



National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Horizon scan of **European food systems**

Basis for a strategic foresight study

Horizon scan of European food systems

Basis for a strategic foresight study

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Colophon

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Synopsis

Horizon scan of European food systems

Basis for a strategic foresight study

Food systems refer to everything involved in food production, processing and availability in supermarkets and shops, through to its consumption. These systems are subject to choices by politicians, industry, consumers and others with effects on health, the environment, society and the economy. Currently, Europe's food systems have too many adverse impacts on people and the environment. Extensive changes are needed to ensure sufficient availability of safe and healthy food, now and in the future, and to enable the development of fair, sustainable food systems.

The European FutureFoodS partnership brings together scientists from 29 countries who are working to accelerate those changes. In the context of this project, RIVM performed a horizon scan to identify which developments up to 2050 have the potential to affect European food systems. Examples of relevant developments include climate change, international conflict, ageing populations, economic growth and the power wielded by big companies.

RIVM then invited stakeholders from Italy, Bulgaria and Germany to discuss which developments they believe will have the greatest impact on food systems in their respective countries. Participants included representatives from various fields relating to food systems, such as policy, science, agriculture and industry, offering room to envision solutions based on these stakeholders' often disparate views on the required changes.

While all three countries consider climate change the most impactful development, there are differences as well. Germany thinks transitioning to a circular economy is important, while Bulgaria is most concerned about the availability of fresh water. Italy is convinced that AI will have major effects, both good and bad. RIVM believes that these differences must be taken into account to ensure countries' involvement to make the changes required to support Europe's future food systems.

The horizon scan may be used to explore different scenarios for the future of European food systems (foresight study). These scenarios can help to reveal where challenges and opportunities lie, creating a good starting point for European and national policy plans.

Key words: horizon scan, food systems, FutureFoodS, Europe, future, future exploration, developments, conceptual framework, climate change, nutrition

Publiekssamenvatting

Horizon scan van Europese voedselsystemen

Basis voor een strategische toekomstverkenning.

Een voedselsysteem is alles wat nodig is voor de productie en verwerking van voedsel, het aanbod in de supermarkt, tot en met de consumptie. De politiek, industrie, consumenten en anderen maken daarin keuzes die gevolgen hebben voor de gezondheid, het milieu, de maatschappij en de economie. Op dit moment hebben de voedselsystemen in Europa te veel negatieve gevolgen voor mens en milieu. Ingrijpende veranderingen zijn nodig om, nu en in de toekomst, genoeg veilig en gezond voedsel te hebben. En daarvoor voedselsystemen te ontwikkelen die duurzaam en eerlijk zijn.

Om deze verandering te versnellen, werken wetenschappers uit 29 landen samen in het Europese FutureFoodS project. Het RIVM bracht hiervoor in kaart welke ontwikkelingen tot 2050 invloed kunnen hebben op de Europese voedselsystemen. Dat heet een horizon scan. Voorbeelden zijn klimaatverandering, internationale conflicten, vergrijzing, economische groei en de macht van grote bedrijven.

Daarna besprak het RIVM met belanghebbenden uit drie landen welke ontwikkelingen volgens hen de meeste invloed op het voedselsysteem in hun land hebben. Dat waren Italië, Bulgarije en Duitsland. Hiervoor waren bewust vertegenwoordigers uit verschillende onderdelen van het voedselsysteem uitgenodigd, zoals beleid, wetenschap, landbouw en industrie. Zo was er ruimte om hun - vaak uiteenlopende - opvattingen over veranderingen te horen en hen bij oplossingen te betrekken.

Alle landen vinden klimaatverandering de belangrijkste ontwikkeling, maar er zijn ook verschillen. Duitsland legt de nadruk op de overgang naar een circulaire economie, terwijl Bulgarije vooral bezorgd is over de beschikbaarheid van zoetwater. Italië vindt de invloed van AI groot, zowel positief als negatief. Het is belangrijk om met deze verschillen rekening te houden om landen mee te krijgen bij de veranderingen die nodig zijn voor de Europese voedselsystemen van de toekomst.

De resultaten van deze horizonscan kunnen worden gebruikt om verschillende toekomstbeelden van Europese voedselsystemen te schetsen (toekomstverkenning). Deze beelden laten zien waar uitdagingen zijn en kansen liggen en vormen een goede basis om plannen te maken voor Europees en nationaal beleid.

Kernwoorden: horizon scan, voedselsystemen, FutureFoodS, Europa, toekomst, toekomstverkenning, ontwikkelingen, conceptueel raamwerk, klimaatverandering, voeding

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Summary

European food systems face major challenges. They have a large impact on the health of people and the planet. In the near future, they need to be more resilient to climate change, geopolitical disruptions and future supply chain shocks. A transition of food systems is necessary for sustainable and just food systems that provide healthy and safe nutrition for current and future generations.

The FutureFoodS European Partnership was established to accelerate this transition. Within FutureFoodS, an alliance of international organisations is working together on an observatory to monitor this transition now and in the future. To provide a basis for the transition monitoring and possible transition paths, RIVM publishes this horizon scan.

A horizon scan is the first part of a strategic foresight study. It answers the question: What future is coming to us, with regard to the European food systems? This horizon scan contains (1) a conceptual framework of European food systems, (2) a corresponding glossary of definitions, (3) a selection of the most relevant and uncertain drivers most likely to shape the future of European food systems and (4) a description of that impact on regional food systems.

The horizon scan consisted of two parts: First, we did a desk study on future driving forces relevant for the food system in Europe. Second, workshops with experts were organised to prioritise the driving forces and discuss causal mechanisms.

For the literature study, we used horizon scans performed for Dutch foresight studies complemented with international studies. To take the diversity within the EU into account, we have selected three European countries for the workshops: Bulgaria, Germany and Italy respectively in Eastern Europe, North-Western Europe and Southern Europe. The workshops were organised with a multidisciplinary group of participants. With these diverse groups of policy makers, (scientific) experts, representatives of non-profit organisations and the private sector, we were able to ensure a broad spectrum of perspectives on the food systems and the challenges. In each country, we asked participants to prioritise the list of driving forces: In their opinion, which driving forces were most relevant and uncertain for the future of their food system? We also asked them to illustrate how these driving forces would affect health, the environment, the economy and the social context in their country.

The results of the workshops showed similarities and differences. In all countries, participants prioritised climate change as the most impactful trend, followed by increasing food modification and technology and increasing geopolitical instability and conflicts. There were also clear regional differences in priorities. Italian participants prioritised the rise of AI and machine learning, while German participants scored the transition to a circular economy high. Bulgarian participants prioritised

the declining availability of fresh water as an important trend for their food system. These differences illustrate that the relative urgency and relevance of specific challenges to the food system differ significantly across European regions.

This horizon scan underlines both the value of a comparative, multi-country approach and the importance of taking into account regional variation in the development of European food system policy. The results of this horizon scan provide a strong and nuanced basis for the next phase of the FutureFoodS partnership, in which we will develop coherent, policy-relevant scenarios.

Keywords: foresight study, horizon scan, conceptual framework, driving forces, regional food systems, FutureFoodS, Europe, future, climate change, food

1 Introduction

European food systems are facing major challenges, now and in the future. Food systems need to provide safe, affordable, nutritious and healthy food within the planetary boundaries. At the same time, they need to be prepared for a growing population and become more resilient to climate change, geopolitical disruption, and future supply chain shocks. Yet, translating these complex challenges into actionable policy strategies remains difficult. Policymakers not only need to understand the current challenges but also need to anticipate future trends that will shape food systems.

Food systems are the primary driver in exceeding five of the nine planetary boundaries that define a “safe operating space” for humanity, including land system change, biosphere integrity, freshwater change, biogeochemical flows and greenhouse gas emissions driving climate change [1, 2]. Globally, food production accounts for 26% of greenhouse gas emissions, and 70% of freshwater withdrawals and 78% of marine and freshwater eutrophication are used for agriculture [3]. Within the EU, food systems (from agricultural production to dietary patterns) are responsible for 30% of greenhouse gas emissions [4] and produce almost 60 million tons of food waste annually [5]. Beyond their environmental impact, food systems also contribute significantly to non-communicable diseases including obesity, cardiovascular diseases, type 2 diabetes, and cancer, which are the leading cause of morbidity and mortality in the European Region and place a substantial burden in healthcare systems [6, 7]. A transition of food systems, including dietary changes, is therefore essential to achieve sustainable and just food systems that provide healthy and safe food for current and future generations [2].

The FutureFoodS partnership was created to support the transition towards healthy, safe, environmentally friendly, socially secure, fair, and economically viable food systems for Europe [8]. This partnership, co-funded by the European Commission, has developed four key research and innovation areas to drive the change towards sustainable food systems: 1) change the way we eat, 2) change the way we process and supply food, 3) change the way we connect with food systems, and 4) change the way we govern food systems. Within this partnership, RIVM leads Task 5.5, which aims to use strategic foresight to depict the future of food systems.

Strategic foresight is a systematic and proactive approach used to explore and anticipate future trends, challenges, and opportunities to inform and guide decision-making and strategy development. Rather than predicting the future, strategic foresight enables policy makers to proactively anticipate possible futures and to support policies aimed at transitioning the food system. Strategic foresight usually consists of three common building blocks focusing on different foresight questions: 1) what future(s) are we facing, 2) what are the most important challenges raising from these futures and 3) what are options for action to target these challenges [9].

Within the first instalment of FutureFoodS (2024-2026), a horizon scan as part of strategic foresight is employed to explore how future European food systems are influenced by driving forces such as climate change, geopolitical disruption, shifting consumer preferences, and technological innovation. Horizon scanning is a foresight method that systematically identifies and assesses the trends and driving forces most likely to shape the future of a given domain. It draws on literature and knowledge of a diverse range of stakeholders. This horizon scan is a central part of Task 5.5.

The horizon scan identifies key driving forces, uncertainties, and emerging developments that will shape the future of European food systems. By systematically exploring "what future(s) we are facing", the scan provides a foundation for further analysis of challenges, opportunities thereby informing policy development. The results are shared within the FutureFoodS observatory, a platform for exchanging methods, data, and assessments related to the transition towards sustainable European food systems.

With this horizon scan, we aim to equip policymakers, researchers, and stakeholders with relevant insights into the driving forces that will influence the future of food systems in Europe. In this way, our research contributes to the shared ambition of FutureFoodS: achieving healthy, safe, fair, and environmentally friendly food systems within planetary boundaries.

Structure of the report

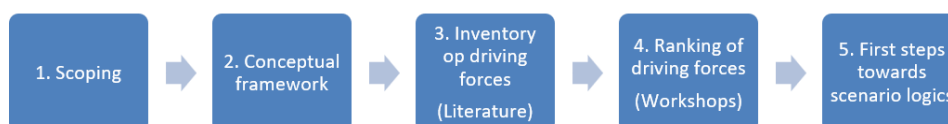
This report describes a horizon scan of the future of Europe food systems. In Chapter 2 we describe the methodology, followed by the results in Chapter 3, including the conceptual framework, the longlist of driving forces and findings of three country workshops in Bulgaria, Germany and Italy. In Chapter 4, we then highlight the similarities and differences in findings between the three country workshops. Additionally, we reflect on the methodology used and take a first look at the next steps for scenario development. Chapter 5 entails the discussion and Chapter 6 describes the conclusions and recommendations for next steps. Supplementary materials can be found in the appendices. An overview of the references for the inventory of driving forces (Appendix 1), and a description of the driving forces (Annex 2) can be found here, as well as a list of the participants (Annex 3) and results per country (Annex 4). Lastly, a glossary is available that accompanies the conceptual framework (Annex 5)

More information available: <https://www.futurefoodpartnership.eu/>

2 Horizon scanning methodology

Many approaches, methods and tools exist to conduct a foresight study [9]. The choice for the method and tools follows the question to be addressed. Within this foresight exercise, we focused on the question “What futures are we facing regarding the European food systems?”. Therefore, a horizon scan was chosen as method. Within the horizon scan, we followed the following steps: 1) scoping; 2) the development of a conceptual framework; 3) the inventory of the driving forces; 4) ranking the drivers by importance and uncertainty, and 5) first step towards scenario logics and scenario development (see Figure 1). These first steps lay the basis to develop scenarios.

Figure 1 Steps of the horizon scanning within a strategic foresight study



2.1 Scoping

We started this horizon scan with further defining its scope. For FutureFoodS this comprised the following aspects.

Geographical location

The primary focus was the EU and the European food systems. However, European food systems are linked to global and regional levels. Global issues, such as climate change influence the European food systems. The challenge is to find a balance between the EU level, where policy strategies are formed, while accounting for the diversity in the EU. Therefore, country workshops were organised in three in European countries: Bulgaria, Germany and Italy.

Time horizon

We are looking 25 years ahead, approximately at the year 2050. This time horizon was chosen to fully cover structural changes. We are looking at the whole period, from now until 2050, to be already relevant for policy development in the coming years.

Topical focus

- FutureFoodS addresses the food system from post-harvesting and onward. Pre-harvesting is part of the EU-partnership Agroecology, which focusses on the transition towards resilient, productive and prosperous farming systems [10]. In practice, it proved not always possible to maintain this distinction. Where pre-harvesting aspects were also relevant, they have been included in this analysis.
- The food system is influenced by a broad range of driving forces, therefore we are looking at broad trends and broad impacts. Regarding the impacts, we look at four food system outcomes: environment, health, social, economy.

