D1.5 Inventory and analysis of foresight studies on European livestock production systems

horizon-stepup.eu

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101136785

Author(s)/Organisation(s)	Elodie MERLOT, Audrey BETHINGER, Océane ESPIN, INRAE
Contributor(s)	-
Work Package	WP1
Delivery Date (DoA)	June 30, 2025
Actual Delivery Date	June 30, 2025
Abstract:	T1.5 aims to identify the diversity of scenarios on the European livestock sector developed by public, scientific, and economic stakeholders, to highlight underexplored impacts within these future visions and to identify mentioned trade-offs. Indeed, the European livestock sector faces major challenges, including environmental pressures, ethical concerns, and health risks and foresight analysis helps explore possible futures and inform shared visions for sustainable livestock systems. We mapped and reviewed 86 foresight studies published since 2010, analysing 257 scenarios that we encoded into 22 descriptive variables and 93 system variables across six categories. Through statistical analysis on a sub-corpus of 50 studies and 160 scenarios, we identified 7 scenario families ranging from deregulated, intensive models to highly regulated, agroecological transitions. Most scenarios anticipate reduced land use and livestock numbers, with only a few projecting increased production. Technological adoption is widespread, but agroecological practices are mainly present in transformative scenarios. While most scenarios focused on production methods, volumes, and trade outcomes, many topics issues were largely neglected like value chain dynamics, One Health issues and social sustainability. Scenarios largely ignore disruptive events and many European regions, suggesting the need for more inclusive, crisis-aware, and systems-based foresight approaches for Europe's livestock future.

Document Revision History			
Date	**Version**	**Author/Contributor/ Reviewer**	**Summary of main changes**
09/06/2025	1	Elodie MERLOT, Audrey BETHINGER, Océane ESPIN (INRAE)	First draft
23/06/2025		Arnd BASSLER (BLE), Hervé GUYOMARD (INRAE), Sandra NOVAKOVIC (FoodScaleHub), Wellington OSAWE (TEAGASC), Claire ROGEL-GAILLARD (INRAE)	Document review
30/06/2025	Final	Elodie MERLOT, Audrey BETHINGER, Océane ESPIN (INRAE)	Final draft

Participant Number	Participant organisation name	Short name	Country
1.	TEAGASC - AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY	Teagasc	Ireland
2.	SVERIGES LANTBRUKSUNIVERSITET	SLU	Sweden
3.	INSTITUT NATIONAL DE RECHERCHE POUR L'AGRICULTURE, L'ALIMENTATION ET L'ENVIRONNEMENT	INRAE	France
4.	STICHTING WAGENINGEN RESEARCH	WR	Netherlands
5.	IFIP-INSTITUT DU PORC ASSOCIATION	IFIP	France
6.	EUROPEAN FORUM OF FARM ANIMAL BREEDERS	EFFAB	Netherlands
7.	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	CSIC	Spain
8.	UDRUZENJE ZA PREDUZETNISTVO I INOVACIJE FOODSCALE HUB	FSH	Serbia
9.	INSTITUT DE L'ELEVAGE	IDELE	France

10.	ASSOCIAÇÃO PARA A INVESTIGAÇÃO E INOVAÇÃO EM NUTRIÇÃO E ALIMENTAÇÃO ANIMAL - FEEDINOV	FEEDINOV Colab	Portugal
11.	BUNDESANSTALT FÜR LANDWIRTSCHAFT UND ERNÄHRUNG	BLE	Germany
12.	UNIWERSYTET PRZYRODNICZY W POZNANIU	PULS	Poland
13.	JOHANN HEINRICH VON THUENEN-INSTITUT, BUNDESFORSCHUNG INSTITUT FUER LAENDLICHE RAEUME, WALD UND FISCHEREI	Thuenen	Germany
14.	IST-ID ASSOCIAÇÃO DO INSTITUTO SUPERIOR TÉCNICO PARA A INVESTIGAÇÃO E O DESENVOLVIMENTO	IST-ID	Portugal
15.	INSTITUT TECHNIQUE DE L'AVICULTURE, DE LA CUNICULTURE ET DE LA PISCICULTURE-ITAVI	ITAVI	France
16. AP	THE QUEEN'S UNIVERSITY OF BELFAST	QUB	UK

Title: Sustainable Livestock Systems Transition and Evidence Platform for Upgrading Policies

Type of action: HORIZON Research and Innovation Action

Topic: HORIZON-CL6-2023-FARM2FORK-01-6

Start date of project: 1 January 2024 ● Duration: 48 months

Table of contents

Executive summary **1**

1. Introduction **4**

2. Methodology **6**

2.1. Initial corpus 6

2.2. Analysed corpus 7

2.2.1. Scenario sheets 7

2.2.2. Variables table 7

2.2.3. Statistical analysis 8

3. Results **10**

3.1. Description and comparison of the analysed corpus and the final corpus 10

3.2. Results of the Multiple Correspondence Analysis (MCA) 14

3.3. Narratives of scenario families 16

3.3.1. Cluster “Intensification and specialisation” 18

3.3.2. Cluster “Segmentation of production systems” 23

3.3.3. Cluster “Sustainability and protectionism” 30

3.4. Positioning of ongoing European partner projects scenarios 35

4. Discussion and perspectives **36**

4.1 Limits of the adopted methodology 36

4.2. Cross-analysis of scenarios and scenario families 37

4.2.1. Synthetic comparison of scenario families according to their main driving variables and output variables 37

4.2.2. Geographic and temporal distribution of scenario families 41

4.2.3. Animal species 42

4.2.4. European animal products autonomy and population diets 43

4.3. Integration of the Safe and Just Operating Space (SJOS) concept (Deliverable 6.1) 44

4.4. Identification of neglected topics 45

4.5. Comments on trade-offs 47

5. Conclusion **49**

6. References of the final corpus of European foresight studies on livestock production systems **51**

Annexes **55**

Annex 1. System variables 55

Annex 2. Comparison with SJOS variables of D6.1 59

Annex 3. List of foresight studies from the final corpus, classified by geographical level, with associated information on scenario distribution across families, time horizon, species covered, whether the study is quantified, and author category..... 62

Annex 4. Final corpus scenarios grouped by family 65

List of figures

Figure 1: Presentation of the methodology steps..... **Erreur ! Signet non défini.**

Figure 2: Number of foresight studies in the corpus analysed initially and then in the final corpus used for the MCA, according to their year of publication and to their time horizon..... **Erreur ! Signet non défini.**

Figure 3: Number of foresight studies in the corpus analysed initially and in the final corpus used for the MCA, according to their geographical scale, and their geographical distribution..... **Erreur ! Signet non défini.**

Figure 4: Distribution of foresight studies in the corpus analysed initially and in the final corpus used for the MCA, according to their central theme and the species considered. ..... **Erreur ! Signet non défini.**

Figure 5: Number of foresight studies of the analysed and final corpuses according to their category of author(s). ..... **Erreur ! Signet non défini.**

Figure 6: Representation of active variables on the first four dimensions of the MCA.**Erreur ! Signet non défini.**

Figure 7: MCA dendrogram with identification of the 7 scenario families and visualisation of the clustering of scenarios into 7 families on the first four dimensions of the MCA. ..... **Erreur ! Signet non défini.**

Figure 8: Brief description of the cluster “Intensification and specialisation” (families 1 and 2)..... **Erreur ! Signet non défini.**

Figure 9: Brief description of the cluster “Segmentation of production systems” (families 3, 4 and 5).**Erreur ! Signet non défini.**

Figure 10: Brief description of the cluster “Sustainability and protectionism” (families 6 and 7). ..... **Erreur ! Signet non défini.**

Figure 11: Representation of livestock production systems main driving variables and impact variables. ..... **Erreur ! Signet non défini.**

Figure 12: Positioning of scenario clusters along the axes of environmental sustainability (climate change, biodiversity, water quality, soil health) and economic performance (production volume, trade, rural areas). ..... **Erreur ! Signet non défini.**

List of tables

Table 1: Overview of the different quantification methods used in foresight studies. 13

Table 2: Variance, percent of variance, and cumulative percent of variance of the first four dimensions of the MCA. 14

Table 3: Distribution of scenarios by family and parent cluster, classified according to geographic scale and species concerned. 16

Table 4: Distribution of PATHWAYS and Re-livestock scenarios according to the scenario families identified in Step-up. 35

Table 5: Comparison of scenario families according to main driving and output variables. 40

Table 6: Number and proportion of scenarios in the analysed corpus anticipating an increase, a decrease or a stabilisation of ruminant and monogastric numbers. 43

List of acronyms / abbreviations

NAME#	MEANING#
CAP#	Common Agricultural Policy#
EU	European Union
ELPS	European Livestock Production Systems
GHG	Greenhouse gas emissions
JOS	Just Operating Space
UN	United Nation
LCA	Life Cycle Assessment
LPS	Livestock Production Systems
MCA	Multiple Correspondence Analysis
PDO	Protected Designation of Origin
SOS	Safe Operating Space
SJOS	Safe and Just Operating Space
WP	Work Packages

List of authors

Elodie Merlot, UMR 1348 PEGASE, INRAE, Saint-Gilles, France.
Audrey Bethinger, DEPE, INRAE, Paris, France.
Océane Espin, DEPE, INRAE, Paris, France.

Executive summary

The European livestock sector faces significant challenges driven by rising global demand, environmental pressures (climate change, ecosystem degradation, resource-intensive use), ethical concerns over animal welfare, and human health risks, including zoonoses and nutrition. **Foresight analysis can offer valuable insights into these challenges by exploring possible futures and fostering a shared vision for European livestock production.** In this task, we mapped foresight exercises published since 2010, focusing on scenarios considering the European livestock sector's evolution between 2030 and 2050. Our objective was to identify the diversity of scenarios developed by political, scientific, and economic stakeholders and to highlight overlooked impacts within these possible futures.

We initially collected 204 documents (grey literature from think-tanks, public and private actors, scientific papers, vision statements) spanning global to sub-national levels covering Europe as a whole or specific country (Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Portugal, Spain, Sweden, the United Kingdom). Then, we refined this initial corpus to 50 comprehensive studies presenting 160 scenarios. These scenarios were characterised using 22 descriptive and 93 system variables across six categories (environment, governance, economy, society, science and technology, and livestock production systems). Variables were selected both *a priori* and iteratively during review. **Using Multiple Correspondence Analysis and hierarchical clustering, we identified seven distinct scenario families.** These range along a gradient from deregulated, intensive high-output systems (families 1–2) to highly regulated, socio-ecological transition models (families 6–7), with families 3–5 representing intermediate, hybrid pathways. **This classification provides a structured overview of potential futures for European livestock production systems described in the foresight literature**.

Family 1 - Economically successful intensive bet (20 scenarios): Economic growth is driven by intensive, tech-based livestock systems with little environmental concern and weak regulation. Private companies dominate value chains, while farmers face low incomes despite high productivity. Trade liberalisation boosts exports, but rural areas decline and social inequalities in food access rise. Consumption trends favour cheap, processed animal products. Technological innovation advances rapidly, yet animal welfare and biodiversity are largely overlooked.

Family 2 - Intensification with limited economic success (33 scenarios): There is moderate environmental concern from whether from civil society or public authorities, but weak political action limits implementation, despite some mitigation efforts and reforestation. Economic instability, declining competitiveness, and reduced public support lead to lower production, increased imports, and widespread farm closures, particularly among smallholders. Large, intensive farms dominate a shrinking sector but technological development is uneven due to limited investment. Animal welfare remains neglected, while consumers favour low-cost, processed products amid declining purchasing power and persistent social inequalities.

Family 3 - Sustainable technology and green growth for cattle (10 scenarios): In this scenario family greenhouse gas reductions is achieved through technological innovations while maintaining or increasing cattle numbers. Governance combines moderate EU influence with flexible, locally adapted regulation and strong public–private coordination. Economically, production and trade grow, farms diversify income with biogas production, and consumers prefer high-quality local products. Technology is central, with major investments in AI, precision farming, and full valorisation of by-products. Livestock systems aim for sustainable efficiency, though animal welfare progress is uneven.

Family 4 - Governance by an organised sector (28 scenarios): The livestock sector is guided by public–private governance, with moderate EU involvement and strong industry coordination (e.g. cooperatives, contracts, labels). Environmental performance improves—greenhouse gas emissions and water quality are better managed, while grasslands are preserved—using targeted technologies and reduced cattle numbers. Quality

labelling and territorial strategies support farmer incomes and competitiveness. Consumption is still protein-rich, with some preference for local and sustainable products. Farms modernise slowly, adopting precision agriculture, but with limited agroecological transition. Multiple livestock systems coexist where animal welfare varies.

Family 5 - Coexistence and segmentation (15 scenarios): There are coexisting intensive and agroecological livestock systems, with uneven environmental progress driven mainly by private or local initiatives. Governance is either centralised (state/corporate) or regionally anchored, with varied roles for the EU. There are both export-oriented and local supply chains with trade especially intra-EU remaining central, and diverse farmer income levels. Societal diets stay meat-based, with segmented consumer preferences and limited concern for animal welfare. Technological adoption is widespread, but genuine innovation and sustainability efforts remain limited.

Family 6 - Sustainable efficiency and protectionism (37 scenarios): This family features strong environmental ambition, with emission reductions, biodiversity gains, and land-use changes driven by regulations, incentive schemes, and carbon offsetting. Governance combines stricter environmental standards with regional and EU-level coordination, alongside eco-conditioned subsidies. Economically, livestock production declines, markets regionalise, and value chains shorten, while consumer demand shifts towards sustainable, traceable, and high-quality animal products. Technological adoption is widespread, supporting both agroecological practices and sustainable intensification, with investment in alternative proteins and food innovations. Livestock systems prioritise resilience, autonomy, and ecosystem services, with declining herd sizes and growing attention to animal welfare and circularity.

Family 7 - (Much) less but better (17 scenarios): This family prioritises extensive, agroecological livestock systems focused on animal welfare, human health, and environmental protection, driven by strong societal demand. Environmental benefits include reduced emissions, improved biodiversity, and enhanced soil and water quality through lower input use and diversified landscapes. Governance features strict, welfare-focused regulation with decentralised, regional cooperation supporting sustainable transitions. Economically, production declines but shifts to high-value, labelled products, supported by short supply chains and protectionist trade. Technology use is moderate and targeted, focusing on rustic breeds and transparency, while livestock numbers fall alongside consumption, with farms integrating crop and animal production and emphasising self-sufficiency.

Although the descriptive variables were not used in the Multiple Correspondence Analysis for the classification of scenario families, the resulting families nonetheless reveal certain orientations regarding livestock species and geographic scales. France was over-represented in the dataset, contributing 22 of the 50 analysed studies. Half of the foresight studies were conducted at the national scale, with the remainder almost evenly split between European and infra-national levels. While scenario families 1, 5, and 6 are broadly distributed across scales and species, other families exhibit more specific patterns. Family 2 scenarios are predominantly conducted at the national or infra-national levels. Family 3 is largely based on national-level studies from Nordic countries and France, with a particular focus on ruminants. Family 4 is exclusively infra-national, emerging from documents focused on specific species. By contrast, families 6 and 7 are more frequently found at the European and national scales and encompass all livestock species.

We also analysed the scenario families based on the system variables. Five out of seven families foresee a contraction in land use for livestock systems—despite differing policy contexts—suggesting a shared assumption of an increasing land scarcity or rising competition with other land uses. Most scenarios also anticipate a decline in animal numbers, particularly for ruminants. Production volumes increase only in families 1 and 3, while stabilising or declining in others, marking a shift from volume-based models towards value- or efficiency-oriented systems. Similarly, high consumption of animal products sustains intensive systems in families 1–2, while families 6–7 assume reduced consumption, supporting more sustainable diets.

Advanced technologies are adopted across all families, yet only the later-transitioning (family 5) and transformative scenarios (families 6–7) describe the uptake of agroecological practices—typically driven by a tighter regulation and localised governance.

This analysis of the 257 foresight scenarios based on the 93 descriptive variables revealed substantial gaps in the literature, as only 45% of the variables table was filled in. There was a particularly low coverage of social sustainability dimensions as well as services and disservices of livestock system (especially on phosphorus and water use). Value chain organisation, including processing, distribution, and income distribution among actors, were also insufficiently addressed. Dietary patterns and food access were rarely explored, and health issues—both human and animal—were notably underrepresented, despite their relevance in the One Health framework. The CAP, though central to European agriculture, was mentioned in only a third of the scenarios. These omissions suggest a tendency to focus on future end states rather than the drivers and mechanisms of transition.

Although trade-offs are best explored through quantitative approaches, **we identified in qualitative terms the family's tendencies regarding frequently-mentioned trade-offs in agricultural systems: the trade-off between economic performance and environmental sustainability, and land use competition.** Family 6 exemplifies strong environmental ambition with clear trade-offs, while families 3 and 7 avoid them through distinct economic strategies, including protectionism or reduced trade. Regarding land use, scenarios mainly showed a reduction in feed–food competition (notably in families 4, 6, and 7), while increases appeared in families 1, 2, and 3. Feed–energy competition was less frequently addressed, with most scenarios indicating stable or rising tensions, again concentrated in families 2 and 3.

Most scenarios in the corpus reflected business-as-usual or moderately sustainable futures, with limited consideration of disruptive climate impacts above 1.5°C or broader societal crises. Yet such events—droughts, conflicts, pandemics—are increasingly relevant and deserve greater integration and quantification. Eastern, Central, and Southern Europe were also under-represented, excluding (semi-)extensive and subsistence livestock systems. While these systems may be less economically central, they play key roles in rural resilience and landscape maintenance, and are likely to persist in some regions by 2050.

1. Introduction

This deliverable covers the activities of **Task T1.5 "Mapping and analysis of recent foresight studies concerned with livestock"** which is part of WP1 "Mapping of farming system typologies, and of the current and potential impact, externalities, and role of livestock in Europe". It aims **to map foresight studies on European livestock farming, to build scenario families sharing a common narrative, and to identify possibly neglected drivers or impacts**, as well as to discuss synergies and trade-offs between various sustainability objectives. The result of this task informs the scenario building in WP6 and feeds the modelling activity in WP4 and WP5.

The European sector of livestock production will be facing inevitable changes in the years to come and there is a lively debate on which direction should be taken[1]. These challenges involve the responses to a global trend for greater animal-based product demand, environmental impacts (climate change, ecosystems degradation and resource-intensive use), but also less addressed issues such as ethical issues (human and animal welfare), and human health considerations (nutritional concerns and zoonotic risks)[2]. Indeed, by 2050, the global demand for livestock derived food products is projected to increase by 60% to 70% because of an income and population growth[3], and the livestock sector finds itself at the heart of complex trade-offs. While part of this increase corresponds to meeting the nutritional needs of populations, western diets are characterised by a consumption of animal products that exceeds nutritional needs and poses other health problems[4]. Livestock farming plays a crucial role in fertilising agricultural soils and closing the geochemical cycles of nitrogen and phosphorus in food systems, while also causing major eutrophication of ecosystems when it exceeds the soil's capacity to fix these nutrients[5]. In the context of climate change, it is estimated that agriculture is responsible for 25% of anthropogenic global warming, with 58% directly or indirectly linked to livestock supply chains[6], while grazing livestock farming also ensures the maintenance of agricultural land devoted to grassland, particularly permanent grassland, which is capable of sequestering a significant amount of CO_2 in the soil[7].

Economically speaking, the livestock sector contributes substantially to the European economy. For example, in 2024, the value of livestock production and livestock products in the EU-27 was equal to €216 billion, representing 41% of the total agricultural activity[8]. At the same time, current generations of farmers are struggling to renew themselves in certain areas of the European Union, partly due to low incomes and heavy workloads[9], the agri-food industry offers jobs that are low-skilled, arduous and poorly paid, and the living and dying conditions of animals in these systems are being severely questioned by European citizens[10].

---

[1] Béné, C., Oosterveer, P., Lamotte, L., Brouwer, I. D., de Haan, S., Prager, S. D., Talsma, E. F., & Khoury, C. K. (2019). When food systems meet sustainability – Current narratives and implications for actions. World Development, 113, 116-130. https://doi.org/10.1016/j.worlddev.2018.08.011

[2] Peyraud, J.-L., & MacLeod, M. (2020). Study on Future of EU livestock : How to contribute to a sustainable agricultural sector ? Final report (European Commission, Directorate-General for Agriculture and Rural Development; 72 p.). https://doi.org/10.2762/810306

[3] OECD/FAO. (2021). Chapter 6—Meat in OECD-FAO Agricultural Outlook 2021-2030 (15 p.). OECD Publishing, Paris. https://www.fao.org/3/cb5332en/Meat.pdf

[4] European Commission. (2025). Food-Based Dietary Guidelines recommendations for meat [Health Promotion and Disease Prevention Knowledge Gateway of the European commission. https://knowledge4policy.ec.europa.eu/health-promotion-knowledge-gateway/food-based-dietary-guidelines-europe-table-8_en

[5] Billen, G., Aguilera, E., Einarsson, R., Garnier, J., Gingrich, S., Grizzetti, B., Lassaletta, L., Le Noë, J., & Sanz-Cobena, A. (2021). Reshaping the European agro-food system and closing its nitrogen cycle : The potential of combining dietary change, agroecology, and circularity. One Earth, 4(6), 839-850. https://doi.org/10.1016/j.oneear.2021.05.008

[6] Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A., & Tempio, G. (2013). Tackling climate change through livestock : A global assessment of emissions and mitigation opportunities (115 p.). Food and Agriculture Organization of the United Nations (FAO), Rome. https://www.fao.org/4/i3437e/i3437e00.htm

[7] Bellarby, J., Tirado, R., Leip, A., Weiss, F., Lesschen, J. P., & Smith, P. (2013). Livestock greenhouse gas emissions and mitigation potential in Europe. Global Change Biology, 19(1), 3-18. https://doi.org/10.1111/j.1365-2486.2012.02786.x

[8] European Commission. (2025). Agri-food data portal. Structural data on Agriculture. EU27 economic agricultural account at current prices. https://agridata.ec.europa.eu/extensions/DataPortal/structural-data.html

[9] Hostiou, N., Vollet, D., Benoit, M., & Delfosse, C. (2020). Employment and farmers' work in European ruminant livestock farms : A review. Journal of Rural Studies, 74, 223-234. https://doi.org/10.1016/j.jrurstud.2020.01.008

[10] See for example the European Citizens' initiative 'End the Cage Age'. https://food.ec.europa.eu/animals/animal-welfare/eci/eci-end-cage-age_en

Since the early 2010s, many studies have been published, **promoting either the sustainable intensification of agriculture for increasing food supplies**, without expanding the agricultural land area, which has been criticised as detrimental to both climate and biodiversity[11] **or the need for a change in consumption patterns and reduction in food wastage** in order to mitigate the rise in food demand and limit the negative impact of the global food system on natural resources and the environment[12]. The problem becomes even more complex if we try to integrate economic, social, and ethical components. **Therefore, multiple compromises are possible to promote livestock services and mitigate negative impacts, reflecting different societal and political choices**.

As a relatively recent tool for governance, with the advantage of providing a kind of "modelling" of strategic choices and estimating their consequences[13], **foresight analysis helps to facilitate discussions between stakeholders, to collectively select no-regrets measures and, finally, to favour the appropriation by all parties of the necessary actions to be taken**. It can draw on various methods, ranging from backcasting to the construction of contrasting exploratory scenarios, and on a variety of data, both quantitative and qualitative. Its legitimacy is based primarily on its usefulness[14], i.e. its ability to provide a real service to decision-makers, particularly in terms of policy choice[15]. Indeed, it helps to shed light on complex choice[16] and facilitates consensus building between parties on complicated issue[17]. Forward-thinking, particularly through the use of scenarios, reduces decision-making bias and improves the quality of final choices for three reasons: the plurality of options, which enriches reflection; the clarification of possible choices, which facilitates the intelligibility of options; and finally, the traceability of decisions, which strengthens their justification[18].

Thus, foresight analysis can contribute to the emergence of a shared vision of the future of European livestock farming. In the present work, we conducted a mapping of foresight studies considering the time horizon of post-2020 - 2050, in which the possible futures of livestock production systems were described. The originality of the approach consisted in constructing "sets of possible futures" based on existing foresight exercises and the extraction of key variables. The method is inspired by systematic reviews developed in particular in the biomedical and environmental sciences field[19] and by the French research project ScenEnvi, which compared international environmental scenarios and aggregated them in "archetypal families"[20]. The aim was to identify the different families of scenarios built by European political, scientific and economic stakeholders involved in these foresight exercises, and to identify any issues of livestock systems that were neglected in these studies.

[11] Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., Pretty, J., Robinson, S., Thomas, S. M., & Toulmin, C. (2010). Food Security : The Challenge of Feeding 9 Billion People. Science, 327(5967), 812-818. https://doi.org/10.1126/science.1185383

[12] Stehfest, E., Bouwman, L., van Vuuren, D. P., den Elzen, M. G. J., Eickhout, B., & Kabat, P. (2009). Climate benefits of changing diet. Climatic Change, 95(1), 83-102. https://doi.org/10.1007/s10584-008-9534-6

[13] Godet, M., & Durance, P. (2008). La prospective stratégique ; pour les entreprises et les territoires (Dunod). https://www.librairies93.fr/livre/9782100518791-la-prospective-strategique-pour-les-entreprises-et-les-territoires-michel-godet-philippe-durance/

[14] Mietzner, D., & Reger, G. (2005). Advantages and Disadvantages of Scenario Approaches for Strategic Foresight. International Journal Technology Intelligence and Planning, 1(2), 220-239. https://doi.org/10.1504/IJTIP.2005.006516

[15] Havas, A., Schartinger, D., & Weber, M. (2010). The impact of foresight on innovation policy-making : Recent experiences and future perspectives. Research Evaluation, 19(2), 91-104. https://doi.org/10.3152/095820210X510133

[16] Cassingena Harper, J., Cuhls, K., Georghiou, L., & Johnston, R. (2008). Future-oriented technology analysis as a driver of strategy and policy. Technology Analysis & Strategic Management, 20(3), 267-269. https://doi.org/10.1080/09537320801997193

[17] Fuller, T., & Loogma, K. (2009). Constructing futures : A social constructionist perspective on foresight methodology. Futures, 41(2), 71-79. https://doi.org/10.1016/j.futures.2008.07.039

[18] Meissner, P., & Wulf, T. (2013). Cognitive benefits of scenario planning : Its impact on biases and decision quality. Technological Forecasting and Social Change, 80(4), 801-814. https://doi.org/10.1016/j.techfore.2012.09.011

[19] Bilotta, G. S., Milner, A. M., & Boyd, I. (2014). On the use of systematic reviews to inform environmental policies. Environmental Science & Policy, 42, 67-77. https://doi.org/10.1016/j.envsci.2014.05.010 / Higgins, J. P. T., & Green, S. (2011). Cochrane Handbook for Systematic Reviews of Interventions (659 p.). John Wiley & Sons. https://docs.edtechhub.org/lib/W4SFJU7Y

[20] de Menthière, N., Lacroix, D., Schmitt, B., & Bethinger, A. (2016). Visions du futur et environnement. Les grandes familles de scénarios. Analyse de prospectives internationales relatives à l'environnement. (Volume 1 : Rapport final de l'étude ScénEnvi; 73 p.). Alliance Allenvi (Alliance nationale de recherche pour l'environnement). https://doi.org/10.17180/8hyj-j017

2. Methodology

Figure 1 outlines the steps of our methodology, which will be detailed in this section of the report.

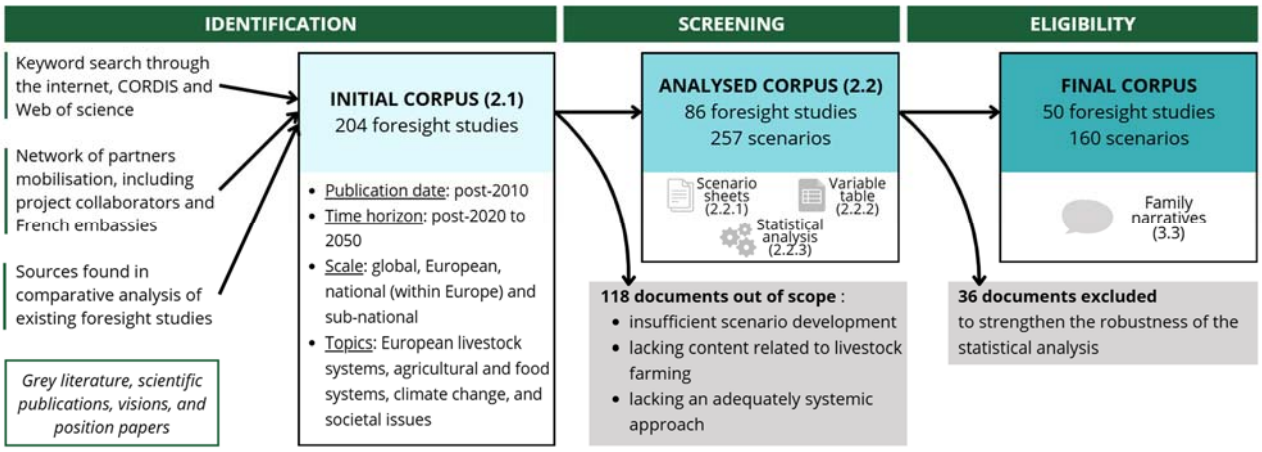

Figure 1: Presentation of the methodology steps.

2.1. Initial corpus

We have compiled a corpus of recent foresight studies (post-2010) that explore potential futures with a temporal horizon extending from post-2020 to 2050. We sought studies describing European livestock systems, but to ensure comprehensive coverage of the available literature, we also included foresight studies on agricultural and food systems, climate change, and societal issues such as human-animal relations. Regarding the geographical scale, we considered all levels, including global, European, national (within Europe), and sub-national scales.

In order to map existing foresight studies, several strategies were implemented. We conducted keyword searches in English and other European national languages through the internet, CORDIS, and Web of Science (combinations based on the words: foresight, scenarios, future, pathways, storylines, narratives, animal farming, livestock farming, animal husbandry, animal breeding, grasslands, pastures, meadows). We also reached out to a network of partners, including project collaborators and French embassies. We included sources of comparative analysis of existing foresight studies and carried out monitoring during the first phase of work. Nevertheless, we do not claim to have achieved exhaustive coverage.

To reflect the perspectives of a broad range of stakeholders, foresight studies were found in the form of grey literature, scientific publications, and position papers. They involved the construction of one or more scenarios that presented a vision of the future, sometimes with a pathway leading to it. These scenarios took the form of narratives/storylines that blend hypotheses, causal relationships, temporal processes, and sometimes quantified results derived from simulations. We aimed to achieve the greatest possible representativeness in order to encompass the entirety of European livestock systems. However, foresight practices are not equally developed in all countries. As a result, there are limited or no documents from Eastern and Southern European countries, where strategies are more commonly produced (see Deliverable 1.6 of the Step-up project).

We collected an initial corpus of foresight studies of 204 documents half of which were in European national languages other than English, with a high proportion of 58 documents in French. Documents that were neither in English nor in French were translated using DeepL.

2.2. Analysed corpus

We reviewed and screened the initial corpus to identify the foresight studies to retain for analysis. The exclusion criteria were as follows: we excluded documents with insufficient scenario development, those lacking content related to livestock farming, or those focusing too narrowly on a single, overly specific dimension, without a sufficiently systemic approach. **This process resulted in an analysed corpus of 86 documents, totalling 257 scenarios with an average of 3 scenarios per document**. For the studies retained, our analysis combined a qualitative approach based on scenario sheets with a quantitative approach using an analysis table, enabling statistical analysis through Multiple Correspondence Analysis (MCA).

