Principal Component Analysis (PCA) was then performed separately for opportunities and challenges. Given the qualitative nature of the sample, PCA was used strictly as an exploratory visualization tool, not for statistical inference. Its purpose was to: (i) identify broad patterns in how companies grouped based on their reported opportunities and challenges, (ii) examine how these patterns related to geographical location (North/South) and company size, and (iii) support the interpretation of clusters when defining company profiles. The PCA results were therefore used qualitatively, in combination with expert interpretation, to assess whether natural clusters aligned with regional and size-based distinctions. These overlapping insights informed the selection of six representative company profiles.

The PCA analysis was performed using RStudio (version 2024.12.1+563) and the factoextra package (version 1.07). Graphics were produced with GraphPad Prism (version 10.4.1 (532)). Artificial intelligence tools, including ChatGPT, were used to synthesize interview findings and cluster patterns into coherent fictional company profiles. This facilitated the structured representation of typical aquaculture business models, capturing regional and scale-related patterns, and served as a complementary analytical aid supporting expert interpretation and synthesis of complex data.

Part 2 – Findings from aquaculture company interviews

1. Willingness of participants to engage in interviews

Out of the 92 companies contacted, 26 interviews were successfully conducted, corresponding to a response rate of 28%. While this rate falls within the typical range for business research, it is relatively low considering the extensive efforts undertaken to engage participants, including repeated written follow-ups and telephone follow-ups whenever possible. Most participants were reached through the S2AQUA network or via close professional connections, illustrating a “people-know-people” dynamic that highlights the importance of trust, familiarity, and social proximity in facilitating engagement. This reliance on established networks suggests that social capital may be a key factor in accessing actors within the aquaculture sector. Nevertheless, this familiarity may also have influenced participants’ responses and introduced potential bias, particularly given that a substantial proportion of the interviews were conducted in Portugal.

Once interviews were secured, participants were generally open to discuss their business models, strategies, and operational practices. However, when conversations turned to sensitive topics – such as company income, initial investment, sale prices, diseases, or sludge management – revealed areas of limited openness, suggesting that confidentiality concerns, competitive pressures, regulatory compliance, and reputational risks may deter participation.

Efforts to engage aquaculture farmers' associations were largely unsuccessful. Most associations declined participation or did not facilitate contact with their members. Only one association – already linked to S2AQUA – expressed openness to dialogue, reinforcing that trust-based familiarity remains a prerequisite for collaboration in this sector.

Although the interview invitations did not explicitly mention CSF, they referenced the FEASTS project. This indicates that CSF itself was not a direct deterrent, but its association with the project may have caused caution among some actors. Overall, engagement appeared influenced by a combination of relational proximity, practical constraints such as limited time, skepticism toward external research, lack of perceived benefit or feedback, and the desire to maintain strategic neutrality in sensitive industry debates.

Additional efforts to expand the interview pool were made through attendance at aquaculture fairs and seminars. Although these in-person interactions were intended to build rapport and extend the network of participants, they resulted in only two additional interviews.

When companies agreed to participate, they typically designated one or two representatives to take part in the interview. Company owners or CEOs were interviewed whenever possible, but this was not always possible. In several cases, managers from different departments, including production, health and welfare, R&D, or market and communication participated instead. This was considered when interpreting the perspectives and decision-making insights gathered through the interviews.

2. Overview of participants profile

Reflecting this diversity, interviews were conducted with CEOs (39%), owners (14%), and managers responsible for production (14%), health & animal welfare (7%), R&D (12%), or market and communication (14%). In contrast to the farmer interviews, which were carried out directly with farm owners, these discussions reflect a broader range of professional perspectives and experiences across the aquaculture sector. While the factual information collected accurately reflects company operations, perceptions and opinions were shaped by each respondent's background, responsibilities, and position within the organization, influencing their viewpoints on operational and strategic matters. Interviewees also varied in

age, gender, educational background, and tenure within their company, factors that may have shaped their perspectives on less tangible aspects such as sectoral opportunities, operational challenges, and long-term strategic visions. The relatively low share of female participants reflects the overall gender distribution within the aquaculture sector, where women are underrepresented both in comparable roles and more broadly across the industry.

The graphs below (Fig. B-3) illustrate the diversity of the interviewees, providing context for the interpretation of the findings that follow. They show the distribution of interviewees by gender, age group, educational background, and employment category.

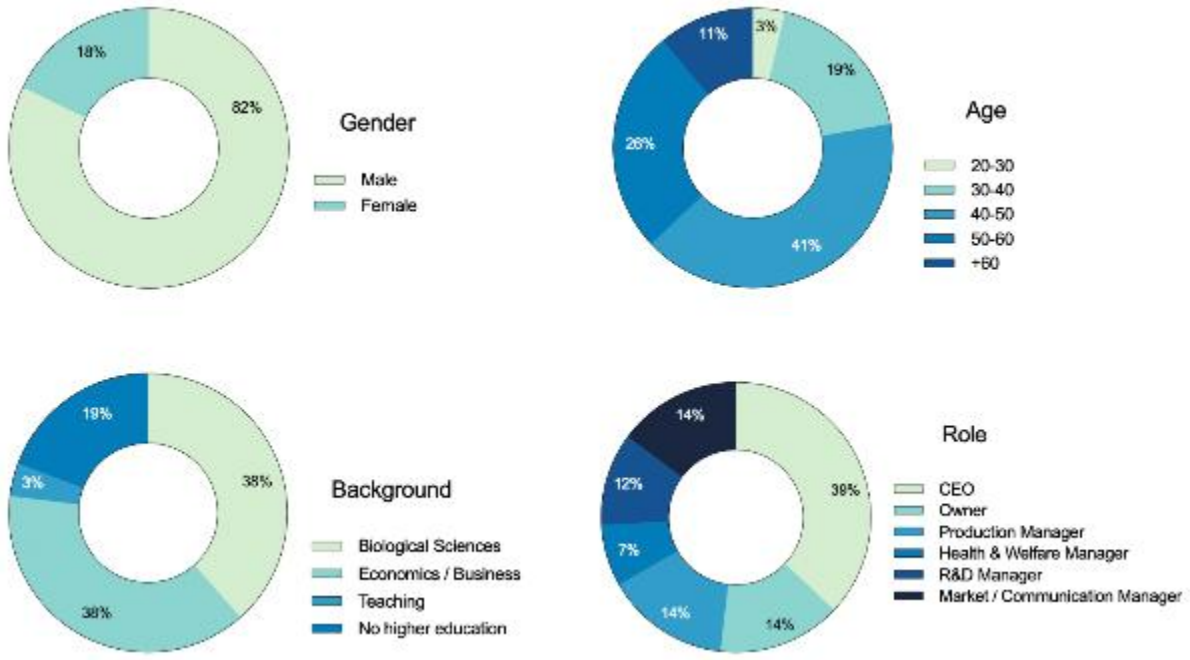


Figure B- 3. Overview of aquaculture interviewees by age, gender, background education, and company role.

Given this diversity of roles, backgrounds, and perspectives – and considering that research with aquaculture companies is still at an early stage – we focused on analyzing current aquaculture businesses, defining company profiles and developing preliminary engagement plans for these profiles, rather than creating generalized personas. This approach allowed us to account for the heterogeneity of participants and the early-stage nature of the research, while providing a structured foundation for subsequent engagement strategies.

3. Overview of the current business models in aquaculture

3.1. Company demographics per region

The analysis of the information collected during the interviews revealed clear regional differences in the size and composition of aquaculture companies across Europe. Although based on a limited sample of 26 aquaculture companies, the results align with and reflect the broader aquaculture context in Europe as described previously in Part 1, Section 2 (Study

context). In the South, aquaculture is dominated by small and micro companies, often family-owned enterprises. In fact, the proportion of micro-companies (less than 10 employees) among the participants was approximately four times higher than in the North. By contrast, the North is characterized by a stronger presence of medium-sized companies (51-250 employees) and large corporations (more than 251 employees) (Fig. B-4).

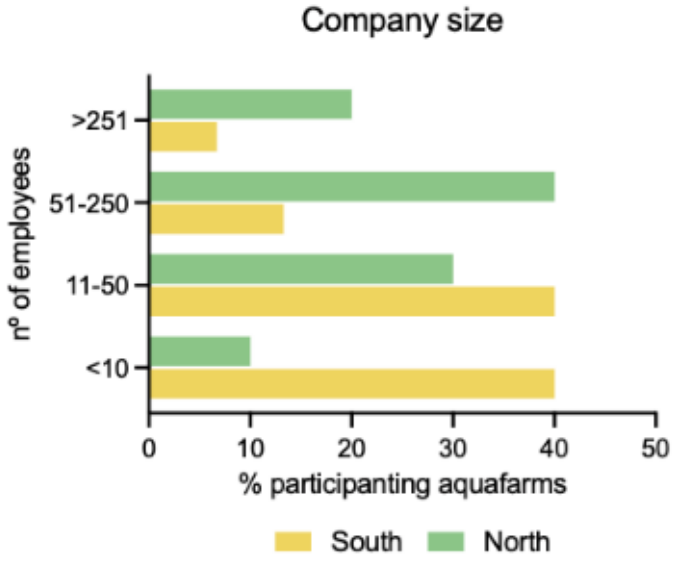


Figure B- 4. Company size of aquaculture enterprises in Northern and Southern Europe, based on interview data. Size categories: micro (<10 employees), small (10–50 employees), medium (51–250 employees), large (>250 employees).

Differences were also observed in the educational profile of employees. In general, across the aquaculture sector in Europe, more than 50% of the workforce does not hold tertiary education qualifications. However, this pattern is more pronounced in the South, where the share of employees with lower education levels is considerably higher. Notably, in the South, some companies reported workforces where 100% of employees had no tertiary education – a situation not observed in the North (Fig. B-5).

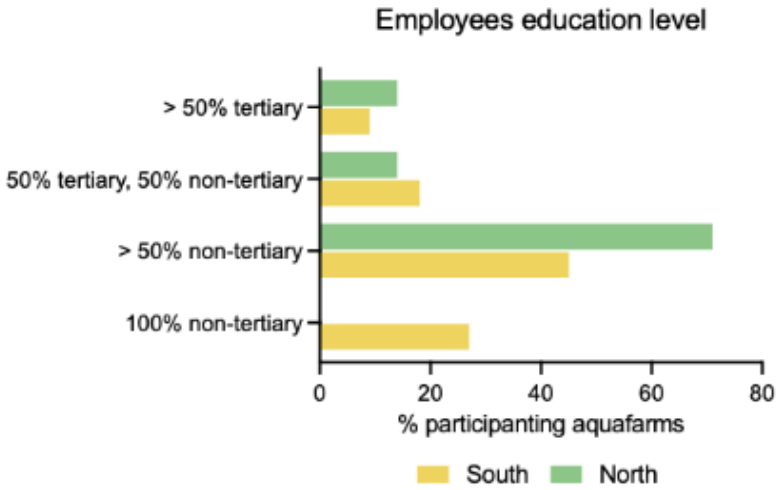


Figure B- 5. Education level of employees in aquaculture companies in Northern and Southern Europe, based on interview data.

These structural differences have important consequences for the sector and are reinforced by disparities in employee education. The generally smaller, often family-owned companies in Southern countries, operate with limited financial, technological, and human resources, which can restrict their ability to adopt new technologies and innovate. Their small scale, however, allows them to remain flexible and responsive to local markets. In contrast, larger Northern companies, benefit from economies of scale and greater access to capital, which support international competitiveness, innovation, and research engagement. At the same time, reliance on larger corporate structures may reduce production model flexibility and increase vulnerability to global market fluctuations.

Key insight: Southern companies' smaller scale and lower workforce education limit adoption of advanced practices but enhance local responsiveness, whereas larger, better-skilled Northern companies are more innovation-ready but less operationally flexible.

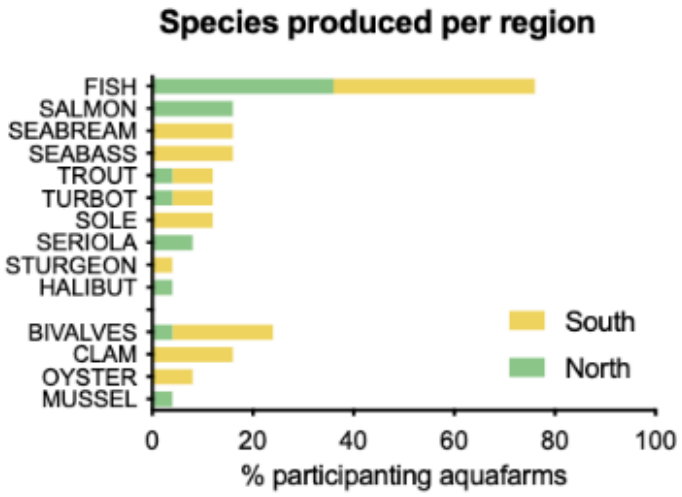
3.2. Species, production systems, and output volumes

Similarly to Section 3.1, the analysis of regional patterns in farmed species, production systems, and output volumes across Europe (Fig. B-6) is based on a relatively small sample of 26 aquaculture companies. Nevertheless, the patterns identified through the interviews are consistent with the wider European aquaculture landscape, corroborating the trends reported in official sources such as FAO and FEAP, as summarized in Part 1, Section 2 (Study context).