Stakeholder engagement

Foresight studies, including this horizon scan, are done more and more with the intensive engagement of stakeholders. We chose to actively engage stakeholders as this leads to better informed, more democratic and more effective decisions [11].

2.2 Development of conceptual framework

Every foresight study is ideally based on a conceptual framework, either an existing one or a fitting framework developed in the project. A conceptual framework helps to further scope the study, and to structure complexity. A conceptual framework provides a visual map of a food system: what is included, what is excluded, and how do parts relate to each other. It also supports how driving forces are related to the impacts.

For this study, an existing framework was not readily available that fully captured the complexity and scope of the European food systems in the context of a foresight exercise. A new conceptual framework was therefore developed, specifically tailored to the needs of this foresight exercise within the FutureFoodS partnership. The starting point for this development was the Drivers-Pressure-State-Impact-Response (DPSIR) framework. This is a well-established framework commonly used to map the relationships between external pressures, system conditions, resulting impacts, and policy or societal responses [12].

To ensure that the framework adequately reflected the specificities of the European food systems, a literature search was conducted to identify existing food system frameworks at the European level. Four relevant frameworks were selected for further analysis: the Food System Activities Framework by SCAR [13], the Food Systems Countdown Initiative Framework [14], the FOSTER Concept Frame [15], and the Food System Model developed by the Joint Research Centre [16]. Each of these frameworks offered valuable perspectives and elements, and the most relevant components of each were selected and integrated with the DPSIR structure. This synthesis process resulted in a concept version of a conceptual framework.

To further develop and validate the framework, a working group was established comprising FutureFoodS partners with relevant expertise. The working group convened twice, with the research team revising the framework after each session based on the feedback received. Partners who were unable to attend the meetings were given the opportunity to contribute their input via email, ensuring broad participation in the development process. Feedback was also gathered from a wider group of FutureFoodS partners, including those working on the Strategic Research and Innovation Agenda (SRIA), thereby further enriching the framework with diverse perspectives from across the partnership. Following this iterative process of consultation and refinement, the RIVM research team produced the final version of the framework (see Chapter 3).

2.3 Inventory and ranking of driving forces

The inventory and selection of the driving forces is an important first step in horizon scanning. First an inventory of driving forces is made by desktop research. Stakeholders were asked to rank the longlist of driving forces.

2.3.1 *Selection of driving forces using a desktop search*

An inventory of driving forces impacting the European food systems was made based on a review of recent literature, including grey literature. This includes reports from SCAR, JRC and the FAO for example. A driving force is a trend or development that has the potential to shape the future of food systems. Literature containing information on driving forces relevant to the European food systems were included. A complete list of included literature can be found in Appendix 1. The DESTEP-methodology (an acronym for demographic, economic, social-cultural, technological, environmental, and political-institutional) was used to organise the inventory of driving forces. For each driving force, a short description was formulated (see Appendix 3).

2.3.2 *Ranking driving forces in country workshops*

Three country workshops were organised between October 2025 and January 2026 to rank the longlist of driving forces. To reflect the diversity of food systems across Europe, the country workshop were held in Italy (Southern Europe), Bulgaria (Eastern Europe), and Germany (North-western Europe). Country selection was primarily driven by the presence of FutureFoodS partners willing to collaborate. Local partners were essential for stakeholder outreach and hosting of the workshops. Countries with atypical food systems, such as the Netherlands with its exceptional import/export profile, were excluded. Rather than being selected as representative cases, these three countries were chosen to reflect the diversity of food systems across Europe and to surface regional differences in how stakeholders perceive and prioritise driving forces shaping the future of food.

The local organising partners were the University of Food Technologies (UFT) in Bulgaria, the Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB) in Germany, and the Council for Agricultural Research and Economics – Research Center on Food and Nutrition (CREA) in Italy.

For the workshops, stakeholders from different fields of the food systems were invited including policy makers, scientific experts, and representatives of non-profit organisations and the private sector. Horizon scanning is inherently a broad exercise and should not be limited by the boundaries of any single discipline or institution. Engaging a diverse group of stakeholders, varying from researchers and policymakers to representatives of the private and non-profit sector, enables to have a diversity in perspectives and expertise. Beyond methodological quality, the participation of stakeholders strengthens shared ownership of the foresight process.

For each session there was a minimum of 15 national participants. Additionally, a maximum of five FutureFoodS WP5-partners from other countries in the region were invited. The WP5-partners were asked to share their expertise on a regional level (e.g. the Danish WP5-partner can give input from Denmark and the Danish food system during the German workshop). A list of participants per country can be found in Appendix 3.

The stakeholder workshops consisted of three parts. First, participants were asked to write down the impacts of the identified driving forces on the outcomes of the regional food systems (social, health, economy and environment). Additionally, participants had the opportunity to write down missing driving forces. This exercise helps the participants to familiarise themselves with the driving forces and to make a more weighted decisions when later scoring the driving forces.

The second part of the stakeholder workshops revolved around scoring the driving forces based on relevance and uncertainty. First, the relevance was scored. Participants each received eight stickers which they had to distribute amongst the driving forces of which they thought were most relevant. The same was then done for the uncertainty of the driving forces. With uncertainty we mean the combination of uncertainty regarding how the driving force will develop and uncertainty in the specific impact on the food system. Assessing uncertainty is essential in a horizon scan, because not every driving force will develop in the same way: some may accelerate, stall, or reverse.

For each country, the absolute sticker scores were converted into percentages. Based on these percentages, the longlist of 38 drivers was ranked from most to least impactful, after which the four most impactful drivers were selected per country (Appendix 4). This was an arbitrary cut-off point, chosen for practical reasons.

During the last part of the workshops in Germany and Italy, stakeholders were divided into four groups where they were asked to develop two scenarios for a specific theme: a best-case and a worst-case scenario. The themes were based on the four key objectives of the FutureFoodS partnership as mentioned in the introduction: change the way we eat, change the way we process and supply food, change the way we govern food system, and change the way we connect to food systems. The prioritised driving forces served as a basis for the scenario development.

3 Results of horizon scanning

This chapter presents the results of the horizon scan, consisting of the conceptual framework, the longlist of driving forces and the results of three country workshops conducted in Bulgaria, Germany, and Italy.

3.1 Conceptual framework

The newly developed conceptual framework is presented in Figure 2. Alongside the conceptual framework, a glossary was developed simultaneously by the RIVM research team and the working group. In addition to definitions, the glossary includes examples of potential indicators for each component of the conceptual framework. Indicators from the JRC dashboard and the position papers in which WP5 partners shared their vision on the purpose, use and design of the Food System Observatory, among others, have been mapped to the conceptual framework to help illustrate how existing data sources and monitoring tools align with the framework's structure [17]. It is worth noting that work on indicators was carried out in parallel within Tasks 5.1 and 5.2 of the FutureFoodS partnership, offering further opportunities for alignment and integration going forward. The full glossary can be found in Appendix 5. Below, a brief description of the main concepts of the framework is provided.

3.1.1 *Driving forces*

The first block of the conceptual framework concerns the driving forces. The DESTEP categorisation (Demographic, Economic, Social-cultural, Technological, Environmental and Political-institutional) was used to systematically structure the driving forces shaping the European food system. Working with the DESTEP categories ensures the broad selection of trends that drive changes across the food system.

3.1.2 *Food system activities*

The second block of the conceptual framework concerns food system activities. These encompass all activities related to food supply chains, food environments, and food demand, as well as the use of natural resources, consumption and diets, and waste, by-products and recycling. Together, these activities form the core of the food system as studied within FutureFoodS, covering the post-harvesting stage onward.

3.1.3 *Food system outcomes*

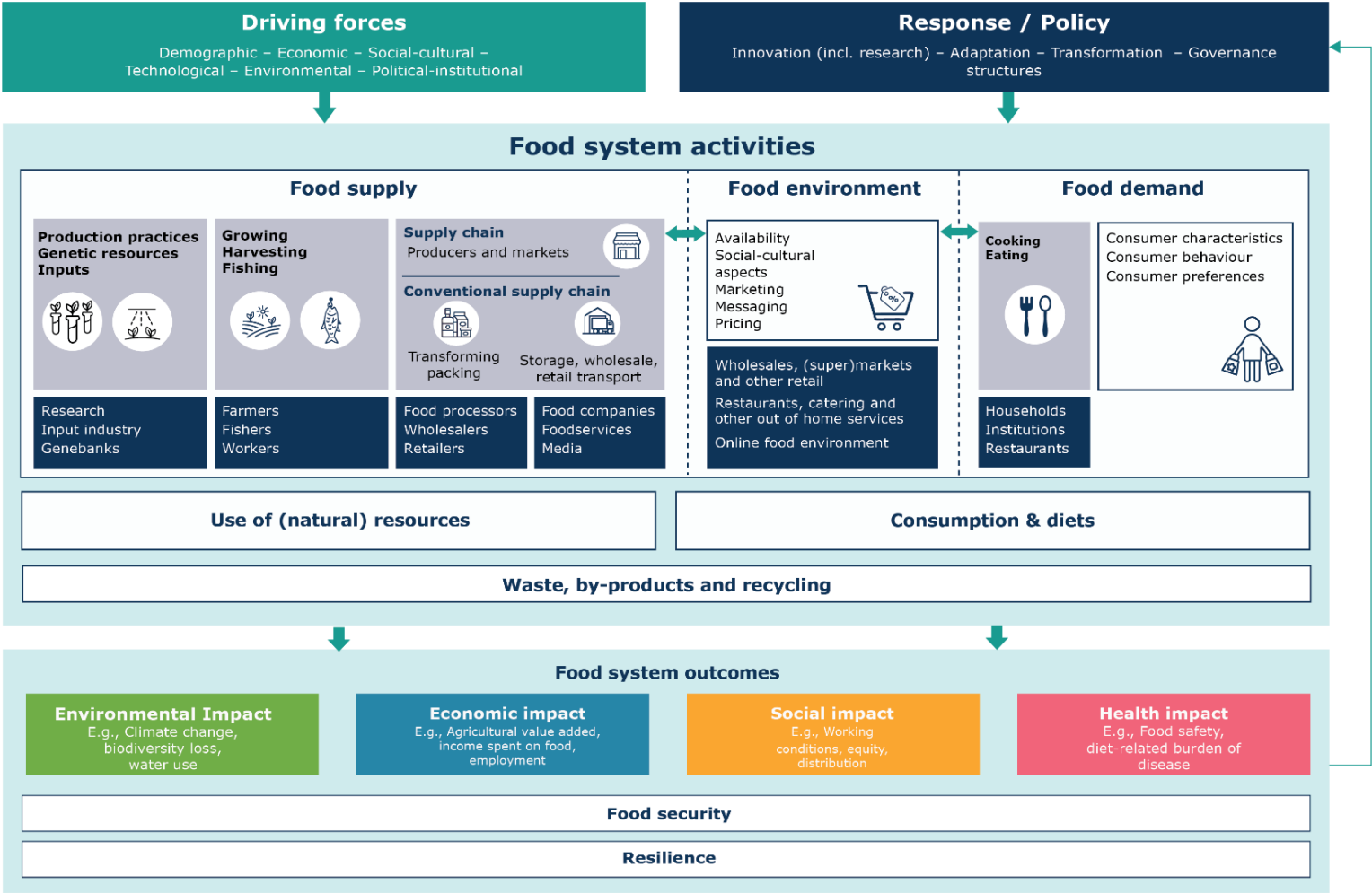
The third block of the conceptual framework concerns food system outcomes. These represent the environmental, economic, social and health impacts that result from food system activities. It also encompasses food security & resilience. Together, these dimensions capture the broad effects that changes in the food system can have on people, societies, and the planet. These outcomes are the ultimate focus of the FutureFoodS foresight study by understanding how driving forces and food system activities combine to shape these impacts across the EU towards 2050.

3.1.4

Response/policy

This last block encompasses the governance structures and policies that address the European food systems. It includes policy measures focused on adaptation, innovation, research, and transformation, supported by governance structures that provide the framework to implement changes. Areas such as public procurement are also relevant in this context. The policies and responses influence food system activities and can steer the direction of change across the food system. These policies can be fed and triggered by food system outcomes.

Figure 2 FutureFoodS conceptual framework



3.2 Longlist of driving forces

The desktop search resulted in a longlist of 38 driving forces influencing the European food systems, divided over the six DESTEP-domains (see Table 1). Six demographic, seven economic and seven social-cultural driving forces were included. For the technological and environmental domains, five driving forces were identified. Lastly, the search yielded eight political-institutional driving forces.