2.2.1. Scenario sheets

We created a summary sheet for each of the 257 scenarios of the analysed corpus. These sheets provided a quick overview of the scenarios without the need to consult the full document, facilitating qualitative analysis. Each sheet included descriptive information about the foresight study at the top (study title, study number, time horizon, year of publication, geographic area, species concerned, and scenario sheet author). It was then followed by a table that organised the content of the scenario using the **DEGEST analysis method**[21] ("Demography," "Environment," "Governance," "Economy," "Society," "Technology and science"). We adapted this method by removing the "Demography" category, and added the category "Livestock Production Systems" (LPS) and "Other" to accommodate potentially important additional information. Finally, the scenario sheet included a section for listing the major stakeholders mentioned and involved in the scenario, as well as a brief summary in a few sentences.

2.2.2. Variables table

To statistically process the scenario sheets, **we created a database in the form of an Excel table**, with the scenarios listed in rows and qualitative variables in columns. Similar to the scenario sheets, our Excel table comprised two types of variables. The first set consisted of **22 descriptive variables**, which provided key information about the foresight study itself and the main stakeholders influencing the scenarios. The second set included **93 system variables** that reflected the content of the scenarios and were categorised according to the DEGEST framework. In each of the DEGEST section, we introduced some variables *a priori*. The other variables were identified and added progressively while reviewing the first scenarios. The list of system variables is available in **Annex 1**.

For the **environmental variables**, we a priori considered the 7 of the 9 planetary limits that can be influenced by agricultural activities: climate change, biosphere integrity (state of biodiversity), biogeochemical flows (phosphorus and nitrogen cycles), land-system change (land use for animal-sourced food on the considered territory and at world scale), novel entities (GMO, pesticides and antimicrobial use), freshwater use (quality and quantity). For the **governance aspects**, power modalities are described at both the document level and the European level, including the status of common agricultural policies (CAP). For the **economic variables**, we paid attention to introduce macro- (production volume, international trade, territorial specialisation, products price, etc.) and micro-economic variables (farmer incomes, farm and land ownership, etc.) and target all actors of the value chain (farmers, agri-food industry, retail, consumers). **Regarding society**, we primarily focused on dietary habits (animal / vegetal ratio in diets, diversity in the diets, presence of ultra-transformed food), and attitude of society towards environmental and animal welfare issues, and variables related to population health were then introduced when reading the scenarios. **Regarding science and technology**, we identified *a priori* variables describing major areas of innovation today in agriculture (digitisation of agriculture, precision farming, genetic breeding priorities) and paid attention to include also

[21] Cornish, E. (2004). Futuring : The exploration of the future (World Future Society, 300 p.). https://doi.org/10.1016/j.futures.2005.01.004

variables describing innovations in the agri-food sector. **Regarding livestock production systems** (LPS) by themselves, we introduced *a priori* variables describing the technical aspects of the system (farm specialisation and size, level of inputs, use of agroecological methods, manure and co-products valorisation, farmer support by the sector, etc.), concerning environmental issues (surfaces in grasslands, share of permanent grasslands, protein origin, food/feed competition, mitigation and adaptation to climate change, etc.), and animal health and welfare issues (animal welfare level, progress in animal health management, consideration of zoonotic risk, etc.).

Each variable could take multiple modalities, which were also introduced *a priori* or added gradually as we progressed through the scenarios. Each scenario row was coded by associating the corresponding modality for each variable. Some of the variables turned out not to have been dealt many times within the final corpus, contributing to the production of a data table with many gaps. If the information was not addressed, it was marked as "NA."

2.2.3. Statistical analysis

An added value of this work lies in processing this corpus through statistical analysis. Since the variables were qualitative, **we applied Multiple Correspondence Analysis (MCA)**. Our dataset (257 scenarios, 93 system variables) was incomplete, as not all scenarios could fully cover the numerous system variables. Using an iterative process, we excluded under-filled scenarios and variables in order to limit the missing data in the dataset and increase the robustness of the MCA. In a preliminary step, we excluded variables that were informed in less than 10% of scenarios or those that were too homogeneous.

We then determined the list of active variables to use in the MCA. We first selected the scenarios that contained information for at least 50% of the system variables. Among these 92 remaining scenarios, we removed the variables that were filled for less than 80% of the scenarios: we obtained a list of 19 candidate variables. For each of these variables, we checked for rare modalities (observed in less than 8% of scenarios and which could impair the MCA), which we then aggregated with the closest modalities to exceed the 8% threshold. We ran a preliminary MCA with this data set (dimensions [92, 19]), which allowed to refine the selection of active variables. The variables “Paradigm” and “FarmSize” turned out to weigh quite heavily in the analysis. However, we didn't want to sort our scenarios according to these two variables, which were either highly correlated with another active variable which was filled in with more reliability (“FarmSize” correlated with “FarmSpecializ”) either not discriminating enough the scenarios (a majority of scenarios presenting the same modality of “Paradigm”). We decided to exclude them from the list of active variables, resulting in a list of 17 active variables.

To obtain the final MCA dataset, the initial dataset (dimension [257, 93]) was filtered in order to keep scenarios that contained information for at least 70% of the 17 predefined variables: 160 scenarios remained. When filtering this subset for variables filled at least at 80%, 3 of the 17 variables were below the threshold: “Landscape” (72% of completed scenarios), “Labels” (78,7%) and “LandLPST” (79,4%). We decided to lower the threshold to 78% in order to retain two of these three variables, for a total of 16 active variables. They cover all DEGEST categories, with a stronger representation of the “economy” (5 variables) and “livestock production systems” categories (4 variables). In the end, **we performed the MCA on the final corpus, a dataset of 160 scenarios issued from 50 documents with an average of 3,1 scenarios per document.** The 16 active variables are listed below:

- Share of land dedicated to LPS on the territory explored in the scenario (**LandLPST**);
- Type of political power (**Power**);
- Policy regulations not explicitly associated with the CAP in the scenario and regulating agriculture, food chain, market and consumers (**Regul**);
- Change, compared to the study publication date, in production volume of the animal product(s) concerned by the study and on the scale of the territory considered by the study (**Volume**);

- Change in international trade of the animal product concerned by the study and on the scale of the territory considered by the study (**Trade**);
- Change in territorial specialisation of production (**TerrSpecialisation**);
- Trends, compared to the study publication date, in the production part under quality schemes and labels (**Labels**);
- Consumer motivation when purchasing animal products (**PurchaseMot**);
- Proportion of animal products in human diets (**AnimalVegetal**);
- Environmental concern and awareness of stakeholders (**EnvConc**);
- Trends in investment in research and development compared to the study publication date (**Research**);
- Technologies or investments implemented in farms, apart from digitisation and the application of precision breeding, which are described by other variables, such as other technologies, equipment and building investments (**FarmTechno**);
- Dominating LPS techno-economic model in the scenario (**LPSModel**), e.g. extensive, intensive, agroecological, sustainable efficiency, coexistence of different models...
- Degree of production specialisation or diversification at farm level (**FarmSpecializ**) (e.g. high specialisation, diversification of productions, mixed farming of cultures and livestock, on farm processing, coexistence of specialised and mixed systems, etc.);
- Development of agroecological practices in animal production systems (**Agroecology**);
- Presumed impact of changing practices on animal welfare (**AWPract**).

We ran the MCA using the R software with the FactoMineR package[22]. The imputeMCA functions automatically imputes missing values with plausible values calculated from the model parameters, using the regularised iterative MCA algorithm with the argument ncp=2. Scenarios were then classified using hierarchical clustering based on their coordinates in the MCA. Clusters defined families of scenarios. The barycentre of each family was calculated, and the scenario closest to it was identified. These scenarios are assumed to be the most representative of their respective families. Narratives were built manually, analysing, for each family, first the results for the active variables but also the rest of the system variables. The return to text-based scenario sheets allowed to illustrate family characteristics with concrete examples from specific scenarios.

[22] Husson, F., Le, S., & Pagès, J. (2017). Exploratory Multivariate Analysis by Example Using R (2e éd.). Chapman and Hall/CRC, 262 p. https://doi.org/10.1201/b21874

3. Results

3.1. Description and comparison of the analysed corpus and the final corpus

As explained in the previous section, the analysed corpus consisted of 86 foresight studies and only 50 were selected in the final corpus for the MCA. The figures below provide a description of these 2 corpuses, presenting the publication date, time horizon, geographical scale, and distribution across European countries, the central theme of the publication, the livestock species included, the categories of authors of the scenarios and finally, the identification of quantified documents and their quantification methods. As the proportions remained relatively stable between both corpuses, we can say that **the final corpus was representative of the European analysed foresight studies on livestock systems**. The list of documents from the final corpus is presented in **Annex 3**, along with the associated information.

Figure 2 shows that more than half of the documents in the analysed corpus were published in the last five years (2020-2025). This indicates a growing interest in foresight studies on livestock systems. The years 2020 and 2023 hold the record, with 12 documents published in each of these years. In the final corpus used for the MCA, the distribution of studies by publication year was broadly similar, with the oldest documents (2010, 2011, 2015) having been excluded. For certain years (2014, 2016, 2019, 2023), only half or fewer of the documents were retained.

Then, the time horizons have been grouped into 10-year periods and mainly correspond to round numbers. For the analysed corpus, two most commonly used time horizons are 2030 and 2050. There are a few exceptions; for instance, one study projected into 2028, as it favoured a 5-year time frame from the publication date. Eleven foresight studies did not explicitly mention a future date, as they were primarily associated with non-quantified visions of the future. Again, the studies selected for the final MCA corpus were proportionally distributed across the decades, with approximately half of the documents retained in each period—except for the 2040–2049 range, where the proportion is higher, and the 2020–2029 period, where the two only documents were selected.

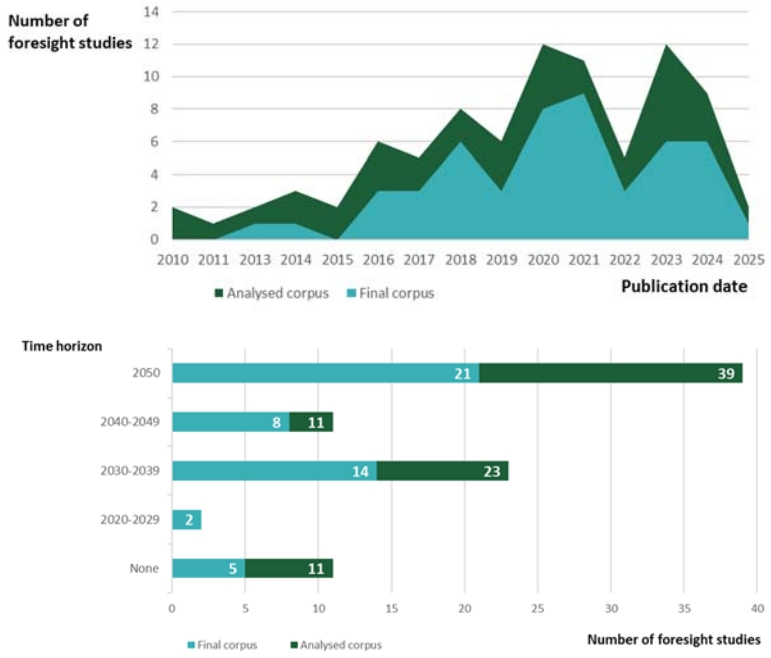

Figure 2: Number of foresight studies in the corpus analysed initially and then in the final corpus used for the MCA, according to their year of publication and to their time horizon.

As shown in **Figure 3** for the analysed corpus, half of the foresight studies were conducted at the national scale, with the remaining studies evenly distributed between the European and infra-national scale. Finally, seven documents were at the global scale. In the final corpus, similarly half of the national-level studies were retained, while global-scale studies were largely excluded in favour of European and infra-national scales. The map allows to visualise that studies at the national and infra-national covered most of the countries in northern and western Europe, with an over-representation of France. However, foresight studies at the territorial scale were present in a more limited number of countries and only in western Europe. The final corpus no longer included studies from Portugal, Italy, and Belgium, which weakens the representation of southern Europe, although these countries had a few documents. In France, several national-level studies were excluded, while almost all infra-national studies were retained.

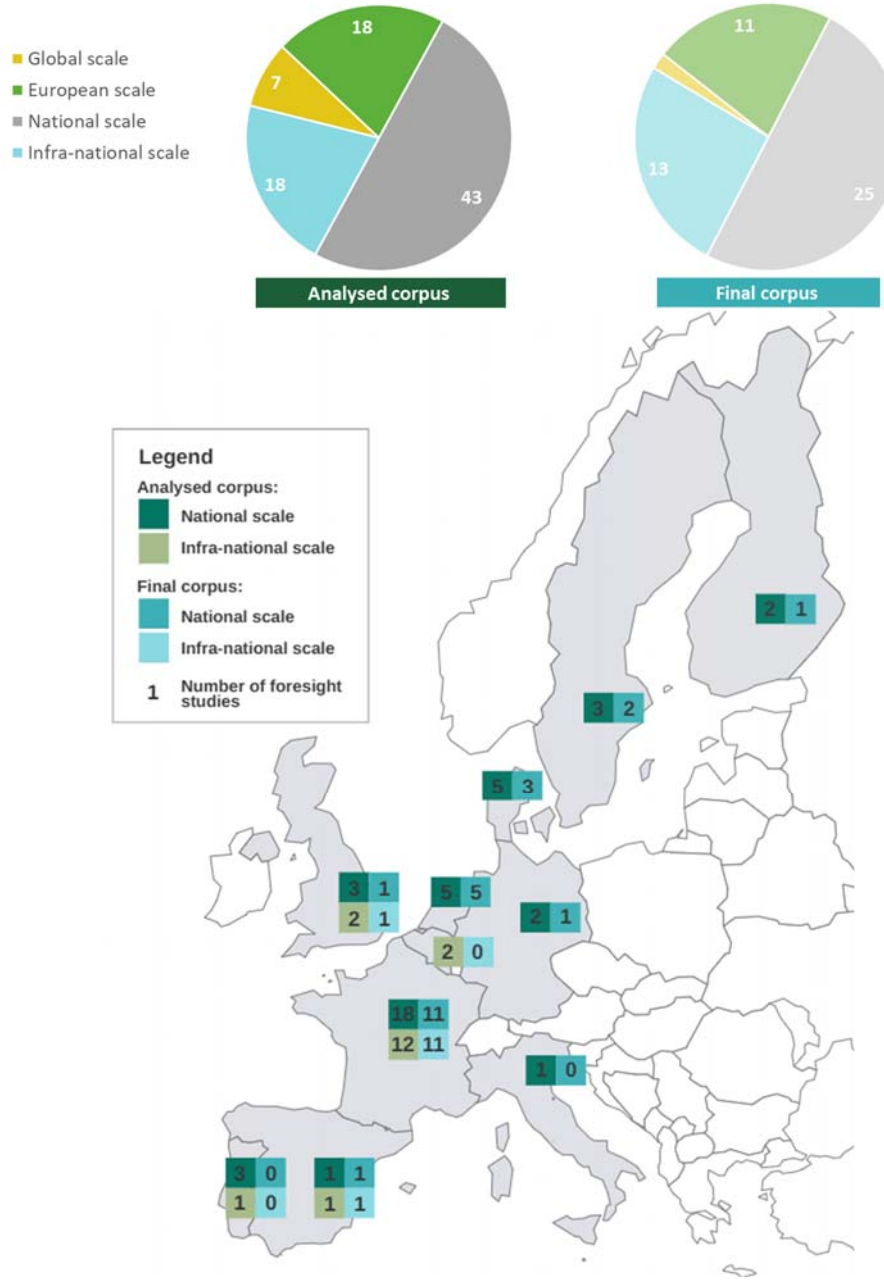

Figure 3: Number of foresight studies in the corpus analysed initially and in the final corpus used for the MCA, according to their geographical scale, and their geographical distribution.

Half of the foresight studies (45) in the analysed corpus focused on livestock production systems, while 24 documents addressed agricultural systems more broadly, and 14 documents focused specifically on climate change (**Figure 4**). Lastly, there were rarer themes, such as societal issues (2), including the human-animal relationship or human nutrition (1). In the final corpus, the study on nutrition was excluded, while the proportion of studies focusing on climate change decreased in favour of those centred on livestock production systems. In the analysed corpus, among the 45 documents on livestock production systems, 31 were specific to a particular species category, with a strong representation of cattle including sheep, although all species were represented. The vast majority of foresight studies, however, focused on livestock in general and were not specific or detailed about particular types of livestock farming. The final corpus used for MCA maintained the representativeness of studies covering all types of livestock and ruminants, and fortunately retains the documents on monogastrics.

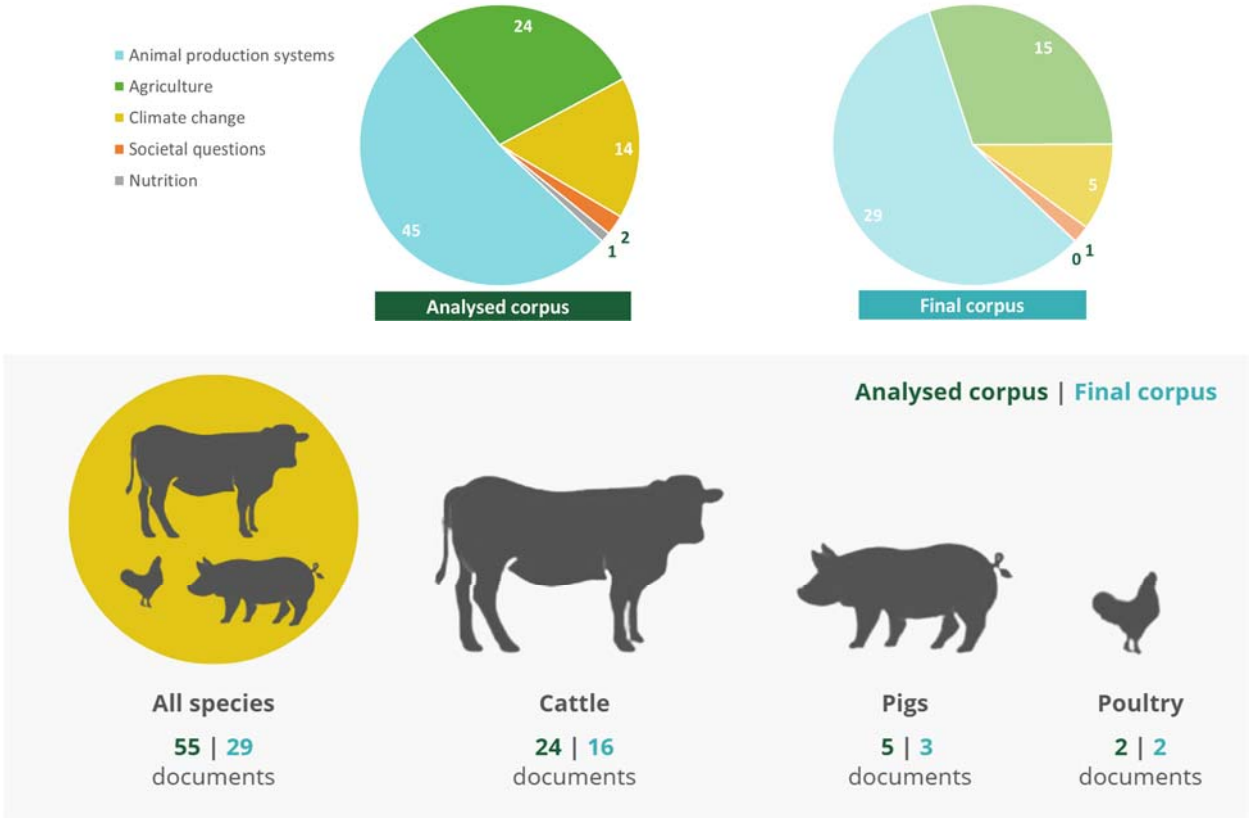

Figure 4: Distribution of foresight studies in the corpus analysed initially and in the final corpus used for the MCA, according to their central theme and the species considered.

Regarding the authors of foresight studies in the analysed corpus, the research sector and public institutions were the most prominent categories, followed by studies from think tanks, the private sector, technical organisations, international agencies, and NGOs (**Figure 5**). The proportions of the different author categories are maintained in the final corpus.

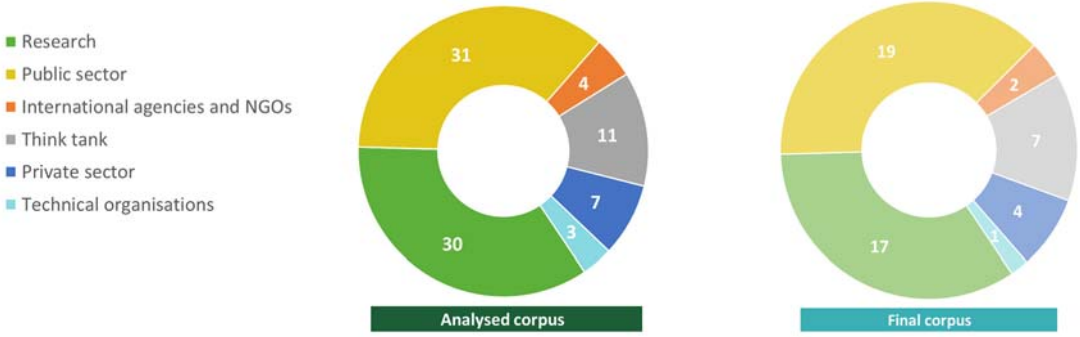

Figure 5: Number of foresight studies of the analysed and final corpuses according to their category of author(s).

Regarding the quantification of foresight studies, half of the analysed corpus (43 documents) is quantified, while in the final corpus used for MCA, fewer than half are quantified (20 documents). Indeed, quantified studies often focus on a limited number of variables, which may have contributed to their exclusion from the final corpus. As shown in **Table 1**, several quantification methods have been used. Some documents rely on modelling—either through a single model (P3, P28, P161, P165, P173) or through the combined or integrated use of multiple models (P8, P18, P30, P35, P47, P48, P154, P155). The same biophysical model (MoSUT) is used in three different foresight studies, representing a total of 8 scenarios. In two of these documents, it is used in combination with other models. Then, in two studies, quantification is carried out via Life Cycle Assessment (LCA). Three documents address climate-related quantification but without detailed methodology. Finally, two documents include an economic assessment.

It is worth noting that most quantified studies address all types of livestock species, except for four (P6, P47, P54, P60). Quantified studies are present across all geographical scales, and their distribution mirrors the overall distribution of documents shown in Figure 3. There is a predominance of national-scale studies (10 documents), followed by European (5), sub-national (4), and global-scale (1) studies.

Table 1: Overview of the different quantification methods used in foresight studies.

QUANTIFICATION METHOD	MODEL AND FORESIGHT STUDY ID	NUMBER OF SCENARIOS
Biophysical models	TYFAm (P3)	**26**
	MoSUT (P8, P155, P173)	
	GlobAgri-Agrimonde-Terra (P28)	
	BioBaM and SOLm (P30)	
	INIATOR (P48)	
	GRAFS model (P165)	
Economic models	AGMEMOD (P48)	**7**
	IAACalc (P155)	
Livestock management models	GLEAM (P48)	**6**
	SPCalc (P155)	
Soil carbon stocks model	ICBM (P35)	**3**
	Yasso07 (P154)	
LCA	P60, P67	**7**
Climate-oriented assessment	P33, P109, P159	**8**
Economic assessment	P6, P54	**9**

3.2. Results of the Multiple Correspondence Analysis (MCA)

The percent of variability explained by the first axes of the MCA is presented in **Table 2**. The first four dimensions represented more than 30% of the variance of the analysed corpus, which is a satisfactory result for an MCA. Analysis of the link between the 4 first axes active variables (**Figure 6**) and with the modalities of active variables (data not shown) allowed to propose an interpretation of the significance of these 3 dimensions. **Dimension 1** was associated with the variables "Agroecology" (adoption of some agroecological practices associated to positive values), "TerrSpecializ" (despecialisation associated to positive values), "Regul" (high standards related to animal welfare and environment associated with positive values) and "AWPract" (better animal welfare conditions associated with positive values). **Dimension 2** was associated with variables "Power" and "EnvConc" (strong local governance and low concern of the society for environmental issues associated with positive values). **Dimension 3** was associated with variables "LPSModel" (coexistence of various models associated to high values, intensive farms associated with negative values) and "FarmSpecializ" (coexistence of a diversity of farms associated with positive values). **Dimension 4** was associated with variables "Volume", "Trade" and "FarmTechno" (good trade balance and increased production volumes associated with positive values, no investment in farm modernisation associated to negative values).

Table 2: Variance, percent of variance, and cumulative percent of variance of the first four dimensions of the MCA.

	Dimension 1	Dimension 2	Dimension 3	Dimension 4
Variance	0.32	0.14	0.12	0.11
Percent of variance (%)	14.45	6.28	5.54	5.10
Cumulative percent of variance (%)	14.45	20.73	26.27	31.37

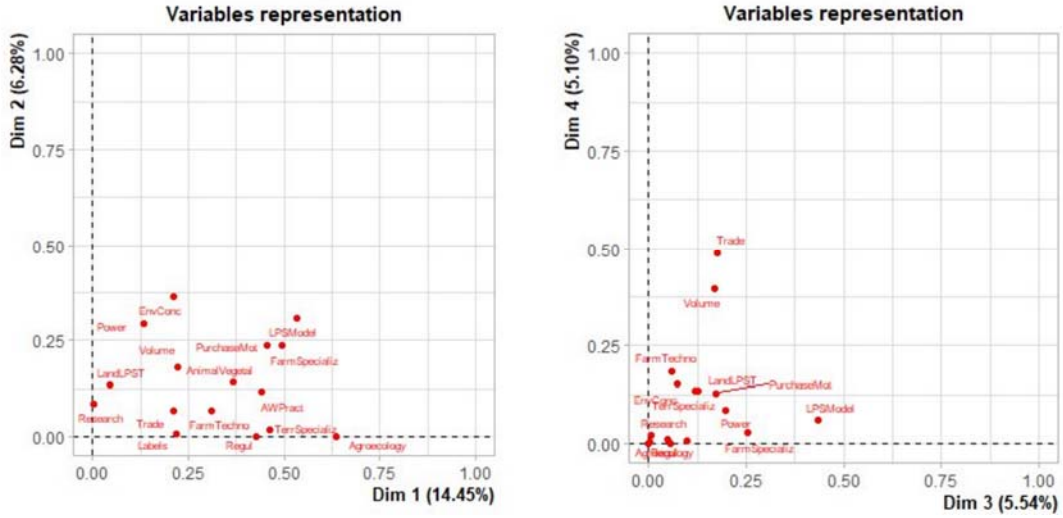

Figure 6: Representation of active variables on the first four dimensions of the MCA.

Figure 7 presents the dendrogram resulting from the hierarchical clustering analysis. It was possible to select the desired number of groups by drawing a horizontal line that separates the scenarios. We have chosen to define seven clusters (or families), as it balances detail and clarity. This number provided sufficient differentiation to capture distinct patterns without merging them into broad trends. It also avoided having too many families, which could make groups too similar and the analysis harder to interpret. These seven families were not independent, as some were closer to each other than others were (and belonged to a common parent cluster). This was the case for families 1 and 2; families 3, 4, and 5; and families 6 and 7.

The charts presented also in **Figure 7** display the scenario families according to the first four dimensions of the MCA. Dimension 1 is retained on the x-axis as it contains the most information overall. **These charts provide initial insights into the characteristics of the scenario families but are insufficient for a detailed analysis.** Their description has been made qualitatively and is presented in the following sections. It can be observed that family 7 and part of family 6 stand out on the right side of dimension 1, which is associated with territorial de-specialisation, the adoption of agroecological and animal welfare practices, promoted by regulation. Conversely, on the left side of the chart, families 1, 2, and 3 correspond to opposing trends, with the latter cluster remaining horizontally spread out. Family 5 is distinct at the top of dimension 2, which relates to the significant role of the local level in governance and low societal concern for the environment. In contrast, family 3 and part of family 4 exhibit negative values on this dimension. Family 5 is also well isolated at the top of dimension 3, representing the coexistence of different livestock production models, where part of family 4 is also located. Finally, dimension 4 - where positive values are associated with increased production volumes, growth in international trade, and adoption of technology on farms - indicates trends for families 1 and 3, while the other families appear more dispersed. Overall, family 4 seemed central across these first four MCA dimensions. Family 2 was the second largest cluster by number of scenarios (33), but these scenarios appear tightly grouped across the dimensions, less so on dimension 4, indicating strong internal cohesion. This was also the case for family 1 (20 scenarios) and family 7 (17 scenarios), whereas family 5, with a similar number of scenarios (15), appeared more dispersed. Families 4 and 6 were more spread out, especially on dimension 4, and contained the most scenarios (28 and 37 respectively).

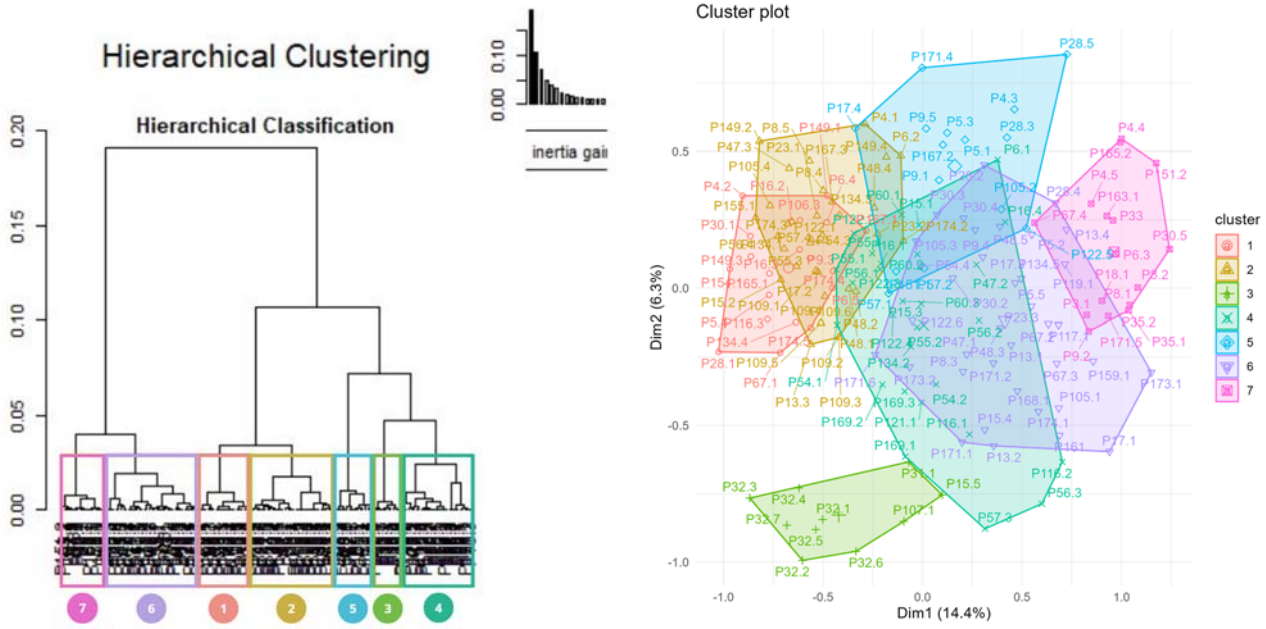

Figure 7: MCA dendrogram with identification of the 7 scenario families and visualisation of the clustering of scenarios into 7 families on the first four dimensions of the MCA.

3.3. Narratives of scenario families

The complete set of scenario families, including their grouping clusters and the number of scenarios, is presented in the **Table 3**. Scenario families have been named as follows:

- **Family 1**: Economically successful intensive bet
- **Family 2**: Intensification with limited economic success
- **Family 3**: Sustainable technology and green growth for cattle
- **Family 4**: Governance by an organised sector
- **Family 5**: Coexistence and segmentation
- **Family 6**: Sustainable efficiency and protectionism
- **Family 7**: (Much) less but better

Table 3: Distribution of scenarios by family and parent cluster, classified according to geographic scale and species concerned.