Overall, aquaculture enterprises tend to be highly specialized, focusing on the cultivation of a single species or, at most, two species with very similar biological requirements and farming methods (ANNEX-2).

In the North, producers predominantly focused on cold-water marine species – mainly salmon, followed by seriola – cultivated through intensive systems such as open-water net cages and RAS. In the South, fish farming displayed a more diverse production landscape, centered on Mediterranean marine species, primarily seabass and seabream. Flatfish farming was also observed among participants, although its representation was lower, with southern producers primarily focused on sole and turbot, while northern producers specialized in halibut (Fig. B-6). Compared to the North, fish production systems in the South were more heterogeneous, encompassing RAS, open-net cages, FTS, and pond-based operations (Fig. B-6).

Bivalve farming was concentrated mainly in the South, with clams and oysters as the main cultivated species. Clam production appeared particularly significant in this sample, largely reflecting the strong participation of Portuguese producers and the long-standing regional tradition of clam farming in southern Portugal. Production systems for bivalves varied by species, with suspended long-lines commonly used for mussels, rack for oysters, and bottom sewing techniques applied for clams (Fig. B-6).



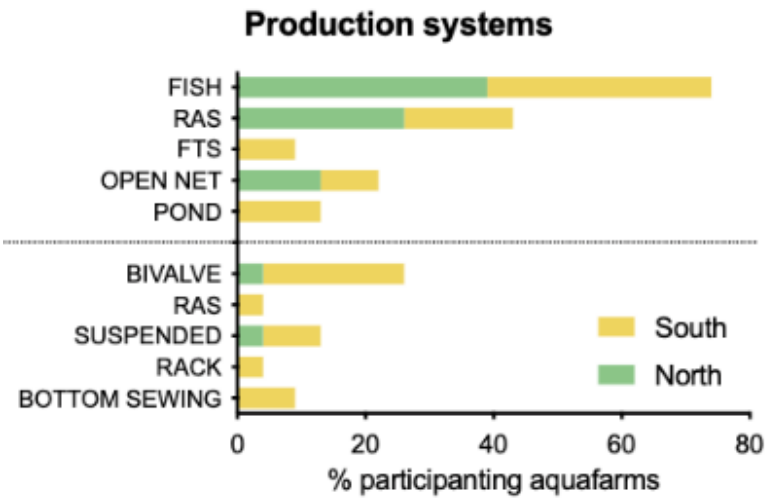


Figure B- 6. Aquatic species and types of production systems used by aquaculture companies in Northern and Southern Europe, based on interview data.

Differences in production capacity further highlight the structural divide between Northern and Southern aquaculture models (Fig. B-7). Among the participating companies, those located in the North demonstrated markedly higher production volumes, with enterprises exceeding 10,000 tonnes per year found exclusively in this region (Fig. B-7). In contrast, small-scale operations with annual outputs below 100 tonnes were observed only in the South (Fig. B-7). This disparity reflects the prevalence of large, industrial-scale systems in Northern Europe and the predominance of smaller, often family-run enterprises in the South, a pattern that aligns with broader trends described in European aquaculture reports[41,42].

[41] FAO, 2024 - Food and Agriculture Organization of the United Nations. (2024). *The state of world fisheries and aquaculture 2024: Blue transformation in action. Rome.* https://doi.org/10.4060/cd0683en

[42] FEAP, 2024 - Federation of European Aquaculture Producers. (2024). FEAP production report 2017–2023. Retrieved from https://feap.info/data-home/data/

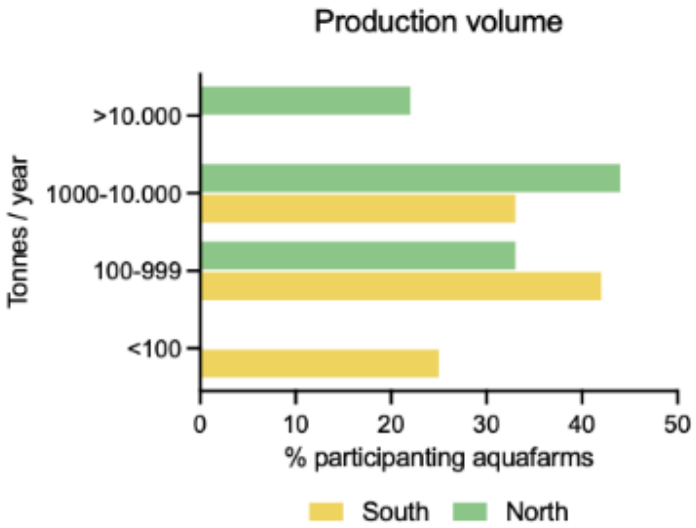


Figure B- 7. Aquafarm production capacity in Northern and Southern Europe, based on interview data.

Key insights: European aquaculture displays distinct regional patterns: Northern producers focus on cold-water marine species using intensive, large-scale systems and achieve higher production volumes, whereas Southern producers cultivate a more diverse range of Mediterranean species and bivalves across heterogeneous, smaller-scale operations, reflecting the predominance of family-run enterprises.

3.3. Investment capacity

Investment in Europe aquaculture is highly differentiated by region both in terms of funding sources and capital scale. The Northern Europe (led by Norway) benefits from a highly capitalized model, where capital largely comes from stock markets, boosted by specialized investors, focus on new technology and sustainability[43]. This allows for high capital deployment, with initial investments, according to our interview data, ranging from €10 million to €95 million (Fig. B-8).

Conversely, Southern Europe relies more heavily on bank financing, family capital, and public funding via EU initiatives to support its more fragmented sector of smaller sized fish and bivalve farms[44]. Consequently, initial investments reported in the South were smaller, ranging from €3 million to €50 million (Fig. B-8).

[43] Hough, C. (2022). *Regional review on status and trends in aquaculture development in Europe – 2020* (FAO Fisheries and Aquaculture Circular No. 1232/1). Food and Agriculture Organization of the United Nations. https://doi.org/10.4060/cb7809en

[44] European Market Observatory for Fisheries and Aquaculture Products (EUMOFA). (2019). *Factors affecting cross-border investments in EU aquaculture*. European Commission. https://doi.org/10.2771/035204

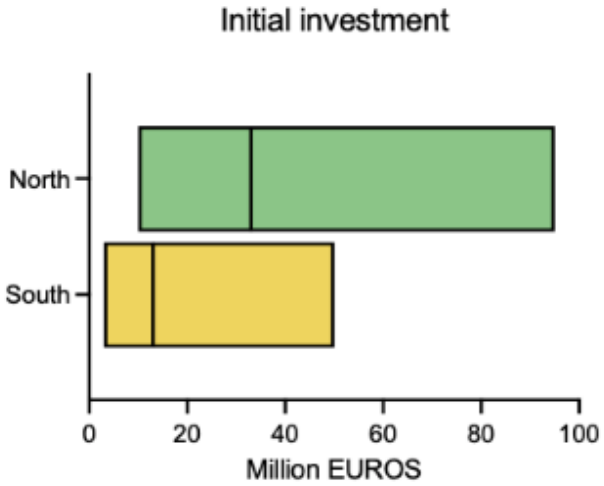


Figure B- 8. Initial capital investment of aquafarms in Northern and Southern Europe, based on interview data.

Key insights: Northern aquaculture benefits from large-scale, high-tech investment, while Southern operations rely on smaller, more fragmented funding sources.

3.4. Production costs

In terms of production costs, the interviews revealed four main expenditure categories common across all companies: feed, energy, human resources, and seeds – the latter referring to fish or bivalve eggs or larvae purchased from external suppliers (Fig. B-9). Regional differences were evident in the relative weight of these costs. Northern companies most frequently identified feed as their primary expense (Fig. B-9), reflecting the dominance of intensive fish production systems where feed efficiency directly affects profitability. In contrast, Southern producers highlighted human resources as their main cost (Fig. B-8), consistent with the prevalence of smaller enterprises where labor represents a proportionally higher share of operational expenses. Additionally, seed costs were more significant among Southern companies, likely due to the higher number of producers exclusively engaged in the grow-out phase. In the North, where vertically integrated operations combining hatchery and grow-out activities were more common, reliance on external seed suppliers and associated costs was comparatively lower.

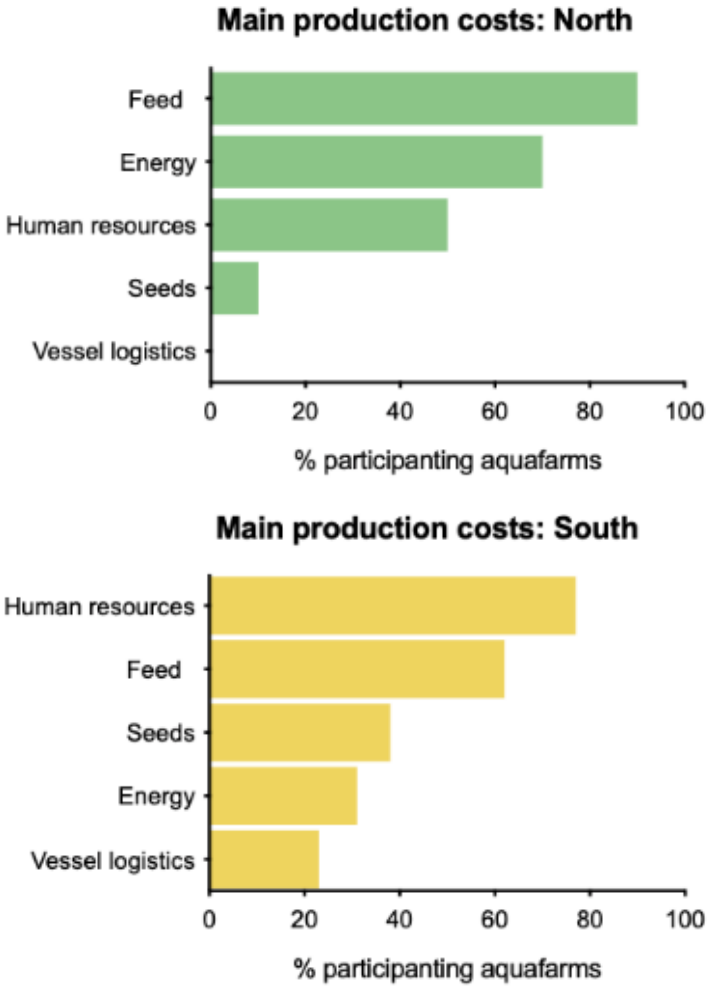


Figure B- 9. Main production costs reported by aquafarmers in Northern and Southern countries in Europe, based on interview data.

Key insights: Feed represents the primary expense across regions, but cost structures diverge: Northern companies also face high energy costs from intensive, technology-driven systems, whereas Southern producers are more affected by labor costs typical of smaller, grow-out-focused operations.

3.5. Main partners

Regarding main partners, the analysis showed that companies across both regions maintain collaborations with similar types of stakeholders. Among the top five reported partners were feed suppliers, academic or research institutions, seed suppliers, and producers' associations (Fig. B-10). The main regional difference concerned the nature of the remaining key partnerships. Northern companies identified service providers as their third most important partners (Fig. B-10), reflecting a greater reliance on specialized external services within larger and more technologically advanced operations. In contrast, Southern companies ranked clients among their most important partners (Fig. B-10), indicating a closer and more direct

relationship with the regional markets, typical of smaller-scale and locally oriented enterprises.

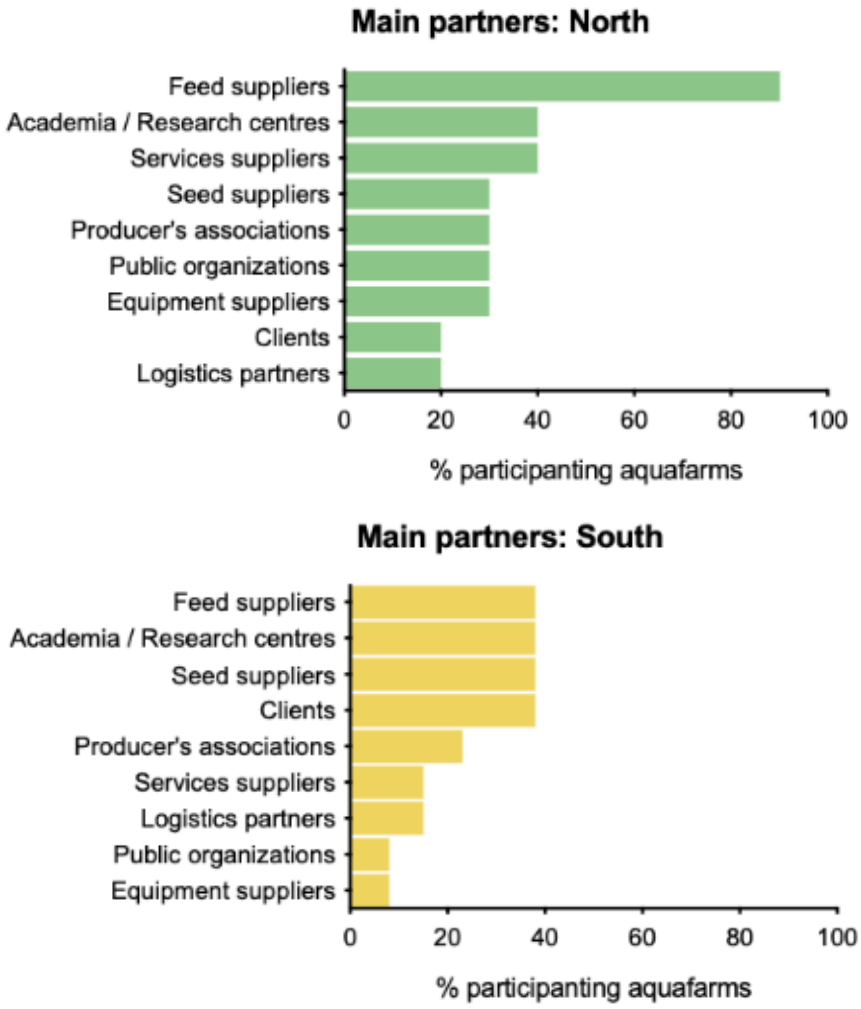


Figure B- 10. Main strategic partners reported by aquafarmers in Northern and Southern Europe, based on interview data.