Table 1 Inventory of driving forces from literature

Demographic	Economic	Social-cultural	Technological	Environmental	Political-institutional
Population decline	Increasing globalisation	Increasing individualisation	Increasing digitalisation	Climate change continues	Multi-actor governance
Ageing society	Economic growth (in GDP)	Decreasing social cohesion	Increasing automation and use of robotics	Soil degradation	Multi-level governance
Increasing urbanisation	Increasing within-country income inequalities	Growing (social-cultural) diversity	Increasing Artificial Intelligence (AI) and machine learning	Decreasing availability of fresh water	Shift towards a multi-polar world order
Population decline in rural areas	Increasing labour market flexibility	Diversifying inequalities	Increasing food modification and technology	Increasing zoonotic and infectious disease risks	Increasing decentralisation
Increasing migration	Towards a circular economy	Increasing education levels	Increasing social media use	From fossil fuels to sustainable energy sources	Increasing geopolitical instability and conflict
Changing household sizes and compositions	Rising price volatility	Increasing awareness on sustainability and health			Increasing political division and polarisation
	Increase in big companies and decrease in smaller companies	Increasing preference for convenience			Increasing public distrust
					Increasing pressure on public expenditures

3.3 Results of the country workshops

Below, the results of the three country workshops are described. For each country workshop, a brief overview of the main characteristics of the national food system is provided (the country profile), followed by an overview of the workshop participants. The country profiles serve as background information and is not meant to be exhaustive. Next, the

driving forces identified by stakeholders as most relevant and most uncertain for the future of the food system in each country are provided. Finally, the impacts of the most relevant driving forces are described, drawing on the workshop discussions to illustrate how these driving forces may influence health, economic, environmental, and social outcomes regarding food systems within each national context.

3.3.1

Bulgaria

The following section provides an overview of key aspects related to the Bulgarian food system and the results from its country workshop.

Country profile of the Bulgarian food system

While agriculture accounts for a relatively modest share of Bulgaria's Gross Domestic Product (GDP), agricultural land covers half of the country's territory [18]. This land is used for the cultivation of a variety of cereals, pulses, fruit trees, and vegetables, and remains critical for rural livelihoods. Bulgaria is self-sufficient in basic and traditional foods, with agricultural products such as wheat and meslin among its top five exports. The country is also a leading EU producer of essential oils and organic products, well-known for herbs, yoghurt, cheese, grapes and wine [19]. The Bulgarian production sector features fragmented land ownership; however, the number of small farms is declining as consolidation increases, resulting in more arable land and a higher number of animals kept on farms. The sector is adopting new agri-food technologies but faces challenges such as an aging workforce and a need for greater investment in research and innovation [20].

Workshop participants

A total of 14 local stakeholders and two FutureFoodS partners participated in the Bulgarian stakeholder workshop, which was held in Plovdiv. The group was composed of a diverse range of actors, including four policymakers, five scientific experts, two representatives of a non-profit organisation and three participants from the private sector. This multidisciplinary composition ensured a broad spectrum of perspectives on the Bulgarian food system and its challenges. In addition to the Bulgarian stakeholders, two partners from the FutureFoodS consortium were present, one from Slovenia, and one from Serbia to contribute insights from the wider Eastern European context. The inclusion of these consortium partners facilitated a richer exchange of knowledge and helped to align the Bulgarian session with broader regional trends and priorities. A detailed list of all participants is provided in Appendix 3.

Identification of relevant or uncertain driving forces for food systems
Stakeholders in the Bulgarian workshops were asked to prioritise the longlist of 38 driving forces, based on their relevance and uncertainty for the future of the Bulgarian food system. The results of the stakeholder prioritisation process are presented in Tables 2 and 3. The overlap between the lists of most relevant and most uncertain driving forces proved to be limited.

*Table 2 Driving forces identified during the workshop as **most relevant** for the Bulgarian food system*

Driving force	Short description
Climate change continues	Climate change is accelerating, bringing more extreme weather, rising temperatures, flooding, and drought.
Increasing food modification and technology	Scientific and technological advancements are transforming food production through innovations such as genetic modification, plant-based and alternative proteins, food fortification, and cellular agriculture.
Decreasing availability of fresh water	Freshwater availability is expected to become increasingly uneven across regions, with climate change, shifting land use, and rising demand collectively reducing effective water supplies and putting growing pressure on agriculture, ecosystems, and urban water use.
Increasing awareness on sustainability and health	Consumers are increasingly prioritising transparency, sustainability, and ethical sourcing in their food choices, alongside a growing shift towards healthier behaviours such as vegetarianism, veganism, and reduced consumption of health-harming products.

*Table 3 Driving forces identified during the workshop as **most uncertain** for the Bulgarian food system*

Driving force	Description
Increasing labour market flexibility	Flexible and non-standard forms of work are expected to grow, with short-term contracts, part-time jobs, and self-employment potentially widening inequalities in income, job security, and career opportunities particularly for women and migrant workers.
Population decline	While global population continues to rise, many regions — particularly in Europe — face declining fertility rates and population shrinkage, which migration may partially offset but is unlikely to fully reverse.
Increasing globalisation	The growing interconnectedness of economies, cultures, and markets drives efficiency gains but also creates vulnerabilities, as supply chains become concentrated and susceptible to trade conflicts and geopolitical disruptions.
Increasing individualisation	People are increasingly making choices based on personal preferences rather than collective or traditional values, leading to greater individual autonomy and diversity of choice, while reshaping social cohesion and community engagement.

Climate change was identified as the most relevant driving force impacting the Bulgarian food system by the majority of stakeholders. Other highly prioritised driving forces included increasing food modification and technology, decreasing availability of fresh water, and growing consumer awareness around sustainability and health. While these driving forces were broadly considered relevant, there was less unanimity among stakeholders compared to climate change. Together, the prioritised driving forces span multiple DESTEP domains, those being the environmental, technological, and socio-cultural domain, reflecting the multidimensional nature of the pressures facing the Bulgarian food system.

Increasing labour market flexibility, population decline, increasing globalisation, and increasing individualisation were identified as the most uncertain driving forces in the Bulgarian context. Notably, when zooming in on the driving forces considered most relevant, these too were scored as relatively uncertain, highlighting the challenge of anticipating how key pressures on the food system will unfold.

During the stakeholder workshops, participants also put forward additional driving forces not included in the original longlist of 38 driving forces. After given all the proposed driving forces full consideration, we decided to add the driving force loss of biodiversity as a separate driving force, rather than part of climate change.

Impacts of driving forces

During the workshop, participants discussed the potential impacts of the identified driving forces on both the food system itself and its outcomes, including health, economic, environmental, and social dimensions. The impacts of the four main driving forces, as described by the stakeholders, are presented below.

Ongoing climate change is expected to decrease food quality, though technological advancements may help mitigate some negative effects. Stakeholders noted that climate change will affect working conditions for seasonal workers and increase the need for climate-resilient crops, microbial proteins, and alternative, climate-smart agricultural approaches. Warmer temperatures are likely to heighten pest pressure, prompting further research into crop adaptation and resilience.

Water scarcity poses a threat to environmental and ecosystem health, drives greater use of fertilisers (and consequent pollution), and highlights the necessity for improved water management strategies. This challenge creates opportunities to adopt alternative agricultural practices, such as no-till farming, agroforestry, and the cultivation of local crop varieties.

Advances in food technology, including crop modification for climate adaptation and increased resilience, are anticipated to have significant health and nutrition impacts. While these technologies may enhance food processing and food security, they could also face scepticism or rejection from consumers. Stakeholders pointed to potential consequences such as increased pressure to withhold information, higher prevalence of processed foods, higher prices for raw foods, and a rise in food intolerances.

Finally, greater public awareness on health and sustainability is driving investments in food innovation. However, the diversity and reliability of available information about food can be confusing for consumers. This situation presents an opportunity for authorities to enhance regulation, labelling, and quality control, which could ultimately improve food quality and enable better-informed consumer choices.

3.3.2 *Germany*

The following section provides an overview of key aspects related to the German food system and the results from its country workshop.

Country profile of the German food system

The German food system is characterised by a strong focus on animal-based production, with livestock farming, particularly pigs, cattle, and poultry playing a central role. Germany is the largest milk producer in the EU and the largest European producer of pork, with grains, rapeseed, sugar beet, and potatoes also featuring prominently. Around 60% of farmland is used to produce animal feed, reflecting the dominance of livestock in the agricultural sector [21]. The sector is largely self-sufficient in staple foods but relies on imports for fruits, vegetables, soy and tropical products. With approximately 11% of agricultural land under organic cultivation and the largest organic retail market in the EU, Germany is a frontrunner in organic farming [22]. The food industry employs around 5.4 million people across nearly 700,000 companies, making it one of the most important economic sectors in the country and accounting for approximately 12% of total industrial employment, with the sector predominantly composed of small and medium-sized enterprises [23].

Workshop participants

A total of 16 local stakeholders and two FutureFoodS partners participated in the German stakeholder session, which was held in Berlin. The group was composed of a diverse range of actors, including 11 (scientific) experts, two representatives of non-profit organisations, and four representatives of the private sector. As with the workshop in Bulgaria, this multidisciplinary composition ensured a broad spectrum of perspectives on the German food system and its challenges. In addition to the German stakeholders, two partners from the FutureFoodS consortium were present, one from Aarhus university in Denmark, and one from the Federal Office for Agriculture and Food (BLE). The inclusion of these consortium partners facilitated a richer exchange of knowledge and helped to align the German session with broader regional trends and priorities. A detailed list of all participants is provided in Appendix 3.

Identification of relevant or uncertain driving forces for food systems

The aforementioned longlist of 38 identified driving forces for the European food system were scored during the workshop in Germany. Again, stakeholders had to score driving forces based on their relevance and uncertainty for the Germany food system. The results of the German stakeholder workshop are presented in Table 4 and 5, providing an overview of the most relevant and most uncertain driving forces.

*Table 4 Driving forces identified during the workshop as **most relevant** for the German food system*

Driving force	Description
Climate change continues	Climate change is accelerating, bringing more extreme weather, rising temperatures, flooding, and drought.
Towards a circular economy	There is a growing shift towards a circular economy, where products and materials are designed for reuse, recycling, and recovery, driving more efficient resource use, reduced environmental pressures, and greater innovation in production and consumption.
Increasing geopolitical instability and conflict	Geopolitical tensions and conflict are expected to intensify towards 2050, disrupting stability and daily life while placing growing pressure on neighbouring regions through migration, humanitarian crises, and resource strain.
Increasing food modification and technology	Scientific and technological advancements are transforming food production through innovations such as genetic modification, plant-based and alternative proteins, food fortification, and cellular agriculture.

*Table 5 Driving forces identified during the workshop as **most uncertain** for the German food system*

Driving force	Description
Increasing AI and ML	The use of artificial intelligence and machine learning in society is expected to grow significantly, enabling pattern recognition and self-learning systems that could drive far-reaching changes across many sectors.
Increasing awareness on sustainability and health	Consumers are increasingly prioritising transparency, sustainability, and ethical sourcing in their food choices, alongside a growing shift towards healthier behaviours such as vegetarianism, veganism, and reduced consumption of health-harming products.
Increasing political division and polarisation	Political polarisation is expected to intensify, driven by economic inequality, cultural diversity, and mistrust in institutions, making consensus-building increasingly difficult and risking greater social fragmentation.
Increasing food modification and technology	Consumers are increasingly prioritising transparency, sustainability, and ethical sourcing in their food choices, alongside a growing shift towards healthier behaviours such as vegetarianism, veganism, and reduced consumption of health-harming products.

Climate change was seen as the most impactful driving force amongst the 38 identified driving forces. Towards a circular economy was also seen as a highly relevant driving force for the food system in Germany. Amongst the higher ranked driving forces were also increasing geopolitical conflict and instability and increasing food modification and technology. Driving forces from multiple DESTEP-domains were thus prioritised, including an environmental, economic, political-institutional and technological ones.

Driving forces that scored highest on uncertainty were increasing AI and ML, increasing awareness on sustainability and health, increasing

political division and polarisation, and increasing food modification and technology. Comparing the most relevant and most uncertain driving forces, we see that Increasing food modification and technology appeared on both lists. The other most relevant trends were also seen as quite uncertain, despite being absent in Table 5.

In addition to the above-mentioned driving forces, workshop participants advocated to add loss of biodiversity as a separate driving force, rather than incorporating it in climate change.

Impacts of driving forces

This section explores the impact of the key driving forces shaping the future of the German food system, as identified and discussed by stakeholders during the workshop. By examining these driving forces and their potential impacts, this section provides insight into the opportunities and challenges facing the German food system in the coming years.

Ongoing climate change is expected to decrease the quality and quantity of agricultural products and raw materials, with increased heat stress affecting both crops and livestock. As droughts and floods disrupt supply chains and strain food system resilience, the risk of food shortages and rising prices increases. Shifts in trade flows and production patterns across Europe may create new opportunities for Germany, such as longer growing seasons and the introduction of new crop types, but animal health and welfare concerns are also expected to intensify.

Transitioning towards a circular economy opens up new business models and may enhance the food system's resilience to market disruptions. Greater focus on sustainability will drive the development of new standards for circular packaging and products derived from side-streams. Increased self- and organisational movements can spur innovation, though attention must be paid to the safety of new materials (such as non-intentionally added substances, NIAS).

Rising geopolitical instability increases food price volatility and disrupts global supply chains. To manage these risks, Germany may diversify its sources of raw materials, but this approach can also lead to a split between EU-focused food sovereignty and international trade. Trust in global trade may decrease, resulting in greater reliance on national and regional food supplies.

Technological advances are leading to the creation of new foods and the use of genetic engineering, sparking debates about naturalness and authenticity. These trends may influence social behaviours and attitudes towards food, with phenomena such as the Ozempic trend, convenience foods, and scientific approaches shaping food culture and eating habits. The demand for raw materials for new technologies, increased patenting of conventional breeding, and potential reductions in seed diversity are also areas of concern.