Geographic scale	Species	Number of scenarios	Cluster Intensification and specialisation		Cluster Segmentation of production systems			Cluster Sustainability and protectionism	
			Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7
World	All	5	1				2	2	
Europe	All	27	6	3			1	10	7
National	All	43	4	16	1		5	11	6
	Focus	43	4	5	9	15	2	6	2
Infra-national	All	10	1				3	5	1
	Focus	32	4	9		13	2	3	1
Total number of scenarios		**160**	**20**	**33**	**10**	**28**	**15**	**37**	**17**

The families are then described in the following sections and in **Figure 8** (families 1 and 2), **Figure 9** (families 3 to 5) and **Figure 10** (families 6 and 7). The analysis of the scenario families according to geographic scale and species concerned is presented in sections 4.2.2. and 4.2.3., respectively.

***Nota bene*:** In the following sections, when describing the families, for variables encoded in the dataset, we indicated in brackets how many times the described level was encountered among the number of scenarios talking about this variable in the family. For example, the family "Governance by an organised sector" contains 28 scenarios and we indicated "a reduction in cattle numbers (9/12)", meaning that among the 28 scenarios, only 12 were describing the number of cattle, and 9 of them indicated a reduction in this number. When we referred to an information contained in a specific scenario, we indicated the code of the scenario (for example P47.2), which can be found in the scenario table of the corresponding family in the **Annex 4** of this report.

3.3.1. Cluster "Intensification and specialisation"

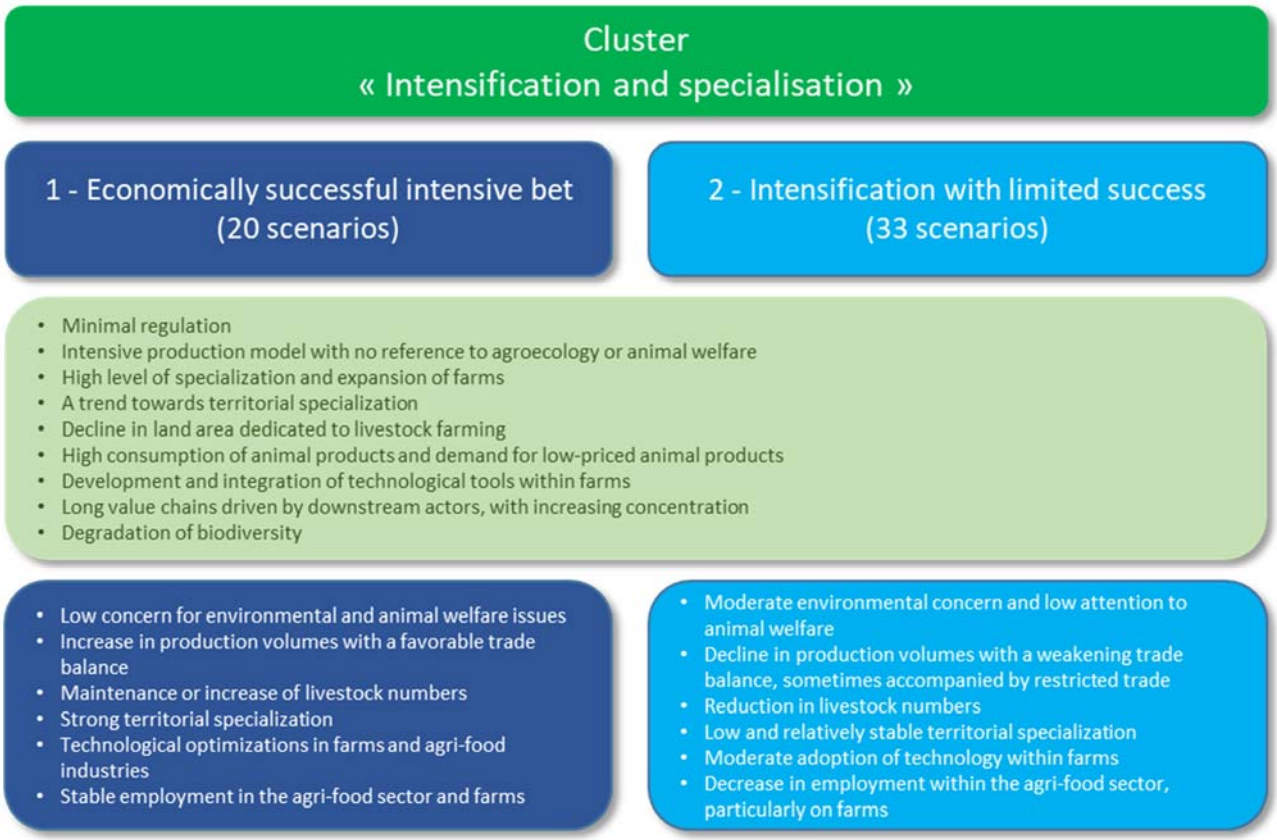

Figure 8: Brief description of the cluster "Intensification and specialisation" (families 1 and 2).

a) Economically successful intensive bet (family 1)

Family 1 consists of 20 scenarios, predominantly focused on animal production systems (13/20), but also on agricultural systems more generally (5), climate change (1), and societal issues (1). Scenarios cover all geographic scales, primarily at the national level (8/20) in France, Scotland, Finland, and the Netherlands, at the sub-national level (5) in France and Spain, at the European level (6), and globally (1). They consider all livestock (12/20) or ruminant farming systems (8). The barycentric scenario is P9.3 (The Human-Animal relationship: five scenarios for 2030 [Bidaud et al., 2016] - "Animals as adjustment variables"). The stakeholders most involved in these scenarios are farmers, private sector actors in processing and distribution, and public authorities, while citizens are less frequently mentioned (11/20).

Environment

In this scenario family, the stakeholders exhibit low concern for the environment (11/19), or show a lack of implementation of environmentally beneficial measures, prioritising productivity in livestock and agriculture instead. Very few scenarios address the local impacts of climate change (6/20), with mixed outcomes, including increases (2), stabilisation (2), or declines (2). In some of these scenarios, climate change was perceived as an opportunity, such as the extended growing season in Scotland (P149.3) or increased exports to North Africa and the Middle East, where food production would become more unstable (P6.5). Regarding energy, there is a constant reliance on fossil fuels (7/8) and low adoption of on-farm energy production options (6/8).

Land allocated to livestock is either declining (8/14) or remains stable (4), primarily due to reductions in grassland (7/10). The freed-up land is predominantly used for urban expansion (P4.2, P6.4, P9.3, P28.1, P165.1), land abandonment leading to landscape closure (P30.1, P134.4, P167.1), or, less frequently, for the

creation of protected areas (P67.1, P106.3). Biodiversity is compromised (9/13) due to the intensification of livestock farming, although the detailed impacts on ecosystem components like water and soil are not specified. The few reasons cited include the loss of landscape diversity (P28.1, P106.3, P149.3), the pressure from the use of inputs (P30.1, P154.1, P174.5), and a general lack of efforts toward biodiversity conservation (5/14).

Governance

In one third of the scenarios, private companies play a significant role in the agricultural sector (7/20), for example, through the influx of capital from new actors into farms (P5.4, P28.1, P16.2, P106.3, P174.4), or the development of integration models for farmers through contractual arrangements (5/6). Otherwise, the political situation remains unchanged (7/20). The role of the European Union is described as mixed, with weak influence in half of the scenarios (8/16), associated with a reduction in financial support to the agricultural sector, which is sometimes directly provided by individual countries instead (P5.4, P154.1). In the remaining eight scenarios, the EU plays a relatively strong or intermediate role, supporting the competitiveness of the agricultural sector by focusing on technological advancements (P149.3, P174.5).

These scenarios depict weak regulation (13/20), with minimal animal welfare and environmental protection standards (P174.5) in order to avoid hindering agricultural and food production. Several examples are mentioned, such as tax relief for businesses or the reauthorisation of the use of animal meal in animal feed (P5.4).

Economy

Economically, the scenarios show an intensification of the liberal economy (14/19) and an increase in international competition, driven by the development of new free-trade markets (P4.2, P105.4, P134.4, P167.1, P174.4, P174.5). Through increased productivity via livestock intensification and technological innovations, European countries experience a rise in the volume of animal product production (14/18). A portion of this production can be exported, improving the European trade balance (17/20).

The scenario family is also characterised by strong territorial specialisation (17/20), continuing in line with each region's comparative advantages, enabling European productions to remain competitive in the previously mentioned markets. This is accompanied by the continued territorial separation of breeding and fattening territories (5/5). The context of product differentiation remains largely similar to the existing situation, with quality labels either remaining stable (6/14) or increasing (6). Distribution networks are long (15/20) at the global scale or intermediate (2) within the European market. In the value chains, the power dynamic is more favourable to the downstream actors (10/15), particularly the large global distribution and processing companies mentioned earlier. They capture most of the added value (P106.3, P134.3, P165.1) at the expense of the farmers, who may be part of integrated chains as mentioned earlier (P5.4, P6.4, P6.5, P134.4, P167.1, P174.4). These industries are highly concentrated, whether in processing (12/13) or distribution (11/12), forming an oligopolistic structure. The agri-food industry is growing strongly (11/13), while the evolution of distribution companies is less detailed in the scenarios. However, some scenarios mention the expansion of e-commerce (P16.2, P16.3, P28.1, P106.3).

There is either a stabilisation (9/15) or a downward trend (6) in agricultural employment, correlating with a decrease in the number of farms (P4.2, P28.1, P16.2, P134.3, P154.1, P167.1). In a strategy of economies of scale, farms are larger (13/17) and more specialised (15/19), with high capital requirements for investment in technological tools. This transformation of farms involves a change in the skills required from farmers related to technological expertise and addressing management and profitability challenges (P134.4, P149.1, P154.1, P174.4). Their incomes are rarely increased (2/13) and are more often decreased (4) or intermediate (4). The rural economy is sometimes described as vulnerable or in decline (5/8), with an increasing distance

between urban and rural realities, and a growing disconnection between citizens and livestock farming (P4.2, P28.1, P174.4).

Society

In light of the described economic functioning of livestock value chains, animal products are predominantly sold at low prices (12/18), facilitated by technological innovation, economies of scale, and market competition. It is also noted that consumers are price-sensitive (10/15), sometimes justified by their limited purchasing power (P5.4, P134.4, P174.4). As such, the society described in the scenarios exhibits inequities in access to animal products and/or labelled products between wealthier and poorer households (7/9). Meat consumption is high (13/16), and although it might slightly decrease in Europe, it is offset by an increase in other regions of the world where European productions are exported (P6.5, P16.2). Consumption habits are becoming more urbanised, with an increasing share of industrially processed or transformed foods (9/14) and a rise in "snackification" and out-of-home dining (6/6).

Technology and science

Research is expanding significantly (12/13) to contribute to technological progress in the agri-food system and boost industries to enhance their competitiveness. Notably, genetic progress is intensifying (10/12), focusing on improving productivity through a better understanding of animal genomes and cutting-edge technologies (e.g., the use of SNPs (Single Nucleotide Polymorphisms), CRISPR-Cas9, GMOs) (P5.4, P6.4, P167.1, P174.5). Additionally, there is a growing emphasis on data mining (12/12) to improve livestock management (P6.5), enhance traceability along the value chain (P6.4, P134.4, P149.1, P149.3), and gain a better understanding of consumer behaviours and preferences (P106.3, P167.1). Research contributes to the expansion of precision livestock farming (11/11) and the technological optimisation of farms through robotics and automation (15/15). This technological development is also evident in the agri-food industry (10/11), aimed at improving efficiency, including the mention of the cracking technique (P28.1, P16.3).

Livestock production systems

Livestock systems are predominantly intensive (15/20) or aim for sustainable intensification (4), with a focus on improving efficiency through technology. The continued presence of small-scale extensive models is occasionally mentioned (P5.4, P6.5, P16.3, P28.1). The number of animals either increases or remains stable, whether for ruminants (increased in 6/13 or stable in 3) or monogastric animals (increased in 4/9 or stable in 4). The feed rations consist largely of concentrated feeds and cereals (12/12), with protein sources originating outside the relevant territory (10/13). Animal health is improved (6/11) through better livestock management and monitoring, biosafety measures, veterinary medicine (including vaccination), and genetic selection. In this scenario family, animal welfare is seldom addressed due to low societal concern (11/14), with a majority of scenarios showing no adoption of animal welfare practices (12/17).

b) Intensification with limited economic success (family 2)

Family 2 consists of 33 scenarios, which encompass both animal production systems (17/33) and agricultural systems (14), with a minority focus on climate change (2). The majority of the scenarios are described at the national level (21/33) or sub-national level (9) in Germany, Scotland, France, Great Britain, and the Netherlands, while European-level scenarios are scarcely represented (3). Over half of the scenarios address all livestock species (19/33), with 11 scenarios focusing on ruminants and 3 on monogastric animals. The barycentric scenario is P48.2 (Scenario study perspective on development directions for Dutch agriculture in 2050 [Lesschen et al., 2020], "Productivity planned scenario"). The stakeholders most frequently mentioned are farmers, governments, and citizens while agri-food industries and distributors are much less cited.

Environment

This family of scenarios reflects an existing concern for the environment, whether from civil society or public authorities (16/30). However, this concern is not fully translated into political measures, agricultural models, or consumption choices, due to the constraints of an economically challenging context (14).

A portion of the scenarios describes a reduction in greenhouse gas emissions at the territorial level (15/23) and mentions the use of mitigation measures (14/26), though without detailing them extensively. These measures may be related to livestock management practices, including feeding and manure management (P13.3, P48.2, P109.2, P174.2), or the reduction in the number of livestock, particularly ruminants (P15.2, P109.1, P155). The use of carbon sinks is sometimes mentioned (8/15), though the risk of grassland degradation is not addressed. Despite these efforts, there is continued global climate change (14/15), leading to extreme weather events, especially in southern countries (P4.1, P167.3), and increased disease prevalence risks (P15.2, P149.2). Other scenarios mention limited mitigation (12/26) and adaptation (8/11) efforts.

Agricultural land decreases significantly (21/27) due to a reduction in livestock farming, and is allocated to other uses. A portion of this land is intended to be reforested (10/22) to preserve biodiversity (P8.4, P109.2, P109.4, P174.2), store carbon (P13.3, P48.4, P149.1), or simply abandoned (P13.3, P134.3). Half of the scenarios in this family present negative impacts on biodiversity, with global degradation continuing (14/15). In some scenarios (P6.2, P47.3, P155), this situation is explained by the decline in grassland areas (12/19) linked to the reduction of ruminant grazing systems and the overall proportion of forages in their diets. In terms of agricultural practices, pesticide use continues (13/19) or slightly decreases (5), nitrogen fertilisation improves (9/16), but soil health (12/16) and water quality (13/18) remain at their current levels.

Governance

Political governance remains unchanged compared to the current situation (23/33), with certain scenarios highlighting states that fail to align their resources with their sustainability ambitions, particularly in terms of environmental protection and animal welfare (7). The power of the European Union is perceived as relatively low (11/17), with some scenarios even envisioning the cessation of the EU's role in agriculture (P6.2, P155, P167.3).

Regulation is minimal (28/32). In the realm of environmental protection, existing standards are maintained, but there is no development of more ambitious measures (P8.4, P54.3, P55.3, P56.4, P57.4, P155, P167.3), and in some cases, a decline is observed (P23.1, P47.3, P174.3). Additionally, there is a notable reduction in livestock financial support (P23.1, P23.2, P47.3, P55.3, P56.4, P149.2, P149.4) due to economic constraints, whereas, in other scenarios, there is an expansion of income support through public subsidies (P15.2, P105.4, P174.2, P174.3).

Economy

From an economic perspective, the scenarios indicate a liberal framework (21/27), sometimes coupled with a crisis or a deteriorating, unstable, and tense economic context for the agricultural sector and society in general (P15.2, P54.3, P55.3, P56.4, P57.4, P134.3, P149.4, P167.3, P174.3). Market liberalisation continues, but Europe becomes less competitive compared to other regions of the world. As a result, European exports of animal products decline in favour of imports (23/30), driven by demand for low-cost products. This is accompanied by a decrease in production volumes (21/31).

Global value chains are long at a global level (15/21), and are mainly driven by downstream actors (11/20), which can lead to an uneven distribution of value (P6.2, P8.4, P15.2, P56.4, P57.4, P134.1), although, in some cases, a more equitable distribution is observed (6). The development of the food processing industry appears to continue (10/16), marked by a decline in the number of structures due to concentration and business expansion (P15.2, P17.2, P134.1, P134.3, P155) in a bid to reduce costs. There is no continuation of

territorial specialisation that stabilise (14/20) or, in some of the more economically favourable cases, see an increase (7).

There is a significant decline in jobs in the agricultural and food sectors (17/19), especially marked by the decrease in the number of farmers and agricultural holdings (19/20) that fail to sustain themselves due to unstable or declining incomes (13/20). This is the result of non-remunerative prices, reduced public support, and sometimes an increase in production costs (P23.2, P122.1). Additionally, the scenarios mention a low renewal rate and significant difficulties in taking over farms due to their size and the cost of land (P6.2, P17.2, P54.3, P55.3, P56.4, P122.1, P134.1). Agricultural holdings are highly specialised (23/28) and large in size (16/24), with an increase in livestock density. Many rural areas are described as vulnerable or in decline (11/13).

On the energy front, the mix is relatively balanced between fossil fuels and the development of renewable energy, notably through agricultural holdings (9/12), whether via bio-gas, agrivoltaics, or bio-fuel production (P6.2, P8.5, P13.3, P23.3, P105.4, P155, P174.2, P174.3).

Society

The prices of animal products are generally low (12/24), high (6), or highly volatile (5). There is a stabilisation (9/21) or a decline in production under labels (8/21), which are disadvantaged by a significant price differential compared to conventional products. This could result in a market share erosion, confining these products to a "niche" consumption, or a reduction in their specifications, making them less ambitious (P15.2, P23.1, P56.4, P134.1, P155). Consumers are primarily sensitive to low prices (16/22). Environmental, social, and ethical concerns take a secondary role in light of the substantial decline in purchasing power due to the deteriorating economic situation (P13.3, P15.2, P23.2, P47.3, P54.3, P56.4, P134.1, P174.3). While animal product consumption remains high (17/29), some scenarios mention a moderate (6) or significant (6) decrease, with a shift towards chicken (P54.3, P155) due to the economic constraints faced by households. The proportion of processed products in diets increases (11/15). Meat is also increasingly used in prepared dishes that better fit lifestyles with time constraints (P13.3, P15.2, P155).

Technology and science

Research evolves slowly and remains largely unchanged compared to the current situation (17/27), with some scenarios showing a decline (6) or growth (4). Overall, stakeholders are supportive of the adoption of technologies, but the main obstacle mentioned is the lack of investment or economic levers (P23.2, P149.2, P149.4, P167.3, P174.3). Genetic evolution is mentioned in 13/33 scenarios, but it is rarely detailed, much like data mining, which is developed in half of the scenarios that address it (7/14). Precision farming sees more widespread adoption on agricultural holdings (15/22), alongside other technologies that enhance efficiency (18/26), particularly robotics and automation (P56.4, P57.4, P17.2, P134.1, P174.2), which are also mentioned in slaughterhouses (P6.2, P17.2). However, this is not the case in all scenarios (8), and two scenarios highlight the lack of effectiveness of adopted technologies, which fail to live up to expectations (P105.4, P122.1). The food processing industry shows a good R&D dynamic (8/12), and there is mention of the development of animal product substitutes (10/15), including plant-based substitutes and cultured meat (P8.4, P15.2, P109.2, P109.3, P167.3, P174.2).

Livestock production systems

Agricultural farms are predominantly intensive (24/33), focusing on greater efficiency and increased productivity of both animals and labour. Four scenarios mention the coexistence of systems where large-scale intensive farms and small traditional farms, aiming for environmental sustainability and animal welfare, operate in parallel. Another four scenarios present extensive farming systems driven by economic

constraints, aiming to reduce production costs as much as possible (P6.2, P23.2, P149.2, P167.3). No agroecological practices are adopted (29/29).

The European livestock population declines for both ruminants (18/26, with 5 remaining stable and 3 increasing) and monogastrics (11/18, with 1 remaining stable and 1 increasing), except for poultry in five scenarios. The animals' feed is composed largely of concentrates and cereals (21/24), half of which are sourced externally from outside the territory (8/16), with the remaining half coming from within (7), at the expense of grasslands. Regarding animal health, several scenarios mention improvements in practices (8/16) through prevention and biosafety measures such as diagnostic testing and disease control programmes (P149.2) and the use of digital twins (P174.2). This is accompanied by a reduction in the use of antibiotics (7/13). However, no practices related to animal welfare are adopted (19/25), reflecting the low level of societal concern for animal welfare (12/17).

3.3.2. Cluster "Segmentation of production systems"

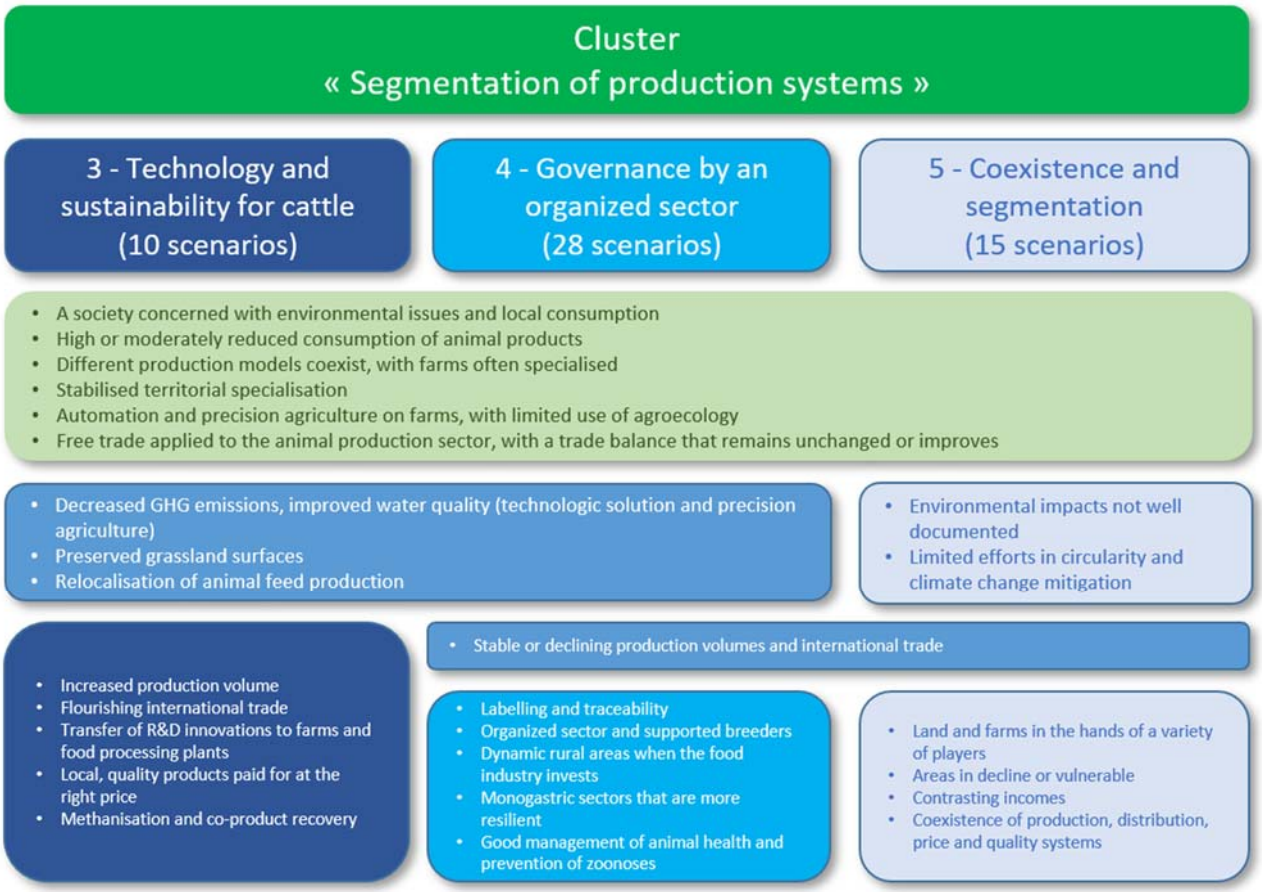

Figure 9: Brief description of the cluster "Segmentation of production systems" (families 3, 4 and 5).

a) Sustainable technology and green growth for cattle (family 3)

This is a small sub-group (n=10) of national-level scenarios drawn from three Nordic studies and one French study. Of the Nordic studies, one Swedish and one Danish are produced by the private sector. Nine out of ten scenarios concern cattle farming, with eight focusing on dairy cattle, while the French study pertains to beef production. Paradoxically, it is this French scenario that lies closest to the barycentre of the scenario family. Key stakeholders mentioned include the state and the EU (10/10), farmers (10/10), and the agri-food industry (9/10), while international organisations, retail actors, and citizens are only rarely referenced. Figure 10 gives a brief description of the cluster "Segmentation of production systems", to which this family belongs together with families 4 and 5.

Environment

All scenarios foresee a reduction in greenhouse gas (GHG) emissions from livestock, primarily through measures quite similar to those described in Scenario 4. These are based on feed efficiency (precision feeding, animal genetics), manure management, soil carbon sequestration, and ecologically intensified farming practices (e.g. precision fertilisation, fertiliser technologies linked to bio-gas production). However, several scenarios (6/10) also partly rely on inputs or technologies that are not yet widely implemented or fully developed, such as rumen- or slurry-based methane inhibitors (P32.1 and .5), nitrification inhibitors for feed crop fields (P31, P32.5), genetic selection of low-methane-emitting ruminants (P32.5), or slurry cooling systems (P31). These agronomic and technical solutions enable GHG reduction targets to be met while increasing herd sizes (7/10) and production volumes (10/10). Soil health is stable or improved (6 and 4/10 respectively), nitrogen cycling is more closed (8/9), and water quality is improved (9/10). Land use for livestock declines globally (8/9), but increases domestically (6/8), due to relocalised feed production (7/10). The area of permanent pasture is stable (6/9) or even expanded and restored (3/9), but never reduced.

Biodiversity is not directly described in these scenarios. However, some do introduce practices favourable to biodiversity, alongside increased permanent grassland, either through land sharing (e.g. agroecological structures like hedgerows and flower strips [P107], pesticide reduction [P15.5, P107], wetland restoration with limited grazing and fallow creation [P32.1, P107], or diverse crop rotations [P32.2]) or land sparing strategies (e.g. targeted afforestation on sensitive areas for drinking water or biodiversity [P31, P32.1], ecological fallow [P31]).

Governance

These scenarios unfold in a liberalised global context where the influence of EU regulation is moderate (7/10 scenarios). Governance is not mentioned in a third of the cases (P32.3, .4, and .5). Livestock regulations are generally not very restrictive (with the exception of the barycentre scenario). Some scenarios describe geographically differentiated environmental regulation, either based on measurable indicators at farm level or by targeting environmentally sensitive areas with stricter nitrogen standards (P32.1 and .6). This reflects an “objective-based governance” approach—flexible and locally adapted, and only a minority of scenarios envision payment for ecosystem services (P15.5, P107). Due to the strong involvement and coordination of the actors of the sector (see economics section), resource management (such as water or land, for example) is often in the hands of private players (6/12) and less often in the hands of governments (4/12). However, state support is present in the form of subsidies for farm modernisation (electrification, new equipment, P107), support for young farmers (P107), and investment support across the supply chain (traceability, quality, animal welfare, low-carbon technology, P15.5, P31). In Denmark (P31), the state plans and finances the reallocation of carbon-rich lands, establishes a national environmental certification scheme (for beef and pork sectors), and promotes synergies between energy, agriculture, and industry (bio-gas, biomass, logistics). Furthermore, public support is directed towards research and innovation (P31, P107), particularly for the development of technologies that do not yet exist (e.g. anti-methane vaccines, gas capture technologies, P31).

Economy

These are green growth scenarios (9/10), with rising production volumes, expanded international trade, a positive trade balance, and territorial self-sufficiency in livestock production (7/7). At farm level, 9/10 scenarios include anaerobic digestion as a revenue source (except the French scenario), and the downstream industry has invested heavily in innovation, often to improve efficiency. These scenarios seldom rely on certification schemes (2/10), except the French scenario, which proposes a comprehensive product quality certification system (covering environment, welfare, and nutrition), and a Danish scenario where the state introduces a climate label. Nonetheless, consumers tend to prefer local, high-quality products (8/9), often at

higher prices (8/10). These scenarios do not detail territorial economic dynamics, specialisation, or the geographic location of agri-food industries.

Society

Animal product consumption has moderately declined (8/8), the presence of ultra-processed foods remains comparable to today (6/8), and the incidence of metabolic diseases remains unchanged (7/7). Both civil society and governments are concerned about livestock's environmental impacts (7/9 combined; 3/10 universally), and about animal welfare (7/9 combined; 9/9 in total).

Technology and science

Research efforts in the cattle sector are substantial (9/10), especially in the use of big data and artificial intelligence (e.g. for genetic selection or decision support, 9/10), precision livestock farming (9/10), and farm-level efficiency innovations (5/10). Genetic selection priorities vary between scenarios (e.g. feed efficiency, intake capacity, productivity, disease resistance). The agri-food industry also invests heavily in technological innovations (9/10), including:

- GHG emissions reduction (e.g. process optimisation in dairies, low-emission packaging, P31),
- Logistical optimisation (e.g. more efficient trucks, bio-gas use, P31),
- Full carcass valorisation (e.g. meat, leather, gelatine, blood for medicine, rumen for bio-gas, offal for animal feed, new processed product lines from less demanded cuts, P15.5, P31),
- Valorisation of dairy by-products in other sectors (e.g. food, energy, fertilisation, P31, P32.5),
- Innovation in traceability and labelling (e.g. to increase transparency and support segmentation, P15.5),
- "Climate check" systems to monitor GHG emissions per kg of milk (P32.1, P32.5).

Livestock production systems

The production systems vary, but often favour sustainable efficiency (6/10). Most farms are specialised (8/10), and beef mostly comes from the dairy sector in Denmark, whereas France and Sweden still foresee a significant role for dedicated beef systems. Nationally, herd sizes are maintained (2/10) or more often increased (7/10). Animal welfare improves in only 6/10 scenarios. Zoonotic risks are seldom addressed (2/10), with limited progress in animal health (e.g. stable antibiotic use in 6/9; improvement in disease management in 3/9). Cattle diets still include high levels of concentrates (7/10), but locally produced protein sources (e.g. legumes, beets, by-products) are commonly used (7/10). Farms are embedded in interlinked systems that reduce dependence between livestock and crop farming—for example, through the use of industrial by-products in animal feed (P32.4, P107). Anaerobic digestion provides income (8/10), and farm by-products are maximally valorised (7/10), with the emergence of new strategies (3/10). Farms invest heavily in automation and modernisation (10/10), and half incorporate technological innovations into their practices. Digestate replaces chemical fertilisers, and crop/forest residues are also used (P31). One Danish scenario envisions feeding cattle with the fibrous fraction of grass bio-refining (with the protein routed to monogastric species, P32.4). The Swedish scenario explores bio-refining of manure to produce high-value nutritional feed for monogastrics and ruminants with an interesting composition in amino-acids (P107).

b) Governance by an organised sector: between modernisation, labelling and management of environmental impacts (family 4)

This sub-family (cluster 4) includes 28 scenarios, each focused on a specific livestock species (ruminants 17/28 scenarios, and monogastrics 11/28). The studies were conducted at national or sub-national levels, originating from France (18), the Netherlands (4), Spain (3), and Sweden (3). The barycentric scenario is 134.2 (Franc-comtois PDO milk, "White Gold Rush"). The stakeholders most frequently mentioned are farmers, governments, agri-food industries, distributors, and citizens.