Key insights: European aquaculture companies share similar core partnerships - feed suppliers, research institutions, seed providers, and producers' associations - but regional differences persist: Northern companies rely more on specialized service providers, while Southern producers maintain closer ties with clients and local markets.

OVERALL FINDINGS

The interviews highlighted clear contrasts between Northern and Southern aquaculture business models.

Northern companies operate at larger scales, focusing on cold-water species such as salmon, with higher production volumes, greater initial investments, and feed as the dominant cost. **Southern producers**, by contrast, manage smaller and more diverse operations, centered on seabass, seabream, and bivalves, with higher relative costs.

Despite these differences, both regions share similar key partnerships – feed suppliers, research institutions, seed providers, and producers' associations – reflecting common dependencies within the European aquaculture value chain.

4. Challenges and opportunities in the aquaculture sector

The structural and operational differences shape how aquaculture companies across regions perceive and respond to sectoral challenges and opportunities, which are explored in this section. The data collected indicate tendencies, which were plotted according to the percentage of respondents reporting the same challenge or opportunity. While the number of interviews was relatively small, these results provide an initial indication of sectoral tendencies and a starting point for further investigation.

Across the interviewed companies, a range of structural, environmental, and economic challenges were identified, reflecting sector-wide issues and regional specific dynamics. Overall, the most frequently mentioned challenges included legislation and regulatory complexity, disease outbreaks, difficulties in attracting specialized workers, climate change impacts, and price competition with non-EU producers. Participants also referred to challenges related to the sector's public perception, noting that aquaculture still suffers from a poorer reputation compared to fisheries, which influences consumer preferences and market acceptance. Other relevant concerns included limited land availability for expansion, the unstable international context, difficulties in securing investment, the sustainability and cost of aquafeeds, and high production costs in general.

Regional differences were evident. Although both northern and southern regions identified legislation, disease outbreaks, and climate change among their top concerns, additional challenges diverged by region. In the North, poor sector reputation and the unstable international context were particularly relevant, illustrating the pressures faced by larger, export-oriented companies operating under strict environmental regulations and within highly competitive global markets. In the South, by contrast, aquafarmers reported greater difficulty in attracting specialized workers and facing price competition with non-EU countries, challenges that are more acute for smaller, family-run enterprises with limited access to skilled labor and capital (Fig. B-11).

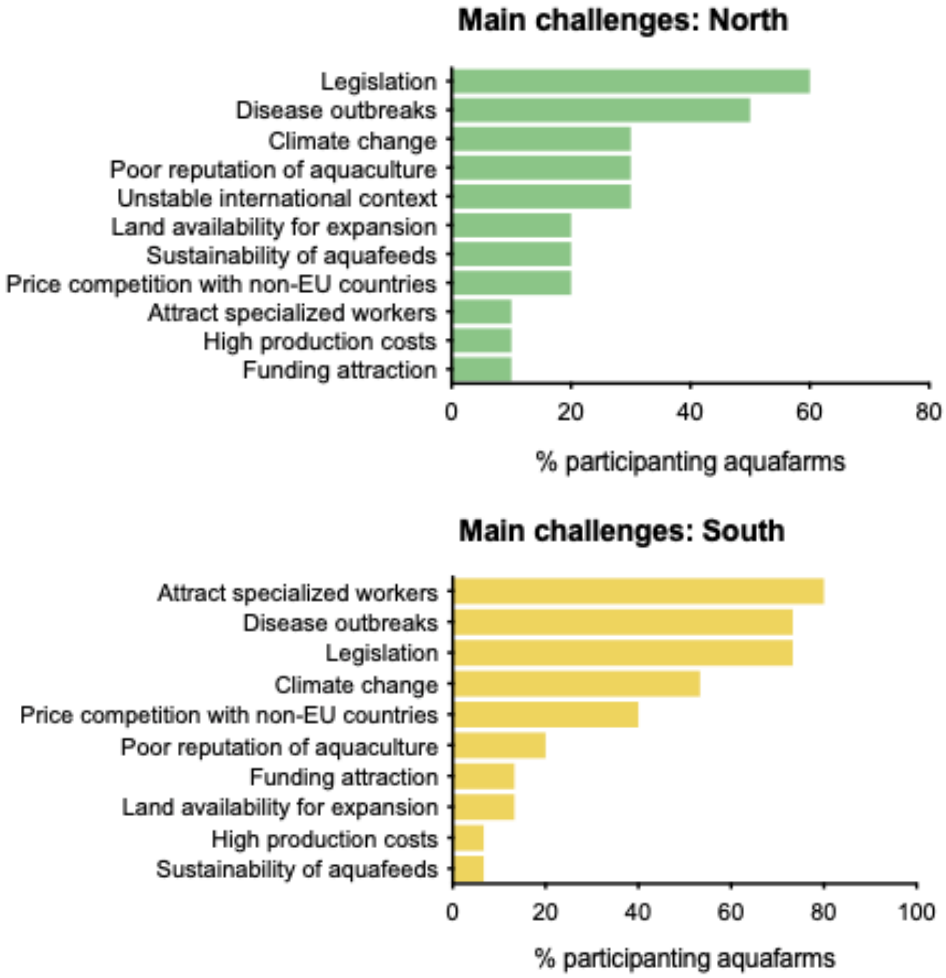


Figure B- 11. Main challenges reported by aquafarmers in Northern and Southern Europe, based on interview data.

While the sector faces region-specific constraints, several shared opportunities also emerged, reflecting the industry's adaptive capacity and potential for sustainable growth. Across Europe, aquaculture companies identified a set of common opportunities driving modernization and competitiveness. Investment in technology, high product quality, strong market demand, the potential to exploit new species, and support from academia and research institutions were consistently highlighted in all regions. Together, these reveal a shared optimism about innovation, consumer trends favoring sustainable seafood, and closer collaboration between industry and science to enhance efficiency, traceability, and resilience.

Regional differences reveal distinct opportunity profiles between the North and the South. Although both regions share investment in technology, high product quality, and strong market demand as key drivers, their emphasis varies. In Northern Europe, investment in technology remains the top priority, supported by strong research partnerships and favorable conditions for funding attraction (Fig. B-12). These factors enable companies to pursue advanced production systems, digitalization, and sustainability-oriented innovation within a

well-capitalized industry framework. In Southern Europe, by contrast, the main opportunity lies in responding to high and growing market demand, driven by both domestic consumption and export potential (Fig. B-12). Southern firms also see scope to strengthen competitiveness by exploiting new species and developing new product formats, reflecting a more diverse and flexible production base. They are attentive to evolving consumer preferences and tend to position themselves to meet these needs, as well as to anticipate future trends, for example, offering filleted rather than whole fish, or ready-to-cook products conveniently packaged. Some producers also enhance product value by selling directly through their own shops or local markets, processing their products into higher-value items such as smoked or marinated seafood.

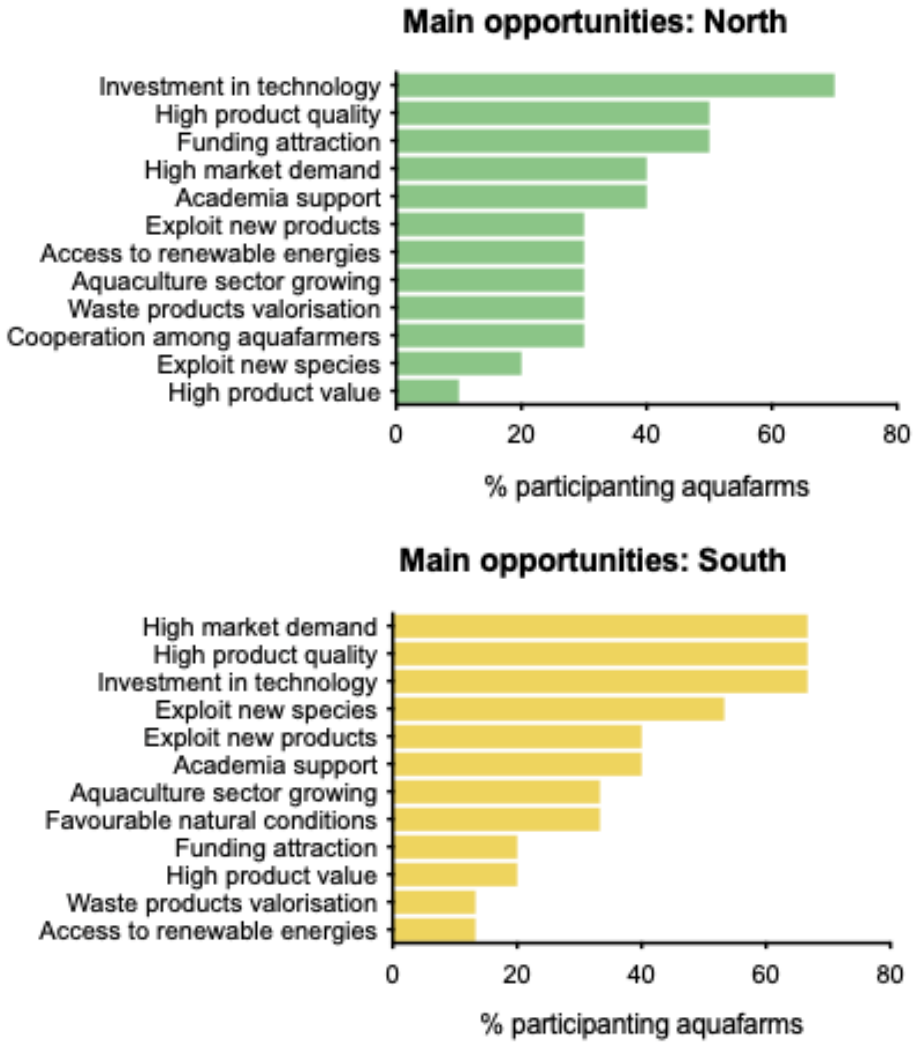


Figure B- 12. Main opportunities reported by aquafarmers in Northern and Southern Europe, based on interview data.

OVERALL FINDINGS

The analysis of challenges and opportunities highlights a sector that is both heterogeneous and interdependent, shaped by regional structures, company size, and access to resources. While all aquaculture firms operate under common pressures – such as regulatory demands, climate risks, and the need for continuous innovation – the balance between constraints and prospects differs markedly between Northern and Southern Europe. These differences are closely linked to company scale, capitalization, and strategic orientation, which together define distinct business models and adaptive capacities.

5. Sample segmentation and company profile development

The segmentation of aquaculture enterprises into six company profiles was based on a combination of qualitative assessment and quantitative exploration. The classification followed three steps:

a) Regional differentiation (North vs South): Initial analysis of interview data revealed clear structural, operational, and market differences between Northern and Southern European aquaculture. Geographical context therefore served as the first criterion for distinguishing company types.

b) Company size: A second key source of variation was company size, reflected in number of employees and operational scale. Size categories ranged from micro enterprises to large corporations. Distinct patterns in investment capacity, technological development, and workforce characteristics justified using company size as a primary classification criterion.

c) Principal Component Analysis (PCA): To further explore how regional context and company size interacted, a PCA was conducted using information on challenges and opportunities reported by each participant. This exploratory tool allowed us to identify clusters of companies sharing similar strategic and structural conditions.

Together, these three steps enabled the identification of six company profiles that reflect the main structural and strategic patterns observed across the aquaculture sector in Europe:

1 – Large Integrated Corporations
2 – Northern Medium Producers
3 – Southern Medium Producers
4 – Northern Small Producers
5 – Southern Small Producers
6 – Micro Local Producers

The count of participating aquafarms per company segment is presented in Figure B-13.

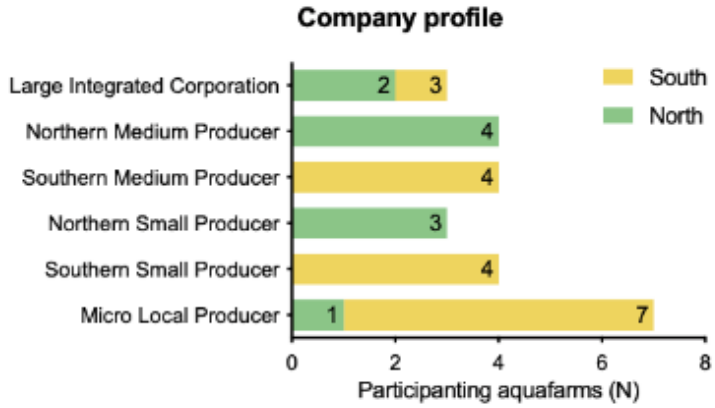


Figure B- 13. Number of participating aquafarms per company profile.

