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About SecureFood

The European Union's (EU) Farm to Fork strategy, the Biodiversity strategy, and the European Green Deal lay down necessary actions that set a long-term vision for how to change how we produce, distribute, and consume food.

In response to these ambitious aims, SecureFood adopts an integrated systems-thinking approach that acknowledges and embraces the complexity of the food supply chain, including all the actors, elements, processes, activities, infrastructure, and essential services of importance in the production, distribution, and consumption of food to maximize the food supply chain resilience.

SecureFood aims to create an ecosystem of scientific knowledge, collaborative processes, and digital tools that will provide evidence-based indications of the risks and vulnerabilities of the different food value categories in other geographies to safeguard food security and ensure that a secure and resilient food supply chain is assured.

The two crucial pillars of the program are the food systems Resilience Management Framework with connected resilience and sustainability orientations, as well as a Resilience Governance Framework that draws upon all of the collaborative principles and guidelines of the successful cooperation between the food supply chain stakeholders, which will be created, tested and demonstrated in real life case studies. These two frameworks will function as applicability and sustainability mechanisms for organizing and adopting the project's results by applying the developed scientific knowledge and enhancing the food system's resilience at different levels.

The ambition of the program consists of four critical dimensions, which are: 1) the evolution of scientific knowledge and development of the exploratory approach, combining research approach methods that facilitate the risk identification process; 2) the successful safeguarding of the food supply by framing the system resilience and broadening its lens, as well as by assessing and measuring it through a holistic approach which goes beyond national borders and strategies; 3) the acceleration of the transformation of the food systems network, which can be achieved by applying a systematic agency driven collaborative governance approach; 4) and finally, the application of innovative scientific knowledge with the use of advanced digital tools, which will contribute to the successful collection and processing of data sets from several platforms to reshape and redesign the food system trajectory.

The methodology employed in this program is based on three foundational and interconnected pillars: the scientific knowledge (existing and developing), the collaborative principles which are dynamically integrated into the methodology, and the development of digital solutions that will cover all parts of the project (forecasting, statistical analysis, etc.)

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List of Abbreviations and Acronyms

Acronym	Meaning
ACER	Agency for the Cooperation of Energy Regulators
AESAN	Spanish Agency for Food Safety and Nutrition
AFAD	Ministry of Interior Disaster and Emergency Management Presidency (Turkey)
AMIS	Agricultural Market Information System
ANEPC	National Emergency and Civil Protection Authority
BBK	*Bundesamt für Bevölkerungsschutz und Katastrophenhilfe* (Federal Office of Civil Protection and Disaster Assistance, Germany)
BCMS	Business Continuity Management System
BLE	*Bundesanstalt für Landwirtschaft und Ernährung* (Federal Officer for Agriculture and Food, Germany)
CAP	Common Agricultural Policy
CCPs	Critical Control Points
CER	Critical Entities Resilience Directive
CERG	Critical Entities Resilience Group
CONSANP	National Council for Food and Nutritional Security
COP21	United Nations Climate Change Conference
CNA	*Conseil National de l'Alimentation* (National Food Council, France)
CSOs	Civil society organisations
D.	Deliverable
DEFRA	Department of Environment, Food and Rural Affairs (UK)
DRM	Disaster Risk Management
DRMKC	Disaster Risk Management Knowledge Centre
EAFRD	European Agricultural Fund for Rural Development
EAGF	European Agricultural Guarantee Fund
EC	European Commission
ECDC	European Centre for Disease Prevention and Control
EGD	European Green Deal
End-users	Internal Stakeholders
ENISA	European Union Agency for Cybersecurity
EOGS	Earth Observation Governmental Service
ERA	European Research Area
ERCC	Emergency Response Coordination Centre
ESG	External Stakeholder Group
F2F	Farm to Fork Strategy
FAO	Food and Agricultural Organization
FEBA	European Food Banks Federation
FSAI	Food Safety Authority of Ireland
FSMS	Food Safety Management System