Environment

Society is concerned with environmental issues in many scenarios (all actors 10/28; civil society and companies 11/28; civil society and the state 5/28) and with animal welfare (21/28). However, the environmental impacts explored are primarily limited to greenhouse gas (GHG) emissions, for which efforts are made and reductions are achieved (18/21). Water quality also improves due to reduced nitrate levels (12/18). In some cases, these progresses are partly due to a reduction in cattle numbers (9/12) or monogastrics (3/9) at the territorial scale. At the same time, livestock systems focus on maintaining grassland areas (stable in 9/15 scenarios; increasing in 6/15), and employ technological or agronomic solutions (13/21) limiting GHG emissions and improving water quality. The scenarios describe a mix of strategies, including:

- Low-emission buildings (P47.2), air washing (P55.1),
- On-site renewable energy and third-generation bio-diesel from forestry residues (P60.1),
- Animal genetic breeding for feed efficiency (5/11),
- Localised protein feed production and reduced input use (11/13),
- Precision feeding (13/18),
- Reduced use of concentrate feed (6/13),
- Use of plant-based co-products in animal diets (P15.3, P16.1).

Only 8 scenarios explicitly mention biodiversity-friendly practices (with improvement for 5 of them), but grassland surfaces are preserved (16/16), and moderate fertilisation is adopted, either by choice or due to extensive farming systems (6/28), and CAP support for ecosystem services (5/9).

Governance

Governance in these scenarios is typically led by states and companies (25/28), with moderate to strong involvement from the EU (8 and 7/19, respectively). Regulatory intensity on livestock varies (high: 14; minimal: 8), but public support for farming—either for farmers or dairies—is present. This includes: EU support by remuneration for ecosystem services (for example in P15.3 and P55.2), or for maintenance of production in low-population areas (P16.1), consumer support for local production or ecosystem services (P56.2), private sector support (P47.2).

Value chains also play a key role. In many cases, farmers are not isolated but represented by structured organisations such as farmer cooperatives (5/13) or vertically integrated entities (5/13), which allow for:

- Coordination among actors,
- Fair value distribution (11/22),
- Contractual arrangements ensuring income stability (5/22),
- Territorial development around shared priorities (quality, exports, innovation, environmental performance),
- Farmers support (14/21) by public services and private actors (education, access to credit, advisory services).

Economy

The current liberal system remains dominant (17/23 scenarios), with some mention of Green Growth (5). Trade balances range from unchanged, to less favourable, to contracting (7, 7, and 4/21 respectively) compared to today. Production volumes have declined or remained stable compared to today (13 and 8/28). Territorial specialisation is either stabilised (17/27) or increased (7/27). Farm numbers continue to decline (19/25), with generational renewal difficulties and an increase in average farm size (14/21). Agricultural employment is decreasing or stable (9 and 7/19). Farmer incomes are acceptable or good (5 and 7/17), when quality is valued and supported (traceability, short supply chains), or when public support and contracts are in place.

A correlation is observed between regional economic dynamism and investment from the agri-food industry: regions are more dynamic (8/13) when agri-food development strategies are implemented (13/18), focused on various objectives such as efficiency (6/18), employee well-being (2), or animal welfare (2). Labelling is increasingly used (15/26; 13 from France, 1 from the Netherlands, 1 from Spain), or stable (11/26) compared to today. Labels contribute to quality assurance and product origin traceability, which enhances both national and international competitiveness in a tense health context (e.g. P15.3, P16.1, P54.1, P55.1, P55.2). Labels also enable value creation (P6.1, P55.2) and meet citizen expectations (P56.2, P54.2), ensuring better remuneration for producers. These labels vary in nature, and the organic label is just one possible strategy (quality labels such as Label Rouge, PDO...).

Society

Most scenarios describe citizens with animal protein-rich diets (10/17), with some noting a moderate decrease in consumption (4/17). Monogastric meat dominates (7/9), and ultra-processed food consumption is stable or increasing (7 and 3/11). Local origin (14/27), product quality (15/27), and sustainability (12/27) are frequently cited in consumer purchasing criteria (22/27), though a few scenarios mention low-cost-seeking consumers (3/27). Quality is also particularly valued by affluent international clients, especially in the dairy and beef sectors (P6.1, P15.3, P16.1, P16.3).

Technology and science

There is little mention of increased R&D (stable in 20/22 scenarios). However, data mining and precision agriculture are developing (11/12 and 13/18), improving on-farm productivity (e.g. optimised feeding in P60.1 and P60.2) and reducing slaughterhouse costs. There are no major technological breakthroughs—livestock farms evolve little (no development in 8 scenarios), or show only moderate modernisation (6/21) or automation (4/21). Some scenarios highlight product innovation in the agri-food industry (3/6), such as premium minced meat, meat texture enhancements, culinary innovations, and strategies to better valorise all meat cuts (P15.3 and P15.1).

Livestock Production Systems

A diversity of systems is observed, with frequent coexistence of multiple models in a single territory (9/29). Systems may be extensive (6), intensive (6), or focused on sustainable efficiency (5). Most farms are specialised (15/28), with some mixed crop-livestock farms (7/28). Many optimise manure use for fertilisation (11/14), but few implement agroecological techniques (22/28 do not). Ruminant numbers declined (9/11), but grassland areas have been maintained or increased (16/17). Beef production increasingly originates from the dairy sector (8/10). There is a significant focus on local protein feed production (11/13), and the food/feed competition has decreased (10/11), due to smaller herds. The monogastric sector is less affected, with animal numbers remaining stable (6/9). Animal welfare is not systematically improved (17/26). Animal health and zoonoses are considered in 10/26 scenarios, with reported successful improvements in animal health management (10/16) and reduced antibiotic use (6/9). As a result, food safety is maintained or improved (10 and 3/15).

c) Coexistence and segmentation (family 5)

This is a sub-family comprising 15 scenarios, most of which are "all-species" (11/15). These are studies conducted at various scales, ranging from sub-national to global. Two scenarios operate at the global level, one at the European level, nine concern France (of which five are at a sub-national level), two pertain to the Netherlands, and one to Germany. The barycentric scenario is 28.5 (AgrimondeTerra, “Land as commons for rural communities in a fragmented world”).

Environment

These scenarios are characterised by a lack of documentation on environmental issues, with environmental variables specified in only 43% of them on average. The impact of agriculture on greenhouse gas emissions is less clearly defined compared to the other two scenario families (decreased or neutral: 4; stable: 3/7). Land use for agriculture is either stable (7/11) or in decline (4/11). When progress is made in biodiversity or GHG emissions, it is often enabled by local or private initiatives (e.g. P105.2, P167.2, P28.5), typically based on the intensification and increased efficiency of livestock farming and agri-food industries (e.g. 122.5, P151.1, P57.2). These efforts are often supported by incentives for beneficial practices via market mechanisms (such as labelling) and other means of internalising externalities (P105).

Governance

These scenarios depict either a concentration of decision-making power in the hands of states and corporations (8/15), or scenarios with strong regional governance (5/15). In the former, the EU plays an intermediate to significant role (6/6), and farms are often integrated into supply chains managed upstream or downstream (e.g. P171.4). In the latter, the EU's role is limited (4/4), and resource management (e.g. water, land) is overseen by private actors (3/8) or local institutions (3/8).

Economy

These scenarios are occurring in a liberal economic world (10/15), marked by market and price volatility. The economic situation of the livestock sector has changed little compared to the present: production volumes have largely been maintained (8/13), or have in some cases declined (5/13), while domestic demand for animal products has remained steady (high or intermediate consumption in 10/15). Import/export issues persist, with the trade balance mostly maintained at current levels (10/15). In some scenarios, reduced volumes are linked to lower domestic demand, yet the balance is preserved either through strong exports outside the EU (e.g. P57.1 for French veal) or reduced imports, driven by consumer preference for locally-produced meat (e.g. veal: P57.2; all animal products: P105.2).

Indeed, most trade remains intra-EU (e.g. P57.11 & .2, P151.1, P105.2, P4.3), particularly involving high-quality products such as organic-labelled goods, which may be deficient in some regions and balanced by intra-EU imports (e.g. P151.1). Nevertheless, international exports are promoted as a key economic objective (e.g. P122.5, P167.2, P28.1 & .5, P171.4, P4.3, P5.1). However, reduced competitiveness on international markets is sometimes observed due to European environmental standards (e.g. P5.1). This is mitigated by European protective mechanisms based on product quality (e.g. P171.4: international agreements protecting ethical and sustainable production; P4.3: standards imposed on imports to limit dumping). Yet, these protections are not uniformly applied across market segments: the processed food industry and catering sectors do not always adopt these standards, creating uneven international competition (P4.3). These scenarios frequently portray the coexistence of export-oriented producers and those focusing on short, local supply chains (e.g. P5.1, P122.5: in France, coexistence of large-scale, robotised pork farms in the West for export and small-to-medium farms focused on national/local distribution elsewhere). Some sectors target high-end export markets (e.g. P151.1: all species) or develop niche products (e.g. P57.1: veal for Israel and Asia). In scenarios where export becomes difficult due to successive crises (economic or sanitary), exports outside the EU become merely a buffer variable (P5.3).

At a territorial level, territorial specialisation has changed little (stable in 7 out of 13 scenarios). Farm concentration has either stabilised (5/12) or increased (3/12), with a variety of outcomes regarding agricultural employment. Rural areas are often declining (5/11), vulnerable (1/11), or marked by the coexistence of thriving and declining zones (2/11). Livestock farmers' incomes vary widely across scenarios: low (2/10), intermediate or unstable (2/10), high (2/10), or a coexistence of prosperous and struggling farmers (3/10). A distinctive feature of this family is that landowners or farm holders are not always the

farmers themselves, but may include various stakeholders (5/13) such as local authorities (P5.3), investors or industrial actors (P151.1, P57.1), co-owning consumers (P105.2), or collective governance entities (P28.5).

As in family 4, food supply chains emphasise consumer information, traceability, and product differentiation through labelling (14/15). Different types of consumers coexist (5/15): those prioritising low prices (4/15) and those opting for higher-quality and/or local products despite higher costs (4 out of 15). They are served through diverse distribution channels (coexistence in 7/13; e-commerce and supermarkets in 2/13), corresponding to varied value chain lengths (coexistence in 8/15; intermediate in 4/15).

Society

Diets have remained meat-based (7/14) or intermediate (3/14), yet relatively diverse (6/9), with consumption of ultra-processed foods remaining the same (6/12) or increasing (4/12). Concern for animal welfare varies considerably across scenarios (low or absent: 4/11; civil society and companies without state involvement: 4/11). Environmental concern is moderate (low interest: 3/14; driven solely by civil society: 5/14; led by the state without civil society: 3/14). In line with these low requirements, societal acceptance of livestock farming is high (5/8).

Technology and science

Digital tools are widely adopted on farms (9/10), and there is investment in automation and robotics (7/15), but notable investment in research and innovation appears in only a minority of scenarios (5/12). However, few scenarios report genuine innovation, whether in the form of new agroecological techniques (3 out of 15) or productivity/efficiency improvements (2/15). Reflecting the diversity of farming models, breeding goals also vary (performance, resilience, sustainability, animal welfare, climate change adaptation). Similarly, livestock production industries innovate little (7/9), though some investment is directed at efficiency, animal welfare in slaughterhouses, and sustainability (6/12). Product differentiation via labelling is a primary focus. In contrast, in half of these scenarios (5/10), other agri-food sector actors have developed a range of animal product alternatives (plant-based from legumes, lab-grown meat).

Livestock production systems

All scenarios (15/15) present a diversity of techno-economic farming models, including specialised, mixed, and diversified farms (11/14), both small- and large-scale operations (8/14). Some focus on agroecology while others pursue conventional intensification (e.g. P28.5). The former tends to offer high-priced quality products; the latter, lower-end products—resulting in price level coexistence (6/9). Livestock farmer demographics have either remained stable (5/12) or increased (4 out of 12). Herd sizes for both ruminants and monogastrics have remained stable (4/9 and 5/8 respectively) or declined (5/9 and 3/8). Agroecological principles (e.g. crop-livestock integration, nutrient cycle closure, reduced synthetic inputs, natural regulation) are applied in a third of the scenarios (4/11). Overall, however, these scenarios are marked by limited efforts in circularity (waste: 4/6 with no effort), mitigation (no effort: 4/8; carbon trading: 1/8), or adaptation to climate change (4/6). Animal welfare has not progressed (8/15) or has regressed (1/15).

3.3.3. Cluster "Sustainability and protectionism"

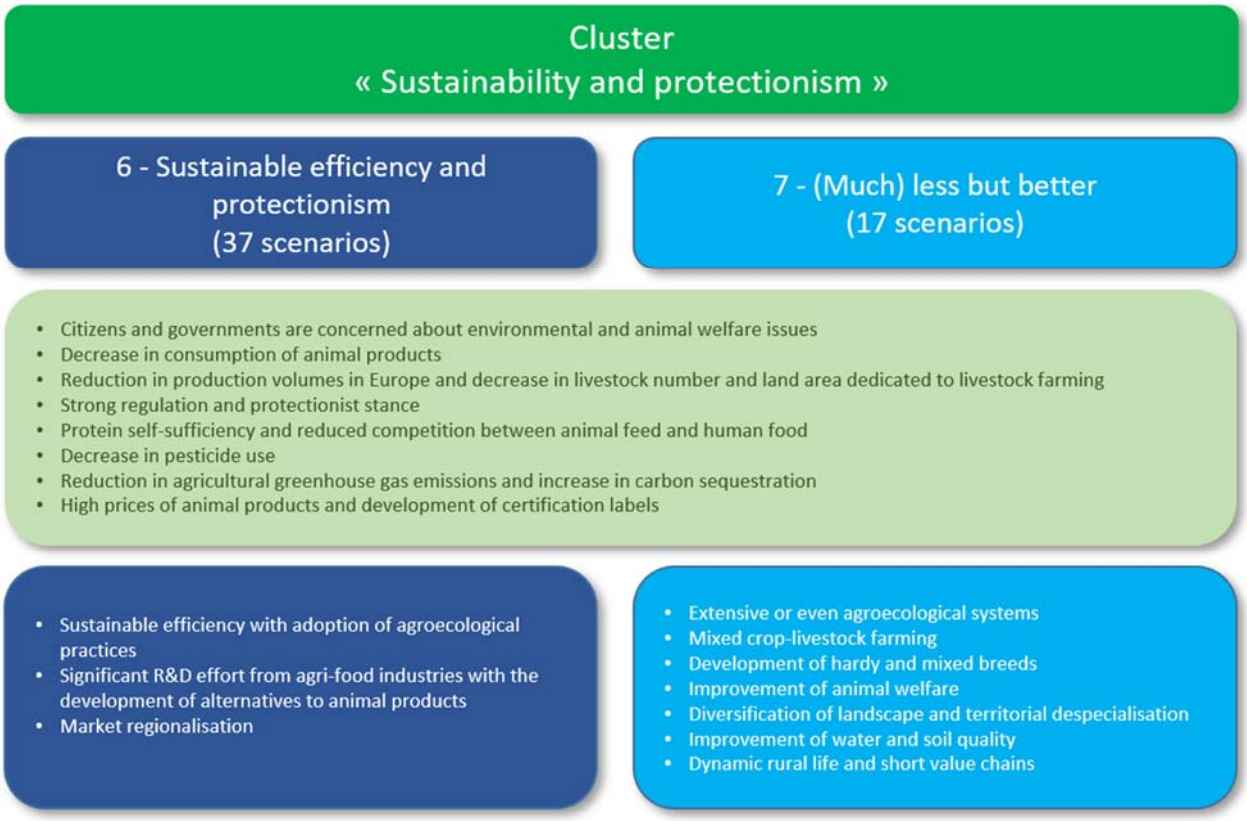

Figure 10: Brief description of the cluster "Sustainability and protectionism" (families 6 and 7).

a) Sustainable efficiency and protectionism (family 6)

Family 6 comprises 37 scenarios. These originate from studies focused on livestock systems (18/37) or agricultural systems more broadly (14), with a few scenarios addressing climate change (4) or societal issues (1). Geographically, the scenarios cover the global scale (2/37), Europe (10), and the national level (17), including France, Germany, and the Netherlands. At the sub-national level (8), scenarios take place in France and the United Kingdom. They address all livestock species collectively (28/37) or, in roughly equal numbers, monogastrics (5) and ruminants (4). The barycenter scenario of this family is P5.5 (Breton Agriculture 2040 – 5 Future Scenarios [Chambres d'Agriculture de Bretagne, 2023] - "Brittany's agriculture becomes more plant-based – Livestock farming declines, and more space is given to plant production.") The main actors featured in these scenarios are public authorities (30/37), citizens (27), livestock farmers (26), and agro-food and retail industries (22).

Environment

This family is characterised by a strong environmental concern (30/32), encompassing climate change, ecosystem protection, and biodiversity conservation. Populations demand stricter regulations to address these issues, and public authorities are responsive to these calls. Regarding climate change, a reduction in agricultural emissions is mentioned in half of the corpus (16/26), and 22 out of 25 scenarios report the implementation of mitigation measures, suggesting a significant ambition, although the effectiveness of these measures is not always assessed. Several scenarios refer to technical solutions related to feed and manure management (P8.3, P13.2, P47.1, P159, P161.1, P171.1), as well as the use of decarbonised energy sources (P13.2, P173.1, P173.2). There is substantial reliance on carbon offsetting (18/23), with carbon sequestration occurring in soils or biomass. Several scenarios describe incentive-based financial systems for farmers providing these services (P5.2, P13.2, P47.1, P134.5, P159). Only one scenario mentions the risk of

increased N2O emissions associated with higher grazing (P48.3). Some scenarios address climate change adaptation challenges, though detailed measures are seldom proposed (9/13).

There is a marked reduction (19/30) or stabilisation (10) of land areas dedicated to livestock production. Several scenarios allocate these freed lands to woodland expansion (P5.2, P13.1, P13.4, P30.2, P30.3, P30.4, P48.5, P67.3, P173.1, P173.2) or other, often unspecified, uses. This decline results from decreasing herd sizes and production levels, while pasture areas remain relatively stable (11/21), with some scenarios indicating decreases (6) and others increases (4). One scenario highlights the need for additional land to produce animal feed locally, a key issue in this family (P159). Crop production sees a moderate (11/21) to substantial (7/21) reduction in pesticide use, with values in the scenarios ranging from -10% (P173.1, P173.2) to -60% (P8.3). Soil health is improved (11/13) or stable (2), sometimes linked to carbon sequestration in soils contributing to fertility (P13.4, P28.4, P117). Biodiversity is improved (15/24) or stable (6), mainly due to favourable agricultural practices and the maintenance of pastures (16/25). Scenarios also emphasise increased crop rotations and diversification (P67.3, P105.1, P168) and the implementation of semi-natural elements (P48.3, P161.1, P173.1, P174.1) facilitated by the presence of livestock farming.

Governance

At the political level, the situation remains largely unchanged (20/33), with several scenarios emphasising the importance of multi-actor and multi-level cooperation, highlighting a significant role for regions and local territories (P5.5, P13.1, P13.4, P17.1, P30.3, P30.4, P117, P119, P134.5, P174.1). The power of the European Union is considered to be relatively strong (13/27) or moderate (8), with the Common Agricultural Policy (CAP) featuring an enhanced environmental sustainability component (11/17). Several scenarios describe incentive-based measures such as eco-conditioned subsidies or payments for environmental services provided by livestock farming (P5.2, P15.4, P23.3, P62.2, P47.1, P119). Regulation is stricter in most scenarios (31/35), notably through strengthened environmental protection policies and more stringent standards, as well as penalties and taxes (P5.5, P23.3, P48.5, P54.4, P105.3, P171.1, P174.1).

Economy

The economic context is described as liberal in 19 out of 35 scenarios, while 8 scenarios mention a green growth situation, characterised, for example, by climate and environmental criteria applied to imports (P5.2, P13.2, P105.1). Another 8 scenarios indicate protectionist policies within Europe. Consequently, trade is described as restricted in half of the scenarios (15/31), otherwise it is either improved (10) or stable (5). There is a clear tendency towards regionalisation of markets in pursuit of autonomy and sustainability (P5.2, P13.1, P28.2, P67.2, P105.3, P171.2, P174.1). This family features a marked decline in production volumes (25/30) or stability (4), driven by reduced livestock numbers to address climate and environmental challenges and adapt to decreased domestic demand. There is an increase in certification schemes (22/32), with several scenarios reporting growth in organic farming areas and two scenarios describing new labels for pasture-based livestock production (P15.4, P47.1). Some scenarios also report export strategies for these high-quality products (P5.2, P30.2, P117, P122.6, P134.5, P173.1).

Half of the scenarios indicate a trend towards territorial de-specialisation (17/32), while 14 scenarios suggest maintenance of the current situation. This is accompanied by a geographical shortening of distribution channels, occurring at local (10/30), intermediate (9), or mixed scales (8), reflecting a movement towards relocalisation linked to the bioeconomy. The agri-food industry is developing in 13 out of 20 scenarios, with tendencies towards small-scale relocalisation (9/21) or diversification (5). These changes occur either within the framework of large global market operators restructuring their governance (P13.1, P13.4), or favouring SMEs and micro-enterprises (P17.2, P30.3, P67.2, P159, P173.1). Several scenarios also report a better distribution of added value along the supply chains (9/19). Regarding distribution, which is generally little detailed, several scenarios mention the growth of local markets with short supply chains and direct sales

from producers (P5.2, P8.3, P15.4, P28.4, P67.2). There is a modest trend towards a relatively dynamic rural life (12/18), with scenarios specifying good connectivity to urban areas.

No clear trend emerges regarding farm size, as it may decrease (9/27), remain stable (8), or increase (7). Similarly, while some scenarios indicate farm diversification (12/29), notably towards mixed cropping-livestock systems (6) or energy production, others show continued specialisation (8). In half of the scenarios, the number of farm managers increases (11/22) or remains stable (5). The reasons cited include a higher workload depending on livestock farming methods, which may require more labour (P17.2, P28.2), a positive image of farming that enhances the profession's attractiveness (P17.1, P134.5), and improved remuneration (13/20).

There is a tendency towards increased use of renewable energy (9/16), with a significant proportion produced on farms (14/19) in pursuit of energy autonomy (P5.2, P28.2). This includes biogas production from bio-waste, grasslands, manure, dedicated crops, as well as agrivoltaics and, occasionally, biofuel production (P8.4, P161.1).

Society

There is a consumer trend towards seeking sustainable products (14/29), although this does not represent half of the family's scenarios. Expectations vary widely across scenarios and may include environmental respect, animal welfare, local origin, health concerns, or quality assurances such as high standards. This information is often conveyed through labelling on products, enabling consumer identification. Consumers are therefore well informed, and many scenarios indicate a willingness to pay a premium, despite rising prices of animal products (16/25). This is facilitated by a strong acceptability of livestock farming (16/21), associated with an enhanced image of the profession and trust built through traceability, which supports consumers' willingness to pay. There is also a notable reduction in animal product consumption, either significant (15/31) or more moderate (11). Scenarios provide limited details on consumption habits, but some highlight the influence of flexitarian, vegetarian, and even vegan diets, alongside increased consumption of plant-based proteins (P5.2, P13.4, P15.4, P28.4, P67.2, P105.1, P119, P161.1, P173.1). There is also a trend towards decreased consumption of processed foods (10/20) or stability in this regard (8).

Technology and science

In family 6, research activity is either expanding (19/34) or remaining stable (14) across a wide range of fields, including ecosystem knowledge and preservation, digital and technological innovations, and resource efficiency. Half of the corpus reports the development of new genetic traits (15/15) addressing diverse demands for efficiency and resilience (P117, P119, P161.1). There is a trend towards the use of data mining (11/17), notably blockchain technology for enhanced traceability. There is widespread adoption of technologies on farms (29/35), including precision livestock farming (16/22), automation (9/29), as well as agroecological practices aimed at optimising productivity and reducing environmental impact. R&D development within the agri-food industries is more mixed (13/23) with varied strategies to improve efficiency. Many scenarios mention a shift towards the production of new food products (14/19), including plant-based food substitutes and lab-grown meat, and even insect-based products for human consumption (P67.3).

Livestock production systems

The predominant livestock farming model within this family is sustainable intensification (19/37), reflecting an ecological agriculture that leverages science and technology. Other scenarios highlight extensive farming models (7) or a coexistence of various intensive and extensive systems (6). Agroecological practices are also frequently mentioned (21/29), with some scenarios presenting sustainable intensification and agroecology as complementary approaches to modernising agriculture (P28.2, P28.4, P30.4, P117).

There is a marked decline in livestock numbers, both ruminants (18/24, and 6 stable scenarios) and monogastrics (17/21, and 4 stable scenarios). Some scenarios specify that this decline should be slight to preserve the ecosystem services provided by livestock farming (P48.3, P48.5, P168). A clear trend in this family is the pursuit of greater territorial autonomy for forage and protein production (21/26) to enhance resilience (P23.3, P117, P119). This is linked to crop rotation practices and a reduced share of concentrates and cereals in animal feed rations (13/19). Certain scenarios indicate that monogastrics increasingly rely on former foodstuffs and by-products within a circular economy approach (P67.3, P161.1, P168, P174.1). Animal health is infrequently addressed, with only 8 out of 13 scenarios mentioning improvements achieved through diverse strategies. Similarly, the adoption of animal welfare practices is mentioned in just 8 of 13 scenarios, despite being a significant societal concern (18/25). The most commonly cited strategies involve providing animals with outdoor access and increased space (P17.3, P48.3, P48.5, P54.4, P161.1).

b) (Much) less but better (family 7)

There are 17 scenarios in this cluster. They are based on studies focusing on livestock farming or agriculture (13) and sometimes climate (3), mainly covering all livestock species (14). Geographically, they concern France (8), Europe (7), the Netherlands (1) and Denmark (1). The barycentre scenario of this family is P6.3 (Prospective study of the ruminant meat sector in the Massif Central, horizon 2050 - five scenarios for better anticipation and adaptation [INRA, 2016] - “AGROECO”: Agro-ecological meat for all). The scenarios involve numerous actors, each with very different roles: public authorities are omnipresent in regulation, strategic guidance and economic incentives (P163, P151.2, P4.4); citizens are a driver of change through consumption (P165.2, P171.1, P4.5); farmers are sometimes under pressure, but also drivers of innovation, or supported in the transition (P6.3, P163, P67.4); NGOs and associations are influential, their campaigns lead to start-ups or niche products (171.5).

This family describes less intensive (often extensive) systems adapted to local resources (grass, co-products) and focused on animal welfare, human health and the environment in response to strong societal demand for ethical, healthy and often small quantities of animal products. They are part of agroecological and economically relocalised territorial approaches, accompanied by proactive public governance.

Environment

All scenarios incorporate environmental concerns. Biodiversity is generally improved (10/13), mainly due to a significant reduction in pesticide use (12/15). As a result, water quality improves (5/6) as does soil quality (6/8). Agricultural GHG emissions decrease (5/11), sometimes to carbon neutrality (5/11), thanks to a reduction in the number of animals, the quasi elimination of inputs (replaced by long rotations incorporating legumes (P165.2)), and the enhancement of grasslands (P163). Landscape management is being reviewed to be more diversified (grazing, hedges, trees) (12/15) and carbon sequestration in soils is increasing (6/9).

Governance

The livestock farming and processing sectors are both constrained and supported by strong legislation (15/15). For example, regarding animal welfare, the regulation follows the principles of Welfare Quality, with which compliance is ensured at every stage (livestock farming, transport, slaughter) (P67.4). Governance is shared and there is regional cooperation. For example, water public policies are decentralised at the watershed level, considered more consistent with agricultural planning (P6.3). The states and local authorities also play a key role in the food transition (P151.2).

Economy

Trade is restricted by protectionism (12/17). Prices for animal products are high (9/11). Indeed, production is declining sharply but is concentrated on high value-added products backed by quality labels (PDO, organic) and animal welfare labels (P171.5).

Short supply chains are developing strongly (11/11), with distribution concentrated on markets (8/9) and exports turning to niche markets (P4.4).

Farmers are remunerated for the services provided by livestock farming (landscape, biodiversity) and some additional income can come from anaerobic digestion or solar panels (P6.3).

Society

Consumers play a decisive role in all scenarios, driving demand towards fewer animal products (17/17), greater sustainability (11/14) and quality (3/14), greater transparency, and even radical ethics. At the societal level, citizens and governments are concerned about environmental issues (11/12) and animal welfare (10/17). Consumers have high expectations in terms of health, the environment and animal welfare. They want consistency between their aspirations and their purchases (P4.4)

We see two groups of customers: a large group focuses on the consumption of high-quality products, even though these come at a premium, another group of consumers is now vegetarian or plant-based but is still closely in touch with farmers. This trend may even continue in the most radical scenarios until vegans become the majority and omnivores are stigmatised (P4.5).

Technology and science

The scenarios do not describe intensive technicisation, with research efforts remaining stable or declining (12/15), but rather moderate and targeted use of technology. Research institutes are mobilised to develop rustic and mixed breeds (P67.4), or even lighter animals that are better suited to grass (P163). Data collection infrastructures and blockchain technology ensure transparency on animal welfare. These technology innovations can be criticised for replacing human-animal interaction (P171.5). Precision livestock farming (PLF) facilitates animal health management and the adaptation of systems to agroecological principles (P6.3) through individualised animal monitoring (P67.4).

Livestock production systems

All scenarios describe a reduction in intensification, with increased diversification and a return to grasslands. Production volumes across the territory have fallen (14/17) and local land use for livestock farming has decreased (12/17). Monogastric (12/12) and ruminant (13/13) livestock numbers have fallen across the territory in line with reduced consumption of animal protein, rustic and mixed breeds are developing (8/9) and systems are self-sufficient in terms of protein supply (12/12). Some farms are even converting to plant-based production to meet the needs of vegan or vegetarian consumers (P171.5).

The production system is extensive (12/17) or even agroecological (5/17), and animal welfare is always improved compared to today (17/17). Livestock systems are redesigned to maximise positive experiences for animals, with reduced densities and the grouping of production phases (breeding and fattening on the same farm) (P67.4). Industrial livestock farming disappears, particularly for pigs and poultry. Ruminants are kept, but exclusively in grassland systems (P30.4). There are fewer suckler cows, but they are better valued on grass, and the total number of cows decreases without a decrease in the number of farms (P163).

Farms combine animal and plant production (11/17) and agricultural land is less specialised (16/17), with a reduction in large-scale crops in favour of fruit and vegetables (151.2). There is a decrease in feed/food competition (12/12). When considered in the scenarios, rural life is dynamic (5/7).

3.4. Positioning of ongoing European partner projects scenarios

There are two ongoing European partner projects that focus on the future and sustainability of livestock systems in Europe, called PATHWAYS and Re-Livestock. Step-up is both closely aligned with and complementary to these projects which are primarily focused on disruptive innovations targeting niche or mainstream production systems within specific contexts. Their description is presented below.

The project "Pathways for Transitions to Sustainability in Livestock Husbandry and Food Systems," known as PATHWAYS, is a Horizon 2020 European project (GA: 101000395) coordinated by the Swedish University of Agricultural Sciences (SLU) and involving 30 partners from 12 countries. Running for five years (2021–2026) with a budget of €9 million, its aim is to identify and promote sustainable practices throughout the European livestock production and supply chains. The goal is to reduce environmental impacts while meeting societal expectations for safe, nutritious, and affordable meat and dairy products.
https://pathways-project.com/

The Re-Livestock project is a Horizon Europe project (GA: 101059609) coordinated by the Spanish National Research Council (CSIC) and involves 37 partners from 14 European countries and Australia. This five-year project (2022–2027) has a total budget of €13.5 million. It aims to go beyond traditional approaches to reducing emissions and adapting to climate change in livestock farming by adopting an integrated approach that combines practices from animal feed, genetics, animal welfare, farm management, and environmental and socio-economic assessment.
https://re-livestock.eu/

PATHWAYS has developed four scenarios, and Re-Livestock has developed five. **Table 4** shows the distribution of these scenarios according to the identified scenario families. None of them fall within families 3, 4, or 5.

Table 4: Distribution of PATHWAYS and Re-livestock scenarios according to the scenario families identified in Step-up.