Fictional company profiles, derived from aggregated data and qualitative insights, represent typical configurations of resources, activities, and strategic orientations rather than real entities. Together, they illustrate the operational diversity of European aquaculture and how structural and regional factors influence competitiveness, innovation, and sustainability strategies.

The following sections describe the six profiles in detail.

Source: Image generated by Google's generative AI model (Gemini) in response to a user prompt

COMPANY PROFILE:

LARGE INTEGRATED CORPORATION

LARGE INTEGRATED CORPORATION

COUNTRY	NO
CULTURED STOCK	**Atlantic Salmon**
PRODUCTION VOLUME	**20000 T/ year**
EMPLOYEES	**300**

GENERAL CHARACTERISTICS

With over 300 employees, the company manages multiple production sites, including open-sea cages and land-based RAS facilities. It operates a fully integrated value chain covering broodstock, hatchery, nursery, grow-out, processing, and distribution. Production volumes reach tens of thousands of tons per year. Continuous reinvestment supports technological modernization, workforce training, and energy efficiency.

PRODUCTION SYSTEMS AND RESOURCES

The company combines conventional open-net pen systems with advanced hybrid RAS units to optimize fish health and reduce environmental impacts. Main resources include high-quality feed, energy-intensive water circulation systems, and specialized human capital. R&D and monitoring tools support decision-making on feed efficiency, disease control, and environmental performance.

PARTNERSHIPS AND NETWORKS

Key partners include feed and equipment suppliers, universities, research institutes, and public agencies. These collaborations drive innovation in biosecurity, welfare standards, and digital monitoring.

VALUE PROPOSITION AND MARKET ORIENTATION

The company positions itself as a producer of premium-quality salmon, combining environmental responsibility and traceability. Products range from whole fish and fillets to value-added goods such as sausages and burgers. By-products are increasingly used in circular economy initiatives. Sales are primarily through distributors and retail partners, with growing interest in direct-to-market strategies for specialty products.

MAIN CHALLENGES

- Stringent environmental and welfare regulations
- Disease management (especially sea lice)
- Unstable international context affecting trade and input costs

KEY OPPORTUNIITIES

- Strong investment capacity supporting technological Innovation
- Product diversification and value-added products
- Circular use of waste and by-products

Source: Image generated by Google's generative AI model (Gemini) in response to a user prompt

COMPANY PROFILE:

NORTHERN MEDIUM PRODUCER

NORTHERN MEDIUM PRODUCER

COUNTRY	DK
CULTURED STOCK	**Trout and pike-perch**
PRODUCTION VOLUME	**2500 T/ year**
EMPLOYEES	**100**

GENERAL CHARACTERISTICS

The company employs just over 100 people and manages a land-based RAS operation producing trout and pike-perch. Established by a group of biologists and private investors, it embodies the region's science-driven approach to aquaculture. Production volumes remain moderate - significantly below industrial salmon farms - but the enterprise distinguishes itself through high product quality and operational agility. Financing comes from a mix of private equity and reinvested profits, supporting continuous growth and innovation.

PRODUCTION SYSTEMS AND RESOURCES

Its production relies entirely on recirculating aquaculture systems (RAS), designed for optimal water use, energy efficiency, and environmental control. The company invests heavily in digital monitoring, automated feeding, and water quality management. Skilled staff, including biologists, technicians, and experienced fish farmers, ensure tight integration between R&D and production.

PARTNERSHIPS AND NETWORKS

Strong collaboration with Danish and international research institutions enables the company to test and apply new technologies such as IMTA systems (Integrated Multi-Trophic Aquaculture) and advanced processing methods. It maintains close links with feed and equipment suppliers and participates in innovation networks that connect producers, universities, and public authorities.

VALUE PROPOSITION AND MARKET ORIENTATION

The company positions itself in niche markets, focusing on premium, sushi-grade products and high-value exports to Northern Europe. Its brand identity rests on sustainability, traceability, and consistent product quality. Products include whole and filleted trout and pike-perch, with potential to expand into specialty formats and value-added lines.

MAIN CHALLENGES

- Negative public perception of aquaculture
- Complex environmental regulations
- Competing with larger, lower-cost producers

KEY OPPORTUNIITIES

- Scaling up production through investment
- Leveraging partnerships with academia to improve efficiency and sustainability
- Developing value-added products

Source: Image generated by Google's generative AI model (Gemini) in response to a user prompt

COMPANY PROFILE:

SOUTHERN MEDIUM PRODUCER

SOUTHERN MEDIUM PRODUCER

COUNTRY	ES
CULTURED STOCK	**Turbot and sole**
PRODUCTION VOLUME	**6900 T/ year**
EMPLOYEES	**150**

GENERAL CHARACTERISTICS

Employing around 150 people, the company operates a RAS-based production system for turbot and sole. It evolved from a family-owned business into a professionalized enterprise through a mix of EU structural funds and private capital. Continuous investment has modernized hatchery operations, expanded processing capacity, and improved efficiency. Production volumes are moderate but stable, targeting high-value species that align with premium market demand.

PRODUCTION SYSTEMS AND RESOURCES

The company operates fully recirculating aquaculture systems optimized for water efficiency, temperature control, and disease prevention. Integrated hatchery and grow-out facilities enable complete production cycles. Main resources include high-quality feed, energy, skilled human capital, and advanced monitoring technologies that ensure traceability and consistent output.

PARTNERSHIPS AND NETWORKS

Strong relationships with feed suppliers, veterinary services, and regional universities underpin the company's innovation and biosecurity. Collaborations with local authorities and industry associations facilitate access to funding and knowledge exchange. The company also engages in certification programs to maintain high sustainability and quality standards demanded by international buyers.

VALUE PROPOSITION AND MARKET ORIENTATION

The company positions itself as a reliable supplier of premium, traceable aquaculture products. It markets both fresh and value-added formats – fillets and gutted fish – to European distributors, retail chains, and restaurants. The emphasis on certification and product integrity supports brand reputation and long-term customer relationships.

MAIN CHALLENGES

- Managing skilled workforce retention
- Complex environmental and animal welfare regulations
- Limited access to coastal sites for expansion

KEY OPPORTUNIITIES

- Growing market demand for high-quality seafood
- Diversification into new species
- Leveraging partnerships with academia to drive technological improvements

Source: Image generated by Google's generative AI model (Gemini) in response to a user prompt

COMPANY PROFILE:

NORTHERN SMALL PRODUCER

NORTHERN SMALL PRODUCER

COUNTRY	NL
CULTURED STOCK	**Halibut**
PRODUCTION VOLUME	**100 T/ year**
EMPLOYEES	**40**

GENERAL CHARACTERISTICS

This family-owned enterprise employs around 40 people and operates a compact RAS facility dedicated to halibut production. Despite its modest size, it manages part of the production cycle – grow-out and processing. Continuous investment in modern equipment and digital tools has enabled efficient operations and compliance with high environmental standards.

PRODUCTION SYSTEMS AND RESOURCES

Production is based on a recirculating aquaculture system (RAS) designed for energy efficiency, precise environmental control, and minimal water use. The company applies advanced water treatment technologies and real-time data monitoring to optimize growth conditions. Its workforce combines experienced fish farmers and young technicians.

PARTNERSHIPS AND NETWORKS

Collaboration with local research institutes and technical universities drives the company's innovation. Joint projects have produced prototype equipment and digital monitoring tools later adopted by other small producers. Partnerships with logistics and tourism operators strengthen its regional footprint and complement its direct-to-consumer sales model.

VALUE PROPOSITION AND MARKET ORIENTATION

The company focuses on niche, premium markets emphasizing freshness, sustainability, and local origin. It integrates aquaculture with tourism by running an on-site seafood restaurant and offering guided tours of the facility. Products are sold directly through the restaurant, its website, and a network of local distributors, providing transparency and reinforcing consumer trust.

MAIN CHALLENGES

- Complex licensing procedures
- Limited availability of suitable sites for expansion
- Disease outbreaks

KEY OPPORTUNIITIES

- Growing market demand for locally farmed seafood
- Easy access to renewable energy infrastructure
- Waste products valorization

Source: Image generated by Google's generative AI model (Gemini) in response to a user prompt

COMPANY PROFILE:

SOUTHERN SMALL PRODUCER

SOUTHERN SMALL PRODUCER

COUNTRY	**PT**
CULTURED STOCK	**Seabream Seabass**
PRODUCTION VOLUME	**400 T/ year**
EMPLOYEES	**35**

GENERAL CHARACTERISTICS

Employing around 35 people, the company manages earthen ponds dedicated to seabass and seabream production. The company has modernized gradually through EU-funded improvements in infrastructure and management practices. While maintaining traditional low-intensity operations, it has integrated moderate technological upgrades to enhance water quality control and traceability.

PRODUCTION SYSTEMS AND RESOURCES

The company's earthen ponds rely on natural seawater exchange, ensuring a semi-extensive production model with relatively low environmental impact. The system is complemented by basic digital monitoring and selective mechanical aeration. Feed and energy account for the largest cost shares, while production stability is maintained through local environmental knowledge and skilled on-site management.

PARTNERSHIPS AND NETWORKS

The enterprise collaborates with veterinary consultants, feed suppliers, and local distributors. Occasional cooperation with research institutions and producer associations supports access to technical guidance and training. Most employees are recruited locally and trained internally, reinforcing the company's strong community roots.

VALUE PROPOSITION AND MARKET ORIENTATION

The company emphasizes product freshness, consistency, and a close connection to place. It markets whole fish and fillets through local distributors, restaurants, and direct sales. Its reputation as a responsible, community-based producer supports consumer trust and long-term commercial relationships.

MAIN CHALLENGES

- Managing skilled workforce retention
- Complex environmental and animal welfare regulations
- Competing with non-EU producers (e.g. Turkey)

KEY OPPORTUNIITIES

- Diversifying production with new native species
- Growing market demand for sustainable and locally farmed seafood
- Favorable natural conditions for production

Source: Image generated by Google's generative AI model (Gemini) in response to a user prompt

COMPANY PROFILE:

MICRO LOCAL PRODUCER

MICRO LOCAL PRODUCER

COUNTRY	**PT**
CULTURED STOCK	**Oysters and clams**
PRODUCTION VOLUME	**12 T/ year**
EMPLOYEES	**3**

GENERAL CHARACTERISTICS

This family-run enterprise employs three people and focuses on oyster and clam farming using traditional methods. It operates as part of a producers' association that provides shared logistics, quality control, and market coordination. Production is highly seasonal and dependent on natural conditions. Investments are minimal, typically directed toward maintaining boats, seedbeds, and essential equipment.

PRODUCTION SYSTEMS AND RESOURCES

The company relies on bottom-seeding and rack-and-bag systems, both labor-intensive and adapted to local environmental rhythms. Natural seawater flow supports shellfish growth without mechanical filtration or artificial feeding. Operations depend on skilled manual labor, small vessels, and a deep understanding of the ecosystem.

PARTNERSHIPS AND NETWORKS

Membership in a local producers' association is central to the company's functioning, enabling shared transport, depuration, and compliance with food safety standards. Informal cooperation with nearby producers strengthens knowledge exchange and resilience against environmental fluctuations.

VALUE PROPOSITION AND MARKET ORIENTATION

The enterprise's identity rests on tradition, quality, and local origin. Products are marketed as fresh, artisanal shellfish cultivated through low-impact methods. Sales occur mainly through wholesalers, small restaurants, and local markets, though there is growing interest in direct sales via tourism channels and online platforms.

MAIN CHALLENGES

- Constrained investment capacity
- Administrative complexity and regulatory costs
- Environmental variability affecting productivity

KEY OPPORTUNIITIES

- Regional branding to enhance market visibility and price margins
- Diversifying production with new native species
- Support from associations to adopt sustainable practices and improve competitiveness

6. Aquafarmers vision for the future of the aquaculture sector

Interviews with aquaculture producers revealed a shared sense of optimism about the sector's capacity for growth, adaptation, and technological progress. While visions vary depending on company size and regional context, most aquafarmers emphasized the importance of sustainable expansion, product quality, and environmental responsibility as key drivers of future competitiveness. Across all profiles, there is a strong orientation toward increasing production efficiency, diversifying species and products, and consolidating business resilience in a changing global context.

Large Integrated Corporations foresee a future where technological innovation and investment capacity remain central to maintaining global competitiveness. Their long-term vision focuses on scaling production, improving prophylaxis and biosecurity, and adding value through the circular use of by-products. These companies expect to balance international leadership with social and environmental responsibility in coastal communities.

Northern Medium Producers aim to reach full profitability through moderate expansion, species diversification, and stronger integration of R&D in daily operations. Their outlook combines scientific innovation - such as investments in IMTA systems - with stable, sustainable growth within a competitive European market.

Southern Medium Producers envision consolidating their position as leaders in sustainable, high-value aquaculture in Southern Europe. Their goals revolve around increasing production quantity and quality, achieving steady but controlled growth, and expanding into international markets while upholding environmental and product excellence.