3.3.3

Italy

The following section provides an overview of key aspects related to the Italian food system and the results from its country workshop.

Country profile of Italian food system

Italy is one of Europe's leading agricultural producers and food processors. The north of the country specialises in grains, soybeans, meat and dairy, while the south focuses on fruits, vegetables, olive oil, wine and durum wheat. Despite its strong domestic production and being a major exporter of products such as wine, cheese, pasta and olive oil, Italy relies significantly on agricultural imports to support its food manufacturing and animal production [24]. Key imports include coffee, live cattle, corn, wheat and soybean, among others. Italy leads the EU in agricultural added value and holds the largest number of Protected Designation of Origin (PDO) and Protected Geographical Information (PGI) certified products (over 800) reflecting a food system built around quality, regional identity, and the globally recognised Made in Italy brand. The country also has one of the highest shares of organic agricultural area at the EU level (19%) [25]. The Italian food value chain is predominantly composed of small and medium-sized family-owned enterprises. At the consumer level, health and wellness trends continue to shape demand.

Workshop participants

A total of 21 stakeholders and 3 FutureFoodS partners participated in the Italian stakeholder session, which was held in Rome. Also in Italy the group was composed of a diverse range of actors, including two policymakers, ten scientific experts, four representatives from non-profit organisations, and five participants from the private sector. This multidisciplinary composition ensured a broad spectrum of perspectives on the Italian food system and its challenges. In addition to the Italian stakeholders, three partners from the FutureFoodS consortium were present, one from EA: Education research and technology in Greece, one Italian partner of CIHEAM Bari and one Italian partner from the Ministry of Agriculture, Food Sovereignty and Forests (MASAF) - Technical expert FutureFoodS to contribute insights from the wider Eastern European context. The inclusion of these consortium partners facilitated a richer exchange of knowledge and helped to align the Italian session with broader regional trends and priorities. A detailed list of all participants is provided in Appendix 3.

Identification of relevant or uncertain driving forces for food systems
Italian stakeholders also assessed the relevance and uncertainty of the 38 identified driving forces. The outcomes of this scoring exercise are presented in Table 6 (most relevant driving forces), and Table 7 (most uncertain driving forces). The complete, ranked list of trends as evaluated by the Italian stakeholders is provided in Appendix 4.

*Table 6 Driving forces identified during the workshop as **most relevant** for the Italian food system*

Driving forces	Description
Climate change continues	Climate change is accelerating, bringing more extreme weather, rising temperatures, flooding, and drought.
Increasing AI and ML*	The use of artificial intelligence and machine learning in society is expected to grow significantly, enabling pattern recognition and self-learning systems that could drive far-reaching changes across many sectors.
Increasing geopolitical instability and conflict*	Geopolitical tensions and conflict are expected to intensify towards 2050, disrupting stability and daily life while placing growing pressure on neighbouring regions through migration, humanitarian crises, and resource strain.
Increase in big companies and decrease in smaller companies	Food production and agricultural supply chains are increasingly dominated by a small number of large companies.

* Shared place in ranking

*Table 7 Driving forces identified during the workshop as **most uncertain** for Italian food system*

Driving forces	Description
Increasing geopolitical instability and conflict	Geopolitical tensions and conflict are expected to intensify towards 2050, disrupting stability and daily life while placing growing pressure on neighbouring regions through migration, humanitarian crises, and resource strain.
Increasing food modification and technology	Scientific and technological advancements are transforming food production through innovations such as genetic modification, plant-based and alternative proteins, food fortification, and cellular agriculture.
Increasing AI and ML	The use of artificial intelligence and machine learning in society is expected to grow significantly, enabling pattern recognition and self-learning systems that could drive far-reaching changes across many sectors.
Increasing awareness on sustainability and health	Consumers are increasingly prioritising transparency, sustainability, and ethical sourcing in their food choices, alongside a growing shift towards healthier behaviours such as vegetarianism, veganism, and reduced consumption of health-harming products.

A majority of stakeholders identified climate change as the most critical driving force influencing the future of the Italian food system. In addition to climate change, the advancement of Artificial Intelligence (AI) and Machine Learning (ML), along with increasing geopolitical instability and conflict, were also perceived as highly significant. Furthermore, market concentration among large companies was considered particularly relevant within the Italian context. The prioritisation of these driving forces reflects the importance of multiple DESTEP domains, including environmental, technological, economic, and political-institutional dimensions.

Notably, both the advancement of AI and ML and the escalation of geopolitical conflict, two driving forces assessed as highly relevant, were also characterised by a high degree of uncertainty. Additional driving forces identified as highly uncertain included the increasing food modification and technologies and the growing awareness of sustainability and health-related issues.

During the workshops, participants also had the opportunity to propose any potentially missing driving forces. Multiple missing driving forces were put forwards. Several additional trends were suggested. Upon consideration, loss of biodiversity was incorporated into the longlist as a distinct driving force, separate from climate change. However, as this driving force was added after the scoring exercise, it was not evaluated by participants and is therefore absent from the tables presenting the longlist.

Impacts of driving forces

During the workshop, participants discussed the potential impacts of key driving forces on the Italian food system. The main findings are presented here, highlighting how ongoing developments such as climate change, technological innovation, geopolitical instability, and market concentration may shape future challenges and opportunities for food production, distribution, and consumption in Italy. Additionally, participants were asked to look at the impact of the driving forces on the four outcomes, those being economic, health, social and environmental outcomes.

Ongoing climate change is expected to increase environmental pressures, leading to higher resource use and intensifying price volatility. As a result, farming systems will become more fragile, with greater stress on food production and shifts in the types and quantities of available food. These changes are likely to deepen territorial inequalities and elevate food prices. Vulnerable populations may face greater health inequalities and reduced access to nutritious foods, especially as supply chains simplify under global market tensions. Consequently, dietary habits will need to adapt to changing product availability.

The increasing use of Artificial Intelligence (AI) and Machine Learning (ML) presents both opportunities and challenges for the food system. These technologies can drive personalisation in diets, leading to healthier choices and reduced food waste, and facilitate the development of apps that help consumers make more informed decisions. However, their adoption also creates new job demands and training requirements, underscoring the need for an adaptable workforce.

Geopolitical instability increases competition among countries and disrupts supply chains, thereby threatening food availability, affordability, and diversity. Supplies of agricultural inputs, such as fertilisers, seeds and grain become especially vulnerable under these conditions, further reducing overall food security. While such instability can stimulate interest in policies supporting food security and

sovereignty, it also poses risks such as loss of biodiversity and a weakened European Union.

The consolidation of the food sector, driven by the growth of large companies, could reduce farmers' incomes, diminish food diversity, and increase the prevalence of ultra-processed foods. This driving force threatens agro-ecological farms and may lead to "diet homologation", with negative consequences for food quality.

4 Similarities and differences

In the previous chapter, the results from the separate workshops were described, showing the most relevant and uncertain driving forces per country. However, we aim to put the regional differences into a European context and synthesise the bigger picture for the European food system. In this chapter, outcomes of the three stakeholder workshops are analysed and compared (see Table 8). First, we will discuss the similarities between driving forces, then we will highlight the main differences.

Table 8 Comparison of prioritised driving forces

Driving forces	Description	Bulgaria	Germany	Italy
Climate change continues	Climate change is accelerating, bringing more extreme weather, rising temperatures, flooding, and drought.	X	X	X
Increasing geopolitical instability and conflict	Geopolitical tensions and conflict are expected to intensify towards 2050, disrupting stability and daily life while placing growing pressure on neighbouring regions through migration, humanitarian crises, and resource strain.		X	X
Increasing food modification and technology	Scientific and technological advancements are transforming food production through innovations such as genetic modification, plant-based and alternative proteins, food fortification, and cellular agriculture.	X	X	
Increasing AI and ML	The use of artificial intelligence and machine learning in society is expected to grow significantly, enabling pattern recognition and self-learning systems that could drive far-reaching changes across many sectors.			X
Increasing awareness on sustainability and health	Consumers are increasingly prioritising transparency, sustainability, and ethical sourcing in their food choices, alongside a growing shift towards healthier behaviours such as vegetarianism, veganism, and reduced consumption of health-harming products.	X		
Increase in big companies and decrease in smaller companies	Food production and agricultural supply chains are increasingly dominated by a small number of large companies.			X
Towards a circular economy	There is a growing shift towards a circular economy, where products and materials are designed for reuse, recycling, and recovery, driving more efficient resource use, reduced environmental pressures, and greater innovation in production and consumption.		X	

Driving forces	Description	Bulgaria	Germany	Italy
Decreasing availability of fresh water	Freshwater availability is expected to become increasingly uneven across regions, with climate change, shifting land use, and rising demand collectively reducing effective water supplies and putting growing pressure on agriculture, ecosystems, and urban water use.	X		

4.1 Main similarities between countries

Table 8 shows an overview of the most relevant driving forces for the food system, based on the three stakeholders workshops. If a driving force was in the top 4 of at least two countries, the driving force was marked as a similarity. Three overarching driving forces were subsequently identified: 1) climate change, 2) increasing food modification & technology, and 3) increasing geopolitical instability and conflict.

4.1.1 *Climate change as an overarching driver*

Climate change was the only driving force selected by workshop participants in all three countries, making it the strongest point of consensus across countries and a clear overarching driving force for the European food system as a whole. In Bulgaria, Germany, and Italy, participants not only identified climate change as one of the most relevant driving forces for their regional food systems, but also scored it as highly certain, meaning that its continued development is broadly expected. Where some uncertainty did exist, it did not relate to whether climate change would progress, but rather to the specific nature and scale of its impacts across different regions.

The impacts of climate change as identified by participants are wide-ranging. Shifting weather patterns and an increased frequency of extreme events (including droughts and floods) are expected to reduce both the quantity and quality of agricultural products, increasing the risk of food shortages and rising prices while placing growing strain on food system resilience and supply chain stability. Animal health and welfare concerns are also anticipated to intensify as a result of changing climatic conditions.

While these negative consequences were broadly recognised across all three countries, the workshops revealed some nuance in how impacts are perceived regionally. Bulgarian and Italian participants focused primarily on the adverse effects of climate change for their food systems. German participants, by contrast, also pointed to potential opportunities, noting that a longer growing season resulting from rising temperatures could open new agricultural production possibilities for Northern Europe. This illustrates that while climate change is a shared and certain driving force, its specific implications vary depending on regional geography and context.

Two additional driving forces closely linked to climate change deserve mention here. First, decreasing freshwater availability was highlighted across all three country groups as relevant and certain driving force. Second, biodiversity loss was identified as a missing driving force in all three countries. This reflects a widely shared recognition of the essential role that biodiversity plays in maintaining resilient and sustainable food systems.

In sum, climate change and its related driving forces pose significant challenges for the European food system, though the specific impacts differ by region. Alongside these challenges, participants also identified opportunities, such as extended growing seasons in Northern Europe and an increased incentive to transition towards more sustainable agricultural practices.

4.1.2 *Geopolitical instability and conflict*

Geopolitical conflict and instability emerged as a key driving force in two of the three countries (Germany and Italy) signalling a shared concern about its implications for the future of European food systems. Recent years have seen a notable increase in tensions both within Europe and globally, with direct consequences for how food is produced, distributed, and accessed. The high prioritisation of this driving force by participants in both countries underscores a broad recognition that geopolitical risks are not only persistent but are likely to become increasingly influential in shaping the food landscape in the years ahead.

One of the most prominent impacts identified by participants was the disruption of food supply chains. Political instability and conflict can result in border closures, sanctions, and the emergence of new trade barriers, making it more difficult to move products, inputs, and people freely across borders. Participants noted that in response to such disruptions, countries and food system actors may place greater emphasis on self-sufficiency, redirecting focus towards local and regional food sources and production systems. While this shift could strengthen food system resilience, it may equally limit the diversity of foods available to consumers and raise broader questions about how to balance food sovereignty with the well-established benefits of international trade.

The absence of this driving force from the Bulgarian Top 4 is notable, though it does not necessarily indicate that geopolitical instability is considered irrelevant in that context. It may reflect a different framing of geopolitical risk, or that other driving forces were considered more immediately pressing by Bulgarian participants. Regardless, the shared prioritisation of this driving force by Germany and Italy points to a meaningful degree of convergence in how Western and Southern European food system stakeholders perceive the geopolitical landscape and its implications for food security and supply chain stability in the coming decades.

4.1.3 *Increasing food modification and technology*

The increasing modification of food and the advancement of food technologies emerged as a shared priority in two of the three countries (Bulgaria and Germany) indicating a common recognition that scientific

and technological innovation is reshaping the food system in fundamental ways. This driving force encompasses a broad range of developments, including genetic modification, plant-based and alternative proteins, food fortification, and cellular agriculture, all of which are transforming how food is produced, processed, and consumed.

The prioritisation of this driving force by participants in both Bulgaria and Germany suggests a shared awareness that food technology advancements are not a distant prospect but an increasingly present and relevant force in their regional food systems. Whether viewed as an opportunity or a challenge, participants in both countries recognised that these innovations have the potential to significantly alter the structure of food production, the composition of diets, and the competitive landscape of the food industry in the years ahead.