Step-up scenario families	PATHWAYS project scenarios	Re-Livestock project scenarios
1	Efficiency first	Eur-LFS-SSP4: European Livestock Farming Systems in an **Unequal but Green** Era Eur-LFS-SSP5: European Livestock Farming in an **Innovative but Fossil-fuelled** Era
2	-	Eur-LFS-SSP2: European Livestock Farming Systems in an **Established** Era Eur-LFS-SSP3: European Livestock Farming Systems in a **Self-Sufficient** Era
3	-	-
4	-	-
5	-	-
6	Rural renaissance Feed no Food	Eur-LFS-SSP1: European Livestock Farming Systems in a **Sustainable** Era
7	High Animal Welfare	-

4. Discussion and perspectives

4.1 Limits of the adopted methodology

For this project, we chose to compile the broadest possible corpus of foresight studies on European livestock systems. Our aim was to capture the perspectives of various stakeholders on various territories associated with diverse farming practices. Consequently, **the final corpus is heterogeneous and diversified, though many systems remain unrepresented**. For example, only one document addresses pastoralism that has very specific challenges (P116 – Envisioning the future of transhumant pastoralism in Spain [Oteros-Rozas et al., 2013]), as it is also the case for Protected Designation of Origin (PDO) (P134 – Franc-comtoise PDO milk production: potential and dynamics to 2030 [Ropssi et al., 2017]). Additionally, only five documents focus on monogastric livestock, two on poultry and three on pigs.

We chose never to exclude a study based on criteria of quality or relevance, which could have been debatable and led to different choices depending on the disciplinary field considered (agronomic, economic, social, environmental, etc.). At the various stages of corpus cleaning, the exclusion of a study was always motivated by a lack of precision in the information or the absence of at least one scenario for the livestock sector, or, subsequently, by an insufficient number of variables described in the scenarios derived from these studies. The disparities among the scenarios—as already explained related to the geographic scale, the thematic focus, and whether or not it has been quantified—make direct comparisons very difficult. **The variables described differ from one scenario to another, so there is not always a common basis between scenarios.** This is reflected in the fact that the completion rate of the full variables analysis table (257 scenarios x 93 variables) is only 33%. For this reason, statistical analysis proves especially useful in handling such a large and diverse corpus.

Although the MCA-based clustering method is supposed to be unbiased, this method has limits and weaknesses. **The selection of variables and associated modalities established a specific analytical framework, which influenced the formation of families**. Furthermore, we selected active variables and scenarios (160 × 16), resulting in a data completion rate of 87% but it also led to a loss of information by excluding the least complete scenarios in terms of the number of variables processed. To fill in the missing data, we used the "imputeMCA" function, which statistically estimates these values. However, the imputed values tend to belong to the mean, thereby downplaying rarer modalities. Since MCA groups similar modalities together, the use of this function may have influenced the formation of the scenario families. Furthermore, the statistical method defines boundaries between families, but they remain somewhat porous, especially among families grouped in the same parent cluster. Likewise, they can share common trends. Consequently, some scenarios lie on the boundary and could reasonably belong to one family or another. To better characterise and illustrate the families, we chose to identify the scenarios closest to the barycentre. However, upon reviewing them, we felt that they do not always accurately reflect the specific characteristics of each family. Finally, **this approach mainly served to structure the dataset in order to present the landscape of possibilities for future livestock systems**.

MCA grouped scenarios into families based on the common features they share. As a result, these families do not necessarily provide very disruptive insights. It is because these family-features are major trends—phenomena with strong inertia over the medium to long term—that are highly influential for the system and well known to stakeholders in the sector. But some scenarios within the families may be more original, with their unique aspects tending to be diluted in the present study. In foresight discipline, such singular elements could belong to weak signals, wild cards:

- **Weak signals** are characterised as low-profile pieces of information that carry the potential for major transformations. They herald the emergence of new phenomena that may cause a shift in major trends, discontinuities, or the birth of new trends. For example, this includes the international

expansion of online sales of animals and animal products (P6.2, P104.2) or the widespread adoption of robots to replace certain jobs in agriculture and agri-food sectors (P6.2, P167.1).

- **Wild cards, also known as black swans**, refer to unpredictable situation and events and cannot be anticipated based on past experiences or knowledge. They are usually negative, catastrophic events, with extreme impacts that reshape our understanding of the world. Several scenarios, for instance, consider the end of the Common Agricultural Policy (CAP) for various reasons, including the rise to power of an anti-European government leading to the collapse of the EU and the end of the euro (P167.3). On the geopolitical front, hypotheses such as the creation of the E7 group (Emerging 7: China, India, Brazil, Mexico, Russia, Indonesia, and Turkey) replacing the G7 are also mentioned (P13.3).

4.2. Cross-analysis of scenarios and scenario families

4.2.1. Synthetic comparison of scenario families according to their main driving variables and output variables

The main driving variables and output variables are presented in **Figure 11**. A synthetic comparison of the 7 families of scenarios according to these variables is proposed in **Table 5**.

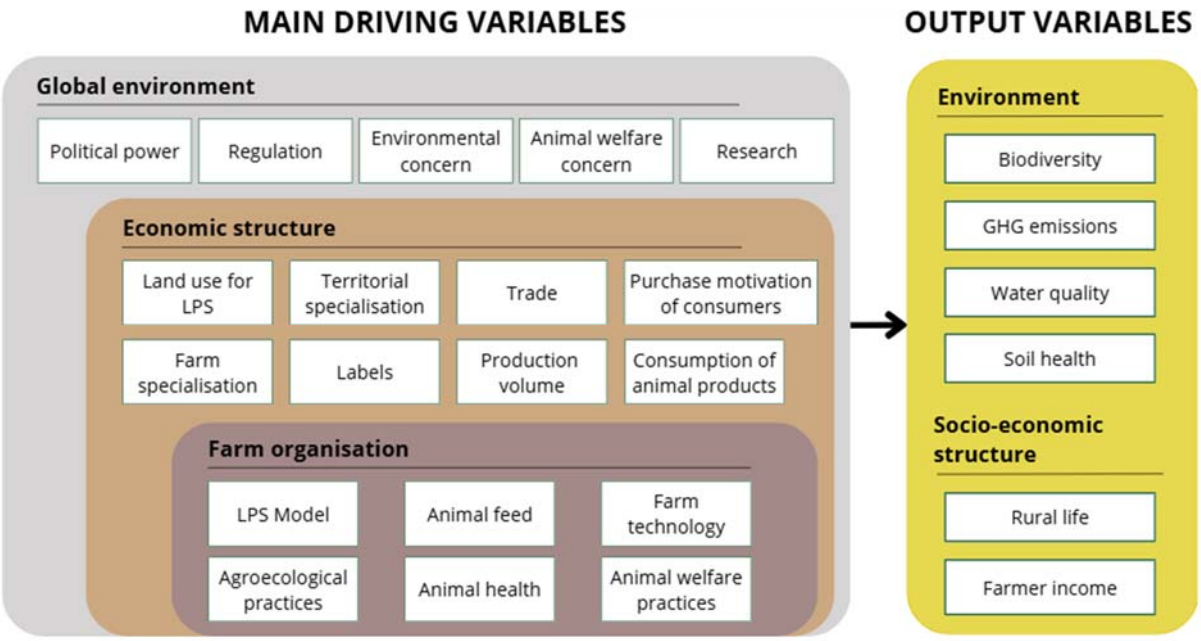

Figure 11: Representation of livestock production systems main driving variables and impact variables.

Regarding the main driving variables, the cross-comparison of the seven scenario families reveals a clear gradient from deregulated, high-output intensification (families 1–2) towards tightly regulated, socio-ecological transitions (families 6–7), with families 3–5 occupying intermediate, hybrid positions.

Political authority remains "stable" through most families, despite certain changes. In family 1 private actors play a strong influential role, whereas family 5 exhibits a dual State–private configuration and family 7 moves towards multi-level local governance. Regulation follows the same trajectory, rising from "minimal" (families 1–2) to "high" (families 6–7). This increasing regulatory density is accompanied by progressively stronger environmental and animal-welfare concerns: both variables are low in families 1–2, high in families 3–4, dip slightly in family 5 and peak again in families 6–7. Thus, societal pressure for environmental stewardship and ethical livestock production intensifies as scenarios move away from laissez-faire paradigms.

Despite divergent policy settings, land use for livestock production systems (LPS) appears decreasing in five of the seven families, reflecting the common assumption of land scarcity and/or competing claims for other uses. In families 1 through 4, livestock farming remains highly specialised, reflecting a continuation or intensification of current structural trends. In contrast, family 5 allows for the coexistence of different models, while families 6 and 7 envision a shift towards diversification, suggesting mixed or multifunctional farming systems. Territorial specialisation is "high" families 1 and 2 but turns to "despecialisation" in families 6–7, indicating a possible strategic re-coupling of crops and animals at regional scale. Families 1 and 2 foresee stable or reduced importance of quality or origin schemes such as labels. By contrast, families 4 to 7 predict an increased role for labelling, highlighting consumer interest in certified or differentiated products. Trade openness mirrors these shifts: it is "favourable" under liberalised families 1 and 3, becomes "unfavourable" or "stable/decreased" in families 2, 4 and 5, and ends in explicitly "restricted" regimes in families 6–7. Reduced trade flows imply shorter supply chains and greater self-reliance, consistent with the local governance emphasis noted above.

In families 1 and 2, consumer choices are predominantly driven by price, indicating a market where cost remains the main determinant. Family 4 places emphasis on local origin, quality, and sustainability, while family 5 suggests a blend of price, quality, and local origin as key motivators. Families 6 and 7 show a clear shift towards sustainability and broader ethical or societal considerations influencing purchasing behaviour. High consumption of animal products underpins the intensive LPS model of families 1–2. As dietary change scenarios gain traction, consumption drops to "moderate" in family 3 and "low" in families 6–7. Production volume follows suit: it increases in families 1 and 3 but decreases or stabilises elsewhere, underscoring a pivot from volume-driven growth to value- or efficiency-driven strategies. The two "coexistence" families (4–5) illustrate transitional compromises where high or moderate consumption co-exists with efforts to curb volumes through productivity gains.

All families rely on advanced farm technology, yet its purpose diverges. In intensification archetypes (1–2) digitalisation and automation primarily enhance scale and labour productivity. In efficiency-centred family 3, these tools are complemented by broader innovations, while families 6–7 redeploy them for diverse or precision farming aimed at ecological optimisation. Feed sourcing shows the most pronounced shift: imported concentrates dominate families 1–2, are progressively "relocalised" in families 3–4, and culminate in "protein autonomy" in families 6–7. This move towards circular feed systems is the operational counterpart of trade restriction and territorial despecialisation.

Agro-ecological practices emerge only in the late-transition (family 5, "variable") and transformative families (6–7, "yes"), signalling that such practices are conditional on stronger regulation and localised governance. Animal health and welfare practices evolve in parallel: from "NA" (implicitly low) in families 1 and 5 to "better" or "increased" in families 2, 4, 6–7, with family 3 showing "stable" welfare improvements aligned with its sustainable-efficiency narrative.

Taken together, Table 5 portrays a coherent narrative arc. Families 1 and 2 represent globalised, technology-driven intensification with minimal societal oversight. Families 3, 4 and 5, experiment with sustainable intensification and coexistence, balancing productivity with emergent ethical-environmental norms. Families 6 and 7 embody a paradigmatic shift: strong public (and local) governance, eco-centric regulation, reduced trade dependency, territorial re-embedding of LPS and widespread adoption of agro-ecological principles.

The output variables represent the impact that the production system has on the natural and socio-economic environments. Families 1 and 2 cluster around an unsustainable path: both register biodiversity degradation and, although their greenhouse-gas (GHG) profiles differ—stable in family 1 and decreased in family 2—the overall environmental balance is negative. In sharp contrast, families 6 and 7 combine improved biodiversity with decreased GHG emissions, signalling genuine benefits for the

environment. The remaining clusters are hindered by data gaps: families 3–5 lack any biodiversity entry, undermining the robustness of their environmental assessment. While no significant change is expected in families 2 and 5, an improvement in water quality is anticipated in families 3, 4, and 7. This suggests that more diversified or sustainability-oriented systems may contribute positively to this environmental outcome. No assessment is available for Families 1 and 6. Soil health is expected to remain stable in family 2 and stable or improved in family 3. Families 6 and 7 foresee improvements, likely linked to more agroecological practices. Again, no information is provided for Families 1, 4, and 5. Nevertheless, GHG mitigation appears to be a cross-cutting tendency: five of the seven families report decreased emissions, suggesting that low-carbon technologies or management practices are becoming mainstream.

Families 6 and 7 display high/diversified or improved farm income and a dynamic rural life—an encouraging alignment of environmental and social co-benefits. At the other extreme, families 1, 2 and 5 confront vulnerable or declining rural communities, with farmer incomes stable, unstable or decreased. Family 4 is an intermediate profile: it boasts high income and a dynamic countryside and, crucially, biodiversity information is missing.

The absence of biodiversity information for families 3–5, and of any socio-economic entries for family 3, constitutes a critical knowledge gap that could mask substantial risks or opportunities. Similarly, the lack of GHG data for family 5 complicates cross-family comparisons.

Table 5: Comparison of scenario families according to main driving and output variables.

	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7
MAIN DRIVING VARIABLES							
Political power	Influence of private actors	Stable	Stable	Stable	States and private actors	Stable	States and local governance
Regulation	Minimal	Minimal	Moderate	Moderate	Variable	High	High
Environmental concern	Low	Moderate	High	High	Moderate	High	High
Animal welfare concern	Low	Low	High	High	Moderate or low	High	High
Research	High	Stable	High	Stable	Stable	High	Stable
Land use for LPS	Decreased	Decreased	Decreased	Variable	Stable	Decreased	Decreased
Farm specialisation	High	High	High	High	Coexistence	Diversification	Diversification
Territorial specialisation	High	High or stable	NA	Stable	Stable	Despecialisation	Despecialisation
Labels	Stable	Stable or decreased	NA	Increased	Increased	Increased	Increased
Production volume	Increased	Decreased	Increase	Stable or decreased	Stable	Decreased	Decreased
Trade	Favourable	Unfavourable	Favourable	Stable or decreased	Stable or decreased	Restricted or favourable	Restricted
Purchase motivation of consumers	Price	Price	NA	Local origin, quality, sustainability	Price, quality, local origin	Sustainability and various other motives	Sustainability
Consumption of animal products	High	High	Moderate	High or moderate	High or moderate	Low	Low
LPS Model	Intensive	Intensive	Sustainable efficiency	Coexistence	Coexistence	Sustainable efficiency	Extensive or agroecological
Animal feed	Imported concentrates	Imported or relocalised concentrates	Relocalised concentrates + forages	Relocalised proteins + grass	NA	Protein autonomy	Protein autonomy
Farm technology	High: digitalisation, automation, breeding	Moderate: digitalisation, automation	High: digitalisation, innovation	High: digitalisation	High: digitalisation, automation	High: diverse	Moderate: precision farming
Agroecological practices	NA	NA	No	NA	Variable	Yes	Yes
Animal health practices	NA	Better	Stable	Better	NA	NA	Better
Animal welfare practices	NA	NA	Increased	Moderate	Stable	NA	Increased
OUTPUT VARIABLES							
Biodiversity	Degradation	Degradation	NA	NA	NA	Improved	Improved
GHG emissions	Stable	Decreased	Decreased	Decreased	NA	Decreased	Decreased
Water quality	NA	Stable	Improved	Improved	NA	NA	Improved
Soil health	NA	Stable	Stable or improved	NA	NA	Improved	Improved
Rural life	Vulnerable or in decline	Vulnerable or in decline	NA	Dynamic	Vulnerable or in decline	Dynamic	Dynamic
Farmer income	Stable or decreased	Unstable or decreased	NA	High	Contrasted	High or diversified	Improved

4.2.2. Geographic and temporal distribution of scenario families

Many studies were produced for the French national or infra-national territories (21 of the 50 studies from the final corpus, representing 76 of the 160 clustered scenarios) and several global and European-level authors are also French. **This over-representation of French scenarios may be the result of three contributing factors.** First, we do not claim to have identified all foresight studies, especially these published in languages other than English or French. Identifying studies on the sub-national level was particularly much easier for the authors of this report when it came to French studies. Secondly, France is an agricultural and livestock farming country. For example, in 2022, French farms produced €88.2 billion worth of agricultural products (€31.4 billion from animal production and €56.9 billion from plant production), representing a 17.9% share of the EU production value[23]. The absence of foresight studies on livestock farming in certain EU countries, can be explained by the fact that this sector does not represent a major economic issue there. Finally, France is a country where the culture of foresight analysis may be more developed than in other parts of the EU[24].

However, besides France that was represented in every family, **some geographical specificity can be observed, suggesting that the national economic or political context would favour some families**. However, these observations should be treated with caution due to the small number of foresight studies for some of these countries and the fact that 108 scenarios out of 258 have not been categorised because of their low variable completion rates.

- **Scenarios at the global and European scale were never classified in the family 4 "Governance by an organised sector", which can be related to the fact that describing local structures accurately for all European territories and animal productions represents an enormous amount of work.** Nevertheless, a recent European-wide prospective study, which did not deal with livestock farming but still concerned an agricultural subject[25], showed that it is possible to develop a European-wide prospective study, and illustrate the feasibility of its scenarios by proposals for local applications to a limited number of territorial situations. It is regrettable that we have not been able to find an equivalent for the animal production sector. In the end, **most of the scenarios developed at the European level belonged to cluster 3 "Sustainability and protectionism"** (10 scenarios from family 6 "Sustainable efficiency" and 7 scenarios from family 7 "(Much) less but better" out of 25), which were among the families dealing the best with environmental issues. This might rely on the fact that all the European studies from the final corpus used for clustering were produced after 2018, in the context of the development and implementation of the European Green Deal, and therefore incorporated its challenges into their foresight.
- All scenarios concerning UK, dealing either with sheep production, either with all species without distinction, belonged to the cluster "Intensification and specialisation" and among them, most were in the family 2 "Intensification with limited economic success" (8 out of 12 scenarios).
- Scenarios from the Scandinavian countries, Denmark and Sweden except the only scenario from Finland, were in their great majority in the cluster 2 "Segmentation of production systems" (12 out of 13 scenarios), and made up most of the scenarios in family 3 "Technology and sustainability for cattle" (9/10). None of the Scandinavian scenarios were in the families 2 or 5, displaying the most fragile economic situation.
- Spain presented 3 out of 4 scenarios in the family 4 "Governance by an organised sector".

[23] Insee. (2024). Poids économique de l'agriculture et de l'agroalimentaire en France. Transformations de l'agriculture et des consommations alimentaires - Édition 2024. https://www.insee.fr/fr/statistiques/7728839?sommaire=7728903

[24] Futuribles. (2025). The history and memory of foresight. https://www.futuribles.com/en/la-prospective/histoire-et-memoire-de-la-prospective/histoire-de-la-prospective/

[25] Mora O. (coord.), Berne J.-A., Drouet J.-L., Le Mouël C., Meunier C. (with the contribution of Forslund A., Kieffer V., Paresys L.) (2023). European Chemical Pesticide-Free Agriculture in 2050. Foresight Report, INRAE (France), 643p. https://dx.doi.org/10.17180/ca9n-2p17

- The Netherlands (19 scenarios) were mainly represented in families 6 “Sustainable efficiency” (6 scenarios), 2 “Intensification with limited success” (5 scenarios) and 4 “Governance by an organised sector” (4 scenarios).
- The family 7 “(Much) less but better”, was mainly represented by scenarios for the French territory (8/16) or European territory (5/16). Among European scale scenarios, three were proposed by French authors (TYFA scenario of IDDRI think tank and two scenarios of the “Possible developments in the livestock farming controversy” study led by French technical institutes), and one involved IDDRI among the authors (“High animal welfare” Pathways scenario), which suggests that this disruptive vision of the future of livestock farming is perhaps more developed in France than in other European countries.

One might wonder whether the scenario families correspond to different publication periods, in relation with the world or European global context. The temporal distribution of studies is shown in Figure 2 in Section 3.1. Globally, 48% of scenarios were published between 2021 and today (after the Covid crisis). At the family scale, family 1 was uniformly described from 2014 to 2024, resulting in only 25% scenarios (5/20) published after 2021, and 9 scenarios out of 10 in family 3 were published before 2021 (plus one on 2021). Publication dates of families 2, 5, 6 and 7 were distributed in a similar way to that of the global corpus. Studies published after 2021 were clearly over-represented among family 4 (67%) illustrating that foresight approaches have been more and more mobilised in the past years at the territorial level.

4.2.3. Animal species

Task T1.1 of the Step-up project involved the “mapping and analysis of European Livestock Production Systems (ELPS)” and resulted in the identification of 34 livestock categories covering dairy cattle, suckler cows, finishing cattle, sheep meat, sheep dairy, dairy goats, pigs, laying hens, and broilers. **Our analysed corpus contains 20 documents targeting a specific livestock species (106 scenarios in total). We examined which categories from D1.1 these scenarios corresponded to.** Thus, the categories “Dairy cattle - Green maize and/or temporary grassland systems”, “Pig indoor conventional systems” and “Poultry - Commercial systems” are the most represented, while subsistence farming is almost never present in the scenarios. The corresponding variable has a completion rate of 12.1%, but it is rarely linked to livestock and rather refers to home gardens for fruit and vegetable production (P6.3, P13.4, P165.2, P167.3). One global-scale scenario highlights the importance of backyard livestock systems for their essential role in household food security, particularly among low-income households (P28.5).

In the final corpus used for MCA, **75 scenarios out of 160 were targeting a specific animal production, with an over-representation of dairy or beef cattle** (43 scenarios), 6 targeting ruminants (all ruminant species), 4 targeting sheep, 13 targeting pig, and 9 targeting poultry. The over-representation of scenarios dealing with ruminant species might result from the fact that the continued farming of ruminants is more controversial than that of monogastric animals, given the contrasting environmental effects that this production can have depending on the production system chosen and the current trends of a declining consumption and sector decapitalisation. Indeed, ruminants are the main producers of greenhouse gas emissions attributed to livestock farming in the form of methane[26]. However, depending on the type of production system and the amount of surface used for grasslands, particularly permanent grasslands, ruminant farming can also provide many ecosystem services that monogastric productions do not. Indeed, grazing permanent grasslands, that are growing on lands that cannot be used for other type of agricultural production, avoids the competition of animal feed with human food, but also has a positive role on carbon storage in soils, biodiversity, and

[26] Joly, F., Roche, P., Fossey, M., Rebeaud, A., Dewulf, J., van der Werf, H. M. G., & Boone, L. (2024). How closely do ecosystem services and life cycle assessment frameworks concur when evaluating contrasting animal-production systems with ruminant or monogastric species? Animal, 18(12), 101368. https://doi.org/10.1016/j.animal.2024.101368

maintenance of an open landscape[27]. **Therefore, the ruminant sector is questioning its future, and foresight studies aim to offer potential pathways and stimulate debate.**

In our foresight corpus, scenarios that treat all species combined are distributed across all families except family 4. The scenarios of family 4 "Governance by an organized sector", do not consider all animal species simultaneously but deal with a specific production or species (either ruminants in general, either bovine cattle in general, beef cattle, dairy cattle, pigs or poultry). Interestingly, **most of the pig scenarios belonged to this family (9/13)**, where the pig production sector was globally less affected by the reduction in volume production than the ruminant sector. Despite their small number, **the 10 scenarios dealing specifically with poultry were distributed in all families except family 1**. This is surprising for a sector that is expected to be the leading supplier of global meat demand in the future. **Scenarios dealing specifically with dairy production (34 scenarios), were seldom found in family 6 (only 2 scenarios) and never in family 5 or 7**.

4.2.4. European animal products autonomy and population diets

It is noticeable that **a majority of scenarios of the analysed corpus planned a decrease in animal numbers in Europe** (**Table 6**), while all acknowledged the rise in world demand for animal-based food, and a major part also anticipated consumption in Europe to remain as high as today (83/199) or only moderately decrease (50/199). For milk production, this dilemma was often overcome by further increasing animal productivity via genetic progress and nutrition. For meat, this often meant that territories were aiming for self-sufficiency (50/80), even if it meant reducing exports. Some scenarios predicted an increased reliance on imports (15/80). **Seven scenarios out of 80 informing about animal products autonomy, anticipated that dependence on international markets could lead to crisis where the region's demand for animal products would not fully guaranteed** (5 scenarios that were not kept in the final MCA corpus, and 2 scenarios belonging to family 2: P13.3 and P167.3). These crises were related, depending on scenarios, to global conflicts or drought in countries exporting to Europe (P13.3), but also to the European economy (P167.3 and Portuguese scenarios P36.2 and P37) and environmental collapse related to climate change and intensive farming (P167.3), leading to food scarcity on the territory and decline in people's purchasing power, forcing them to adopt poorly balanced diets.

Table 6: Number and proportion of scenarios in the analysed corpus anticipating an increase, a decrease or a stabilisation of ruminant and monogastric numbers.

	Increase	Stable	Decrease	Decrease but poultry	Total
Ruminants	26 (14%)	35 (19%)	119 (66%)	-	**180**
Monogastrics	16 (13%)	30 (24%)	73 (58%)	7 (5%)	**126**

In the analysed corpus, **114 scenarios of the 198 scenarios mentioning this question anticipated either a moderate decrease by 20% or less (50 scenarios) or a major decrease (64 scenarios) in animal product consumption.** While this transition in diets was often seen as essential to achieving environmental goals, the path towards achieving it, particularly in terms of public policy implementation, was often poorly described. Nevertheless, this was not the case in Agrimonde Terra[28] which explored this question though in the broader context of healthy diets and not exclusively that of animal products consumption: "Measures implemented at the national level include health education and the reconfiguration of food systems to target key players

[27] Karlsson, J. O., Tidåker, P., & Röös, E. (2022). Smaller farm size and ruminant animals are associated with increased supply of non-provisioning ecosystem services. Ambio, 51(9), 2025-2042. https://doi.org/10.1007/s13280-022-01726-y

[28] Le Mouël, C., De Lattre-Gasquet, M., & Mora, O. (2018). Land Use and Food Security in 2050 : A Narrow Road - Agrimonde-Terra (1ère édition, 400 p.). Editions Quae, Matière à débattre et decider, ISBN 978-2-7592-2880-5. https://www.quae.com/produit/1521/9782759228805/land-use-and-food-security-in-2050-a-narrow-road

and products (e.g., subsidized prices for fruit and vegetables; reduction of losses and waste; assistance to open-air markets; support for school food programmes; taxation of unhealthy foods)"(p.136). "These policies have included the **taxation of unhealthy foods**, such as highly processed products and soft drinks, and the **prohibition of advertising and marketing for unhealthy products**" (p.235). Measures implemented at the national level include **health education and the reconfiguration of food systems to target key players and products**: **subsidized** prices for fresh fruit and vegetables, and legumes; **reduction** of losses and waste related to collection and storage; **investment** in open-air market infrastructure for **improving food access** for low-income households; **innovation** in the food industry to support the use of whole grains, pulses and coarse grains; support for **food procurement programmes**, with the inclusion of fresh produce and local sourcing"(p.235).

4.3. Integration of the Safe and Just Operating Space (SJOS) concept (Deliverable 6.1)

Task T6.1 enabled the "definition of a Safe and Just Operating Space (SJOS) for EU livestock, with identification of its various dimensions". The framework presented in this document was built before the preliminary version of the SJOS was developed in WP6 of the Step-up project. Therefore, the SJOS variables were published after the variables in this report had been set. The description of the SJOS is based on broad dimensions within which variables are classified, each associated with one or more indicators. The variables we developed for the project sometimes correspond to SJOS variables and sometimes to indicators too, depending on the level of detail. **The Safe Operating Space (SOS) adapted to animal productions proposed in T6.1 includes 11 variables linked to 19 indicators. For the Just Operating Space (JOS), it comprises 21 variables associated with 28 indicators.** Correspondence between our variables and SJOS variables is presented in **Annex 2**.

Regarding the SOS variables, **all 11 variables were used in this study except for "Aerosol loading"**, which is primarily linked to ammonia emissions from animal manure. This aspect appears in a few scenarios but not prominently enough to justify the creation of a dedicated variable. The documents that address it most significantly originate from the Netherlands (P47, P48, P169, P171) and Denmark (P31, P32). Practices to reduce ammonia emissions include increasing the proportion of grazing in livestock management (P48.3, P169.1), adapting feed rations by reducing crude protein content and increasing roughage (P107, P159), and promoting low-emission or environmentally friendly housing systems, such as improved manure management technologies (P31, P32.5, P169.1).

Several SOS indicators refer to grasslands in the variable "Biodiversity state" and warrant some comments. As in D6.1, we attempted to differentiate between permanent and temporary grasslands by creating a variable representing the ratio of their changes in time. However, this distinction is rarely made explicitly in the scenarios. Consequently, grasslands are poorly characterised, and information regarding their management is very limited. For example, some scenarios mention the need for fertilisation of grasslands at varying intensities to optimise forage resources (P6.4, P134.4, P161.1). Another SOS indicator is grazing density, which appears only sporadically in the scenarios and did not lead to the creation of a dedicated variable. Grazing density increases in some scenarios (P47.1, P134.4, P149.3, P155), primarily due to a decline in pasture areas. Other scenarios suggest limits to grazing density, setting thresholds of grazing intensity to prevent degradation of forage resources and biodiversity (P30.4, P149.4). Finally, some scenarios envisage the rearing of ruminants with virtually no grazing, or only dedicated to the preservation of specific areas, such as wetlands, to be protected for reasons of carbon sequestration and the preservation of biodiversity (P32.4, P32.6). Overall, even without explicit mention of density, many animal welfare practices refer to providing animals with greater outdoor space. Finally, regarding the SOS, the indicator "Carbon

sequestration" was extended in our case to include agroecological infrastructures, forests, and wetlands, depending on the mentions in the scenarios, and was therefore not limited solely to storage in grasslands.

Regarding the JOS variables, 6 out of 21 of them were not covered at all in this work due to their high level of specificity and absence from the foresight studies. These variables are associated with the dimensions of livestock systems resilience and social equity. They include the following variables and their associated indicators:

- Income resilience (Farm net income – Total subsidies / Total Output);
- Transferability (Fixed assets (excluding land) + stocks / FTE farmer);
- Structure (Gross product of the farm's main production before aid / farm gross product before aid (%));
- Autonomy (Yearly bank loans repayment / Gross Product (%));
- Subsidies sensitivity (Total subsidies / Farm net income (%));
- Income distribution (Palma Ratio);
- Gender equality (Number of female-owned agri-businesses of farm and on-farm products/businesses and % women/men students in agriculture).

Within the economic dimension, we do not have variables related to the "Profitability" of animal value chains associated with the indicator "Average value added in animal food value chain." However, other variables such as trade, farm development trends, and employment provided information on the profitability and economic dynamism of value chains.

Regarding the social equity dimension, specifically the "Welfare" variable in the "one welfare" sense, we did not create a variable related to livestock farmers' welfare, which is rarely addressed in the scenarios outside economic and demographic approaches. We used a variable about livestock farming acceptability, related to the image of agriculture and the farming profession in society, as well as the public's knowledge, understanding, and trust in the sector. These concerns were well represented in the foresight scenarios. The few scenarios that mentioned improved quality of life for farmers emphasised a more stable economic situation, risk-sharing mechanisms, autonomy in decision-making, and better work organisation, allowing farmers more free time and making the profession more attractive to younger generations (P5.5, P23.3, P67.2). For the "Education" variable, we did not create or report variables related to the number of people with a professional diploma working in agro-industry, as this aspect was absent from the scenarios.