Northern Small Producers anticipate a future defined by innovation, diversification, and adaptability. They plan to expand visitor-oriented activities, develop new value-added products, and strengthen breeding programs. These producers see themselves as examples of sustainable, community-integrated aquaculture, balancing profitability with environmental stewardship.

Southern Small Producers articulate a vision rooted in local continuity and steady improvement. Their strategic outlook prioritizes sustainable growth, family ownership, and workforce stability, with specific objectives including moderate production increases, diversification of species, and new certifications to strengthen credibility and market access.

Micro Local Producers, representing the smallest and most traditional actors, focus primarily on business continuity and preserving artisanal methods. Their future perspective is one of cautious optimism – maintaining production through improved branding, eco-certification,

and direct-to-consumer sales, while ensuring the survival of cultural and ecological heritage in coastal aquaculture communities.

Across all profiles, the aquafarmers interviewed share a common ambition: to grow responsibly, innovate within their means, and ensure that European aquaculture remains both competitive and sustainable. Differences emerge in scale and pace - large corporations driving technology and global integration, while small and micro producers focus on identity, stability, and cultural value - but all reflect a strong commitment to a resilient, future-oriented aquaculture sector in Europe.

Aquafarmers perspectives on CSF

Although the topic of cellular agriculture was not a focus of the interviews, it emerged spontaneously in a few discussions about the future. Across all cases, respondents expressed a similar degree of cautious skepticism regarding the market entry of CSF products. The main concerns related to the current lack of information on the technological readiness for large-scale production, the absence of specific legislation and regulatory frameworks, and the uncertainty surrounding economic viability. Nevertheless, those who addressed the topic also showed openness to potential future synergies, particularly as technological, legal, and market uncertainties are progressively clarified. Overall, aquafarmers remain neutral at this stage, adopting a "wait-and-see" attitude while monitoring how CSF develops within the broader European aquaculture landscape.

Part 3 – Implications for integration of CSF into the aquaculture sector

1. Comparative readiness of aquaculture companies for CSF integration

The ability of aquaculture enterprises to integrate CSF solutions varies considerably across company profiles. Northern and capital-intensive producers are significantly better positioned to lead or pilot integration, while Southern and small-scale producers are likely to engage indirectly through partnerships or shared infrastructure. To assess how prepared each company profile is to adopt or integrate CSF into their operations, their readiness levels were defined according to their structural, technological, and organizational factors – including company size, investment capacity, human capital, R&D maturity, and exposure to innovation networks. The scale is structured across six levels – maximal, high, moderate, selective, low, and minimal – reflecting progressively lower capacity for integration.

Large Integrated Corporations. These companies show the **maximal readiness** for CSF integration. Their vertically integrated operations encompass production, processing, and

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distribution, offering clear points of interface with CSF. They maintain in-house R&D teams, automation systems, and digital monitoring infrastructures – essential enablers for bioprocess control and traceability. Their corporate structures facilitate compliance with regulatory requirements and alignment with sustainability goals, while access to stock market financing and dedicated innovation budgets allows them to absorb the risks of early adoption. International branding and established certification frameworks could accelerate consumer acceptance of hybrid or cultivated products.

Northern Medium Producers. This group demonstrates **high readiness**, typically through collaboration rather than internal R&D. Many have invested in advanced production technologies such as RAS, automated feeding, and water-quality control automated systems. Active partnerships with universities and research centers create entry points for pilot projects, while their mid-sized structure allows agility in testing niche innovations. Readiness is linked to participation in consortia, demonstration hubs, or joint ventures, positioning them as regional demonstrators of hybrid aquaculture models.

Southern Medium Producers. These companies show **moderate readiness** reflected by a mix of ambition and constraint. These firms operate within local and export markets and show interest in sustainability certification and product innovation. Limited in-house R&D infrastructure or automation capacity means that access to collaborative R&D environments and technical guidance is essential. Integration remains dependent on partnerships and supportive regional innovation systems.

Northern Small Producers. The companies present **selective readiness**. Their scale limits infrastructure investment, but innovation culture, flexibility, and community ties support small-scale experimentation. Ideal for demonstration projects and consumer engagement, they act as intermediaries between technology developers and the public.

Southern Small Producers. These companies have **low readiness**. Mainly family-run, with limited capital and technology access. Participation in EU-funded diversification projects or partnership-based initiatives can provide indirect paths to CSF adoption through shared pilot units or processing facilities.

Micro Local Producers. This companies shown **minimal readiness** for direct integration. They can contribute through marketing and cooperative initiatives. Their integration is symbolic and associative, emphasizing narrative value and consumer trust-building rather than technical adoption.

Table B- 1. Summary of readiness across company profiles.

COMPANY PROFILE	READINESS	KEY ENABLERS	CSF ENGAGEMENT PATHWAY
Large Integrated Corporations	Maximal	Full vertical integration, in-house R&D, automation, financial strength, certifications	Lead pilots and scale hybrid/CSF production; influence sector adoption
Northern Medium Producers	High	Advanced production systems, research partnerships, mid-size agility	Collaborative pilots, demonstration projects, joint ventures
Southern Medium Producers	Moderate	Limited R&D, partial automation, innovation via partnerships	Incremental adoption through partnerships and innovation networks
Northern Small Producers	Selective	Flexible operations, innovation culture, community ties	Small-scale demonstrations, consumer engagement, niche pilots
Southern Small Producers	Low	Family-run, limited tech and capital	Shared facilities, cooperatives, collaborative participation
Micro Local Producers	Minimal	Artisanal scale, traditional methods	Symbolic/associative integration: marketing, co-branding

2. Potential to mitigate key challenges through CSF integration

Aquaculture companies face a range of production, environmental, and market challenges, including disease outbreaks, climate variability, regulatory constraints, and reputational pressures. While adopting CSF can partially mitigate these challenges, not all companies are equally prepared to benefit. Table B-2 includes companies for which a given challenge was identified, and readiness to adopt CSF is maximal to moderate. Each entry links the challenge to potential CSF mitigation strategies to guide targeted engagement.

Table B- 2. Potential to mitigate sector challenges based on company readiness for CSF.

CHALLENGE	MITIGATION FOCUS	BENEFITING COMPANIES*	IMPACT	INTEGRATION & EFFICIENCY OPTIONS
Disease and biosecurity risks Disease outbreaks, parasites, and contamination in aquaculture systems remain persistent problems	Closed, pathogen-free CSF and hybrid RAS-CSF systems reduce exposure to pathogens	○ Large Integrated Corporation ○ Northern Small Producer	○ Stabilized production ○ Lower disease and contamination losses	○ Integrate CSF modules or adopt RAS-CSF hybrid systems to safeguard offshore or intensive production sites ○ Use shared biosecure filtration and water treatment systems ○ Recycle water and nutrients within closed loops
Climate change and environmental variability Temperature fluctuations, salinity changes, and oxygen limitations constrain aquaculture productivity	CSF allows controlled production independent of environmental conditions, ensuring consistent output	○ Large Integrated Corporation ○ Southern Medium Producer	○ Consistent yields ○ Reduced climate risk	○ Deploy climate-resilient CSF units or retrofit facilities to maintain output ○ Implement heat recovery and energy-shared systems
Spatial constraints and regulatory complexity Limited coastal areas and complex permitting restrict physical expansion	Facility-integrated CSF modules expand output without new permits or sea sites	○ Northern Medium Producer ○ Southern Medium Producer	○ Increased production within existing space ○ Regulatory compliance	○ CSF modules are installed within existing RAS or processing areas ○ Use vertical or modular farming designs to maximize space ○ -Employ shared monitoring, automation, and control systems to optimize operational efficiency

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				○ Implement waste-to-resource loops (nutrient recovery for fertilizers)
Operational and production risks Seasonal shortages, slow growth, and biological variability affect production	Hybrid setups stabilize yields and buffer against seasonal fluctuations	○ Large Integrated Corporation ○ Northern Medium Producer	○ Predictable volumes for key species ○ Flexibility in production scheduling	○ Implement multi-cycle cultivation and staggered production schedules.
Market perception and sustainability reputation Aquaculture's image is sometimes negatively perceived due to environmental or welfare concerns	CSF products enhance transparency and low-impact, welfare-friendly branding	○ Large Integrated Corporation ○ Northern Small Producer	○ Strong sustainability positioning ○ Consumer trust	○ Closed-loop operations improve environmental footprint and traceability ○ Promote shared circular practices, e.g., bioremediation of effluents

* considering challenge priority and readiness level.

3. Strategic opportunities for CSF integration

Interviews with producers highlighted key growth opportunities in the traditional aquaculture sector, including entering premium markets, investing in technology and R&D, developing academic partnerships, diversifying production, and improving energy efficiency. These existing strengths and ambitions also provide pathways for integrating CSF, enabling companies to leverage current assets and capacities to explore hybrid or cellular approaches (Table B-3). Only companies with moderate or higher readiness levels were included to guide targeted engagement.

Table B- 3. Strategic opportunities for leveraging CSF integration.

STRATEGIC OPPORTUNITY	INTEGRATION PATHWAY	BENEFITING COMPANIES*
Growing market demand for sustainable seafood	Increasing consumer interest in traceable, environmentally friendly products opens new markets for hybrid or CSF. Allows producers to expand product lines while reinforcing sustainability claims. Premium-focused firms are best positioned to capitalize on this shift.	○ Large Integrated Corporation ○ Northern Medium Producers
Investment in technology and R&D	Companies with established RAS systems, automation, and in-house R&D can adapt existing infrastructure for hybrid CSF production.	○ Large Integrated Corporation ○ Northern Medium Producer
Academic and research partnerships	Strong collaborations with universities and research institutions accelerate knowledge transfer, applied research and demonstration initiatives providing practical insights for gradual integration of CSF technologies.	○ Northern Medium Producers ○ Southern Medium Producers
Production diversification and value-added products	Producers exploring new species and product formats can integrate CSF to expand premium lines or create hybrid offerings, increasing differentiation in competitive markets.	○ Large Integrated Corporation ○ Southern Medium Producers ○ Northern Medium Producers
Renewable energy access and resource efficiency	Producers investing in sustainable energy or efficient production systems can extend these efficiencies to CSF operations, reducing costs and environmental impacts. This alignment reinforces sustainability credentials and strengthens the business case for integration.	○ Large Integrated Corporation ○ Northern Medium Producers ○ Northern Small Producers

* considering opportunity and readiness level.

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Part 4 – Engagement strategy and recommendations for implementation

The analysis above (Part 3) highlights the heterogeneity of CSF integration potential within European aquaculture. While large and technologically advanced producers possess the infrastructure and capital to pioneer hybrid productions, smaller enterprises can participate indirectly through cooperation, shared infrastructure, or value-chain partnerships.

Building on these differentiated capacities, the next section outlines strategic pathways for engagement, ensuring that all types of aquaculture enterprises, from integrated corporations to micro local producers, can play a role in the transition toward CSF systems.

1. Engagement strategy

This section outlines a framework for engaging aquafarmers based on company readiness, translating differentiated capacities into actionable pathways that allow all producers, from large integrated corporations to micro local enterprises, to participate in and benefit from CSF integration. The strategy emphasizes inclusivity, alignment with growth priorities and sustainability objectives, and applies a differentiated approach based on AA1000SES principles of Inclusivity, Materiality, and Responsiveness.

Maximal to High-readiness enterprises (Large integrated corporations, Northern medium producers): **Active co-creation**

- Profile: Companies with strong R&D capabilities, operational capacity, and potential strategic interest in hybrid or full CSF systems.
- Engagement approach: Lead small- to medium-scale pilot projects; participate in multi-stakeholder workshops including suppliers, academic partners, technology providers, and distributors; explore technical, operational, regulatory, and market feasibility.
- Expected outcomes: Demonstrate feasibility, act as pioneers, co-create best practices, and provide feedback to refine broader sector adoption strategies.
- Alignment:
  Inclusivity: Internal teams, suppliers, academic, and technology collaborators.
  Materiality: Addresses sustainability, resource efficiency, and market innovation.
  Responsiveness: Iterative adaptation based on operational results and stakeholder feedback.

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Example of a pilot system | Prototype Hybrid RAS-CSF Pilot

A hybrid system can integrate small-scale CSF units within a conventional RAS facility, producing part of the biomass via RAS and another via controlled cellular bioreactors. High-readiness enterprises may leverage advanced knowledge in RAS features[45] - high water recirculation, nutrient management, integrated monitoring of pH, temperature, dissolved gases, and nitrogen and phosphates – to support both conventional and cellular production.

Circularity and shared infrastructure opportunities may include:

- Effluent and spent medium treatment: integrated systems for treating both RAS water and CSF spent media, using filtration, nutrient recovery, and bioremediation.
- Bioremediation via algae/microalgae: (micro)algae assimilate residual nutrients, generating secondary biomass that can be processed to extract nutrients for CSF media[46].
- Shared energy and monitoring systems: centralized control and resource flows improving operational efficiency and reducing costs.
- New species production: CSF may enable cultivation of species not feasible in conventional aquaculture, such as tuna or other high-value species.
- Resource synergies: Fish processing by-products can be converted into defined supplements for CSF media under controlled conditions.

This pilot would allow evaluation of operational feasibility, energy efficiency, co-location synergies, and circular resource use. Insights inform hybrid system design, scaling strategies, and sector engagement, while demonstrating the potential for integrated, circular aquaculture and production of novel species through CSF.