The implications of this driving force are wide-ranging. On one hand, food modification and new technologies offer potential solutions to some of the most pressing challenges facing food systems, including improving nutritional quality, reducing environmental impact, and increasing the resilience and efficiency of food production. On the other hand, they also raise important questions around consumer acceptance, regulatory frameworks, equity of access, and the potential displacement of traditional food production methods and rural livelihoods.

4.2 Main differences between countries

While some driving forces such as climate change, geopolitical instability and food technology advancements could be seen as overarching European driving forces, the workshops also revealed some regional differences. By comparing the top 4 driving forces (Table 8), a number of notable regional differences are highlighted here. However, it is important to note that this section focuses on presenting the observed differences, without providing an in-depth interpretation or analysis of the underlying causes. A more thorough explanation would require additional time and further input from stakeholders. Naturally, there are many more differences between countries, but this falls outside the scope of the current study. For a full overview of the rankings per country, see Appendix 4.

4.2.1 *Increasing use of AI and ML*

Italy was the only country where participants identified the increasing use of artificial intelligence and machine learning as a highly relevant driving force for their food system. Artificial intelligence encompasses the growing application of pattern recognition, and self-learning systems across many sectors, including food production, processing, and distribution. While AI and ML are broadly acknowledged as transformative technologies, participants in Bulgaria and Germany did not select this as a priority driving force in their regional food system context. Italy thus stands out from the other countries by prioritising this driving force over the other offered driving forces (see Country profile Italy).

4.2.2 *Increasing awareness on sustainability and health*

A driving force exclusively flagged by Bulgarian stakeholders was the increasing awareness of sustainability and health. Consumers are increasingly seeking transparency in (food) sourcing, favouring sustainable and ethically produced products, partially driven by social media. There is a growing trend towards healthier behaviour, including increased interest in vegetarianism and veganism, and reducing the consumption of unhealthy products. This trend reflects a broader global movement in consumer attitudes towards food, but between the three workshops it only emerged as a top priority in the Bulgarian context. German and Italian participants, while operating in food systems where such consumer trends are also present, did not include this among their selected priorities. As such, it stands out as a regionally specific finding, indicating that Bulgarian participants viewed changing consumer values as one of the more defining forces shaping their food system in the years ahead (see Country profile Bulgaria).

4.2.3 *Increase in big companies and decrease in smaller companies*

The ongoing consolidation of food production and agricultural supply chains was exclusively identified as a significant driving force by Italian participants. This driving force, which affects many aspects of the food system from market access for smaller producers to pricing, diversity of supply, and regional food economies, was not amongst the four most important driving forces in either the Bulgarian or German workshop. It thus is a distinctively Italian concern, suggesting that the structural concentration of the food and agriculture sector was experienced by Italian participants as one of the more pressing driving forces shaping the future of their food system, in a way that did not resonate equally with participants in the other two countries. This finding is not completely surprising as Italy relies more on small to medium sized business compared to the other two countries (see Country profile Italy).

4.2.4 *Towards a circular economy*

Germany participants were the only group across the three countries that selected the driving force towards a circular economy. This driving force focusses on designing products and materials for reuse, recycling, and recovery, in order to reduce waste and limit environmental pressure. This driving force has big implications for food packaging, waste management, supply chain design, and agricultural inputs. The driving force did not feature in the list of prioritised driving forces in either Italy or Bulgaria, making it Germany-specific priority. The finding indicates that German workshop participants considered the circular economy transition to be among the more relevant and defining driving forces for their food system, distinguishing their results from those of the other two country groups (see Country profile Germany).

4.2.5 *Decreasing availability of fresh water*

Bulgarian participants were the only group ranking the decreasing availability of fresh water as a key driving force affecting their food system. Freshwater resources are becoming scarcer and more unevenly distributed across regions. Climate change, shifting land use, and rising demand are driving this shortage. These pressures directly affect farming, ecosystems, and urban water supplies. Neither German nor

Italian participants identified this as a top priority. This makes freshwater scarcity a distinctly Bulgarian concern in this study. Participants there clearly see it as an urgent and structural threat to their regional food system (see Country profile Bulgaria).

5 Discussion

This horizon scan provides a multi-country perspective on the future of European food systems. The results indicate that climate change, geopolitical instability and technological change are perceived as mutual driving forces across different national contexts. The horizon scan also showed differences between the countries in their prioritisation of driving forces. In the following discussion, we relate these results to existing literature and describe methodological strengths and limitations of our approach.

5.1 Comparison with literature

The current study is, to the best of our knowledge, one of the few horizon scans on European food systems towards 2050, thereby enriching the current literature. The few existing horizon scans, such as FIT4FOOD2030 [27] and the SCAR Foresight exercises [26], differ from this horizon scan in several aspects. First, this horizon scan is conducted after the major disruptions of the 2020s, including the COVID-19 pandemic and recent geopolitical conflicts, allowing it to capture newer trends that previous horizon scans did not capture. Second, it explicitly considers health impacts alongside environmental, economic, social and technological impacts, providing a more comprehensive view of food systems than existing horizon scans. Third, it uses a structured, multi-country stakeholder prioritisation approach, generating empirically grounded insights into how actors in different national contexts perceive and rank driving forces shaping the future of food systems in Europe.

Furthermore, the framework developed in this study adds a distinct contribution to the existing literature. This framework explicitly integrates strategic foresight with a food system perspective while positioning health as a central outcome. Existing frameworks either include health impacts or foresight, not both [14, 15, 17, 26]. By combining the two, the present framework fills an important gap in the literature and provides a novel basis for assessing how driving force will affect both food systems and population health now and in the future.

5.2 Reflection on methodology

This study used an horizon scanning methodology to identify relevant driving forces for the future of food systems in Europe, emphasising European regional differences. The pre-established list of 38 driving forces was based on extensive literature and served as the foundation of this study. However, stakeholder participation played a crucial role in the prioritisations of driving forces by their relevance and uncertainty. We have invited a wide range of stakeholders to ensure reliable results. The stakeholders were policymakers, scientific experts and representatives from non-profit organisations and the private sector. This resulted in participants with knowledge from different parts of the food system, like farmers organisation, experts on supply chains and science, and policy makers from, for example, the ministries of health. We also aimed to invite stakeholder that think beyond their own field of

expertise so that they feel comfortable to contribute to discussions on the broad scope of this research.

Despite our efforts to have a diverse group of stakeholders with different fields of expertise, in practice it turned out to be difficult. Participation required availability of the stakeholders, which was easier for some groups than others. Therefore, certain stakeholder groups were underrepresented and the group composition varied per country. For example, in Germany there were more scientists compared to the other two countries and less policy makers. Moreover, citizens were not represented amongst the stakeholders in any of the countries. The workshop results therefore reflect the views of a specific group of stakeholders. They may not represent the wider population. It is important to keep this in mind when interpreting the findings.

Feedback gathered from the participants showed that participants valued the interdisciplinary nature of the workshops. They found it useful to discuss food system challenges with professionals from different backgrounds. The workshop format effectively supported the core objective of identifying driving forces, impacts, and research needs. Bringing together diverse local experts helped surface context-specific challenges that a single cross-national session would likely have missed. Differences between countries thus confirmed the value of organising local workshops.

It is important to note that each workshop represents a snapshot in time. The workshops were held at different points throughout the year: Bulgaria in October 2025, Germany in December 2025, and Italy in January 2026. This means that participants in each country were responding to a different moment in time. Between these workshops, several significant geopolitical events took place. In January 2026, the United States launched a military operation in Venezuela. This added to an already turbulent geopolitical situation that included ongoing tensions around the war in Ukraine, global trade tensions, and rising concerns about energy and food security in Europe. These events may have influenced how participants perceived and prioritised certain driving forces. What felt most urgent to Bulgarian participants in October may have been framed very differently by Italian participants just a few months later.

Furthermore, participants noted that driving forces do not operate in isolation. In this study, driving forces were scored individually, which does not fully capture how they interact and reinforce each other. For example, water scarcity may intensify the effects of climate change on food production, while digitalisation may shape how circular economy practices are adopted. A systems-based scenario approach could provide a more complete picture of how driving forces collectively shape the food system.

5.3 Basis for scenario development

The scope of the current study was to conduct a horizon scan in which relevant driving forces were identified, mapped, and ranked according to their relevance and uncertainty across three countries. This is an

essential first step in a foresight study and forms a solid basis towards scenario development. Where horizon scanning considers driving forces individually, a scenario approach goes further by examining the interrelations between driving forces. Scenarios thus better reflect the complexity of the real world in which food systems operate. Scenarios allow for the identification of future challenges and opportunities, and provide a strong foundation for developing policy strategies, including as input for European policy.

Building on the horizon scan results, initial steps towards scenario development were taken in the German and Italian workshops, where participants explored best-case and worst-case scenarios across the four objectives of FutureFoodS. In a best-case scenario, the most important driving forces develop in a favourable direction, revealing opportunities for food systems, policy, and society. In a worst-case scenario, these driving forces move in an unfavourable direction simultaneously, highlighting the challenges and pressures that food systems may face and helping to prepare policy responses accordingly. It should be noted that these best- and worst-case exercises served as a preliminary orientation rather than as fully developed scenarios. This simplified approach was designed to quickly generate scenario insights and familiarise participants with integrated, trend-based thinking and not to produce the final scenarios of the FutureFoodS project. A full scenario development process requires considerably more time, depth, and methodological rigour.

6 Conclusion

The current study yielded several results that together strengthen the scientific and practical understanding of the future of European food systems.

First, the desktop research resulted in a comprehensive longlist of the most important driving forces shaping the European food system. This updated and structured overview of driving forces can be widely used for future (foresight) research and policy development.

Second, a conceptual framework was developed that offers a valuable and practical tool for structuring and analysing the future of food systems across different national contexts, thereby enabling more consistent and comparable analyses across countries. Moreover, this framework is a first to combine foresight, food systems and health outcomes into a single integrated framework. It thereby offers a new opportunity through which future food system dynamics can be studied.

Lastly, the stakeholder workshops provided insights into the most relevant driving forces for the European food system while also recognising differences between European countries. These insights are essential for tailoring food system strategies to specific national contexts across Europe. Beyond the insights themselves, the workshops also helped to establish strong stakeholder networks within different European countries. Those networks provide a valuable foundation for future collaboration, knowledge exchange, and continued engagement in shaping the future of European food systems.

Together, these results form a strong and multifaceted foundation for the next phase of the FutureFoodS project. To achieve the overarching objective of FutureFoodS to build resilient, sustainable and equitable food systems, it is essential to take concrete next steps. Building on the results of this horizon, coherent, policy-relevant scenarios can be systematically developed, enabling the formulation of actionable options for different types of actors and provide an evidence-based basis for policy measures at European, national and local level. By doing so, the FutureFoodS partnership can support policymakers and practitioners in proactively shaping the transition of European food systems rather than merely responding to emerging crises.

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Appendix 1 Overview of literature for inventory of driving forces

Author	Date	Title
Béné, C., et al	2019	Understanding food systems drivers: A critical review of the literature
BlueHealth	2019	Conceptual framework and Trendanalysis for BlueHealth Future Scenarios (D6.1)
CASA project/ Bisoffi, S.	2019	Meta-analysis of recent foresight documents in support of the 5th SCAR Foresight Exercise: Synthesis.
ECDC	2025	Future challenges for infectious disease prevention and control - A strategic foresight approach to enhance European public health preparedness and resilience
EIT Food	nd	Megatrends map: Triggers and drivers of change.
ESPAS	2024	Global trends to 2040 - Choosing Europe's Future
ESPAS/ JRC	2024	Horizon scanning: Emerging issues for EU policymaking, Issue 5
ESPAS	2026	Horizon scanning: Emerging issues for EU policymaking, Issue 10
EuroHealthNet	2023	The future of public health in Europe
European Commission	2025	Resilience 2.0: Empowering the EU to thrive amid turbulence and uncertainty - Strategic foresight report
European Commission	2025	The Megatrends Hub Knowledge for policy
European Environment Agency	2022	Reimagining the food system through social innovations Publications European Environment Agency (EEA)
European Environmental Agency (EEA)	2024	European Climate Risk Assessment
Eurostat	2025	https://ec.europa.eu/eurostat/web/interactive-publications/migration-2025
FAO	2018	The future of food and agriculture: Alternative pathways to 2050.
FAO	2022	The future of food and agriculture: Drivers and triggers for transformation.
FAO	2023	Harvesting change: Harnessing emerging technologies and innovations for agrifood systems transformation – Global foresight synthesis report