4.4. Identification of neglected topics

The identification of neglected topics in European foresight studies on livestock production systems was conducted at the level of the analysed corpus over 257 scenarios. Using the variable table, it was possible to **calculate the completion rate of each variable across the scenarios**. The average completion rate was 45%; particular attention will be given to those variables falling below this threshold. Some variables were scarcely completed, reflecting a lack of consideration for these topics within the scenarios. When the topic was mentioned, it was recorded in the table without differentiating the weight or depth of the information. As a result, among the variables most frequently referenced, some scenarios provided no detailed explanations or descriptions, presenting them simply as facts or future states. **The most neglected topics were the management of impacts on natural resources, downstream value chains, eating behaviours, health from a One Health perspective and the CAP.**

<u>Resource management and the impact of livestock on natural resources: the overlooked issues of water and phosphorus</u>

Within the environment category, **the variables least frequently completed were phosphorus use (17.9%), water use (23%), and water quality (31.9%)**. Consistently, natural resource governance is a topic that was sparsely addressed in the foresight scenarios, appearing in only 22.2% of them. Meanwhile, the issue of land

ownership and its availability for livestock farmers could have been given greater emphasis (26.3%). **This lack of attention to water-related issues is concerning**, given the current situation where livestock production plays a major role in impacting or preserving aquatic environments, either through significant pollution and eutrophication or through the preservation of wetlands. Furthermore, in the context of climate change, which may increase uncertainties regarding water availability, this oversight appears particularly detrimental. **Phosphorus use and cycling were rarely addressed in the scenarios, even though this element plays a critical role in livestock systems**, particularly through feed production, manure management, and environmental impacts such as eutrophication. It was identified as a potential environmental pressure stemming from poultry and pig farming, which required substantial land for manure application (P154.1). Phosphorus also acted as a barrier on the development of intensive production systems in countries such as the Netherlands, which has implemented a phosphate rights system that establishes a phosphate ceiling limiting the national number of dairy cows (P47.1). Similarly, in Scotland, sheep production was not sufficiently competitive due to high phosphate prices, which restricted highly intensive sheep farming (P149.1).

Limited information on value chains and gaps in organisational modes

At the production level, the organisation of supply chains regarding farming systems, including the distinction or allocation between breeding and fattening, was rarely discussed (14%), as was the management of co-products and carcass balancing (17.9%), which received little attention. The representation of farmers and their collective organisation were also frequently omitted (26.5%). Cultural services linked to livestock farming, such as landscape maintenance typically associated with grazing ruminant systems, as well as economic services for rural areas— including rural economic dynamics (31.2%), agri-tourism (17.1%), and energy production (37%)—were less frequently addressed in the scenarios.

The description of the industrial fabric of processing and distribution could be more detailed and thorough within a systemic approach to animal product supply chains. Processing is more extensively described than distribution, both in terms of development (45.5% vs. 32.3%) and concentration of companies (31.9% vs. 21.4%). Furthermore, the distribution of value among actors in the supply chains was not consistently addressed (41.6%), nor was farmers' income (44.4%).

However, it is important to note that value chains varied significantly depending on the territorial scale under consideration. **The complexity and diversity of organisational structures and operational models across different regions made it challenging to provide a comprehensive and consistent overview.** But it allowed to understand how different key actors and processes influenced the development of livestock systems and it highlights constraints and opportunities for sustainability and resilience.

Diets and eating habits in the background

Beyond the overall consumption levels of animal products, aspects related to **evolving eating behaviours and food access were occasionally mentioned as contextual factors**. These included variables such as consumption patterns of cooked meals, ready-made dishes, or food eaten outside home (22.2%), diversity of raw products consumed (24.5%), identification of the dominant animal protein in diets (30.4%), trends in average caloric intake per population (33.1%), and the consumption levels of ultra-processed foods (40.5%). In connection with these factors, we introduced a variable addressing food justice, specifically the accessibility of animal products to the population, which was deducted from 26.1% of the scenarios.

Limited attention to health issues

A large majority of the corpus failed to adequately address issues related to the One Health concept. Human health aspects, such as metabolic diseases, were rarely mentioned, with a coverage rate of only 17.5%. Similarly, animal health concerns, including zoonoses and epizootic diseases, were scarcely considered (14%), despite their prominence in current global health discussions following the COVID-19 pandemic and other outbreaks (notably referenced in scenarios P9.3, P16.3, P116.3, and P174.5). Furthermore, references to antimicrobial use or reduction appeared in only 26.8% of the scenarios, while

general animal health practices were mentioned slightly more often but remained under-represented (34.6%).

CAP not mainly seen as a key driver of change

While the Common Agricultural Policy (CAP) remains the principal agricultural policy framework in Europe, **it was mentioned in only a minority of the scenarios (34.6%)**. This raises questions about the drivers considered responsible for the transformation of livestock systems depicted in the foresight scenarios. It also reflects a lack of detailed description of the evolutionary pathways, with a stronger focus on depicting future states rather than the processes leading to them.

The corpus proved to be **incomplete in its coverage of the social aspects of sustainability, as well as the diversity of services and disservices provided by livestock** beyond its economic, food, and climate-related roles.

4.5. Comments on trade-offs

Analysing trade-offs is essential when envisioning the evolution of livestock production systems in Europe given the multifaceted and interconnected challenges. Livestock systems must balance environmental sustainability, economic viability, One Welfare, One Health, land use and social acceptability, which can lead to competing priorities. A thorough trade-off analysis allows for a systematic evaluation of these competing goals, revealing where compromises are necessary and where synergies might be leveraged. It helps anticipate unintended consequences of certain pathways, thereby facilitating the design of more resilient and sustainable livestock systems in the face of uncertainty.

A recent systematic review highlighted the importance of considering spatial scale in trade-off analyses[29]. To date, such analyses have predominantly been conducted at the farm or regional level, rarely addressing multiple spatial scales simultaneously. Furthermore, it emphasised that effective trade-off assessments should actively involve the relevant stakeholders to ensure the findings are contextually relevant and actionable. Then, **the identification of trade-offs is preferably conducted through quantitative analysis**. Within the Step-up project, quantification is planned in other tasks that are expected to provide more robust results on trade-offs. **In this section, we propose to analyse the most frequently mentioned trade-offs relating to livestock systems within the scenarios and to illustrate these by highlighting differences between the scenario families.** We focused our analysis on trade-offs between economic performance and environmental sustainability, as well as those related to land use.

One of the main trade-offs studied when assessing the sustainability of livestock systems is the tension between indicators of performance and environmental sustainability[30], or less frequently, animal welfare. As proxies for these two dimensions, we used some of the variables from the scenarios. In **Figure 12,** we built the “environmental sustainability” axe with the variables “climate change”, “biodiversity”, “water quality” and “soil health” and the “economic performance” axe with the variables “production volume”, “trade” and “rural areas”. We then positioned the scenario families according to these two axes to provide a visual representation. The zone of trade-offs is located along the diagonal extending from the top left to the bottom right. Families 1 and 2 prioritise intensification at the expense of the environment but diverge in outcomes, with family 1 achieving strong economic results and family 2 facing limited success. Positioned at the centre, family 5 is marked by coexistence of models without clear economic dominance and does not provide information about environmental impacts. Family 3 achieves strong economic performance and moderate

[29] Breure, T. S., Estrada-Carmona, N., Petsakos, A., Gotor, E., Jansen, B., & Groot, J. C. J. (2024). A systematic review of the methodology of trade-off analysis in agriculture. Nature Food, 5(3), 211-220. https://doi.org/10.1038/s43016-024-00926-x

[30] Domingues-Santos, J. P., Gameiro, A. H., Bonaudo, T., Tichit, M., & Gabrielle, B. (2019). Exploring trade-offs among indicators of performance and environmental impact in livestock areas. Regional Environmental Change, 19(7), 2089-2099. https://doi.org/10.1007/s10113-019-01538-z

environmental gains, mainly through climate-focused technological innovations. Families 4, 6 and 7 form a gradient of increasing environmental ambition and slightly decreasing economic performance.

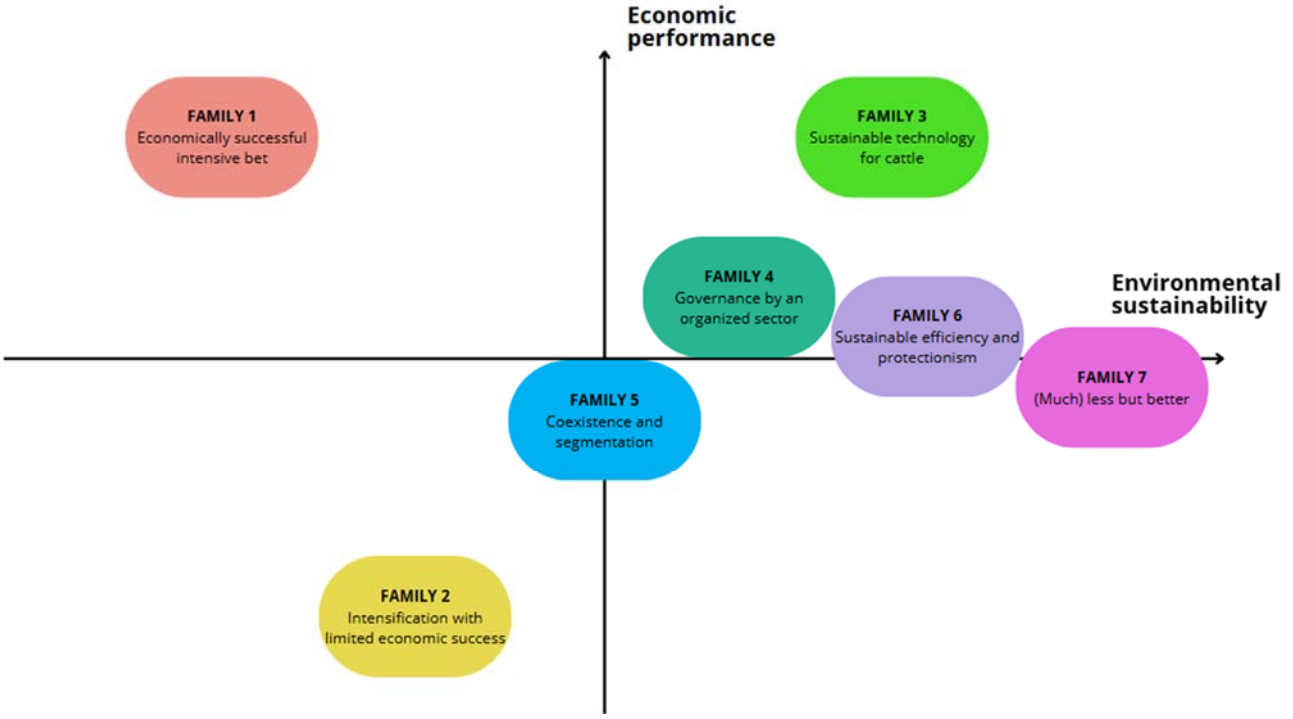

Figure 12: Positioning of scenario clusters along the axes of environmental sustainability (climate change, biodiversity, water quality, soil health) and economic performance (production volume, trade, rural areas).

Another central trade-off concerns land use allocation among competing demands[31], including food production for humans, feed production for animals, habitat conservation for biodiversity, and energy generation. To address this, we created two variables: one capturing the competition between feed and food production, and another representing the competition between feed–food production and energy generation. We also considered different strategies of land sharing versus land sparing within the variable related to biodiversity conservation strategies. The first variable was completed for 76 out of 160 scenarios, showing a main trend of decrease (46 scenarios), with an increase only in 16 scenarios, or maintenance of the current situation in 13 scenarios. Scenarios indicating a reduction in feed–food competition are primarily found in families 4, 6, and 7, while those reflecting an increase belong to families 1, 2, and 3. The variable addressing competition with energy production was less frequently completed, with 57 out of 160 scenarios. Among these, most scenarios indicate a trend towards increased competition (22) or no change relative to the current situation (22), while fewer describe a decrease in competition (13). Similarly, decreases in competition are mostly described in families 4, 6, and 7, whereas increases are predominantly found in families 2 and 3.

Furthermore, a clear contrast could be observed between scenarios planning to maintain high or intermediate levels of animal products in human diets (15/29), that often mentioned a higher rate of monogastric meat in the diet (13/15), and scenarios planning a strong reduction of meat in human diets (greater than 50%), that did not mention any increase in monogastric share (17/29) or even an increase in the share of ruminant products (meat and milk) in population diets (8/29). This contrast reflects the fact that **the desire to preserve biodiversity in a land sharing strategy relies on maintaining a minimum number of ruminants that use grasslands**, **and that it is therefore necessary to reduce total human consumption of animal products in order to meet greenhouse gas reduction targets.**

[31] Davis, K. F., Yu, K., Herrero, M., Havlik, P., Carr, J. A., & D'Odorico, P. (2015). Historical trade-offs of livestock's environmental impacts. Environmental Research Letters, 10(12), 125013. https://doi.org/10.1088/1748-9326/10/12/125013

5. Conclusion

This work aimed to review the foresight literature produced on the livestock sector since 2010, in order to highlight the different futures and evolutions that European stakeholders have envisioned for this sector. In particular, we wanted to examine how trade-offs were imagined between the benefits provided by this economic activity (food production for Europeans and/or for the rest of the world, employment, ecosystem services, landscape maintenance, and other environmental and cultural values) and its disservices (inequality in wealth distribution along the value chain, water, air and soil pollution, greenhouse gas emissions, increased land use). **Given the contrasting geographic and economic situations of EU countries, we hoped to see whether different visions emerged across different member states.** We did not aim for exhaustiveness, as foresight studies are often written in national languages and published as reports that are poorly indexed in scientific and technical literature databases. It is therefore possible that we missed studies produced in countries for which we ultimately found no documentation despite our efforts.

We must acknowledge a major limitation of this work: the uneven geographic distribution of the foresight studies we were able to collect. The absence of studies (Ireland, Italy, Poland) or the very weak representation (Germany, Spain) of countries where livestock plays a significant economic role is an undeniable lack in foresight literature. Furthermore, France was overrepresented. Depending on the scenario families we identified, France accounted for between 40% and 64% of the scenarios—except for the small family 3 "Sustainable technology and green growth for cattle", where France was represented by only one scenario out of ten. However, no family was 100% French, which allows us to conclude that the overrepresentation of France did not result in the creation of scenario families that would only be valid in the French livestock context, and that the proposed scenario families are relevant across several EU countries. This possible bias is also countered by the fact that France, displaying many animal production systems, encompasses the European diversity on its territory.

We were able to analyse a corpus of 50 foresight studies with 160 scenarios and to identify seven scenario families representing a range of possible futures from Western and Northern Europe. These families varied in how much emphasis they placed on the mission of “feeding the world,” the extent to which they relied on future technological developments, and their concern for the environmental impacts and animal welfare of livestock production. In a global context of increasing demand for animal products, the evolution of European diets and the question of whether or not to aim for self-sufficiency in animal production and animal feed emerged as fundamental drivers. Whether or not to account for the environmental impacts of livestock farming also proved to be central and in opposition to economic competitiveness and the affordability of food for the European populations. Thus, the development of livestock systems that improve issues such as water and air pollution, soil health, and take into account climate change, appears in these scenarios to be possible only when the European economic situation allows populations to pay more for food, and when European, national, or regional support mechanisms protect European livestock farming from competition with animal products from the rest of the world. We must note that variables describing the Just Operating Space, as well as issues related to the One Health concept, in connection with epizootic and zoonotic risks, are largely absent from the scenarios analysed.

While foresight allows us to think about the future in order to try to influence it, it can also serve to anticipate possible upcoming events and allows us to be prepared in case these unlikely events do occur. **The study corpus seemed to generally consider "business as usual" scenarios or relatively positive developments in the sector** (i.e. a reduction but continued presence of livestock farming and a stable or improved environmental impacts, rarely worsened, etc.). It appeared that the impacts on the livestock sector of events related to climate change exceeding 1.5°C (fires, droughts, hailstorms, storms or floods) were often not sufficiently integrated into the scenarios. Yet their impact deserves to be quantified. We also saw few scenarios addressing the evolution of livestock farming following major crises affecting European societies as

a whole, whether political, conflict-related, climatic, or health-related in nature. However, events of the past five years lead us to believe that this type of scenario should not be overlooked.

Finally, **the under-representation of Eastern, Central, and Southern European countries in the corpus excluded countries where livestock farming is predominantly (semi-)extensive or contributes to a (semi-)subsistence farming** (see Deliverable 1.1 of the Step-up project). Although animal production in these regions may have limited macroeconomic relevance, the lack of foresight studies prevented us from assessing their role in the social structuring of rural areas, in the technical and economic sustainability and resilience of local farming systems, and landscape maintenance—particularly in the context of climate change, which increases the frequency of extreme events. This gap is reflected in our work by the absence of any scenario family describing extensive and subsistence livestock farming, which, however, may not have fully disappeared from Europe by 2050.

6. References of the final corpus of European foresight studies on livestock production systems

ADEME. (2021). Transition(s) 2050—Choisir maintenant agir pour le climat—Rapport (n° 011627; 687 p.). https://librairie.ademe.fr/societe-et-politiques-publiques/5072-prospective-transitions-2050-rapport.html

Agora Agriculture. (2024). Agriculture, forestry and food in a climate neutral EU. The land use sectors as part of a sustainable food system and bioeconomy. (212 p.). https://www.agora-agriculture.org/fileadmin/Projects/2024/2024-09_EU_Agriculture_forestry_and_food_in_a_climate_neutral_EU/AGR_336_Land-use-study_WEB.pdf

Alliot, C., Segré, H., Clément, L., Brillion, C., Ly, S., Doublet, S., Charru, M., Casenave, J., & Hasnaoui Amri, N. (2023). Analyse du système alimentaire de la région Occitanie, de sa durabilité et de sa résilience. Rapport complet. (121 p.) [Solagro, Basic, AlimEnTerres]. ADEME. https://librairie.ademe.fr/agriculture-alimentation-foret-bioeconomie/6842-analyse-du-systeme-alimentaire-de-la-region-occitanie-de-sa-durabilite-et-de-sa-resilience.html

Aubert, P.-M., & Poux, X. (2024). Des filières viandes françaises sous tension : Entre pressions compétitives et accès à la biomasse (50 p.). IDDRI, AScA, BASIC, Solagro. https://www.iddri.org/sites/default/files/PDF/Publications/Catalogue%20Iddri/Etude/202407-ST0524-viandes%20FR_0.pdf

Auty, H., Bessell, P., Boden, L., Bronsvoort, M., Duckett, D., Kyle, C., Liu, J., & McKendrick, I. (2015). What will the Scottish sheep industry look like in 2040 and how resilient will it be to livestock disease? (24 p., p. EN). Centre of Expertise on Animal Disease Outbreak (EPIC). https://www.rhet.org.uk/media/1531/epic-sheep-scenario-planning-report-final.pdf

Beldman, A., Reijs, J., Daatselaar, C., & Doornewaard, G. (2020). De Nederlandse melkveehouderij in 2030: Verkenning van mogelijke ontwikkelingen op basis van economische modellering (88 p.). Wageningen Economic Research. https://doi.org/10.18174/532156

Berlizot, T., Bour-Desprez, B., Lejeune, H., Mercier, É., Molinier, M.-L., Rey, G., Riou, Y., Seinger, P., D'Orfeuil, J., & Thibault, H.-L. (2020). Agri 2050—Une prospective des agricultures et des forêts françaises (n°18066; 198 p.). Conseil Général de l'Alimentation de l'Agriculture et des Espaces Ruraux, Ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt, France. https://agriculture.gouv.fr/quel-avenir-de-lagriculture-et-de-la-foret-francaises-en-2050

Bidaud, F., Lesage, M., & Claquin, P. (2016). Le rapport Homme-Animal : Cinq scénarios à l'horizon 2030 (Analyse n°95; 8 p.). Centre d'Etude et de Prospective, Ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt, France. https://agriculture.gouv.fr/le-rapport-homme-animal-cinq-scenarios-lhorizon-2030-analyse-ndeg-95

Billen, G., Le Noë, J., & Garnier, J. (2018). Two contrasted future scenarios for the French agro-food system. Science of The Total Environment, 637 638, 695 705. https://doi.org/10.1016/j.scitotenv.2018.05.043

Cerles, A., Poux, X., Lhern, M., & Agabriel, J. (2016). Etude prospective des filières viande de ruminants du Massif Central, horizon 2050—Cinq scénarios pour mieux anticiper et s'adapter (136 p.). INRA. https://www.inrae.fr/sites/default/files/pdf/etude-prospective-des-filieres-viande-de-ruminants-du-massif-central-horizon-2050.doc%281%29.pdf

Chaib, R., Macombe, C., & Thomopoulos, R. (2023). Scénarios possibles d'évolution de la filière porcine française. Viandes et produits carnés, VPC-2023-3914. https://www.viandesetproduitscarnes.com/index.php/fr/economie-et-consommation/264-scenarios-possibles-devolution-de-la-filiere-porcine-francaise

Chambres d'agriculture de Bretagne. (2023). Agricultures bretonnes 2040—5 scénarios d'avenir (27 p.). https://opera-connaissances.chambres-agriculture.fr/doc_num.php?explnum_id=185179

Climate Change Committee. (2020). The Sixth Carbon Budget—The UK's path to Net Zero (Chapter 1-Agriculture and land use, use change and forestry; 82 p.). https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Agriculture-land-use-land-use-change-forestry.pdf

Commission on the Future of Agriculture (ZKL). (2021). The Future of Agriculture—A common agenda (36 p.). http://bmel.de/goto?id=93316

Danish Agriculture & Food Council. (2017). Climate-neutral 2050 (28 p.). https://agricultureandfood.dk/media/uofnbtfb/climate-neutral-2050-dafc.pdf

Danone. (2023). Estrategia de descarbonización del vacuno de leche en España (240 p.). https://www.danoneespana.es/content/dam/corp/local/esp/1_somos_danone/2_danone-en-espa%C3%B1a-productos-l%C3%A1cteos-y-de-origen-vegetal/informe-baca/Danone-informe_2023.pdf

Delanoue, E., Dockes, A., Roguet, C., & Magdelaine, P. (2018). Les évolutions possibles de la controverse autour de l'élevage dessinent cinq futurs contrastés : Une analyse prospective à l'horizon 2040. (10 p.) [Journées 3R]. Institut de l'Elevage / IFIP-institut du porc / ITAVI. https://ifip.asso.fr/documentations/35803-les-evolutions-possibles-de-la-controverse-autour-de-lelevage-dessinent-cinq-futurs-contrastes-une-analyse-prospective-a-lhorizon-2040/https://ifip.asso.fr/actualites/

Delanoue, E., Gelin, M., Chouteau, A., Dockes, A.-C., Roguet, C., & Baumont, R. (2024). Comment améliorer l'attractivité des métiers des filières d'élevage ? État des lieux et prospective à l'horizon 2035. INRAE Productions Animales, 37(1). https://doi.org/10.20870/productions-animales.2024.37.1.7951

Direction Générale de l'Energie et du Climat, Ministère de la transition écologique, de la biodiversité, de la forêt, de la mer et de la pêche, France. (2023). Synthèse du scénario de référence de la stratégie française pour l'énergie et le climat (47 p.). https://www.ecologie.gouv.fr/sites/default/files/documents/Synth%C3%A8se%20sc%C3%A9nario%20de%20r%C3%A9f%C3%A9rence%20SNBC-PPE.pdf

Etienne, E., & Uthayakumar, T. (2024). Élevage allaitant : Changer de logique pour sortir de l'impasse (28 p.). Fondation pour la nature et l'Homme. https://www.fnh.org/elevage-bovin-viande-un-modele-a-bout-de-souffle/

FranceAgriMer. (2017). Prospective filière lait de vache (342 p.). https://www.franceagrimer.fr/fam/content/download/53941/document/publi-entiere-Somme%20Lait.pdf?version=7

FranceAgriMer. (2018). Prospective filière française de la viande bovine à l'horizon 2040. Tome 2. Représentation du système et scénarios (251 p.). https://www.franceagrimer.fr/content/download/59616/document/Prospective%20Viande%20Bovine_Tome%202.pdf

Goscianski, C., & Guilloux, M. (2021). Production de viande porcine en Pays de la Loire, Prospective à l'horizon 2030 (28 p.). Chambre d'agriculture Pays de la Loire. https://rd-pays-de-la-loire.chambres-agriculture.fr/?id=2976878&tx_news_pi1%5Bnews%5D=101732&tx_news_pi1%5Bcontroller%5D=News&tx_news_pi1%5Baction%5D=detail&cHash=977c6f51897c2d6372adc1d3bb7d4a0a

Greenpeace. (2022). Fra foder til føde II (36 p.). Danmarks Naturfredningsforening, Dansk Vegetarisk Forening, Dyrenes Beskyttelse, Foreningen for Regenerativt Jordbrug, Klimabevægelsen i Danmark, Greenpeace, Rådet for Grøn Omstilling, World Animal Protection, & Økologisk Landsforening. https://www.greenpeace.org/denmark/udgivelse/landbrug/fra-foder-til-foede-ii/

HKScan, Arla, Växa, LRF, Lantmännen, Svenskt, Kött, Yara, & DeLaval. (2021). Rapport Framtidens jordbruk—Mjölk & Nötkött (48 p.). https://www.lantmannen.se/globalassets/mjolkochnotkottrapport.pdf

Joya, R., Doublet, S., & Hamon, J. (2023). Quelles agricultures compatibles avec la neutralité carbone pour la région Bretagne ? Scenarios prospectifs pour l'atteinte du facteur 2 en 2050 (100 p.) [Ceresco, Solagro]. Région Bretagne. https://www.ambition-climat-energie.bzh/wp-content/uploads/2024/07/Etude-GES-agricoles-rapport-final-vf.pdf

Karlsson, J., Röös, E., Sjunnestrand, T., Pira, K., Larsson, M., Andersen, B. H., Sørensen, J., Veistola, T., Rantakokko, J., Manninen, S., & Brubæk, S. (2017). Future Nordic Diets: Exploring ways for sustainably feeding the Nordics (566 ISSN 0908-6692; 95 p. 10.6027/TN2017-566). Nordisk Ministerråd. https://urn.kb.se/resolve?urn=urn:nbn:se:norden:org:diva-5046

Karner, K., & Mitter, H. (2024). Re-Livestock project: Deliverable 7.1—Shared Socio-Economic Pathways for the European livestock sector (Ref. Ares8476891; 79 p.). BOKU. https://re-livestock.eu/wp-content/uploads/2025/01/Attachment_0-2-1.pdf

Kristensen, T., Overgard Lehmann, J., & Mogensen, L. (2019). Fremtidens helhedsorienterede og balancerede kvægproduktion—Visioner og udfordringer for malkekvægsbedriften frem mod år 2040 (DCA rapport Nr. 146; 98 p.). DCA - National Center for fodevarer og jordbrug, Aarhus Universitet. https://dcapub.au.dk/djfpublikation/djfpdf/DCArapport146.pdf

Labzaé, P., Ramond, J.-F., & Rouault, N. (2021). Production de volaille de chair en Pays de la Loire, Prospective à l'horizon 2030 (28 p.). Chambre d'agriculture Pays de la Loire. https://rd-pays-de-la-loire.chambres-agriculture.fr/publications/toutes-les-publications/detail-publication/actualites/production-de-volaille-de-chair-en-pays-de-la-loire-prospective-a-lhorizon-2030/

Le Mouël, C., De Lattre-Gasquet, M., & Mora, O. (2018). Land Use and Food Security in 2050: A Narrow Road - Agrimonde-Terra (1ère édition, 400 p.). Editions Quae. https://www.quae.com/produit/1521/9782759228805/land-use-and-food-security-in-2050-a-narrow-road

Lehtonen, H., Saarnio, S., Rantala, J., Luostarinen, S., Maanavilja, L., Heikkinen, J., Soini, K., Aakkula, J., Jallinoja, M., Rasi, S., & Niemi, J. (2020). Maatalouden Ilmastotiekartta—Tiekartta kasvihuonekaasupäästöjen vähentämiseen Suomen maataloudessa (87100; 165 p.). MTK, Luke, SLX. https://jukuri.luke.fi/handle/10024/546180

Lesschen, J. P., Reijs, J., Vellinga, T., Verhagen, J., Kros, H., Vries, M. de, Jongeneel, R., Slier, T., Martinez, A. G., Vermeij, I., & Daatselaar, C. (2020). Scenariostudie perspectief voor ontwikkelrichtingen Nederlandse landbouw in 2050 (10.18174/512111; 140 p.). Wageningen Environmental Research. https://doi.org/10.18174/512111

Lysias Advies, Schuttelaar & Partners, & Rebel. (2021). Scenariostude kalverketen (55 p.). Ministry of Agriculture, Nature and Food Quality (LNV).

Moller, B., Voglhuber-Slavinsky, A., & Dönitz, E. (2023). Three scenarios for Europe's food sector in 2035 (60 p.) [Fox project]. Fraunhofer institute for systems and innovations research ISI. https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccv/2020/Fox_Scenario_Brochure.pdf

Moret, E. (2021). Production de lait de vache en Pays de la Loire, Prospective à l'horizon 2030 (28 p.). Chambre d'agriculture Pays de la Loire. https://rd-pays-de-la-loire.chambres-agriculture.fr/?id=2976878&tx_news_pi1%5Bnews%5D=101690&tx_news_pi1%5Bcontroller%5D=News&tx_news_pi1%5Baction%5D=detail&cHash=c4a4f97a41861cc20e6043a51284da64

Moret, E., & Simon, Y. (2021). Production de veaux de boucherie en Pays de la Loire, Prospective à l'horizon 2030 (28 p.). Chambre d'agriculture Pays de la Loire. https://rd-pays-de-la-loire.chambres-agriculture.fr/publications/toutes-les-publications/detail-publication/actualites/production-de-veaux-de-boucherie-en-pays-de-la-loire-prospective-a-lhorizon-2030/

Oteros-Rozas, E., Martín-López, B., López, C. A., Palomo, I., & González, J. A. (2013). Envisioning the future of transhumant pastoralism through participatory scenario planning: A case study in Spain. The Rangeland Journal, 35(3), 251 272. https://doi.org/10.1071/RJ12092

Pathways consortium. (2024). Pathways project storylines (EU H2020 project No101000395).