Note: For moderate to low readiness enterprises, engagement focuses on collaboration, knowledge exchange, and conceptual exploration rather than technological pilots.

Moderate to Selective-readiness enterprises (Southern medium producers, Northern small producers): **Active participation**

- Profile: Firms with moderate operational capacity and interest in innovation, but cautious regarding investment scale.
- Engagement approach: Join pilot trials, feasibility studies, workshops, and market testing; engage in collaborative research or co-development projects.
- Expected outcomes: Provide practical insights on operational feasibility and market acceptance; identify collaborative adoption pathways.
- Alignment:

  Inclusivity: Interaction with academic, industry, and community stakeholders.

  Materiality: Activities address operational, environmental, and market challenges relevant to the enterprise.

  Responsiveness: Learning from pilots and feedback to inform iterative improvements.

[45] Roy, S. M., Choi, H., & Kim, T. (2025). Review of state-of-the-art improvements in recirculating aquaculture systems: Insights into design, operation, and statistical modeling approaches. Aquaculture, 605, 742545. https://doi.org/10.1016/j.aquaculture.2025.742545

[46] Haraguchi, Y., Okamoto, Y., & Shimizu, T. (2022). A circular cell culture system using microalgae and mammalian myoblasts for the production of sustainable cultured meat. Archives of Microbiology, 204(10), 615. https://doi.org/10.1007/s00203-022-03234-9

Low to Minimal-readiness enterprises (Southern small producers, Micro local producers): **Informed awareness and knowledge transfer**

- Profile: Smaller or resource-constrained operations with limited capacity to pilot CSF systems directly.
- Engagement approach: Participate in sectoral workshops, knowledge-sharing networks, and association-led initiatives; explore indirect participation via partnerships, use of company's by-products, co-branding and cooperative value-chain models.
- Expected outcomes: Gain exposure to innovation, improve capacity and market visibility, and contribute feedback on collaborative adoption initiatives.
- Alignment:
  Inclusivity: Engagement through associations, networks, and community collaborations.
  Materiality: Focus on achievable, context-sensitive pathways.
  Responsiveness: Gradual adaptation via peer learning and cooperative initiatives.

This differentiated framework ensures that engagement approaches are proportionate to readiness, risks are mitigated, and knowledge is circulated across the sector.

Maximal to high-readiness enterprises act as pilots and demonstrators, moderate to selective-readiness enterprises engage through collaborative validation and market testing, and low to minimal-readiness enterprises participate via knowledge exchange and partnership-driven mechanisms.

Together, these tailored pathways aim to create a balanced, inclusive foundation for European aquaculture's participation in the transition toward hybrid and CSF systems.

2. Recommendations and strategic pathways for engaging aquafarmers

Integrating aquafarmers into CSF systems requires careful consideration of sector-specific realities, structural differences, and uncertainties regarding feasibility, costs, and market opportunities. The following recommendations provide a structured framework for inclusive, evidence-based engagement.

Align engagement with sector priorities and growth trajectories

Our analysis, aligned with published data[47] and public reports[48], shows that aquaculture enterprises differ widely in technological levels, scale, species produced, production systems, and investment capacity. Engagement strategies should thus acknowledge that the sector is

[47] Cai, J. et al. (2023). A global assessment of species diversification in aquaculture. Aquaculture, 576, 739837. DOI: 10.1016/j.aquaculture.2023.739837

[48] World Bank. (2023). The global aquabusiness investment guide. World Bank Group.

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both diverse and expanding[49] and that companies may prioritize the advancement of conventional aquaculture practices over the integration of new production models such as CSF. Engagement must remain sensitive to ongoing growth objectives and sustainability priorities, recognizing that immediate adoption of novel approaches like CSF may not align with producers' short-term plans.

Consider technological and economic constraints

CSF adoption involves substantial technical complexity and high initial costs, which may limit readiness for some producers. Engagement should therefore provide realistic evaluations of barriers while exploring practical pathways within existing aquaculture systems, such as hybrid approaches or nutrient/by-products reuse initiatives. Linking new technologies to familiar production contexts allows producers to progressively build capacity, identify synergies, and participate in adoption at a pace suited to their scale and resources, ensuring inclusivity and minimizing disruption to ongoing operations.

Address knowledge gaps and uncertainty

Technological feasibility, operational requirements, investment costs, and regulatory complexity remain key uncertainties for CSF adoption[50,51]. Insights gathered from a few spontaneous discussions during the interviews suggest that producers approach these novel technologies cautiously. Engagement strategies should reflect this by providing evidence-based guidance through pilot projects, technical demonstrations, and open-access data, helping aquafarmers evaluate feasibility, understand potential benefits and limitations, and make informed decisions in line with their operational realities. Transparent communication of opportunities and constraints ensures engagement aligns with producers priorities and encourages considered participation.

Leverage adaptation potential

Aquaculture is a relatively recent industry compared to traditional agriculture, which may facilitate adaptation to new production approaches. Historical examples, such as fishers transitioning to aquaculture[52], indicate that more recent sectoral changes can ease adoption, whereas long-established agricultural systems may have more entrenched practices. Understanding these dynamics can inform engagement strategies and highlight pathways that leverage prior experience with operational transitions.

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[49] Food and Agriculture Organization of the United Nations (FAO). (2022). The State of World Fisheries and Aquaculture 2022: Towards Blue Transformation. FAO.

[50] Good Food Institute. (2024). State of the industry: Cultivated meat, seafood, and ingredients 2024. https://gfi.org/wp-content/uploads/2025/04/2024-State-of-the-Industry-Cultivated-meat-seafood-and-ingredients-GFI.pdf

[51] Borriello, A. et al. (2025) A global comprehensive review on cultured seafood. npj Sci Food 9, 142 DOI: 10.1038/s41538-025-00461-4

[52] Cleaver, C., Johnson, T. R., & Hanes, S. P. (2024). Challenges and opportunities for integrating aquaculture with commercial fishing in Maine. *Marine Policy, 170,* 106407

Support equitable CSF adoption across readiness levels

While large-scale, centralized operations may be better positioned to adopt CSF technologies, as it was evidenced in the case of CM[53,54], inclusive strategies are essential to prevent marginalization of smaller producers and local economies. Engagement should provide pathways for all actors to contribute insights and benefit from emerging systems, including indirect participation through knowledge sharing, collaborative projects and partnerships, shared infrastructure and value-chain initiatives. Tailoring engagement according to company readiness fosters equitable adoption, mitigates the risk of market concentration, and ensures that CSF integration complements rather than displaces existing aquaculture practices.

Include broader aquaculture stakeholders

Engagement should extend beyond individual aquafarmers to encompass key actors across the aquaculture ecosystem: feed suppliers, microalgae producers, processors, distributors, research institutions, and producer associations. Feed suppliers may provide raw ingredients for CSF media; microalgae producers could contribute to nutrient recycling or medium remediation; and distribution networks could facilitate market integration of CSF products. Early involvement of these stakeholders will strengthen technical development, shared-infrastructure use, and market acceptance of CSF products.

Engage aquafarmers effectively

Trust, credibility, and pre-existing relationships are central to securing participation. In this study, only one association connected to the S2AQUA network participated, and individual producer engagement relied on personal or professional connections. Sector events (e.g. aquaculture fairs) proved largely ineffective due to time constraints of potential interviewees. Engagement should therefore prioritize direct, trust-based approaches, using intermediaries or known contacts, and remain flexible, concise, and low-burden to respect daily operational demands.

An additional pathway to raise sector awareness is the targeted dissemination of scientific knowledge on CSF at aquaculture-specific conferences and workshops. Sharing evidence-based research, technical demonstrations, and case studies can increase understanding of CSF technologies, stimulate discussion, and introduce producers and aquaculture researchers to innovative production approaches. Such engagement not only informs stakeholders but also opens opportunities for dialogue, collaborative experimentation, and gradual integration of CSF practices into existing aquaculture systems.

[53] Cultivated Meat. (2025). UK Parliament POSTnote 740. https://researchbriefings.files.parliament.uk/documents/POST-PN-0740/POST-PN-0740.pdf

[54] Stephens, N. et al. (2018). Bringing cultured meat to market: Technical, socio-political, and regulatory challenges in cellular agriculture. Trends in Food Science & Technology, Vol 78, 155–166.

Account for policy and regulatory context

EU policy frameworks – including the Common Fisheries Policy and the Strategic Guidelines for a More Sustainable and Competitive EU Aquaculture – together with European funding instruments, can facilitate the gradual integration of CSF. Effective engagement should account for these regulatory dimensions, aligning outreach and consultation strategies with existing compliance requirements and economic incentive structures. Early dialogue with competent authorities, including the European Commission, the European Food Safety Authority (EFSA), and national food agencies, can help aquafarmers navigate evolving definitions, risk assessments, and approval processes for CSF products, thereby reducing uncertainty. Transparent communication on policies, funding opportunities, and regulatory expectations is essential to build trust, lower perceived risks, and ensure that engagement efforts remain feasible, inclusive, and proportionate across different scales of production.

Support evidence-based economic feasibility and sustainability assessment

Comparative Life Cycle Assessments (LCAs) are crucial to support informed decision-making. LCAs should evaluate energy use, resource efficiency, environmental impacts, and product quality for conventional aquaculture, hybrid systems, and CSF production. In addition to LCAs, Techno-Economic Assessments (TEAs) provide complementary insights by quantifying capital expenditures, operational costs, production efficiency, and potential profitability of novel systems. Combining LCAs and TEAs allows aquafarmers to evaluate both environmental and economic trade-offs, identify cost drivers, and assess financial feasibility under different operational scenarios. Evidence-based assessments enable producers to make strategic choices aligned with sustainability goals, optimize resource use, and plan phased adoption of CSF technologies while managing economic risk.

Foster inclusive knowledge exchange and dialogue

Structured engagement – such as roundtables, workshops, and demonstration projects – can bridge knowledge gaps, build trust, and provide opportunities for multi-stakeholder dialogue. This allows aquafarmers to express concerns, assess technical feasibility, understand regulatory and market considerations, and generate data to refine engagement strategies and identify practical pathways for hybrid or cellular integration.

Future engagement should adopt a pragmatic, evidence-informed approach that acknowledges aquafarmers' diversity, technological and economic constraints, and potential centralization effects. Pilots, demonstrations, sustainability assessments, and structured dialogue are essential to develop actionable, context-sensitive strategies for hybrid of full CSF adoption, ensuring equitable outcomes and sector-wide learning.

Key insights:

- Engagement must align with sector diversity, growth priorities, and readiness levels;
- Direct, trust-based approaches outperform generic events; leverage known contacts and intermediaries;
- Include broader aquaculture stakeholders (feed, microalgae, processors, researchers) for technical and market integration;
- Address knowledge gaps via pilot projects, demonstrations, and evidence-based guidance;
- Combine LCAs and TEAs to inform environmental and economic decision-making;
- Gradual, context-sensitive adoption pathways (e.g. hybrid systems) enhance inclusivity and reduce risk.

Part 5 – Next steps within FEASTS project

The project will organize roundtables to initiate discussions about CSF with aquaculture stakeholders, explore aggregated insights from interviews and hypothesis, and investigate aquafarmers' perceptions and potential integration pathways. A short communication video will support these discussions, serving as a catalyst for discussion and reflection. Insights collected during the roundtables and through feedback on the video will inform refinements to the engagement plan, and outputs may be leveraged as Key Exploitable Results (KERs) for broader awareness and engagement initiatives. These results will also be included in FEASTS project final report.

1. Roundtables to explore stakeholder perspectives on CSF

To explore aquaculture stakeholders' perspectives on CSF and begin a structured dialogue on its potential integration, two regional roundtables will be organized. To account for the diversity of the sector, the differentiated readiness profiles identified in Part 3, and the specific regional characteristics of aquafarmers across Europe, these sessions will take place in Northern and Southern Europe, respectively. The roundtables will present aggregated findings from the interviews, reflecting sector-wide challenges, opportunities, and differentiated readiness across company profiles, and will explore aquafarmers' perceptions of CSF as a potential complementary production pathway, considering structural, technological, and operational diversity.

Whenever possible, each roundtable will bring together a diverse set of participants, including aquafarmers of varying scales, representatives of producer associations, researchers in cellular agriculture and aquaculture, private-sector stakeholders from feed and value-chain innovation companies, and policymakers from relevant institutions. This diversity will ensure that discussions reflect the full spectrum of operational realities and regional contexts within European aquaculture. Since only two roundtables are planned within FEASTS, these initial sessions include participants across different profiles to capture a broad spectrum of

perspectives. Future roundtables and engagement activities beyond FEASTS could benefit from segmenting participants by company profile or readiness level to allow for more focused and in-depth discussions, while still ensuring representation of smaller or resource-limited producers.

The sessions will begin with a synthesis of interview findings, covering constraints and growth opportunities, followed by an introduction to cellular aquaculture. A short video clip (Part 4, Section 2) will serve as a catalyst for discussion, illustrating the vision of coexistence between traditional and CSF production. Expert researchers will clarify technical processes, while policy and industry representatives will contextualize regulatory, market, and innovation frameworks.