Author	Date	Title
Federal Food Safety and Veterinary Office (FSVO).	2022	Avenir de la sécurité sanitaire des aliments : Les scénarios possibles pour les années 2022-2032 et leur impact sur la sécurité sanitaire des aliments et la nutrition [Future of food safety: Possible scenarios for the years 2022–2032 and their impact on food safety and nutrition]
Fit4Food2030	2018	Report on baseline and description of identified trends, drivers and barriers of EU food system and R&I - Description of Trends
Fit4Food2030	2018	Analysing the Trends That are Affecting our Food System - FIT4FOOD2030
Foresight4Food	2025	Food Systems of the Future: A synthesis of food system drivers and recent scenario studies
FOSTER	2024	D 1.2 Interim Report New Topics in Food Systems - Horizon Scanning Long List
International Organization for Standardization (ISO)	nd	ISO - Prosperity
JRC	2020	Climate change and Europe's water resources
JRC	2025	Outlook and demographic perspectives for EU's rural regions: A modelling-based exercise (JRC Working Papers on Territorial Modelling and Analysis No. 01/2025; JRC140514).
JRC	2025	Cross-border and emerging risks Europe is facing
JRC	2024	Analysis of risks Europe is facing
PWC	2022	Megatrends - Five global shifts reshaping the world we live in
RIVM	2017	Drijvende krachten van de voedselconsumptie en het voedselaanbod - Achtergrondrapport bij 'Wat ligt er op ons bord? Veilig, gezond en duurzaam eten in Nederland.'
SCAR	2020	RESILIENCE AND TRANSFORMATION Report of the 5th SCAR Foresight Exercise Expert Group - Natural resources and food systems: Transitions towards a 'safe and just' operating space
SCAR	2020	Online annexes: "Facts & figures" reports of the 5th SCAR Foresight Exercise — Natural resources and food systems: Transitions towards a 'safe and just' operating space.
Scientific Group for the UN Food Systems Summit	2021	Shift to healthy and sustainable consumption patterns: A paper on Action Track 2.
UN	2020	Shaping the Trends of Our Tim: Report of the UN Economist Network for the UN 75th Anniversary
UN Environment Programme	2024	Navigating New Horizons A global foresight report on planetary health and human wellbeing
UN Environment Programme	2025	The Weight of Time Facing a new age of challenges for people and ecosystems

Author	Date	Title
Wageningen Economic Research/ Berkhout, P., Achterbosch, T., van Berkum, S., Dagevos, H., Dengerink, J., van Duijn, A. P., & Terluin, I. J.	2018	Global implications of the European food system: A food systems approach – summary
World Economic Forum	2026	Global Risks Report 2026
World Economic Forum	2025	Global Risks Report 2025
World Economic Forum	2024	Quantifying the Impact of Climate Change on Human Health INSIGHT REPORT JANUARY 202

Appendix 2 Description of driving forces

Demographic	
Population decline	While globally population numbers are expected to rise, some regions are projected to experience a decline , with significant variation between countries. Many nations are already seeing lower fertility rates , and this trend is likely to continue in the coming years. In certain areas, migration may help to balance out population decreases—particularly in parts of Western and Northern Europe—but it is unlikely to fully reverse the broader trend
Ageing society	The population is ageing at a rapid pace . By 2050, the proportion of older people is expected to rise significantly, while the share of younger people will decline. Both the number of people aged 65–80 and those over 80 are set to increase considerably. At the same time, healthy life expectancy is expected to rise , meaning that many older adults will remain active and independent for more years than in the past.
Increasing urbanisation	The number of people living in urban areas is expected rise gradually toward 2050, reinforcing the concentration of residents and services in cities . This trend is not uniform, as growth will vary widely between cities and regions. In many cases, capital cities are projected to see ongoing population increases, attracting people for work, education, and new opportunities. Much of this urban growth is driven by a net influx of younger people .
Population decline in rural areas	The number of people living in rural areas is gradually decreasing, though this trend varies by country and region. As more young people move to cities, rural communities often experience a higher average age among their population . With fewer rural residents, schools, healthcare facilities, shops, and public transport become less viable. This, in turn, makes rural areas less attractive , accelerating depopulation.
Increasing migration	Driven by factors such as conflicts, climate change and/or economic motivation, an increase in the number of refugees and migrants is expected. The free movement of people within Europe also leads to a rise in labour migrants and an influx (and outflow) of young, highly educated individuals. These migration flows bring new lifestyles, religions, cultures , and perspectives into societies, contributing to greater diversity and change

Changing household sizes and compositions	The average household size is decreasing , with an increase of 1-person household. Households become smaller due to low fertility rates (smaller families), changes in partnership patterns (divorce, people living more often alone), and ageing (widowed spouses). This results in an increase in the number of households .
Economic	
Increasing globalisation	Globalisation is expected to continue. It refers to the increasing interconnectedness and interdependence of economies , cultures, and markets around the world leading to the cross-border exchange of goods, services, information, and cultural practices. This resulted in major efficiency gains, but also created vulnerabilities, as supply chains become dependent on a very limited number of links. Trade conflicts, such as tariff increases or trade restrictions between major economic blocs, can hinder exports and imports.
Economic growth (in GDP)	Overall, average economic growth in many countries is expected to be moderate , though there will be significant differences between nations and regions. Demographic trends and innovation are important drivers of long-term economic development. While innovation is likely to continue improving efficiency and profitability, its pace may be slower than in previous decades. At the same time, slower population growth and an ageing population mean that, even with a rising retirement age, the potential workforce will expand less rapidly than before—potentially putting a brake on economic growth
Increasing within-country income inequalities	Income inequality between European countries has been narrowing in recent years, while within-country income inequality is projected to rise moderately in many places by 2050. However, these trends will differ from one nation to another. Looking ahead, factors such as technological change, automation, and demographic pressures—including ageing populations—are likely to affect wages for lower and middle earners, while high-skilled workers and capital owners may benefit more. At the same time, welfare systems that help reduce disparities could come under fiscal pressure as health and pension costs increase.
Increasing labour market flexibility	In the coming 25 years, flexible and non-standard forms of work are expected to continue growing. Short-term contracts, part-time jobs, and self-employment will make up a larger share of employment, which may reduce long-term job security for many workers. This trend can particularly affect women and migrant workers, who are often overrepresented in these more precarious roles, frequently earning lower wages and receiving fewer social protections. While increased flexibility can benefit some sectors and individuals, it may also contribute to widening inequalities in income, job security, and career opportunities.

Towards a circular economy	There is a strong movement toward a circular economy, focusing on reducing waste , using resources much more efficiently and a stronger bio-based orientation . Products and materials are increasingly being designed for reuse, recycling, and recovery instead of disposal. This shift is expected to reshape production and consumption patterns, help reduce environmental pressures, and foster greater innovation and sustainability
Rising price volatility	Climate events and geopolitical shocks are increasingly disrupting price stability in Europe, with (food) prices expected to remain both higher and more volatile in the future. Extreme weather, changing growing conditions, and supply chain disruptions can drive up production costs, while conflicts and trade tensions add further instability. These fluctuations are often intensified by market dynamics, leading to variable trade tariffs and increased uncertainty .
Increase in big companies and decrease in smaller companies	(Food) production is increasingly being concentrated among fewer, larger companies . A similar trend can be seen in the supply of essential inputs for agriculture and food production, such as fertilisers, seeds, agrochemicals, and machinery, where a small number of powerful firms dominate the market. While this consolidation can enhance efficiency, it also reduces competition and diversity within supply chains. As a result, both farmers and consumers may become more dependent on a limited group of large players.
Social-cultural	
Increasing individualisation	People feel less connected to traditional, collective values, resulting in declining participation in traditional institutions (such as trade unions, marriage and the church). The need to make choices based on personal preferences and desires is increasing. This leads to greater diversity of choice and autonomy for individuals in how they shape their lives, resulting in increased individualisation. But it also leads to new forms of social cohesion and engagement in society.
Decreasing social cohesion	Social cohesion is undergoing significant transformation as societies become more fragmented due to urbanisation, individualisation, demographic changes, migration, digital communication, and changing cultural norms. These developments can lead to more polarisation and segregation . Traditional structures of community life -such as extended family gatherings or neighbourhood-based social events - are becoming less common, and people are less frequently connected by collective traditions like shared meals or communal food preparation. At the same time, new forms of community are emerging, often built around shared interests such as social media food communities, dietary preferences, or environmental movements)

Growing (social-cultural) diversity	Societies are expected to become more diverse , shaped by growing social, cultural, ethnic, gender, generational, and educational differences. Migration, demographic change, and evolving social norms will contribute to this trend, creating societies that are more varied in lifestyles, values, and needs. This increasing diversity will both new opportunities and challenges.
Diversifying inequalities	Strong social support systems and worker protections have helped create more equal societies in the past. However, in recent years, different types of inequality have been increasing. While income inequality is often the main focus, other gaps are also widening—such as those between men and women, generations, people from different backgrounds , and those with or without digital skills. Although differences in education and health are getting smaller, the gap between rich and poor continues to grow.
Increasing education levels	The number of people that complete tertiary education is growing. Younger generations and women often have higher levels of education than previous generations. As education becomes more personalised and tailored to the individual, there is likely to be much more variety in the types of courses and qualifications people achieve. At the same time, competition and cooperation between educational institutions are increasing, both nationally and internationally, leading to even more diversity and specialisation in education.
Increasing awareness on sustainability and health	Consumers are increasingly seeking transparency in (food) sourcing , favouring sustainable and ethically produced products, partially driven by social media. There is a growing trend towards healthier behaviour , including increased interest in vegetarianism and veganism, and reducing the consumption of health harming products.
Increasing preference for convenience	Driven by busy lifestyles and increasing urbanisation, there is a growing desire among consumers for products, services, and experiences that save time and effort by making daily life easier, quicker, and more efficient . This trend can be seen in many areas, including food consumption, where more individuals are opting for ready-to-eat meals, meal kits, and food delivery services rather than preparing meals from scratch.
Technological	
Increasing digitalisation	The digitalisation of society is on the rise. Digital technologies are changing peoples' lives - from the way we communicate to how we live and work. Digitalisation is a gradual process: society is increasingly using digital services and IT, becoming progressively more dependent on them. Companies and critical infrastructures are also increasingly relying on third-party services, such as cloud storage, virtual private networking systems, and data analysis systems. However, digitalisation also brings risks as greater dependence on third parties is created. The interconnectedness and digitalisation of society make us more vulnerable to digital disruptions.

Increasing automation and use of robotics	Important future application domains for robots, with a high impact on everyday life , will include healthcare, agriculture, civil, commercial or consumer sectors, logistics and transport. Industrial robotics have already become a cornerstone in several of high-value manufacturing industries and also have an impact on a broad range of end-user markets and applications.
Increasing Artificial Intelligence (AI) and Machine Learning	The use of artificial intelligence in society will increase. Artificial intelligence is the ability of a machine to perform cognitive tasks as well as, or better than humans. IT systems can recognise patterns in large amounts of data and are thus increasingly becoming self-learning. AI will certainly increase in the future , but the speed and extent of its application are uncertain. This can lead to far-reaching and (in some cases) unpredictable changes .
Increasing food modification and technology	Scientific and technological advancements lead to significant changes in how food is produced, improved and consumed. A combination of food modification and innovative food technology result in genetic modification (to make crops more resistant), plant-based and alternative proteins, fortification of food (proteins, vitamins, minerals; plant based milk, fortified cereals) and cellular agriculture (e.g. lab growing meat) amongst others.
Increasing social media use	The use of social media continues to grow rapidly across all age groups and regions. With the proliferation of smartphones, improved internet connectivity, and the launch of new platforms, individuals and organisations are spending more time online, sharing content, networking, and consuming information. The rise in usage is influencing public opinion and behaviour. Consumers adjust their purchasing behaviour based on what they see online, stimulating demands for certain products. This might influence (food) trends and specific diets, which in turn shapes what producers and retailers offer.
Environmental	
Climate change continues	The Earth is warming up. The climate is changing faster than we previously thought and we are noticing it more and more. Climate change causes an increase in extreme weather , higher temperatures, higher risk of flood due to heavy showers and rising sea levels, drought, water scarcity and loss of biodiversity. Climate change will critically determine the future state of natural resources, as well as the future conditions of and constraints to agricultural production. The impact of climate change will differ per region.
Soil degradation	Soil degradation is worsening driven by climate change, intensive land use, and poor management. Over-cultivation, erosion and desertification diminishes soil fertility and structure. Nutrient imbalances affect most farmland. Consequences include reduced yields , water retention, and biodiversity, with higher flood and drought risk.

Decreasing availability of fresh water	Availability of fresh water is expected to become more uneven , with some regions experiencing wetter winters and other regions drier summers. Changes in climate, land use, and increasing water demand are likely to further reduce the availability of freshwater. Rising temperatures will intensify evaporation and soil moisture loss, decreasing effective water supplies even in areas where rainfall increases. These changes will put additional pressure on agriculture , ecosystems, and urban water use.
Increasing zoonotic and infectious disease risks	Humans are increasingly exposed to new pathogens , particularly zoonoses (infectious diseases transmitted from animals to humans). The frequency of these diseases is rising, driven by factors such as intensive livestock farming, unsustainable resource extraction, and habitat disturbance. Activities like deforestation, land use change, urbanisation, wildlife trafficking, and unsustainable agricultural practices further elevate the risk of zoonotic disease emergence and spread. Additionally, climate change and the globalisation of trade and travel facilitate the introduction and establishment of new disease vectors .
From fossil fuels to sustainable energy sources	To achieve the climate targets there is a continued need to transition from fossil fuels to sustainable energy sources such as solar and wind power. This transition involves modernizing grids, expanding energy storage, and electrifying transport and industry. The shift to renewable energy will require additional land , but estimates vary.
Political-institutional	
Multi-actor governance	The political landscape is characterised by a proliferation of actors and the emergence of new forms of governance . States and intergovernmental institutions may still be at the heart of much international policymaking but non-state actors and novel governance mechanisms increasingly shape outcomes in global politics.
Multi-level governance	Multi-level governance is seeing increased attention as governments at all levels are seeking to improve service delivery and address complex challenges. This trend involves greater collaboration between national, regional, and local governments to achieve shared goals.
Shift towards a multi-polar world order	The world order is in transition and is shifting towards a multi-polar world order , where on the geopolitical stage several centres of power coexist with each other. In this, the power of the West has declined .
Increasing decentralisation	There is a growing importance of regional cooperation and governance , where decision-making is decentralised from national governments to regional entities or local governments. This trend often arises from various factors, including socio-economic changes, cultural dynamics, and the need for localised responses to global challenges.