Peyraud, J.-L., Aubin, J., Barbier, M., Baumont, R., Berri, C., Bidanel, J. P., Citti, C., Cotinot, C., Ducrot, C., Dupraz, P. P., Faverdin, P., Friggens, N. N. C., Houot, S., Nozières-Petit, M.-O., Gaillard, C. R., & Santé-Lhoutellier, V. (2020). Atelier de Réflexion Prospective interdisciplinaire Science pour les élevages de demain. Rapport de synthèse. (10.1545/x83c-0674; 53 p., p. 53 pp.). INRAE. https://doi.org/10.15454/x83c-0674

Peyraud, J.-L., & MacLeod, M. (2020). Study on Future of EU livestock: How to contribute to a sustainable agricultural sector? Final report. European Commission, Directorate-General for Agriculture and Rural Development. https://www.researchgate.net/publication/344667557_Study_on_Future_of_EU_livestock_how_to_contribute_to_a_sustainable_agricultural_sector_Final_report_EUROPEAN_COMMISSION_Directorate-General_for_Agriculture_and_Rural_Development

Peyraud, J.-L., Nielsen, V. H., Granados, A., & Macherez, F. (2019). Vision Paper towards European Research and Innovation for a sustainable and competitive livestock production sector in Europe (36 p.). Animal Task Force. https://www.dafa.de/wp-content/uploads/ATF_Vision_Paper_2019.pdf

Poux, X., & Aubert, P.-M. (2018). Une Europe agroécologique en 2050 : Une agriculture multifonctionnelle pour une alimentation saine (Study N°09/18; 78 p., p. 78). IDDRI-AScA. https://www.iddri.org/fr/publications-et-evenements/etude/une-europe-agroecologique-en-2050-une-agriculture

Röös, E., Mayer, A., Muller, A., Kalt, G., Ferguson, S., Erb, K.-H., Hart, R., Matej, S., Kaufmann, L., Pfeifer, C., Frehner, A., Smith, P., & Schwarz, G. (2022). Agroecological practices in combination with healthy diets can help meet EU food system policy targets. Science of The Total Environment, 847, 157612. https://doi.org/10.1016/j.scitotenv.2022.157612

Ropssi, A., Hanus, A., & Belot, P.-E. (2017). La production de lait AOP Franc-Comtoise : Potentialité et dynamiques à l'horizon 2030 (ACTeon environnement&IDELE Institut de l'élevage; 58 p.). Ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt et le Comité Interprofessionnel de Gestion du Comté. https://agriculture.gouv.fr/la-production-de-lait-aop-franc-comtoise-potentialite-et-dynamiques-lhorizon-2030

Schwoob, M., Gross, C., Verdier, E., & Vipery, F. (2022). Eau, agriculture et changement climatique en Bourgogne-Franche-Comté : Éléments de prospective (Analyse n°181; 4 p.). Ministère de l'Agriculture et de la Souveraineté alimentaire et Chambre régionale d'agriculture Bourgogne-Franche-Comté. https://agriculture.gouv.fr/eau-agriculture-et-changement-climatique-en-bourgogne-franche-comte-elements-de-prospective-analyse

Smulders, B., Valkenburg, R., Markus, A., & Romme, G. (2025). Imagining alternative futures for the Dutch poultry industry. Futures, 166, 103519. https://doi.org/10.1016/j.futures.2024.103519

The Shift Project. (2024). Vers des économies régionales bas carbone – Expérimentation en Bretagne. Rapport final. (234 p.). https://bretagne-environnement.fr/notice-documentaire/vers-des-economies-regionales-bas-carbone-une-experientation-en-bretagne

Vogelzang, T., Berkout, P., van Doorn, A., Jongeneel, R., Poppe, K., Smit, B., & Terluin, I. (2016). The CAP after 2020; a sketch for a redesign (167 p.). LEI Wageningen University & Research. http://dx.doi.org/10.13140/RG.2.1.2268.5040

Zira, S., Röös, E., Ivarsson, E., Friman, J., Møller, H., Samsonstuen, S., Olsen, H. F., & Rydhmer, L. (2022). An assessment of scenarios for future pig production using a One Health approach. Livestock Science, 260, 104929. https://doi.org/10.1016/j.livsci.2022.104929

Annexes

Annex 1. System variables

Nota bene: The rows highlighted in blue correspond to the active variables used for the statistical analysis.

VARIABLE CATEGORY	VARIABLE ID	VARIABLE	INFORMATION PROVIDED
Environment	**Env**	Environmental trend	General trend in the scenario towards consideration of environmental issues.
Environment	**BiodivS**	State of biodiversity	Changes in biodiversity state compared to today.
Environment	**BiodivT**	Technics and practices used to improve biodiversity	Use of strategies and practices to preserve and promote biodiversity.
Environment	**Pesticides**	Pesticides use in vegetal productions	Trend in pesticide application in crop systems and grasslands.
Environment	**AgriGHG**	Greenhouse gas emissions in agriculture	Evolution of agriculture / livestock greenhouse gas emissions from the territory considered by the study (positive or negative emissions considering carbon sink) compared to the study publication date.
Environment	**GlobalGHG**	Global greenhouse gas emissions	Evolution of global greenhouse gas emissions at global scale (positive or negative emissions considering carbon sink) compared to the study publication date.
Environment	**Carbon**	Carbon sequestration	Evolution of carbon sequestration in agricultural soils and forests compared to the study publication date.
Environment	**WaterQ**	Water quality	Changes in surface water quality and underground water compared to the study publication date.
Environment	**WaterU**	Water use in agriculture	Changes in water use for livestock and agriculture compared to the study publication date.
Environment	**LandLPST**	Share of land use dedicated to LPS on the study territory	Share of land use dedicated for livestock production at the scale of the territory considered by the study and compared to today.
Environment	**LandLPSW**	Share of land use dedicated to LPS at global scale	Share of land use dedicated for livestock production at global scale and compared to today.
Environment	**Landscape**	Landscape	Modification of agricultural landscapes and associated aesthetics or functions.
Environment	**Soil**	Soil health	Changes in biological and physicochemical soil quality compared to the study publication date.
Environment	**Ncycle**	Nitrogen cycle	Degree to which nitrogen is used sustainably as a fertiliser, compared to the study publication date.
Environment	**Pcycle**	Phosphorus cycle	Degree to which phosphorus is used sustainably as a fertiliser, compared to the study publication date.
Governance	**Power**	Political power	Reader appreciation about the ownership of political power.
Governance	**Europe**	European governance	Ambition, coordination, and cooperation at the EU level, including the role of European institutions in shaping the farming sector.
Governance	**Resources**	Resources managers	Actors in charge of managing agricultural resources among public structures, private structures or local communities.
Governance	**Regul**	Regulations other than CAP	Policy regulations not explicitly associated with the CAP in the scenario and regulating agriculture, food chain, market and consumers (e.g. laws, taxes or incentives).

Governance	**CAP**	CAP regulation	Orientation and instruments of CAP support (e.g. productivity, ecosystem services, rural development).
Governance	**FarmRep**	Farmers representation	Farmers' ability to organise and represent their interests at different levels (EU or other political instances).
Economy	**Paradigm**	Global economic paradigm	Reader appreciation about the economic paradigm described in the scenario.
Economy	**Volume**	Production volume of animal products	Change, compared to the date of study publication, in production volume of the animal product(s) concerned by the study and on the scale of the territory considered by the study.
Economy	**Trade**	World trade of animal products	Change in international trade of the animal product concerned by the study and on the scale of the territory considered by the study (e.g. increased or decreased balance or restricted trade).
Economy	**Consumption**	Consumption level in the society	Global relation of society with consumption.
Economy	**EnergyMain**	Energy supply	Dominant sources of energy on the territory considered by the study.
Economy	**EnergyFarm**	Energy production on farms	Extent of energy generation (e.g. anaerobic digestion, solar) on farms.
Economy	**Jobs**	Jobs in farming and agri-food chains	Employment trends in farming (including farmers and employees) and agri-food chains compared to the study publication date.
Economy	**FarmIncom**	Farmer incomes	Evolution of income levels for farmers compared to the study publication date.
Economy	**TerrSpecialis**	Territorial specialisation	Change in territorial specialisation of productions.
Economy	**LandOwner**	Land owner	Ownership structure of agricultural land among farmer, private structure, public structure or diversity of actors.
Economy	**FarmOwner**	Farm owner	Ownership and legal form of farming enterprises among farmers, companies or shared structures.
Economy	**ChainValueSize**	Value chain size	Scale and integration level of actors involved in the value chain, from production to retail, considering long and global scale, intermediate scale in Europe, short and local scale and coexistence of them.
Economy	**ChainValueFair**	Value chain fairness	Degree of equity and transparency in value distribution, benefiting more to the downstream actors (food industries and retail), integrated industries models or fair distribution along the chain.
Economy	**IndustryDev**	Food industry development	Trends in food processing industries development in the territory considered by the study (e.g. industrial processes optimization for efficiency, sustainability, working conditions).
Economy	**IndustryOwner**	Food industry concentration	Market concentration in the processing sector.
Economy	**Retail**	Type of food retailing	Structure and nature of food retail and food supply (supermarkets, logistic centre and e-commerce, farmers market).
Economy	**RetailOwn**	Food retailer concentration	Market concentration in the processing sector.
Economy	**Labels**	Labels	Trends in the production part under quality schemes and labels (development in number and importance) that can be statutory or voluntary labelling, compared to the study publication date.
Economy	**PurchaseMot**	Purchase motivation of consumers	Consumer motivation when purchasing animal products (e.g. price, convenience, sustainability, local origin, quality, health preoccupation).
Economy	**Price**	Price of animal products	Consumer costs of animal products.
Economy	**Agrotourism**	Agrotourism	Growth of tourism-related activities on farms and rural areas.
Society	**GlobalSoc**	Global societal vision for the citizens	Reader appreciation about the values and society model described in the scenario (e.g. individualist, solidarity-based, welfare State, technological progress).

Society	**LifeExpect**	Human population life expectancy	Average life expectancy in the population compared to the study publication date.
Society	**MetabDis**	Metabolic diseases and obesity	Prevalence of diet-related diseases compared to the study publication date.
Society	**DietGeneral**	Average diet calorie	General caloric intake level per capita compared to the study publication date.
Society	**ProductDiv**	Diversity of food products	Variety of raw and processed food items available that can be diversified, standardised or less diversified due to decrease in importations.
Society	**AnimalVegetal**	Proportion of animal products in human diets	Proportion of animal products in human diets that can be high, low or presenting and intermediate decrease compared to the study publication date.
Society	**DietAnimal**	Main animal products in the diet	Dominant types of consumed animal products (milk, ruminant meat, monogastric meat or only poultry meat compared to today).
Society	**Ultratransform**	Ultratransformed food	Prevalence of highly processed food in the diet.
Society	**DietEquity**	Equity of access to quality animal products	Socioeconomic disparities in access to quality animal food translated into the accessibility of animal products to all the population.
Society	**DietHabits**	Habits of food consumption (when and where)	Patterns in mealtime and eating locations including traditional habits, out-of-home catering or snackification.
Society	**Safety**	Hygiene and safety of animal-based products	Change in food safety standards and hygiene practices compared to the study publication date.
Society	**FoodSecurity**	Food security	Population's secure access to sufficient and nutritious food in the territory considered by the study.
Society	**WorldConcern**	Concern about nutritional needs of the world	Consideration of global food equity and solidarity and concern for extra-European regions.
Society	**RuralLife**	Rural communities dynamism	Development and attractiveness of rural life that can be dynamic, contrasted, vulnerable or declining.
Society	**FarmDemo**	Demography of farmers	Change in the number and age of self-employed farmers (excluding employees) compared to the study publication date.
Society	**AWConc**	Animal welfare concern	Animal welfare concern and awareness of stakeholders (State, civil society, companies).
Society	**EnvConc**	Environmental concern	Environmental concern and awareness of stakeholder (State, civil society, companies).
Society	**Acceptability**	Acceptability of LPS	Societal acceptability of animal production systems (in relation with its environmental impact, transparency on production conditions, etc.) that can be good, poor or contrasted.
Society	**SelfProd**	Self-production	Mention and degree of individuals producing their own food (meat and vegetables).
Technology and science	**Research**	Research and innovation trend	Reader appreciation about the trends in investment, direction and intensity of agricultural research and development, and innovation efforts compared to the study publication date.
Technology and science	**GeneticsLS**	Genetics of livestock	Criteria used for breeding improvements such as productivity, feed intake and efficiency, disease resistance, rusticity, mixed production.
Technology and science	**NovelEntities**	Novel entities	Emergence of synthetic or genetically engineered biological products.
Technology and science	**DataMining**	Data mining development	Use of digital data technologies across sectors (e.g. sensors, monitoring tools, blockchain).

Technology and science	**PLF**	Precision livestock farming	Development of AI and digital tools for livestock management (feeding, health, etc.).
Technology and science	**FarmTechno**	Other livestock technologies, equipment and building	Technologies or investments implemented in farms such as other technologies, equipment and building investments, automation, apart from digitisation and the application of precision breeding, which are described by other variables.
Technology and science	**FoodTechno**	Alternatives to conventional animal protein	Development of substitutes to animal products such as plant-based products, insect-based products or lab-grown meat.
Technology and science	**IndusTechno**	Technology for transformation and distribution	Advances in food processing and logistics technologies.
LPS	**LPSModel**	Type of livestock production system	Dominating LPS techno-economic model in the scenario such as sustainable efficiency (sustainability based on a high efficiency of intrant use), agroecology (including organic farmers), extensive (sustainability based on extensive systems), profit maximization (efficiency for a profit-oriented system without sustainability concern) or coexistence.
LPS	**FarmSize**	Farm size	Average of farm size considering capital, hectares and number of animals compared to the study publication date.
LPS	**FarmSupp**	Farmer education and/or other informational support along professional life	Availability and financial support to education, training and advisory services for farmers compared to the study publication date.
LPS	**FoodFeed**	Food VS feed competition (at world scale)	Degree of global competition between food and feed use of crops compared to the study publication date.
LPS	**FoodEnergy**	Food and feed VS energy competition (at local scale)	Local competition on the territory considered by the study, for land and biomass between food/feed and energy uses compared to the study publication date.
LPS	**HerdSizeRum**	Number of ruminants on the considered territory	Evolution in the population of ruminants on the territory considered by the study and compared to its publication date.
LPS	**HerdSizeMono**	Number of monogastrics on the considered territory	Evolution in the population of monogastrics on the territory considered by the study and compared to its publication date.
LPS	**FarmSpecialis**	Farm specialisation	Degree of production specialisation or diversification at farm level (e.g. high specialisation diversity of production mixed farming of cultures and livestock, on farm processing, coexistence of specialized and mixed systems).
LPS	**SectorComplex**	Sector complexity	Splitting of production stages of an animal life between farmers, either one farmer or successive farmers.
LPS	**SectorMeat**	Sector provenance for meat	Identification of meat provenance sector, either dairy or dedicated meat sector or mixed sector.
LPS	**Agroecology**	Agroecology practices	Implementation of agroecological practices in animal production systems.
LPS	**AWPract**	Animal welfare practices	Presumed impact on animal welfare of changing practices towards welfare-enhancing practices from farm to slaughterhouse.
LPS	**Zoonoses**	Zoonoses and epizooties consideration	Risk management and awareness related to animal diseases focused on zoonoses and epizooties.

LPS	**AMB**	Antimicrobial and antiparasitic use	Trends in antimicrobial and antiparasitic use compared to the study publication date.
LPS	**HealthPract**	Other animal health practices	Health care strategies including preventive strategies with prophylactic measures, biocontrol, alternatives medicines or no progress or even a decrease in animal health.
LPS	**SupplPract**	Additives and supplements in the feed	Use of additives for nutritional and other purposes in animal diets, including the concentrate-to-grass feed ratio in ruminant nutrition.
LPS	**ProtOrig**	Protein origin in the feed	Geographical origin of protein in animal diets between inside or outside Europe and source of protein such as alternatives to soya.
LPS	**GrasslandSurface**	Change in grassland surface	Evolution in total area of grasslands in the territory considered by the study.
LPS	**GrasslandRatio**	Changes in the ratio of permanent/temporary grassland	Changes in the ratio of grassland type: - if permanent grassland increases and temporary grassland decreases, then the ratio increases - if temporary pasture increases and permanent pasture decreases, then the ratio decreases
LPS	**Co-products**	Use of animal co-products	Consideration of the diverse animal co-products (leathers, wool, horns, etc.) between minimal valorisation, improved valorisation, new strategies.
LPS	**Manure**	Management of livestock manure	Chosen strategy for manure handling and recycling between fertilisation and anaerobic digestion.
LPS	**Waste**	Management of wastes from agro-food systems	Handling of non-manure waste from production to consumption such as minimisation of losses, valorisation strategy within a circularity approach or limited progress.
LPS	**ClimatPract_Adapt**	Climate adaptation practices	Implemented farm-level and territories strategies to adapt to climate change or limited efforts.
LPS	**ClimatPract_Mitig**	Climate mitigation practices	Implemented practices aimed at reducing climate impact (e.g. technological innovations, reducing herd size, carbon trading, etc.) or limited efforts.

Annex 2. Comparison with SJOS variables of D6.1

Nota bene: This table is taken from Deliverable D6.1 of the Step-up project, with the addition of the final column, "Variable T1.5". It links the variables identified for the SJOS to those presented in this report. The names in parentheses correspond to the variable ID, which refer to **Annex 1**. The cells marked with a cross and highlighted in red indicate SJOS variables that are not associated with any variable from this report.

DIMENSIONS	QUESTIONS	VARIABLES	INDICATORS	VARIABLES T1.5
SAFE OPERATING SPACE VARIABLES				
BIODIVERSITY	What is the state of biodiversity associated with livestock production systems?	BIODIVERSITY STATE	Total Permanent Pasture Area	Grassland area (**GrasslandSurface**)
			Total Temporary Pasture Area	Grassland area (**GrasslandSurface**)
			Livestock density on pastures	x
			Domestic diversity	x

			General biodiversity	State of biodiversity (**BiodivS**)
LAND USE	Are livestock production systems **competing** with other **land use**?	LAND COMPETITION	Required agricultural area for feed demand (pastures and feed splitted)	Land use for livestock production systems at local and global level (**LandLPST** and **LandLPSW**)
	Is **Soil health** associated with livestock farming sufficient to ensure production viability?	SOIL HEALTH	Soil organic carbon concentration in pasture and feed soils	Carbon sequestration in biomasse that can be in soils of woods (**Carbon**)
			Manure produced (discriminated by excretion in pastures and storage manure)	Management of livestock effluent/manure (**Manure**)
WATER USE	What is the effort needed from livestock production systems concerning **water use**?	WATER USE	Consumptive Blue Water uses ASF production	Water use in agriculture (**WaterU**)
NUTRIENT FLOWS	How significantly do livestock production systems alter **nitrogen cycles**?	NITROGEN CYCLE	Release of organic and inorganic fertilizer (Nitrogen)	Nitrogen cycle (**Ncycle**)
			Input of organic and inorganic fertilizer (Nitrogen)	Nitrogen cycle (**Ncycle**)
	How significantly do livestock production systems alter **phosphorus cycles**?	PHOSPHORUS CYCLE	Release of organic and inorganic fertilizer (Phosphorus)	Phosphorus cycle (**Pcycle**)
			Input of inorganic fertilizer (Phosphorus)	Phosphorus cycle (**Pcycle**)
CHEMICAL POLLUTION	Is livestock farming too **pesticide-intensive**?	PESTICIDE POLLUTION	Use of pesticides for animal feed production	Pesticides use in vegetal productions (**Pesticides**)
	Is livestock farming too **antimicrobial-intensive**?	ANTIMICROBIAL POLLUTION	Use of antimicrobials in animal breeding	Antimicrobial and antiparasitic use (**AMB**)
AEROSOL LOADING	Is there an issue with **air pollution** produced by livestock farming?	AEROSOL LOADING	Share of the Ammonia emissions allowed for ASF production	x
			Share of PM 2.5 emissions allowed for livestock production	x
CLIMATE	Is livestock farming a disproportionate contributor to **GHG emissions**?	GHG EMISSIONS	Share of GHG emissions allowed for livestock production	Greenhouse gas emissions in agriculture (**AgriGHG**)
	Is livestock farming a disproportionate contributor to **Radiative forcing**?	RADIATIVE FORCING	Share of Radiative forcing allowed for livestock production	Greenhouse gas emissions in agriculture (**AgriGHG**)
JUST OPERATING SPACE VARIABLES				
NUTRITION SECURITY	Can European consumers buy animal-source foods recommendations at an **affordable** price?	AFFORDABILITY	Share of population that cannot afford animal-source foods	Equity of access to quality animal products (**DietEquity**) Concern about nutritional needs of the world (**WorldConcern**)
			Percentage of price increase of animal-source foods	Price of animal products (**Price**)
	Does the EU guarantee a **stable supply** of animal-source foods?	SUPPLY STABILITY	Import dependency ratio for animal-source foods	Protein origin in the feed (**ProtOrig**)
			Self-sufficiency ratio for feed	Protein origin in the feed (**ProtOrig**)
	Is Europe producing excessive **waste** from animal-source foods?	WASTE MANAGMENT	Share of animal-source foods waste from food processing, transport and food waste from commodities and food services consumption	Management of wastes from agro-food systems (**Waste**)
HEALTH AND SAFETY	Is animal health and biosafety putting human health at risk?	ANIMAL HEALTH AND BIOSAFETY	Zoonoses	Specific management (increased awareness) of zoonoses and epizooties (**Zoonoses**)
			Animal source food consumption safety	Hygiene and safety of animal-based products (**Safety**)

	Are we over-consuming animal-source food?	ASF COMSUPTION	Share of population that over-consume animal-source foods (split products ?)	Proportion of animal products in the diet (**AnimalVegetal**)
ECONOMY	Is animal products and services value chain a **profitable activity**?	PROFITABILITY	Average value added in animal food value chain	x
	Is animal products and services value a **productive** activity?	PRODUCTIVITY	Total factor productivity in animal food value chain	Production volume of animal products (**Volume**)
	How many people are **employed** directly and indirectly by the animal production sector in EU?	EMPLOYMENT	Number of employment (EQUIVALENCE TO full-time workers) in animal production (full sector)	Demography of farmers (**FarmDemo**)
			Evolution of employment rate in rural areas	Number of jobs in the agricultural and food sector (**Jobs**) Rural communities' dynamism (**RuralLife**)
	TBD	MARKET ORGANISATION	Share of value added for primary producers in the food chain	Value chain fairness (**ChainValueFair**)
	Do **sectoral wages** continue to attract future farmers?	WAGES	Difference between sectoral and MS wages	Demography of farmers (**FarmDemo**)
LIVESTOCK SYSTEMS RESILIENCE	Is the current **workforce** capable of sustaining itself and meeting future demands effectively?	WORKFORCE	(Difference or ratio) of young farmers and farmers going into retirement	Demography of farmers (**FarmDemo**)
	Are EU livestock systems able to guarantee **viable** income earning farms?	INCOME LEVELS	Net farm income / FTE (Full-Time Equivalent) farmer	Farmer incomes (**FarmIncom**)
		INCOME RESILIENCE	Farm net income - Total subsidies / Total Output	x
	Are EU livestock systems able to be **passed on easily** and **cost effectively**?	TRANSFERABILITY	Fixed assets (excluding land) + stocks / FTE farmer	x
	Are farms to sensitive to **market conditions**?	STRUCTURE	Gross product of the farm's main production, before aid / farm Gross Product before aid (%)	x
	How **financially autonomous** are livestock systems?	AUTONOMY	Yearly bank loans repayment / Gross Product (%)	x
	Are livestock systems too **sensitive to subsidies**?	SUBSIDIES SENSITIVITY	Total subsidies / Farm net Income (%)	x
SOCIAL EQUITY	Is there equity concerning livestock farms **income distribution** (sectoral, spatial)?	INCOME DISTRIBUTION	Palma Ratio	x
	Is one **Welfare** guaranteed in Livestock farms?	WELFARE	Animal friendly practices index?	Animal welfare practices (**AWPract**)
			Farmers welfare index?	x
	Are there enough people **competent** to work in the EU agro-industry?	EDUCATION	Nb of people with a professional diploma who work in agro-industry	x
			Nb of people with a professional diploma who work in livestock farms	Farmer education and/or other informational support along professional life (**FarmSupp**)
	Is **Gender equality** respected in livestock production systems?	GENDER EQUALITY	Number of female-owned agri-businesses of farm and on farm product/business	x
			% women/men students in agriculture	x

Annex 3. List of foresight studies from the final corpus, classified by geographical level, with associated information on scenario distribution across families, time horizon, species covered, whether the study is quantified, and author category.

GEOGRAPHICAL LEVEL	STUDY ID [number of scenarios]	STUDY TITLE	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7	TIME HORIZON	SPECIES	QUANTIFIED	AUTHOR CATEGORY
World	**P28** [5]	Land Use and Food Security in 2050: a Narrow Road / Agrimonde-Terra **(Le Mouël et al., 2018)**	1				2	2		2050	All	yes	Research
Europe	**P3** [1]	TYFA (Ten years for agroecology) **(Poux & Aubert, 2018)**							1	2050	All	yes	Think tank
Europe	**P4** [5]	Possible developments in the livestock farming controversy point to five contrasting futures: A prospective analysis to 2040. **(Delanoue et al., 2018)**	1	1			1		2	2040	All	no	Technical organisation
Europe	**P30** [5]	Agroecological practices in combination with healthy diets can help meet EU food system policy targets **(Röös et al., 2022)**	1					3	1	2050	All	yes	Research
Europe	**P35** [2]	Future Nordic diets **(Karlsson et al., 2017)**							2	2050	All	yes	Other public structure
Europe	**P67** [4]	Pathways project **(Pathways consortium, 2024)**	1					2	1	2050	All	yes	Research
Europe	**P106** [1]	Three scenarios for Europe's food sector in 2035 **(Moller et al., 2023)**	1							2035	All	no	Think tank
Europe	**P117** [1]	Vision Paper towards European Research and Innovation for a sustainable and competitive livestock production sector in Europe **(Peyraud et al., 2019)**						1		post-2020	All	no	Think tank
Europe	**P119** [1]	Interdisciplinary foresight workshop: Science for tomorrow's livestock farming. Summary report. **(Peyraud et al., 2020)**						1		2050	All	no	Research
Europe	**P161** [1]	Agriculture, forestry and food in a climate neutral EU. The land use sectors as part of a sustainable food system and bioeconomy. **(Agora Agriculture, 2024)**						1		2045	All	yes	Think tank
Europe	**P168** [1]	Future of EU livestock: how to contribute to a sustainable agricultural sector? Final report **(Peyraud & MacLeod, 2020)**						1		2030-2050	All	no	Other public structure

Europe	**P174** [5]	Re-Livestock project: Deliverable 7.1 - Shared Socio-Economic Pathways for the European livestock sector **(Karner & Mitter, 2024)**	2	2				1		2050	All	no	Research
National Denmark	**P31** [1]	Climate-neutral 2050 **(Danish Agriculture & Food Council, 2017)**			1					2050	All	no	Private sector
National Denmark	**P32** [7]	The holistic future of balanced cattle production - visions and challenges for the dairy farm towards 2040 **(Kristensen et al., 2019)**			7					2040	Cattle (Milk)	no	Agri. public structure
National Denmark	**P33** [1]	From feed to food II - A new path for Danish agricultural production and food consumption within the planet's limits **(Greenpeace, 2022)**							1	2040	All	yes	NGO
National Finland	**P154** [1]	Climate roadmap for agriculture - Roadmap for reducing greenhouse gas emissions in Finnish agriculture **(Lehtonen et al., 2020)**	1							2035	All	yes	Private sector
National France	**P8** [5]	Transition(s) 2050 Choosing now to act for the climate **(ADEME, 2021)**		2				1	2	2050	All	yes	Other public structure
National France	**P9** [5]	The Human-Animal relationship: five scenarios for 2030 **(Bidaud et al., 2016)**	1				2	1	1	2030	All	no	Agri. public structure
National France	**P13** [4]	Agri 2050 - A foresight study of French agriculture and forestry **(Berlizot et al., 2020)**		1				3		2050	All	no	Agri. public structure
National France	**P15** [5]	Prospective French Beef Meat Sectors by 2040 – Volume 2. System Representation and Scenarios **(FranceAgriMer, 2018)**		1	1	2		1		2040	Cattle (Meat)	no	Agri. public structure
National France	**P16** [4]	Foresight for the cow's milk sector **(FranceAgriMer, 2017)**	2			2				2050	Cattle (Milk)	no	Agri. public structure
National France	**P17** [4]	How can we improve the attractiveness of livestock sector jobs? Current situation and foresight to 2035 **(Delanoue et al., 2024)**		1			1	2		2030	All	no	Research
National France	**P18** [1]	Summary of the reference scenario of the French strategy for energy and climate **(DG de l'Energie et du Climat, Ministère de la transition écologique, de la biodiversité, de la forêt, de la mer et de la pêche, France, 2023)**							1	2050	All	yes	Other public structure
National France	**P122** [6]	Possible scenarios for the development of French pork production **(Chaib et al., 2023)**		1		3	1	1		2028	Pig	no	Research
National France	**P155** [1]	French meat industries under pressure: between competitive pressures and access to biomass **(Aubert & Poux, 2024)**		1						2035	All	yes	Think tank
National France	**P163** [1]	Suckler farming: a new approach to break the deadlock **(Etienne & Uthayakumar, 2024)**							1	post-2025	Cattle (Meat)	no	NGO
National France	**P165** [2]	Two contrasted future scenarios for the French agro-food system **(Billen et al., 2018)**	1						1	2040	All	yes	Research

National Germany	**P105** [4]	The Future of Agriculture - A common agenda **(Commission on the Future of Agriculture (ZKL), 2021)**		1			1	2		2030	All	no	Agri. public structure
National The Netherlands	**P47** [3]	Dutch dairy farming in 2030 - Exploration of possible developments based on economic modelling **(Beldman et al., 2020)**		1		1		1		2030	Cattle (Milk)	yes	Research
National The Netherlands	**P48** [5]	Scenario study perspective on development directions for Dutch agriculture in 2050 **(Lesschen et al., 2020)**		3				2		2050	All	yes	Research
National The Netherlands	**P167** [3]	The CAP after 2020, a sketch for a redesign **(Vogelzang et al., 2016)**	1	1			1			post-2020	All	no	Research
National The Netherlands	**P169** [3]	Scenario study on veal farms - Scenarios for a different chain design **(Lysias Advies et al., 2021)**				3				2030	Cattle	no	Research
National The Netherlands	**P171** [5]	Imagining alternative futures for the Dutch poultry industry **(Smulders et al., 2025)**					1	3	1	2050	Poultry	no	Research
National Spain	**P121** [1]	Dairy cattle decarbonisation strategy in Spain **(Danone, 2023)**				1				post-2025	Cattle (Milk)	no	Private sector
National Sweden	**P60** [3]	Scenarios for future pig production using a One Health approach **(Zira et al., 2022)**				3				2040	Pig	yes	Research
National Sweden	**P107** [1]	Report future agriculture Milk & Beef - Towards climate-neutral agriculture in 2050 **(HKScan et al., 2021)**			1					2050	Cattle	no	Private sector
National United Kingdom	**P109** [6]	The sixth carbon budget - The UK's path to Net Zero **(Climate Change Committee, 2020)**		6						2050	All	yes	Other public structure
Infra-national France	**P23** [3]	Water, agriculture and climate change in Burgundy-Franche-Comté: elements of foresight **(Schwoob et al., 2022)**		2				1		2050	Ruminants	no	Agri. public structure
Infra-national France	**P134** [5]	Franc-comtoise PDO milk production: potential and dynamics to 2030 **(Ropssi et al., 2017)**	1	2		1		1		2030	Cattle (Milk)	no	Agri. public structure
Infra-national France	**P5** [5]	Breton agriculture 2040 - 5 future scenarios **(Chambres d'agriculture de Bretagne, 2023)**	1				2	2		2040	All	no	Agri. public structure
Infra-national France	**P159** [1]	Towards low-carbon regional economies - an experiment in Brittany **(The Shift Project, 2024)**						1		2050	All	yes	Think tank
Infra-national France	**P173** [2]	What types of agriculture are compatible with carbon neutrality in Brittany? Scenarios for achieving Factor 2 in 2050 **(Joya et al., 2023)**						2		2050	All	yes	Think tank
Infra-national France	**P6** [5]	Prospective study of the ruminant meat sector in the Massif Central, horizon 2050 - five scenarios for better anticipation and adaptation **(Cerles et al., 2016)**	2	1		1			1	2050	Cattle (Meat)	yes	Research
Infra-national France	**P151** [2]	Analysis of the Occitanie region's food system, its sustainability and resilience **(Alliot et al., 2023)**					1		1	2050	All	no	Other public structure

Infra-national France	**P54** [4]	Broiler poultry production in Pays de Loire - Foresight to 2030 **(Labzaé et al., 2021)**		1		2		1		2030	Poultry	yes	Agri. public structure
Infra-national France	**P55** [4]	Pork production in the Pays de la Loire region, Foresight to 2030 **(Goscianski & Guilloux, 2021)**		1		3				2030	Pig	no	Agri. public structure
Infra-national France	**P56** [4]	Milk production in the Pays de la Loire region, Foresight to 2030 **(Moret, 2021)**		1		3				2030	Cattle (Milk)	no	Agri. public structure
Infra-national France	**P57** [4]	Veal calf production in Pays de la Loire, Foresight to 2030 **(Moret & Simon, 2021)**		1		1	2			2030	Cattle	no	Agri. public structure
Infra-national Spain	**P116** [3]	Envisioning the future of transhumant pastoralism through participatory scenario planning: a case study in Spain **(Oteros-Rozas et al., 2013)**	1			2				2030	Ruminants	no	Research
Infra-national United Kingdom	**P149** [4]	What will the Scottish sheep industry look like in 2040 and how resilient will it be to livestock disease? **(Auty et al., 2015)**	2	2						2040	Sheep	no	Research

Annex 4. Final corpus scenarios grouped by family

Nota bene: The rows highlighted in green correspond to the barycentric scenarios of each scenario family.