Discussions will focus on how cellular aquaculture could mitigate existing challenges, including disease management, adaptation to climate change, and licensing constraints, and leverage sector strengths, such as investment capacity, technological infrastructure, and academic collaboration. Through moderated exchanges, aquafarmers will be invited to share their perspectives on the feasibility, desirability, and implications of integrating cellular approaches into existing systems. Participants will also be encouraged to consider hypotheses of cooperation with existing start-ups, their potential role in hybrid or cellular production systems (whether through integration, contribution, investment, or collaboration), opportunities for knowledge exchange, conditions under which they would feel comfortable engaging, and various forms of participation - from shared infrastructure and pilot projects to value-chain partnerships or co-investment strategies. Special attention will be given to pathways that allow smaller or resource-limited producers to meaningfully contribute.

By combining presentation of analytical findings with structured dialogue, the roundtables are designed to collect actionable insights, validate assumptions underlying the engagement plan, and align scientific, industrial, and policy perspectives with practical realities. In this way, they serve as a platform to guide context-sensitive pathways for CSF integration and support the future development of a cohesive and inclusive aquaculture innovation ecosystem.

2. Short-movie clip on integrating CSF into aquaculture

As part of the engagement activities, a short video will support dialogue by presenting cellular aquaculture in a relatable way and encouraging reflection on its potential role within existing aquaculture systems. The video builds on the RespectFarms approach, which successfully engaged farmers, and applies the same methodology to create broader awareness across the aquaculture sector. It presents both the perspective of a traditional aquafarm and a forward-looking vision of how aquaculture could evolve through technological innovation and sustainability-oriented transformation.

The video clip will:

- Translate abstract concepts into relatable narratives and visual examples.
- Act as a discussion catalyst during the roundtables, supporting moderated dialogue and critical reflection on CSF production scenarios.
- Be disseminated widely beyond the immediate project activities, extending the reach of FEASTS outputs and supporting knowledge exchange, awareness, and engagement with aquaculture producers, industry stakeholders, and policymakers across Europe.

Together, the roundtables and video aim to foster trust, dialogue, and evidence-based assessment, enabling aquafarmers to provide actionable insights that will guide practical, context-sensitive pathways for CSF integration across the European aquaculture sector. They serve as complementary tools: the roundtables provide structured, interactive engagement aligned with sector-specific realities, while the video broadens understanding and stimulates reflection at scale.

General conclusions

This report has mapped the current landscape, challenges, and opportunities of both the European livestock farming and aquaculture sectors, identifying how they could engage in and benefit from the integration of CM and CSF technologies. Through interviews with 41 livestock farmers across eight EU countries and 26 aquaculture enterprises across Northern and Southern Europe, along with a comprehensive analysis of their business models, investment capacity, and strategic orientations, the study offers an evidence-based understanding of the readiness and potential of both sectors to participate in cellular agriculture activities.

The results confirm that both sectors are technically advanced yet highly heterogeneous. In livestock farming, we identified entrepreneurial segments committed to resilience, diversification, and sustainable adaptation that demonstrate readiness to pilot CM integration. In aquaculture, Northern and capital-intensive producers are more prepared to pilot hybrid or CSF initiatives, while Southern and small-scale producers require collaborative, partnership-based approaches to access innovation. Despite structural disparities, all profiles demonstrate a shared commitment to sustainable growth, technological improvement, and quality-oriented production.

The findings suggest that CM/CSF integration could address several systemic challenges facing both sectors – such as labor shortages, disease management, environmental pressures, regulatory burdens, and market volatility – while opening new opportunities for diversification, circular use of resources, and value creation in premium and sustainable markets. However, success will depend on critical factors: producer-centered co-development, inclusive participation**,** supportive policy frameworks, and trust-based partnerships between producers, technology developers, industry stakeholders, and regulators. At the same time, it is important to recognize that the level of certainty regarding integration pathways differs between livestock farming and aquaculture. For livestock, previous studies provide a more developed evidence base, allowing clearer identification of farmer groups that could benefit from CM and more confident articulation of adoption pathways. In aquaculture, this study represents the first systematic assessment of aquafarmers' perspectives on CSF. As a result, the findings are necessarily more exploratory.

The engagement strategies developed in this report provide practical frameworks for ensuring that primary producers – regardless of scale or location – can participate meaningfully in CM/CSF implementation. The strategy aligns with the Technology adoption curve, prioritizing co-creation with innovators, engagement based on demonstration with early adopters, and transparent information sharing with the broad farming community. For aquaculture, the preliminary roadmap aligns engagement approaches with readiness levels

ensuring equitable representation, knowledge exchange, and co-development of practical, regionally relevant solutions.

Looking ahead, the planned activities will support ongoing dialogue and translate research into practical implementation. For livestock farming, co-creation workshops will collect feedback on early prototypes. This will help develop a functional blueprint of the CM farm (FEASTS Deliverable D4.7), demonstrating how livestock farming and CM production can complement. For aquaculture, regional roundtables will help validate the study's findings, contributing to a shared understanding of how traditional aquaculture and CSF can coexist and informing potential future initiatives. These collaborative processes are essential for developing models that work within agricultural and aquacultural realities.

Ultimately, this study underscores that the future of CM and CSF can and should be built with farmers and aquafarmers, not around them. Actively engaging producers in innovation processes will help ensure that emerging technologies complement existing practices, enhance productivity, and strengthen the resilience of the primary sector. Through close collaboration with farmers and aquafarmers, Europe can foster a sustainable, equitable, and socially accepted blue economy – one that aligns technological progress with tangible benefits for coastal and rural communities.

Annexes

ANNEX-1. Farmers participating in the research.

Ref.	Country	Gender	Age	Education	1st Generation	Farm Type	Operated Land (Ha)	Species	System	Specialization
R001	Netherlands	Male	30	University	No	Family Farm	40	Cattle	Grazing (or Extensive)	Dairy
R002	Netherlands	Male	30	University	Restarted	Family Farm	Unknown	Cattle	Grazing (or Extensive)	Dairy
R003	Netherlands	Male	40	N/A	No	Family Farm	Unknown	Cattle	Landless / Industrial	Fattening
R004	Germany	Male	40	University	No	Family Farm	40	Pigs	Landless / Industrial	Fattening
R005	Germany	Male	45	University	No	Family Farm	60	Cattle, Pigs	Mixed Farming	Fattening
R006	Netherlands	Male	25	University	Yes	Non-Family Farms	2	Pigs	Other Grazing/Extensive	Breeding
R007	Italy	Male	55	N/A	No	Non-Family Farms	300	Pigs	Mixed Farming	Part breeding / part full cycle
R008	Italy	Male	34	University	No	Family Farm	Unknown	Cattle	Mixed Farming	Fattening
R009	Italy	Male	35	University	No	Family Farm	Unknown	Cattle	Mixed Farming	Fattening
R010	Italy	Male	50	N/A	No	Family Farm	130	Cattle	Mixed Farming	Fattening
R011	Italy	Male	40	Farm	No	Non-Family Farms	24	Poultry	Mixed Farming	Full cycle
R012	Italy	Male	60	University	No	Family Farm	Unknown	Pigs	Landless / Industrial	Full cycle
R013	Spain	Male	40	N/A	No	Family Farm	120	Cattle	Mixed Farming	Dairy
R014	Spain	Male	65	N/A	No	Only Family Farm	20	Cattle	Grazing (or Extensive)	Full cycle
R015	Spain	Female	50	N/A	No	Only Family Farm	70	Cattle	Grazing (or Extensive)	Full cycle
R016	Spain	Male	60	N/A	No	Non-Family Farms	Unknown	Cattle	Mixed Farming	Fattening
R017	Netherlands	Male	50	University	Yes	Family Farm	Unknown	Cattle	Grazing (or Extensive)	Full cycle
R018	Netherlands	Male	45	N/A	No	Family Farm	350	Cattle	Mixed Farming	Fattening
R019	Poland	Male	30	N/A	No	Only Family Farm	100	Cattle, Pigs	Mixed Farming	Fattening
R020	Poland	Male	55	University	No	Non-Family Farms	Unknown	Poultry	Landless / Industrial	Fattening
R021	Poland	Male	45	University	No	Family Farm	60	Pigs	Mixed Farming	Part breeding / part full cycle
R022	Poland	Male	55	University	Restarted	Non-Family Farms	400	Cattle	Grazing (or Extensive)	Part breeding / part full cycle
R023	Germany	Male	30	N/A	No	Family Farm	65	Cattle, Pigs	Mixed Farming	Part breeding /

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										part fattening
R024	Germany	Male	40	N/A	No	Family Farm	100	Cattle, Pigs	Mixed Farming	Part breeding / part fattening
R025	Netherlands	Male	50	N/A	No	Family Farm	65	Cattle	Grazing (or Extensive)	Breeding
R026	Netherlands	Male	30	N/A	No	Family Farm	125	Poultry	Mixed Farming	Fattening
R027	Belgium	Male	40	University	Yes	Only Family Farm	42	Mixed	Grazing (or Extensive)	Full cycle
R028	Italy	Male	68	Farm	No	Family Farm	210	Pigs	Mixed Farming	Full cycle
R029	Italy	Male	35	University	No	Family Farm	Unknown	Cattle, Pigs	Mixed Farming	Full cycle
R030	France	Male	60	University	No	Only Family Farm	54	Cattle	Mixed Farming	Dairy
R031	Belgium	Male	30	University	No	Only Family Farm	75	Cattle	Grazing (or Extensive)	Full cycle
R032	France	Male	40	Technical	No	Only Family Farm	35	Poultry	Mixed Farming	Fattening
R033	France	Female	40	University	No	Family Farm	Unknown	Pigs	Mixed Farming	Full cycle
R034	France	Female	45	University	No	Non-Family Farms	100	Pigs	Mixed Farming	Full cycle
R035	France	Male	50	University	No	Non-Family Farms	200	Pigs	Mixed Farming	Full cycle
R036	Germany	Male	32	Technical	No	Non-Family Farms	90	Cattle	Mixed Farming	Dairy
R037	Germany	Male	45	N/A	No	Family Farm	140	Cattle	Mixed Farming	Dairy
R038	Germany	Male	30	Technical	No	Only Family Farm	120	Pigs	Mixed Farming	Full cycle
R039	Denmark	Male	30	Technical	No	Non-Family Farms	1650	Pigs	Mixed Farming	Full cycle
R040	Denmark	Male	50	University	Yes	Non-Family Farms	3500	Cattle	Mixed Farming	Dairy
R041	Denmark	Male	45	University	No	Non-Family Farms	1000	Pigs	Landless / Industrial	Full cycle

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ANNEX-2. Aquaculture companies participating in the study.

#	REGION	COUNTRY	PRODUCTION SYSTEM	TARGET SPECIES
1	South	Portugal	Land-based (RAS)	Marine fish (turbot, sole)
2	South	Portugal	Land-based (ponds)	Marine fish (seabream, seabass)
3	South	Portugal	Land-based (ponds)	Marine fish (seabream, seabass)
4	South	Portugal	Land-based (RAS)	Marine fish (sole)
5	South	Portugal	Offshore (open net cages)	Marine fish (seabream, seabass)
6	South	Portugal	Offshore (open net cages)	Marine fish (seabream, seabass)
7	South	Portugal	Offshore (long-lines)	Bivalves (clam, oyster)
8	South	Portugal	Land-based (FTS, ponds)	Bivalves (oyster)
9	South	Portugal	Coastal shore (bottom culture)	Bivalves (clam)
10	South	Portugal	Coastal shore (bottom culture)	Bivalves (clam)
11	South	Portugal	Coastal shore (rack culture)	Bivalves (oyster)
12	South	Spain	Land-based (RAS)	Marine fish (turbot, sole)
13	South	Spain	Land-based (FTS, RAS)	Freshwater fish (trout)
14	South	Italy	Land-based (FTS)	Freshwater fish (trout)
15	South	France	Land-based (RAS)	Marine fish (seabream, seabass, meagre)
16	South	France	Land-based (FTS)	Freshwater fish (sturgeon)
17	North	Netherlands	Land-based (RAS)	Marine fish (turbot)
18	North	Netherlands	Land-based (RAS)	Marine fish (seriola)
19	North	Denmark	Coastal shore (long-lines)	Bivalves (mussel)
20	North	Denmark	Land-based (RAS)	Freshwater fish (pike perch, trout)
21	North	Denmark	Land-based (RAS)	Marine fish (seriola)
22	North	Norway	Land-based (RAS)	Marine / Freshwater fish (salmon)
23	North	Norway	Land-based (RAS)	Marine fish (halibut)
24	North	Norway	Fjords (open net cages)	Marine / Freshwater fish (salmon)
25	North	Norway	Fjords (open net cages)	Marine / Freshwater fish (salmon)
26	North	Norway	Fjords (open net cages)	Marine / Freshwater fish (salmon)

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ANNEX-3. Interview focus topics for each thematic section used in both the Farmers and Aquafarmers interviews.