Increasing geopolitical instability and conflict	Geopolitical tensions, conflict, and violence are expected to increase toward 2050, with political instability taking the form of civil wars, unrest, and insurgencies. These ongoing conflicts disrupt safety, stability, and daily life , creating long-term insecurity for affected populations and adding pressure on neighbouring regions through migration, humanitarian crises, and strained resources.
Increasing political division and polarisation	Political division and polarisation are expected to increase, with people and groups moving further apart in their views. Middle ground positions are weakening, while extremes are gaining influence . Economic inequality, cultural diversity, social media, and mistrust in institutions are key drivers. This makes consensus-building more difficult and can lead to greater social fragmentation. While polarisation may energise debate, it also risks deepening divisions and complicating the resolution of shared challenges.
Increasing public distrust	The growing spread of conspiracy theories, amplified by the wide reach of social media platforms, is expected to fuel stronger anti-government sentiment . As these narratives become more mainstream, they contribute to rising levels of distrust in institutions and greater susceptibility to radicalisation. In extreme cases, this can escalate into hostility and even violence directed at public officials.
Increasing pressure on public expenditures	Pressure on public expenditures is increasing driven by factors such as rising healthcare and pension costs, growing demands for public services and infrastructure and higher military expenditures. Economic shocks, such as pandemics or financial crises, often require additional government spending. At the same time, tax revenues may not keep pace due to slow economic growth or tax evasion. Environmental challenges and the need for technological innovation also require significant investment. As a result, governments face difficulties in balancing budgets and maintaining fiscal sustainability, leading to debates over spending priorities and public sector efficiency.

Appendix 3 Participants stakeholder workshops

Stakeholders in workshop Bulgaria

Date: October 23th 2025

Location: Plovdiv

Name	Organisation	Background
Dr. Velitchka Gotcheva	University of Food Technologies Plovdiv	Local host
Barbara Korousic Seljak	Jozef Stefan Institute Ljubljana	FutureFoodS partner Slovenia
Jelena Milesevic	CENM-IMR Belgrade	FutureFoodS partner Serbia
Mariya Hristova	Ministry of Agriculture and Food-European Climate Pact Ambassador from Bulgaria	Policy maker
Svetlana Savova	Risk Assessment Centre on Food Chain	Policy maker
Prof. Vesselka Duleva	National Center of Public Health Protection or Public Health and Analyses- Ministry of Health	Policy maker
Dr Evgeniya Ivanova	Directorate for Food Control at the Central Administration of the Bulgarian Food Safety Agency (BFSA)	Policy maker
Prof. Angel Angelov	University of Food Technologies	Scientific expert
Dr. Rada Dinkova-Hadjiyski	Centre of Competence AgriFood Systems and Bioeconomy	Scientific expert
Dr. Dida Iserliyska	Institute of Food Preservation and Quality	Scientific expert
Prof. Peter Borisov	Agricultural University of Plovdiv, Department of Economics	Scientific expert
Dr. Romyana Georgieva	Agricultural University of Plovdiv, Department of Crop Science	Scientific expert
Dr. Stoilko Apostolov	Foundation for Organic Agriculture BIOSELENA	Representative of a non-profit organisation
Marta Paunova	AgriVentures, online hub where agrifood innovators can find the right funding opportunities to grow their ideas	Representative of a non-profit organisation
Mr. Georgi Dimitrov	Association of Meat Processors in Bulgaria	Representative of a private sector organisation
Mark Cekov	Yablana Natura (organic fruit producer)	Representative of a private sector organisation
Aleksandar Yovchev	Puratos Bulgaria. Food innovation	Representative of a private sector organisation

Stakeholders in workshop Germany

Date: December 1st 2025

Location: Berlin

Name	Organisation	Background
Naser Reyhani	Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB)	Local host
Niels Halberg	Aarhus University Denmark	FutureFoodS partner Denmark
Elke Saggau	SCAR Foresight Chair / BLE	FutureFoodS partner
Barbara Sturm	Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB)	Scientific expert
Monika Schreiner	Leibniz Institute of Vegetable and Ornamental Crops (IGZ)	Scientific expert
Franziska Appel	Leibniz Institute of Agricultural Development in Transition Economies (IAMO)	Scientific expert
Christine Röger	Competence Center for Nutrition (KErn)	Scientific expert
Lia Carlucci	Food Campus Berlin	Scientific expert
Carola Strassner	FH Münster University of Applied Sciences	Scientific expert
Sarah Iweala	University of Göttingen	Scientific expert
Evelyn Medawar	Physicians Association for Nutrition – Regional Office	Scientific expert
Kathrin Specht	Research Institute for Regional and Urban Development gGmbH	Scientific expert
Martin Banse	Thünen Institute of Market Analysis	Expert
Ines Lauber	Studio Inés Lauber	Expert
Phuong Vu	Zukunft – Umwelt – Gesellschaft (ZUG) gGmbH - Artist	Expert
Cecilia Flocco	Federation of European Microbiological Societies	Representative of a non-profit organisation
Nara Capdeville	Slow Food Youth Germany	Representative of a non-profit organisation
Susann Vierbauch	Fraunhofer Institute for Process Engineering and Packaging IVV	Representative of a private sector organisation
Anna Wortberg	Association for the Promotion of Organic Farming Berlin-Brandenburg eV	Representative of a private sector organisation
Inga Cramer	Bioland Verarbeitung & Handel e. V.	Representative of a private sector organisation
Marcus Girnau	Food Federation Germany	Representative of a private sector organisation

Stakeholders in workshop Italy

Date: January 16th 2026

Location: Rome

Name	Organisation	Background
Marika Ferrari	Council for Agricultural Research and Economics (CREA)	Local host
Lorenza Mistura	Council for Agricultural Research and Economics (CREA)	Local host
Noureddin Drioech	CIHEAM Bari	FutureFoodS partner
Alessandra Sgrò	Ministry of Agriculture, Food Sovereignty and Forests (MASAF) - Technical expert FutureFoodS	FutureFoodS partner
Katerina Riviou	Ellinogermaniki Agogi – Education research and technology (EA)	FutureFoodS partner Greece
Valeria De Martino	Italian Institute of Statistics- ISTAT	Policy maker
Valeria Pulieri	Ministry of Education and Merit (MUR)	Policy maker
Estefania Noriega Fernandez	European Food Safety Authority (EFSA)	Scientific expert
Joao Coste Leite	European Joint Research Centre (JRC)	Scientific expert
Maurizio Notarfonso	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Scientific expert
Laura Rossi	National Institute of Health- ISS	Scientific expert
Simona Castaldi	University of Campania, department of Environmental, Biological and Pharmaceutical Sciences and Technologies	Scientific expert
Annalisa Angeloni	Council for Agricultural Research and Economics (CREA)	Scientific expert
Stefano Canali	Council for Agricultural Research and Economics (CREA) Agriculture and Environment - Agroecology Partnership	Scientific expert
Stefano Grando	External expert	Scientific expert
Daniela Martini	University of Milan	Scientific expert
Teresa del Guidice	Unveristy of Napels	Scientific expert
Eva Alessi	World Wildlife Fund Italy- WWF	Representative of a non-profit organisation

Name	Organisation	Background
Luca Colombo	Italian Foundation for Research in Organic and Biodynamic Agriculture	Representative of a non-profit organisation
Massimo Rovai	Slow Food Tuscany	Representative of a non-profit organisation
Sandra Gasbarri	Biodistrict of Via Amerina e delle Forre – Territorial representative	Representative of a non-profit organisation
Umberto Del Vecchio	Cooperativa Italiana di Ristorazione (CIRFOOD)	Representative of a private sector organisation
Donato Rotundo	The General Confederation of Italian Agriculture (CONFAGRICOLTURA)	Representative of a private sector organisation
Giulia Milani	The General Confederation of Italian Agriculture (CONFAGRICOLTURA)	Representative of a private sector organisation
Vincenzo Lenucci	The General Confederation of Italian Agriculture (CONFAGRICOLTURA)	Representative of a private sector organisation
Cosimo Righini	Italian Confederation of Farmers (CIA)	Representative of a private sector organisation

Appendix 4 Ranking of driving forces per country

Bulgaria

Driving force	Impact (%)	Uncertainty (%)
Climate change continues	10,99	5,19
Increasing food modification and technology	7,69	3,90
Decreasing availability of fresh water	6,59	1,30
Increasing awareness on sustainability and health	5,49	0,00
Ageing society	4,40	5,19
Increasing geopolitical instability and conflict	4,40	5,19
Multit-actor governance	4,40	1,30
Towards a circular economy	4,40	0,00
Increasing AI and ML	4,40	0,00
Soil degradation	4,40	0,00
Population decline	3,30	9,09
Increasing social media use	3,30	5,19
Population decline in rural areas	3,30	2,60
Increasing individualisation	2,20	7,79
Increasing migration	2,20	5,19
Increasing decentralisation	2,20	3,90
Growing (social-cultural) diversity	2,20	2,60
Changing household sizes and compositions	2,20	1,30
Increase in big companies and decrease in smaller companies	2,20	1,30
Increasing pressure on public expenditures	2,20	1,30
Increasing education levels	2,20	0,00
Increasing preference for convenience	2,20	0,00
From fossil fuels to sustainable energy sources	2,20	0,00
Increasing labour market flexibility	1,10	10,39
Increasing globalisation	1,10	9,09
Increasing zoonotic and infectious disease risks	1,10	7,79
Increasing public distrust	1,10	1,30
Increasing urbanisation	1,10	0,00
Increasing within-country income inequalities	1,10	0,00
Rising price volatility	1,10	0,00
Decreasing social cohesion	1,10	0,00
Increasing digitalisation	1,10	0,00
Shift towards a multit-polar world order	1,10	0,00
Increasing automation and use of robotics	0,00	3,90
Economic growth (in GDP)	0,00	2,60
Diversifying inequalities	0,00	2,60
Multit-level governance	0,00	0,00
Increasing political division and polarisation	0,00	0,00

Germany

Driving force	Impact (%)	Uncertainty (%)
climate change continues	7,95	4,29
Towards a circular economy	6,62	2,86
Increasing geopolitical instability and conflict	5,96	5,71
Increasing food modification and technology	5,30	6,43
Increasing political division and polarisation	4,64	7,14
Increasing social media use	4,64	2,14
Decreasing availability of fresh water	4,64	1,43
Increasing awareness on sustainability and health	3,97	7,86
Increasing zoonotic and infectious disease risks	3,97	5,00
Increasing globalisation	3,97	4,29
Increase in big companies and decrease in smaller companies	3,97	4,29
Increasing public distrust	3,97	3,57
Soil degradation	3,97	2,14
Ageing society	3,97	0,00
Rising price volatility	3,97	0,00
Increasing individualisation	3,97	0,00
Increasing AI and ML	3,31	8,57
Diversifying inequalities	2,65	3,57
Changing household sizes and compositions	2,65	2,14
From fossil fuels to sustainable energy sources	2,65	1,43
Increasing urbanisation	2,65	0,71
Increasing digitalisation	1,99	0,00
Increasing within-country income inequalities	1,32	1,43
Increasing preference for convenience	1,32	0,71
Increasing automation and use of robotics	1,32	0,71
Increasing pressure on public expenditures	0,66	0,00
Decreasing social cohesion	0,66	5,71
Increasing migration	0,66	3,57
Economic growth (in GDP)	0,66	2,14
Increasing decentralisation	0,66	2,14
Population decline in rural areas	0,66	0,00
Mult-actor governance	0,66	0,00
Population decline	0,00	5,00
Increasing education levels	0,00	3,57
Shift towards a multi-polar world order	0,00	1,43
Increasing labour market flexibility	0,00	0,00
Growing (social-cultural) diversity	0,00	0,00
Mult-level governance	0,00	0,00

Italy

Driving force	Impact (%)	Uncertainty (%)
Climate change continues	8,20	2,41
Increasing geopolitical instability and conflict	6,56	7,83
Increasing AI and ML	6,56	6,02
Increase in big companies and decrease in smaller companies	5,46	1,20
Decreasing availability of fresh water	4,92	1,81
Increasing zoonotic and infectious disease risks	4,92	1,81
Increasing awareness on sustainability and health	4,37	5,42
Ageing society	4,37	2,41
Increasing food modification and technology	3,83	7,23
Increasing public distrust	3,83	0,00
Population decline in rural areas	3,28	4,82
Increasing education levels	3,28	3,61
Increasing urbanisation	3,28	0,60
Decreasing social cohesion	2,73	3,01
Increasing political division and polarisation	2,73	1,81
Increasing migration	2,73	1,20
Growing (social-cultural) diversity	2,73	1,20
Increasing automation and use of robotics	2,73	0,60
Increasing within-country income inequalities	2,73	0,00
Towards a circular economy	2,19	4,82
Increasing globalisation	2,19	3,61
Rising price volatility	2,19	3,61
Increasing social media use	2,19	2,41
Soil degradation	2,19	1,81
Increasing digitalisation	2,19	0,60
Increasing individualisation	1,64	3,61
Increasing preference for convenience	1,09	1,81
Increasing pressure on public expenditures	1,09	1,81
Diversifying inequalities	1,09	1,20
From fossil fuels to sustainable energy sources	0,55	4,82
Shift towards a multi-polar world order	0,55	3,61
Economic growth (in GDP)	0,55	1,81
Population decline	0,55	1,20
Multi-actor governance	0,55	1,20
Increasing labour market flexibility	0,00	3,01
Increasing decentralisation	0,00	3,01
Multi-level governance	0,00	2,41
Changing household sizes and compositions	0,00	0,60

Appendix 5 Glossary

The glossary contains descriptions of aspects of food systems according to the Conceptual Framework (CF; See Figure 1).