SCENARIO ID	STUDY TITLE	SCENARIO TITLE	GEOGRAPHICAL LEVEL	TIME HORIZON	SPECIES	QUANTIFIED	AUTHOR CATEGORY
FAMILY 1 "Economically successful intensive bet"							
P4.2	Possible developments in the livestock farming controversy point to five contrasting futures: A prospective analysis to 2040. **(Delanoue et al., 2018)**	Junk food is on the rise: people are no longer concerned about what they eat	Europe	2040	All	no	Technical organisation
P5.4	Breton agriculture 2040 - 5 future scenarios **(Chambres d'Agriculture de Bretagne, 2023)**	Focus on the economy - The sectors are betting on technology	Infra-national France	2040	All	no	Agri. public structure
P6.4	Prospective study of the ruminant meat sector in the Massif Central, horizon 2050 - five scenarios for better anticipation and adaptation **(Cerles et al., 2016)**	Partnership	Infra-national France	2050	Cattle (meat)	yes	Research
P6.5	Prospective study of the ruminant meat sector in the Massif Central, horizon 2050 - five scenarios for better anticipation and adaptation **(Cerles et al., 2016)**	Geopol	Infra-national France	2050	Cattle (meat)	yes	Research

P9.3	The Human-Animal relationship: five scenarios for 2030 **(Bidaud et al., 2016)**	Animals as adjustment variables	National France	2030	All	no	Agri. public structure
P16.2	Foresight for the cow's milk sector **(FranceAgriMer, 2017)**	The competitive spiral	National France	2050	Cattle (milk)	no	Agri. public structure
P16.3	Foresight for the cow's milk sector **(FranceAgriMer, 2017)**	A successful, regulated dairy industry	National France	2050	Cattle (milk)	no	Agri. public structure
P28.1	Land Use and Food Security in 2050: a Narrow Road / Agrimonde-Terra **(Le Mouël et al., 2018)**	Land use driven by metropolization ["Metropolization"scenario]	World	2050	All	yes	Research
P30.1	Agroecological practices in combination with healthy diets can help meet EU food system policy targets **(Röös et al., 2022)**	Business-as-usual	Europe	2050	All	yes	Research
P67.1	Pathways project **(Pathways consortium, 2024)**	Efficiency first	Europe	2050	All	yes	Research
P106.3	Three scenarios for Europe's food sector in 2035 **(Moller et al., 2023)**	A CO_2-currency and retailers dominate trade and consumption - In a globalised world, markets and technologies ensure prosperity for top performers	Europe	2035	All	no	Think tank
P116.3	Envisioning the future of transhumant pastoralism through participatory scenario planning: a case study in Spain **(Oteros-Rozas et al., 2013)**	Technology-driven	Infra-national Spain	2030	Ruminants	no	Research
P134.4	Franc-comtoise PDO milk production: potential and dynamics to 2030 **(Ropssi et al., 2017)**	Monopoly	Infra-national France	2030	Cattle (milk)	no	Agri. public structure
P149.1	What will the Scottish sheep industry look like in 2040 and how resilient will it be to livestock disease? **(Auty et al., 2015)**	Sheepishly Smart	Infra-national Scotland	2040	Sheep	no	Research
P149.3	What will the Scottish sheep industry look like in 2040 and how resilient will it be to livestock disease? **(Auty et al., 2015)**	Three Bags Full	Infra-national Scotland	2040	Sheep	no	Research
P154	Climate roadmap for agriculture - Roadmap for reducing greenhouse gas emissions in Finnish agriculture **(Lehtonen et al., 2020)**	Baseline scenario	National Finland	2035	All	yes	Private sector
P165.1	Two contrasted future scenarios for the French agro-food system **(Billen et al., 2018)**	Pursuit of past trend towards opening and specialisation	National France	2040	All	yes	Research
P167.1	The CAP after 2020, a sketch for a redesign **(Vogelzang et al., 2016)**	High-tech scenario	National The Netherlands	post-2020	All	no	Research
P174.4	Re-Livestock project: Deliverable 7.1 - Shared Socio-Economic Pathways for the European livestock sector **(Karner & Mitter, 2024)**	Eur-LFS-SSP4: European Livestock Farming Systems in an Unequal but Green Era	Europe	2050	All	no	Research

P174.5	Re-Livestock project: Deliverable 7.1 - Shared Socio-Economic Pathways for the European livestock sector **(Karner & Mitter, 2024)**	Eur-LFS-SSP5: European Livestock Farming in an Innovative but Fossil-fuelled Era	Europe	2050	All	no	Research
FAMILY 2 "Intensification with limited economic success"							
P4.1	Possible developments in the livestock farming controversy point to five contrasting futures: A prospective analysis to 2040. **(Delanoue et al., 2018)**	Productive European agriculture in the face of global disruption	Europe	2040	All	no	Technical organisation
P6.2	Prospective study of the ruminant meat sector in the Massif Central, horizon 2050 - five scenarios for better anticipation and adaptation **(Cerles et al., 2016)**	Liberalisation	Infra-national France	2050	Cattle (meat)	yes	Research
P8.4	Transition(s) 2050 Choosing now to act for the climate **(ADEME, 2021)**	Repair bet	National France	2050	All	yes	Other public structure
P8.5	Transition(s) 2050 Choosing now to act for the climate **(ADEME, 2021)**	Trend	National France	2050	All	yes	Other public structure
P13.3	Agri 2050 - A foresight study of French agriculture and forestry **(Berlizot et al., 2020)**	Renewed Productivism	National France	2050	All	no	Agri. public structure
P15.2	Prospective French Beef Meat Sectors by 2040 – Volume 2. System Representation and Scenarios **(FranceAgriMer, 2018)**	Low-cost meat & imports in a context of economic crisis and greenhouse gas emission limitations	National France	2040	Cattle (meat)	no	Agri. public structure
P17.2	How can we improve the attractiveness of livestock sector jobs? Current situation and foresight to 2035 **(Delanoue et al., 2024)**	Production liberalisation	National France	2030	All	no	Research
P23.1	Water, agriculture and climate change in Burgundy-Franche-Comté: elements of foresight **(Schwoob et al., 2022)**	Deregulation	Infra-national France	2050	Ruminants	no	Agri. public structure
P23.2	Water, agriculture and climate change in Burgundy-Franche-Comté: elements of foresight **(Schwoob et al., 2022)**	Strong economic constraints	Infra-national France	2050	Ruminants	no	Agri. public structure
P47.3	Dutch dairy farming in 2030 - Exploration of possible developments based on economic modelling **(Beldman et al., 2020)**	Hardcore free market	National The Netherlands	2030	Cattle (milk)	yes	Research
P48.1	Scenario study perspective on development directions for Dutch agriculture in 2050 **(Lesschen et al., 2020)**	Reference scenario	National The Netherlands	2050	All	yes	Research

P48.2	Scenario study perspective on development directions for Dutch agriculture in 2050 **(Lesschen et al., 2020)**	Productivity planned scenario	National The Netherlands	2050	All	yes	Research
P48.4	Scenario study perspective on development directions for Dutch agriculture in 2050 **(Lesschen et al., 2020)**	Productivity stricter scenario	National The Netherlands	2050	All	yes	Research
P54.3	Broiler poultry production in Pays de Loire, Foresight to 2030 **(Labzaé et al., 2021)**	Economic disruption scenario	Infra-national France	2030	Poultry	yes	Agri. public structure
P55.3	Pork production in the Pays de la Loire, Foresight to 2030 **(Goscianski & Guilloux, 2021)**	Economic disruption scenario	Infra-national France	2030	Pig	no	Agri. public structure
P56.4	Milk production in the Pays de la Loire, Foresight to 2030 **(Moret, 2021)**	Economic disruption scenario	Infra-national France	2030	Cattle (milk)	no	Agri. public structure
P57.4	Veal calf production in Pays de la Loire, Foresight to 2030 **(Moret & Simon, 2021)**	Economic disruption scenario	Infra-national France	2030	Cattle	no	Agri. public structure
P105.4	The Future of Agriculture - A common agenda **(Commission on the Future of Agriculture (ZKL), 2021)**	General conditions predominantly unchanged, minor progress towards sustainability	National Germany	2030	All	no	Agri. public structure
P109.1	The sixth carbon budget - The UK's path to Net Zero **(Climate Change Committee, 2020)**	Baseline scenario	National UK	2050	All	yes	Other public structure
P109.2	The sixth carbon budget - The UK's path to Net Zero **(Climate Change Committee, 2020)**	Balanced Pathway	National UK	2050	All	yes	Other public structure
P109.3	The sixth carbon budget - The UK's path to Net Zero **(Climate Change Committee, 2020)**	Headwinds	National UK	2050	All	yes	Other public structure
P109.4	The sixth carbon budget - The UK's path to Net Zero **(Climate Change Committee, 2020)**	Widespread engagement	National UK	2050	All	yes	Other public structure
P109.5	The sixth carbon budget - The UK's path to Net Zero **(Climate Change Committee, 2020)**	Widespread Innovation	National UK	2050	All	yes	Other public structure
P109.6	The sixth carbon budget - The UK's path to Net Zero **(Climate Change Committee, 2020)**	Tailwinds	National UK	2050	All	yes	Other public structure
P122.1	Possible scenarios for the development of French pork production **(Chaib et al., 2023)**	Business-as-susual	National France	2028	Pig	no	Research
P134.1	Franc-comtoise PDO milk production: potential and dynamics to 2030 **(Ropssi et al., 2017)**	Each to his own	Infra-national France	2030	Cattle (milk)	no	Agri. public structure
P134.3	Franc-comtoise PDO milk production: potential and dynamics to 2030 **(Ropssi et al., 2017)**	Hygienisation and decline	Infra-national France	2030	Cattle (milk)	no	Agri. public structure
P149.2	What will the Scottish sheep industry look like in 2040 and how resilient will it be to livestock disease? **(Auty et al., 2015)**	Opportunity knocks for some	Infra-national Scotland	2040	Sheep	no	Research

P149.4	What will the Scottish sheep industry look like in 2040 and how resilient will it be to livestock disease? **(Auty et al., 2015)**	Silence of the Lambs	Infra-national Scotland	2040	Sheep	no	Research
P155	French meat industries under pressure: between competitive pressures and access to biomass **(Aubert & Poux, 2024)**	Trendline	National France	2035	All	yes	Think tank
P167.3	The CAP after 2020, a sketch for a redesign **(Vogelzang et al., 2016)**	Collapse scenario	National The Netherlands	post-2020	All	no	Research
P174.2	Re-Livestock project: Deliverable 7.1 - Shared Socio-Economic Pathways for the European livestock sector **(Karner & Mitter, 2024)**	Eur-LFS-SSP2: European Livestock Farming Systems in an Established Era	Europe	2050	All	no	Research
P174.3	Re-Livestock project: Deliverable 7.1 - Shared Socio-Economic Pathways for the European livestock sector **(Karner & Mitter, 2024)**	Eur-LFS-SSP3: European Livestock Farming Systems in a Self-Sufficient Era	Europe	2050	All	no	Research
FAMILY 3 "Sustainable technology and green growth for cattle"							
P15.5	Prospective French Beef Meat Sectors by 2040 – Volume 2. System Representation and Scenarios **(FranceAgriMer, 2018)**	Organized and innovative sector, with a segmented offering, in a thriving global market	National France	2040	Cattle (meat)	no	Agri. public structure
P31	Climate-neutral 2050 **(Danish Agriculture & Food Council, 2017)**	-	National Denmark	2050	All	no	Private sector
P32.1	The holistic future of balanced cattle production - visions and challenges for the dairy farm towards 2040 **(Kristensen et al., 2019)**	Grazing and robust cows	National Denmark	2040	Cattle (milk)	no	Agri. public structure
P32.2	The holistic future of balanced cattle production - visions and challenges for the dairy farm towards 2040 **(Kristensen et al., 2019)**	Local resources and feed self-sufficiency	National Denmark	2040	Cattle (milk)	no	Agri. public structure
P32.3	The holistic future of balanced cattle production - visions and challenges for the dairy farm towards 2040 **(Kristensen et al., 2019)**	Crew and financial optimisation	National Denmark	2040	Cattle (milk)	no	Agri. public structure
P32.4	The holistic future of balanced cattle production - visions and challenges for the dairy farm towards 2040 **(Kristensen et al., 2019)**	Circular economy and non-human feed	National Denmark	2040	Cattle (milk)	no	Agri. public structure
P32.5	The holistic future of balanced cattle production - visions and challenges for the dairy farm towards 2040 **(Kristensen et al., 2019)**	Climate and fewer emissions per kg of milk	National Denmark	2040	Cattle (milk)	no	Agri. public structure

P32.6	The holistic future of balanced cattle production - visions and challenges for the dairy farm towards 2040 **(Kristensen et al., 2019)**	Minimum nitrogen leaching per hectare - geographical location	National Denmark	2040	Cattle (milk)	no	Agri. public structure
P32.7	The holistic future of balanced cattle production - visions and challenges for the dairy farm towards 2040 **(Kristensen et al., 2019)**	The cow - high performance and health	National Denmark	2040	Cattle (milk)	no	Agri. public structure
P107	Report future agriculture Milk & Beef - Towards climate-neutral agriculture in 2050 **(HKScan et al., 2021)**	-	National Sweden	2050	Cattle	no	Private sector
FAMILY 4 "Governance by an organised sector"							
P6.1	Prospective study of the ruminant meat sector in the Massif Central, horizon 2050 - five scenarios for better anticipation and adaptation **(Cerles et al., 2016)**	Excellence	Infra-national France	2050	Cattle (meat)	yes	Research
P15.1	Prospective French Beef Meat Sectors by 2040 – Volume 2. System Representation and Scenarios **(FranceAgriMer, 2018)**	National retreat against a backdrop of global crisis (economic & energy)	National France	2040	Cattle (meat)	no	Agri. public structure
P15.3	Prospective French Beef Meat Sectors by 2040 – Volume 2. System Representation and Scenarios **(FranceAgriMer, 2018)**	Upmarket shift under strong health and societal constraints	National France	2040	Cattle (meat)	no	Agri. public structure
P16.1	Foresight for the cow's milk sector **(FranceAgriMer, 2017)**	High tech milk and deglobalisation	National France	2050	Cattle (milk)	no	Agri. public structure
P16.4	Foresight for the cow's milk sector **(FranceAgriMer, 2017)**	The challenge of regression	National France	2050	Cattle (milk)	no	Agri. public structure
P47.2	Dutch dairy farming in 2030 - Exploration of possible developments based on economic modelling **(Beldman et al., 2020)**	Encouraging nature-inclusive	National The Netherlands	2030	Cattle (milk)	yes	Research
P54.1	Broiler poultry production in Pays de Loire - Foresight to 2030 **(Labzaé et al., 2021)**	Baseline scenario	Infra-national France	2030	Poultry	yes	Agri. public structure
P54.2	Broiler poultry production in Pays de Loire - Foresight to 2030 **(Labzaé et al., 2021)**	Alternative scenario	Infra-national France	2030	Poultry	yes	Agri. public structure
P55.1	Pork production in the Pays de la Loire region **(Goscianski & Guilloux, 2021)**	Tendanciel	Infra-national France	2030	Pig	no	Agri. public structure
P55.2	Pork production in the Pays de la Loire region **(Goscianski & Guilloux, 2021)**	Socio-ecological transition	Infra-national France	2030	Pig	no	Agri. public structure
P55.4	Pork production in the Pays de la Loire region **(Goscianski & Guilloux, 2021)**	Social breakdown	Infra-national France	2030	Pig	no	Agri. public structure

P56.1	Milk production in the Pays de la Loire region **(Moret, 2021)**	Tendanciel	Infra-national France	2030	Cattle (milk)	no	Agri. public structure
P56.2	Milk production in the Pays de la Loire region **(Moret, 2021)**	Co-construction between farmers and citizens	Infra-national France	2030	Cattle (milk)	no	Agri. public structure
P56.3	Milk production in the Pays de la Loire region **(Moret, 2021)**	Societal disruption	Infra-national France	2030	Cattle (milk)	no	Agri. public structure
P57.3	Veal calf production in Pays de la Loire **(Moret & Simon, 2021)**	Societal disruption	Infra-national France	2030	Cattle	no	Agri. public structure
P60.1	Scenarios for future pig production using a One Health approach **(Zira et al., 2022)**	AsUsual	National Sweden	2040	Pig	yes	Research
P60.2	Scenarios for future pig production using a One Health approach **(Zira et al., 2022)**	SusFeed	National Sweden	2040	Pig	yes	Research
P60.3	Scenarios for future pig production using a One Health approach **(Zira et al., 2022)**	SusFeedPig	National Sweden	2040	Pig	yes	Research
P116.1	Envisioning the future of transhumant pastoralism through participatory scenario planning: a case study in Spain **(Oteros-Rozas et al., 2013)**	Control / desired scenario	Infra-national Spain	2030	Ruminants	no	Research
P116.2	Envisioning the future of transhumant pastoralism through participatory scenario planning: a case study in Spain **(Oteros-Rozas et al., 2013)**	Back-to-the-future	Infra-national Spain	2030	Ruminants	no	Research
P121	Dairy cattle decarbonisation strategy in Spain **(Danone, 2023)**	Dairy cattle decarbonisation strategy in Spain	National Spain	post-2025	Cattle (milk)	no	Private sector
P122.2	Possible scenarios for the development of French pork production **(Chaib et al., 2023)**	Technologies to the rescue	National France	2028	Pig	no	Research
P122.3	Possible scenarios for the development of French pork production **(Chaib et al., 2023)**	A more attractive sector	National France	2028	Pig	no	Research
P122.4	Possible scenarios for the development of French pork production **(Chaib et al., 2023)**	Regional magnet / Societal balance	National France	2028	Pig	no	Research
P134.2	Franc-comtoise PDO milk production: potential and dynamics to 2030 **(Ropssi et al., 2017)**	The white gold rush	Infra-national France	2030	Cattle (milk)	no	Agri. public structure
P169.1	Scenario study on veal farms - Scenarios for a different chain design **(Lysias Advies et al., 2021)**	Home and satisfied	National The Netherlands	2030	Cattle	no	Research
P169.2	Scenario study on veal farms - Scenarios for a different chain design **(Lysias Advies et al., 2021)**	Maximum integral	National The Netherlands	2030	Cattle	no	Research
P169.3	Scenario study on veal farms - Scenarios for a different chain design **(Lysias Advies et al., 2021)**	Loyal to local	National The Netherlands	2030	Cattle	no	Research
FAMILY 5 "Coexistence and segmentation"							

P4.3	Possible developments in the livestock farming controversy point to five contrasting futures: A prospective analysis to 2040. **(Delanoue et al., 2018)**	Society and the livestock industry work together to develop progress initiatives	Europe	2040	All	no	Technical organisation
P5.1	Breton agriculture 2040 - 5 future scenarios **(Chambres d'Agriculture de Bretagne, 2023)**	Breton agriculture in resistance mode - Where environmental regulations and the lack of renewal of the workforce are leading to a decline in livestock farming	Infra-national France	2040	All	no	Agri. public structure
P5.3	Breton agriculture 2040 - 5 future scenarios **(Chambres d'Agriculture de Bretagne, 2023)**	Territorialised agriculture - Where a fourth act of decentralisation has taken place without us even knowing it	Infra-national France	2040	All	no	Agri. public structure
P9.1	The Human-Animal relationship: five scenarios for 2030 **(Bidaud et al., 2016)**	A thrifty relationship with animals	National France	2030	All	no	Agri. public structure
P9.5	The Human-Animal relationship: five scenarios for 2030 **(Bidaud et al., 2016)**	A fragmented animal issue	National France	2030	All	no	Agri. public structure
P17.4	How can we improve the attractiveness of livestock sector jobs? Current situation and foresight to 2035 **(Delanoue et al., 2024)**	Diversification of production methods and moving upmarket	National France	2030	All	no	Research
P28.3	Land Use and Food Security in 2050: a Narrow Road / Agrimonde-Terra **(Le Mouël et al., 2018)**	Land use for multi-active and mobile households ["Households" scenario]	World	2050	All	yes	Research
P28.5	Land Use and Food Security in 2050: a Narrow Road / Agrimonde-Terra **(Le Mouël et al., 2018)**	Land as commons for rural communities in a fragmented world ["Communities" scenario]	World	2050	All	yes	Research
P57.1	Veal calf production in Pays de la Loire **(Moret & Simon, 2021)**	Tendanciel	Infra-national France	2030	Cattle	no	Agri. public structure
P57.2	Veal calf production in Pays de la Loire **(Moret & Simon, 2021)**	Co-construction between farmers and citizens	Infra-national France	2030	Cattle	no	Agri. public structure
P105.2	The Future of Agriculture - A common agenda **(Commission on the Future of Agriculture (ZKL), 2021)**	Change predominantly driven by market instruments with some regulation	National Germany	2030	All	no	Agri. public structure
P122.5	Possible scenarios for the development of French pork production **(Chaib et al., 2023)**	An industry with two faces	National France	2028	Pig	no	Research
P151.1	Analysis of the Occitanie region's food system, its sustainability and resilience. **(Alliot et al., 2023)**	Green technologies	Infra-national France	2050	All	no	Other public structure
P167.2	The CAP after 2020, a sketch for a redesign **(Vogelzang et al., 2016)**	Self-Organisation	National The Netherlands	post-2020	All	no	Research
P171.4	Imagining alternative futures for the Dutch poultry industry **(Smulders et al., 2025)**	Retail as an orchestrator	National The Netherlands	2050	Poultry	no	Research

FAMILY 6 "Sustainable efficiency and protectionism"							
P5.2	Breton agriculture 2040 - 5 future scenarios **(Chambres d'Agriculture de Bretagne, 2023)**	Agriculture aims for carbon neutrality - Farmers at the service of a social project	Infra-national France	2040	All	no	Public structure on agriculture
P5.5	Breton agriculture 2040 - 5 future scenarios **(Chambres d'Agriculture de Bretagne, 2023)**	Brittany's agriculture becomes more plant-based - Livestock farming declines, and more and more space is given to plant production	Infra-national France	2040	All	no	Public structure on agriculture
P8.3	Transition(s) 2050 - Choosing now to act for the climate **(ADEME, 2021)**	Green technologies	National France	2050	All	yes	Other public structure
P9.4	The Human-Animal relationship: five scenarios for 2030 **(Bidaud et al., 2016)**	The exfiltrated and idealised animal	National France	2030	All	no	Public structure on agriculture
P13.1	Agri 2050 - A foresight study of French agriculture and forestry **(Berlizot et al., 2020)**	Scholarly Sobriety	National France	2050	All	no	Public structure on agriculture
P13.2	Agri 2050 - A foresight study of French agriculture and forestry **(Berlizot et al., 2020)**	Environmental Capitalism	National France	2050	All	no	Public structure on agriculture
P13.4	Agri 2050 - A foresight study of French agriculture and forestry **(Berlizot et al., 2020)**	Citizens of the Territories	National France	2050	All	no	Public structure on agriculture
P15.4	Prospective French Beef Meat Sectors by 2040 – Volume 2. System Representation and Scenarios **(FranceAgriMer, 2018)**	Competitiveness and differentiation in an international market hindered by energy costs	National France	2040	Cattle (meat)	no	Public structure on agriculture
P17.1	How can we improve the attractiveness of livestock sector jobs? Current situation and foresight to 2035 **(Delanoue et al., 2024)**	Less but better	National France	2030	All	no	Research
P17.3	How can we improve the attractiveness of livestock sector jobs? Current situation and foresight to 2035 **(Delanoue et al., 2024)**	Anti-farming	National France	2030	All	no	Research
P23.3	Water, agriculture and climate change in Burgundy-Franche-Comté: elements of foresight **(Schwoob et al., 2022)**	Protecting the environment	Infra-national France	2050	Ruminants	no	Public structure on agriculture
P28.2	Land Use and Food Security in 2050: a Narrow Road / Agrimonde-Terra **(Le Mouël et al., 2018)**	Land use for regional food systems ["Regionalization" scenario]	World	2050	All	yes	Research

P28.4	Land Use and Food Security in 2050: a Narrow Road / Agrimonde-Terra **(Le Mouël et al., 2018)**	Land use for food quality and healthy nutrition ["Healthy" scenario]	World	2050	All	yes	Research
P30.2	Agroecological practices in combination with healthy diets can help meet EU food system policy targets **(Röös et al., 2022)**	Agroecology-for-exports	Europe	2050	All	yes	Research
P30.3	Agroecological practices in combination with healthy diets can help meet EU food system policy targets **(Röös et al., 2022)**	Localisation-for-protectionism	Europe	2050	All	yes	Research
P30.4	Agroecological practices in combination with healthy diets can help meet EU food system policy targets **(Röös et al., 2022)**	Localisation-for-sustainability	Europe	2050	All	yes	Research
P47.1	Dutch dairy farming in 2030 - Exploration of possible developments based on economic modelling **(Beldman et al., 2020)**	Baseline scenario	National The Netherlands	2030	Cattle (milk)	yes	Research
P48.3	Scenario study perspective on development directions for Dutch agriculture in 2050 **(Lesschen et al., 2020)**	Nature-inclusive proposed scenario	National The Netherlands	2050	All	yes	Research
P48.5	Scenario study perspective on development directions for Dutch agriculture in 2050 **(Lesschen et al., 2020)**	Nature-inclusive stricter scenario	National The Netherlands	2050	All	yes	Research
P54.4	Broiler poultry production in Pays de Loire - Foresight to 2030 **(Labzaé et al., 2021)**	Societal disruption scenario	Infra-national France	2030	Poultry	yes	Public structure on agriculture
P67.2	Pathways project **(Pathways consortium, 2024)**	Rural renaissance	Europe	2050	All	yes	Research
P67.3	Pathways project **(Pathways consortium, 2024)**	Feed no Food	Europe	2050	All	yes	Research
P105.1	The Future of Agriculture - A common agenda **(Commission on the Future of Agriculture (ZKL), 2021)**	Change predominantly societal	National Germany	2030	All	no	Public structure on agriculture
P105.3	The Future of Agriculture - A common agenda **(Commission on the Future of Agriculture (ZKL), 2021)**	Change predominantly driven by regulation	National Germany	2030	All	no	Public structure on agriculture
P117	Vision Paper towards European Research and Innovation for a sustainable and competitive livestock production sector in Europe **(Peyraud et al., 2019)**	-	Europe	post-2020	All	no	Think tank
P119	Interdisciplinary foresight workshop: Science for tomorrow's livestock farming. Summary report. **(Peyraud et al., 2020)**	BAU	Europe	2050	All	no	Research

P122.6	Possible scenarios for the development of French pork production **(Chaib et al., 2023)**	The West comes to a halt	National France	2028	Pig	no	Research
P134.5	Franc-comtoise PDO milk production: potential and dynamics to 2030 **(Ropssi et al., 2017)**	Environmental excellence	Infra-national France	2030	Cattle (milk)	no	Public structure on agriculture
P159	Towards low-carbon regional economies - an experiment in Brittany **(The Shift Project, 2024)**	-	Infra-national France	2050	All	yes	Think tank
P161	Agriculture, forestry and food in a climate neutral EU. The land use sectors as part of a sustainable food system and bioeconomy. **(Agora Agriculture, 2024)**	-	Europe	2045	All	yes	Think tank
P168	Future of EU livestock: how to contribute to a sustainable agricultural sector? Final report **(Peyraud & MacLeod, 2020)**	-	Europe	2030-2050	All	no	Other public structure
P171.1	Imagining alternative futures for the Dutch poultry industry **(Smulders et al., 2025)**	Zero-emission policy development	National The Netherlands	2050	Poultry	no	Research
P171.2	Imagining alternative futures for the Dutch poultry industry **(Smulders et al., 2025)**	Farmers as entrepreneurial innovators	National The Netherlands	2050	Poultry	no	Research
P171.6	Imagining alternative futures for the Dutch poultry industry **(Smulders et al., 2025)**	Living labs in the knowledge economy	National The Netherlands	2050	Poultry	no	Research
P173.1	What types of agriculture are compatible with carbon neutrality in Brittany? Scenarios for achieving Factor 2 in 2050 **(Joya et al., 2023)**	Complementarities and diversification of Breton agriculture	Infra-national France	2050	All	yes	Think tank
P173.2	What types of agriculture are compatible with carbon neutrality in Brittany? Scenarios for achieving Factor 2 in 2050 **(Joya et al., 2023)**	Competitiveness and zootechnical efficiency	Infra-national France	2050	All	yes	Think tank
P174.1	Re-Livestock project: Deliverable 7.1 - Shared Socio-Economic Pathways for the European livestock sector **(Karner & Mitter, 2024)**	Eur-LFS-SSP1: European Livestock Farming Systems in a Sustainable Era	Europe	2050	All	no	Research
FAMILY 7 "(Much) less but better"							
P3	TYFA (Ten years for agroecology) **(Poux & Aubert, 2018)**	-	Europe	2050	All	yes	Think tank
P4.4	Possible developments in the livestock farming controversy point to five contrasting futures: A prospective analysis to 2040. **(Delanoue et al., 2018)**	Livestock farming produces less but with high added value	Europe	2040	All	no	Technical organisation
P4.5	Possible developments in the livestock farming controversy point to five contrasting futures: A prospective analysis to 2040. **(Delanoue et al., 2018)**	Mainstream vegan thinking marginalises meat eaters	Europe	2040	All	no	Technical organisation

P6.3	Prospective study of the ruminant meat sector in the Massif Central, horizon 2050 - five scenarios for better anticipation and adaptation **(Cerles et al., 2016)**	Agroeco	Infra-national France	2050	Cattle (meat)	yes	Research
P8.1	Transition(s) 2050 Choosing now to act for the climate **(ADEME, 2021)**	Frugal generation	National France	2050	All	yes	Other public structure
P8.2	Transition(s) 2050 Choosing now to act for the climate **(ADEME, 2021)**	Territorial cooperation	National France	2050	All	yes	Other public structure
P9.2	The Human-Animal relationship: five scenarios for 2030 **(Bidaud et al., 2016)**	The integrated aniamal	National France	2030	All	no	Public structure on agriculture
P18	Summary of the reference scenario of the French strategy for energy and climate **(Direction Générale de l'Energie et du Climat, Ministère de la transition écologique, de la biodiversité, de la forêt, de la mer et de la pêche, France, 2023)**	Reference scenario of the French strategy for energy and climate	National France	2050	All	yes	Other public structure
P30.5	Agroecological practices in combination with healthy diets can help meet EU food system policy targets **(Röös et al., 2022)**	Local agroecological food systems	Europe	2050	All	yes	Research
P33	From feed to food II - A new path for Danish agricultural production and food consumption within the planet's limits **(Greenpeace, 2022)**	From feed to food II	National Denmark	2040	All	yes	NGO
P35.1	Future Nordic diets **(Karlsson et al., 2017)**	Variant SY (Sufficiency)	Regional	2050	All	yes	Other public structure
P35.2	Future Nordic diets **(Karlsson et al., 2017)**	Variant EY (Efficiency)	Regional	2050	All	yes	Other public structure
P67.4	Pathways project **(Pathways consortium, 2024)**	High Animal Welfare	Europe	2050	All	yes	Research
P151.2	Analysis of the Occitanie region's food system, its sustainability and resilience. **(Alliot et al., 2023)**	Territorial cooperation	Infra-national France	2050	All	no	Other public structure
P163	Suckler farming: a new approach to break the deadlock **(Etienne & Uthayakumar, 2024)**	Durable	National France	post-2025	Cattle (meat)	no	NGO
P165.2	Two contrasted future scenarios for the French agro-food system **(Billen et al., 2018)**	Changing towards autonomy, reconnection and a demitarian diet	National France	2040	All	yes	Research
P171.5	Imagining alternative futures for the Dutch poultry industry **(Smulders et al., 2025)**	Happy animals and healthy humans	National The Netherlands	2050	Poultry	no	Research