#	Thematic section	Focus topic
1.1	Personal & Motivational Aspects	Background and motivation for entering agriculture / aquaculture
2.1	Company Profile & Operations	Production type, volume, and product market forms
2.2		Unique value proposition of the product
2.3		Critical business activities (e.g., legislation, workforce)
2.4		Key resources (financial, human, technological)
2.5		Major production costs
2.6		Strategic partners and networks
3.1	Opportunities & Challenges	Company growth opportunities
3.2		Main challenges and risks
3.3		Future expectations for the sector
3.4		Company's long-term vision of aquafarming
4.1	Human Resources & Organization	Workforce size, age, and education profile
4.2		Compliance with legislation and regulations
5.1	Market & External Environment	Economic trends influencing business
5.2		Competitors in the aquaculture sector
5.3		Consumer preferences and quality requirements
5.4		Customer channels and marketing strategies
6.1	Sustainability & Innovation	Sustainable practices in production
6.2		Technological innovations in aquaculture

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ANNEX-4. Farmer interview questionnaire.

#	Question
1.	Can you briefly tell us something about yourself? How did you start farming? What is your story, and what are your activities on the farm?
2.	What is a typical day like for you? What are the main challenges you face in your daily work?
3.	Who are your customers?
4.	What do you offer your customers (type of animals, format, market demand, volumes)? Any other side revenue stream? How are revenues splits?
5.	How do you use subsidies? Part of the revenue? Where do they come from?
6.	What are your relationships with the supply chain (downstream and upstream)?
7.	How are costs split?
8.	What are your biggest challenges (as a breeder and in agriculture in general)?
9.	What are your plans or goals for the next 3-5 years?
10.	How do you see the future of agriculture/livestock breeding in your area? Looking ahead, how do you imagine the concept of farming and meat production?
11.	What do you like most about your job? What is important to you as a person?

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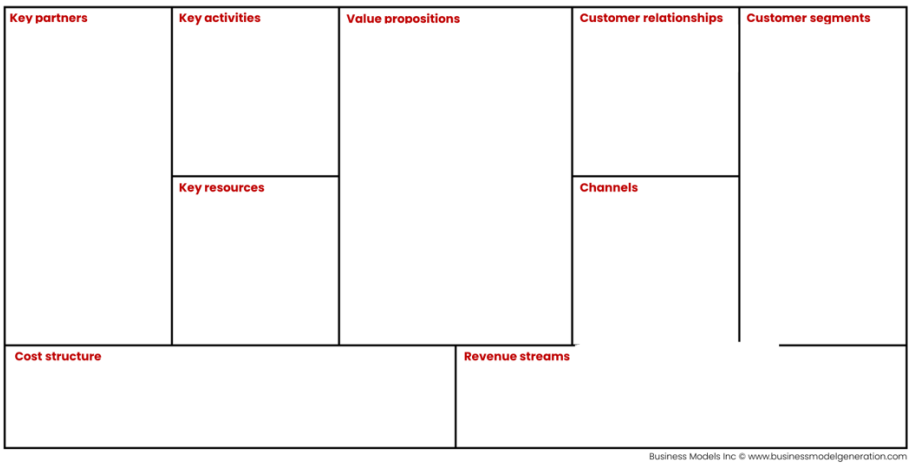
ANNEX-5. Aquafarmer interview questionnaire.

#	Question
1.	What is your background and main motivation for starting to work in aquaculture?
2.	What is your production type and volume, and in what forms do you sell the product (whole fish, fillets, fresh, or packaged)?
3.	What makes your product unique?
4.	Which channels are you currently using to reach your customers?
5.	What are your strategies (e.g. content marketing, social media, email campaigns) to attract customers?
6.	What are the most critical activities involved in running your company's business?
7.	What key resources (financial, human, technological) are essential for your business?
8.	What are the major costs associated with your production operations?
9.	Who are your main strategic partners (e.g. suppliers, distributors, research institutions)?
10.	What are the main opportunities for the success and growth of your company?
11.	What are the main challenges you foresee?
12.	What are your expectations for the evolution of the aquaculture sector?
13.	How many people work at this company? For each department, what is the average age and education level of the employees?
14.	In terms of legislation, what are the main policies and rules the company must implement and comply with?
15.	What economic trends are affecting your business (e.g. market, economic (un)stability, environmental concerns)?
16.	What sustainable practices do you follow (e.g. feed sourcing, water/waste management)?
17.	Who are your main competitors?
18.	Are there any technological innovations (emerging tools, equipment, digital solutions) relevant to aquafarming?
19.	What are the preferences and requirements in terms of product quality for consumers?
20.	Where do you envision your company in the future within the aquafarming industry?

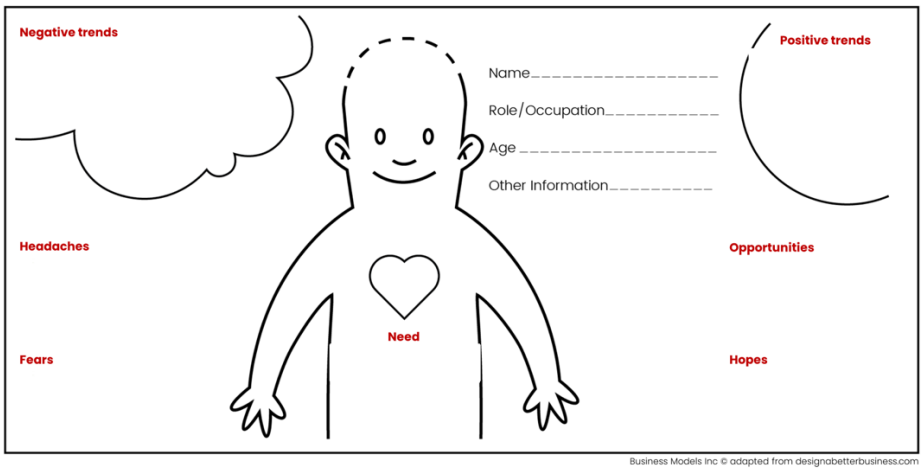
ANNEX-6. Templates of the business model, persona, and context map canvas applied in the study (farmers and aquafarmers).

BMI • Business model canvas



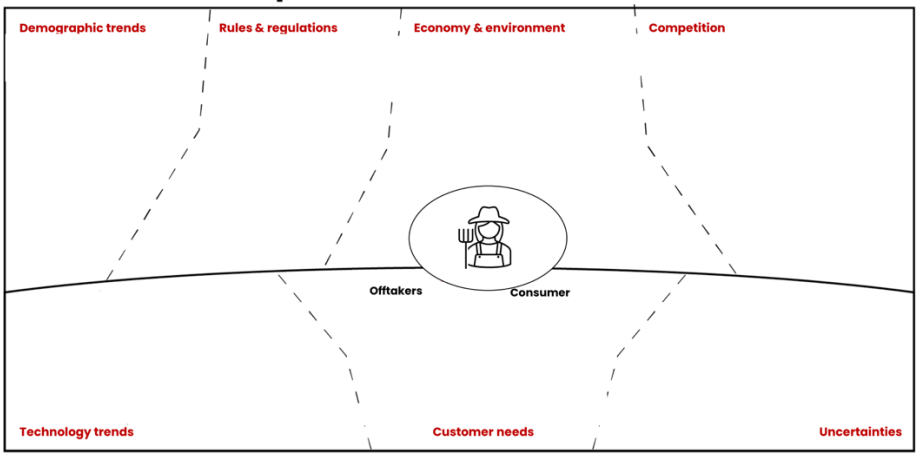
Business Models Inc © www.businessmodelgeneration.com

BMI • Persona canvas



Business Models Inc © adapted from designabetterbusiness.com

BMI • Context map canvas



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ANNEX-7. Challenges Identified by Livestock farmers and Examples Quotes.

Challenges Category	Frequency (% Farmers)	Example Quotes
Regulatory & Administrative Burden: Challenges related to government regulations, paperwork, permits, and administrative tasks	30 (73%)	**R008:** "EU standards; a lot of controls for innovators" **R011:** "Regulations made for big players. Too many rules for small producers" **R033:** "Too much environmental pressure from government (+ animal welfare)"
Economic Pressures: Financial challenges including low margins, unstable prices, debt management, and ROI concerns	28 (68%)	**R013:** "No control on prices for production: 'You just get what [the cooperative] gives you' **R016:** "The price of meat has remained the same for 30 years while the cost of everything else has doubled" **R036:** "ROI is very low in agriculture vs other industries"
Labor Issues: Difficulties finding, retaining, and managing qualified labor	18 (44%)	**R012:** "We can't find people who want to work at the farm" **R026:** "Finding workers [is hard. We employ] refugees, Western-Africans, through temp agencies. They are never the same, it's hard to communicate." **R034:** "Agricultural sector is struggling to attract young people. [It is] hard work, low paying"
Social Perception & Criticism: Negative public perception of farmers and farming practices	17 (41%)	**R008:** "Dishonest attacks from vegans, animal right organizations and media" **R021:** "Attitudes towards farmers have shifted: we are not seen as food producers but as animal oppressors" **R023:** "A lot of change how people see farmers in the community... Unfair treatment"
Infrastructure & Scaling: Difficulty expanding operations, modernization costs, land acquisition problems	15 (37%)	**R007:** "Finding land to buy (for quotas) and obtaining authorizations for big projects is not easy." **R009:** "A lot of investment needed to modernize current infrastructure." **R010:** "Hard to buy more land; efficiency and modernization are expensive." **R020:** "Impossible to expand farms in Poland." **R037:** "Unsure if a barn for 250 cows can be approved in the next 5 years, how can we make a 10–15–20 years investment in these conditions?"
Succession & Generational Transition: Issues related to farm transfer between generations	15 (37%)	**R007:** "Children are neither keen nor able to take over the farm" **R014:** "Biggest challenge for farmers: Finding someone to take over" **R028:** "No future after this generation. No one able to take over"

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Challenges Category	Frequency (% Farmers)	Example Quotes
Market Power Imbalance: Challenges related to power dynamics with processors, retailers, and other supply chain actors	15 (37%)	**R010:** "Giving value to the product distributed by retailers is hard, they want interchangeable products" **R029:** "Retailers don't satisfy the needs of consumers nor farmers" **R038:** "Farmer is the poorest in the value chain. The margin is made by processors and retailers"
Biosecurity & Disease Risks: Threats from animal diseases and biosecurity challenges	14 (34%)	**R013:** "Disease. [I've] lost a herd of 280 cows because of tuberculosis in 2016-2017. [I] had to restart from zero." **R021:** "African Swine Flu: Population of wild boars is exploding, and risks are high"
Operational Challenges: Day-to-day operational difficulties including work-life balance	10 (24%)	**R021:** "Work-life balance could be better" **R029:** "Welfare of people working in agriculture (revenues, mental charge, hours of work, lack of support)" **R032:** "Terrible lifestyle: No life, 365/24/7, alarms at night, weekends"
Industry Structure & Consolidation: Concerns about farm consolidation and changing industry structure	10 (24%)	**R018:** "Farming will concentrate. Only big organizations can buy farms now." **R019:** "In 10 years there will be no family farms anymore - No small players" **R030:** "European type of farms are taking over family farms"
Environmental & Climate Challenges: Issues related to environment, climate change, and sustainability	10 (24%)	**R019:** "Soil is poor in this area. Only corn grows. Not many options for development" **R024:** "New weather patterns difficult to conciliate with characteristics from the ground" **R027:** "Huge pressure on Nature in Flanders (Co2, Nitrogen)"

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ANNEX-8. Opportunities Identified by Livestock farmers and Examples Quotes

Opportunity Category	Frequency (% Farmers)	Example Quotes
Diversification: Renewable energy, hospitality, and mixed business models build resilience	31 (76%)	**R005:** "Many pig farmers have other businesses to diversify their activities and have less risks." **R027:** "Diversification; Tourism supports farming activity and vice versa; lots of support from local community." **R037:** "Diversification to de-risk business"
Technology: Automation and precision agriculture improve efficiency and animal welfare, though investment is a challenge for small farms.	29 (71%)	**R008:** "Technology offers data to monitor each aspect of production; automatization; circular farming." **R012:** "Integrate technology to optimize consumption, emissions." **R013:** "Milking robot frees up some time." **R033:** "Automation = only way to survive; from 5 people to 1." **R035:** "AI replaces workforce; robotization; remote control via smartphone."
Premium Markets: Organic certification and quality labels help small farms compete.	20 (49%)	**R001:** "Premiumization of food consumption" **R022:** "DOP producers won't have issues; quality niche products are valued." **R034:** "Quality labels such as DOP create differentiation." **R041:** "Many people see there is more than the cheapest possible pork."
Direct-to-Consumer: Branding and direct sales increase margins and build stronger consumer relationships.	19 (46%)	**R011:** "DTC is growing, brings more value." **R041:** "Direct-to-consumer allows to tell stories"
Policy Support: Incentives and grants drive innovation and conservation.	18 (44%)	**R009:** "EU incentives for modernization and sustainability. " **R010:** "Subsidy from EU/region for investments." **R015:** "Subsidies for local breed conservation." **R026:** "Tax reduction and subsidy (e.g., for precision farming)."
Sustainability: Green investments unlock new markets and revenue streams.	17 (41%)	**R008:** "Green investments open many doors; circular farming." **R010:** "Production of energy (photovoltaic and biogas) on the farm." **R031:** "Subsidies linked to environment protection become a possible source of revenues."
Market Dynamics: Sector consolidation rewards farmers who meet new standards.	14 (34%)	**R016:** "Bigger farms; more digital farms; subsidies for digitalization." **R039:** "CO_2 tax is an opportunity for big farms to absorb smaller ones; Danish Crown focuses on climate-oriented products."

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