The following sections describe each of the components of the Conceptual Framework (CF), along with examples of potential indicators. Indicators from the JRC dashboard and the FutureFoodS Workpackage 5 Position Papers, among others, have been mapped to the CF to help illustrate their alignment with the conceptual framework.

The CF has been developed using various sources, including input from WP 5. These descriptions aim to ensure consistency between the definitions of key terms used.

Area	Element	Sub-element	Description	Example Indicators
1. Driving forces			<i>Influential forces of changes that are shaping, or that have the capacity to shape or transform a system.</i>	
	a. Demographic		<i>Population characteristics such as population composition, growth and size, and educational attainment.</i>	<i>Population (total, age-sex composition) Annual population growth Primary/secondary education completion rate</i>
	b. Economic		<i>Characteristics of the economy and the labour market, such as economic growth, job structures, employment and unemployment.</i>	<i>Unemployment rate GDP per capita Annual GDP growth</i>
	c. Social-cultural		<i>Characteristics of society, such as quality of life, social cohesion and the relationship between citizens and the government, changing norms and values and a changing role/attitude of citizens</i>	<i>Voice and accountability index Quality of life index</i>
	d. Technological		<i>Developments and innovations in technology, for example in data-driven technology, artificial intelligence (AI), digitisation, genetic engineering, precision medicine and robots/cobots.</i>	<i>Adoption of technologies in agriculture/food sector</i>

Area	Element	Sub-element	Description	Example Indicators
	e. Environmental		<i>Features of the physical environment, such as climate change, air, water and soil pollution and the increase of renewable energy.</i>	<i>Global climate risk index Long term average annual precipitation Soil biodiversity potential index</i>
	f. Political-institutional		<i>Changes, adjustments or reforms in the organisation, functioning and structures of political and administrative institutions within a society. This includes processes related to the organisation of public bodies, the system of governance, power relations, legal frameworks, democratic rules of the game, and the way decision-making takes place at national, European and global levels.</i>	<i>Political stability and absence of violence/terrorism: estimate Legal guarantees to women's equal rights to land ownership and/or control</i>
2. Responses/Policy			<i>Governance structures and policies addressing, among others, the power of multinationals and consumers. It includes policy measures focused on adaptation, innovation, research, and transformation, which are supported by governance structures that provide the framework to implement changes. Areas such as public procurement are also relevant.</i>	<i>Governance effectiveness index Policy coherence Civil society participation index Presence of national health-related food environment policies</i>
	a. Innovation (incl. research)			
	b. Adaptation			
	c. Transformation			
	d. Governance structure			

Area	Element	Sub-element	Description	Example Indicators
3. Food System Activities			<i>Activities related to the food supply chains, food environments, and food demand, as well as the use of natural resource, consumption and diets, and waste, by-products and recycling. These ultimately have an effect on food system outcomes.</i>	
	a. Food Supply		<i>Activities across the food value chain, incl. activities from post-harvest and processing to packaging, distribution, and retail</i>	
		i. Primary production	Farming, fishing, aquaculture and other activities that generate raw food commodities	<i>Characteristics of business throughout the agro-chain and fisheries sector Farm infrastructure index</i>
		ii. Processing	Transformation of raw commodities into intermediate or final food products	<i>Share of processors receiving sustainability-related training</i>
		iii. Packaging	Production of materials used to contain, protect and present food products	
		iv. Distribution and storage (cooling)	Logistics, warehousing and cold-chain infrastructure	<i>Share of distributors receiving sustainability-related training</i>
		v. Retail	Formal and informal outlets where consumers access food, including supermarkets and markets	<i>Share of conventional foods versus organic foods Share of retailers receiving sustainability-related training</i>
		vi. Transport	Movement of food across supply chain	
		vii. Cross-cutting	Elements that influence multiple (or all) stages of the food supply chain	<i>Chain structure of products Use of blockchain/track and trace systems across food chain Supply chain infrastructure index Diversity of service providers (i.e., number of suppliers per region)</i>

Area	Element	Sub-element	Description	Example Indicators
	b. Food Environment		<i>Physical, digital and social environment that affects what people eat</i>	
		i. Availability	Physical availability of sustainable and healthy food	<i>Ratio plant to total protein supply (JRC dashboard) Supply by food group (JRC dashboard) Amount of healthy foods available in store/canteen/etc.</i>
		ii. Social-cultural aspects	Tangible and intangible elements ranging from specific food products and production methods to culinary and gastronomic traditions that strengthen the identity of communities and improve the livelihood of people in the related areas	<i>Number of products under a quality scheme per category and per scheme at primary production and food processing</i>
		iii. Marketing	Information related to food in both the physical and digital environment that can shape consumer behaviour, knowledge and choices	<i>Food labelling (selected as placeholder for JRC dashboard) Food promotion (selected as placeholder for JRC dashboard)</i>
		iv. Food properties	Food attributes that influence its value, acceptability, and desirability, especially in terms of health and sustainability. These include factors such as flavor, nutritional content, production methods, and ingredient composition	<i>Nutritional quality of (processed) food offer (selected as placeholder for JRC dashboard) Metrics assessing nutrient composition and bioavailability of foods</i>
		v. Pricing	Food price at consumption for different food chains/food products	
	c. Food Demand		<i>Addresses consumer behaviour and consumer characteristics, incl. consumer preferences. Consumer characteristics can refer to attributes such as knowledge, available time, resources</i>	

Area	Element	Sub-element	Description	Example Indicators
			<i>(purchasing power), age, sex, culture, religion, etc</i>	
		i. Consumer characteristics	Demographic, socioeconomic and health attributes that shape food purchasing capacity and preferences.	<i>Food literacy Nutritional knowledge Budget available per capita or household for food Consumer dietary preferences (e.g., share of vegetarians), and insight into age, sex, cultural preferences Type of diet practiced Energy and protein requirements Cultural acceptance of (changing) diets Taste preferences among consumers</i>
		ii. Consumer behaviour	Actual food purchase, preparation and consumption decisions and patterns.	<i>Behaviour related to food purchasing (e.g., purchase of organic food), preparation methods, storage, post-processing (e.g., food waste) Frequency of out-of-home consumption Meal frequency and meal quality</i>
		iii. Consumer preferences	Buying behavior and choices of consumers in a market, influenced by various factors such as personal tastes, health concerns, environmental considerations, and social values	<i>Type of diet practiced Cultural acceptance of (changing) diets Taste preferences among consumers</i>
	d. Use of Natural Resources		<i>Direct use of natural resources and materials that are required to support the food chain, including, among others, inputs such as water, land, crops minerals, fertilisers, energy sources, and packaging materials, among others</i>	<i>Fossil fuel use Fertilizer use Use and risk of chemical and hazardous pesticides (JRC dashboard) Water use Share of renewable vs. non-renewable energy used in production Volume of packaging materials per material type Sustainable use of</i>

Area	Element	Sub-element	Description	Example Indicators
				<i>resources (land, soil, water, energy)</i>
	e. Consumption & Diets		<i>Food consumption and diets, for total populations, vulnerable groups</i>	<i>Amount of meat per capita</i> <i>Degree of adherence to food-based dietary guidelines</i> <i>Amount of energy intake</i> <i>Amount of protein intake, share of animal-based food intake</i> <i>Protein consumption (in kg per year) with regard to its source (grain legumes, meat)</i> <i>Costs of diets</i> <i>Environmental impacts of diets, such as dietary exposure to 16 midpoint indicators and 3 endpoint indicators (according to ReCiPe)</i> <i>Nutritional intake</i> <i>Exposure to chemicals and heavy metals</i> <i>Questions addressing eating habits e.g., frequency of fruit and vegetable consumption</i> <i>Total food consumption</i> <i>Consumption (frequency) of food produced in a fair and animal welfare-compatible manner</i> <i>Consumption of organic versus conventional foods?</i> <i>LCA data on food (e.g., per kg) of EU and member state level; modelled or primary data if available</i> <i>Environmental impact across the food chain based on food consumption (e.g. xx% of impact is from 'production phase' and xx% is from 'retail phase')</i>

Area	Element	Sub-element	Description	Example Indicators
	f. Waste, By-products and Recycling		<i>Waste and losses generated throughout all different stages considered in the food supply, from post-harvesting to consumption, including retail and distribution, among others</i>	<i>Food waste per capita Food waste per food group Food waste per food supply chain stage Circularity indicators (% of recovered food waste, efficiency) Household food waste measurement Food waste in school canteen Agricultural efficiency</i>
4. Food System Outcomes			<i>Environmental, economic, social, health and food security & resilience impacts</i>	
	a. Environmental impact		<i>Impact on natural resources and the biophysical drivers of the food system</i>	<i>Soil health-related indicators Climate change, GHG food system emissions (JRC dashboard) Pollution, water quality – nitrates in groundwater (JRC dashboard) Environmental impacts of total food consumption (e.g., at national level), such as dietary exposure to 16 midpoint indicators and 3 endpoint indicators (according to ReCiPe) Comparison between planetary boundaries and environmental impacts of food systems Biodiversity (biodiversity conservation and restoration of natural ecosystem) (JRC dashboard) (JRC dashboard)</i>

Area	Element	Sub-element	Description	Example Indicators
	b. Economic impact		<i>Reflects the overall economic health of the food system</i>	<i>Employment by economic activity (JRC dashboard)</i> <i>Value added along the food supply chain</i> <i>Labour productivity of the different sectors of the food supply chain</i> <i>Food expenditure at household level for different SEP</i> <i>Yearly sale data of important food groups (e.g., fish, meat, fruit, vegetables)</i> <i>(flows of) Trade and import statistics of foods/RPC in EU</i> <i>Average salary by sector</i> <i>Labor conditions</i> <i>Price sensitivity</i> <i>Economic outcomes monitored for different diets</i> <i>Degree of self-sufficiency</i> <i>Share of agriculture in GDP</i>
	c. Social impact		<i>Encompass the outcomes resulting from the interactions between society and the food system</i>	<i>Employment by economic activity (JRC dashboard)</i> <i>Accidents at work</i> <i>Gender employment gap in the food sector</i>
	d. Health impact		<i>Diet-related health impacts</i>	<i>Prevalence of overweight and obesity among adults (JRC dashboard)</i> <i>Prevalence of overweight and obesity among children (JRC dashboard)</i> <i>Burden of disease attributable to dietary risk factors (JRC dashboard)</i> <i>Prevalence of chronic diseases/NCD related to food systems (e.g., diet-related, food borne diseases)</i> <i>Microbiome-related health outcomes</i> <i>Nutritional adequacy of the diet based on FBDG</i> <i>Health eating index as measure of diet quality</i> <i>Subjective health assessment (self-assessment)</i>

Area	Element	Sub-element	Description	Example Indicators
				<i>Health impacts and risks of different diets</i> <i>Nutrient status: blood and urine levels of several nutrients</i> <i>Nutrient supply/intake / share of adequacy in population</i> <i>Prevalence of undernourishment</i> <i>Percentage of children under 5 years of age who are stunted (modelled estimates) (both from FAOSTAT/ Food Security Indicators)</i> <i>Prevalence of anemia among children (from World Bank Group)</i> <i>Food safety, risk of chemical and microbiological contamination for human health:</i> <i>Biological contamination of foods: micro-organisms as viruses, fungi, bacteria and parasites</i> <i>Exposure to toxins and contaminants e.g., lead, mercury, pesticides, PFAS, acrylamide, arsenic, etc.</i> <i>Prevalence of foodborne diseases and incidence of foodborne disease outbreaks</i> <i>Parameters of microbial safety, chemical residues, sensory quality, authenticity and compliance with quality standards</i>

Area	Element	Sub-element	Description	Example Indicators
	e. Food Security & Resilience		<i>Reliable access to sufficient, safe and nutritious food now and under future shocks</i>	<i>Prevalence of moderate or severe food insecurity in the population (JRC dashboard)</i> <i>Food affordability (purchasing power of households relative to the price of food)</i> <i>Share of income used for food</i> <i>Food utilisation</i> <i>Food accessibility</i> <i>Food availability</i> <i>Food available per country, measures in kilocalories</i> <i>Availability of organic foods</i> <i>Organic food offer in out-of-home food/public restaurants and canteens</i> <i>Availability of healthy versus unhealthy food in retail</i> <i>Availability of sustainable versus unsustainable foods in retail and out of home</i> <i>Food supply variability</i> <i>Food price volatility</i>

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