Acronym	Meaning
FSR	Food System Resilience
GRFC	Global Report on Food Crises
HACCP	Hazard Analysis and Critical Control Points
HERA	Health Emergency Preparedness and Response Authority
HLPE	High-Level Panel of Experts
HOPKS	*Hospodářská opatření pro krizové stavy* (Economic Measures for Emergencies, Czech Republic)
IOR	Inter-Organizational Relationships
IPCR	Integrated Political Crisis Response
IRGC	Risk Governance Framework
ISMS	Information Security Management System
ISMEA	Italian Institute for Agri-Food Market Services
ISO	International Organization for Standardization
ISTAT	Italian National Institute of Statistics
JRC	Joint Research Centre
MoWaS	Modular Warning System
NESA	National Emergency Supply Agency
NFP	National Focal Point
NRA	National Risk Assessment
OPRP	Operational Prerequisite Program
PNRR	National Recovery and Resilience Plan
PRPs	Prerequisite Programs
RGF	Resilience Governance Framework
SC	Subcommittee
SeMS	Security Management System
SIAC	Single Intelligence Analysis Capacity
SKKM	National Crisis and Disaster Management (Austria)
SPOC	Single Point of Contact
TC	Technical Committee
TR	Technical Reports
TS	Technical Specifications
UCPM	Union Civil Protection Mechanism
WP	Work Package
WTO	World Trade Organization
WFP	World Food Programme

Executive Summary

Europe's food system is facing a new generation of risks that are faster-moving, more interconnected, and increasingly difficult to manage through fragmented or sector-specific responses. Therefore, food security is no longer only a matter of production capacity, but it increasingly depends on system resilience: the ability of food systems to anticipate shocks, absorb disruption, maintain essential food flows, and recover without compromising access to safe, sufficient, nutritious, and affordable food. Recent crises have demonstrated the systemic nature of food security risks. The COVID-19 pandemic exposed vulnerabilities in food access and supply chain continuity; Russia's war against Ukraine disrupted grain, energy, fertiliser, and logistics markets; the war in Gaza has intensified humanitarian food insecurity and regional instability; and the current tensions affecting the Gulf region and the Strait of Hormuz show how rapidly energy markets, fertiliser supply, transport corridors, and food affordability can converge within a single crisis. In 2025, 266 million people across 47 countries faced high levels of acute food insecurity, representing 22.9 % of the analysed population, according to the *Global Report on Food Crises 2026*. Conflicts, weather extremes, economic shocks remained the principal drivers, underscoring that food crises rarely arise from isolated events but from the interaction of geopolitical instability, market volatility, climate extremes, infrastructure dependencies, and unequal access to resources.

The implications are not only humanitarian; but also operational, economic, political, and strategic, making resilient food systems a shared priority for public authorities and private business. Food governance increasingly sits at the intersection of multiple policy domains: international trade, agricultural policy, environmental protection, climate adaptation, public health, poverty reduction, human rights, and security. It also involves a dense constellation of actor, including public authorities, private companies, industry associations, civil society organisations, research institutions, consumers, and international bodies. These actors operate across multiple levels, from local food systems and national authorities to EU institutions and global markets. As a result, food governance is not merely a technical matter of supply and demand; it is a politically sensitive field in which competing values, interests, responsibilities, and scales of intervention must be negotiated. Therefore, the central governance challenge is no longer simply how to ensure sufficient production, but how to ensure that food system continue to function under conditions of cascading and compounding shocks.

Europe benefits from strong production capacity and trade performance, but it is not immune. In 2024, the EU produced 258 million tonnes of cereals, 162 million tonnes of raw milk, and 21 million tonnes of pigmeat, and recorded a €36 billion trade surplus in agricultural, fishery, food, and drink products. Yet food-system pressures are already transmitted to consumers and businesses: prices for food and non-alcoholic beverages in the EU increased by 2.3% in 2024. In March 2026, the FAO Food Price Index rose to 128.5 points, increasing by 2.4% from February, partly linked to higher energy prices associated with conflict escalation in the Near East.

The SecureFood Resilience Governance Framework responds to this evolving risk landscape by shifting food crisis management from reactive emergency response toward anticipatory, coordinated, and capacity-based governance. The Framework provides a structured approach

for aligning EU institutions, Member States, National Competent Authorities, critical entities, food system operators, small and medium enterprises (SMEs), intermediaries, civil society, and research organisations across the pre-crisis and during-crisis phases. Its contribution lies in translating complex systemic risks into clear governance processes, including risk monitoring, resilience-capacity assessment, information sharing, mitigation planning, escalation, response coordination, and learning. By doing so, the Framework addresses a central governance challenge posed by food-system crises: how to coordinate action across multiple actors, levels, and policy domains while maintaining accountability, proportionality, trust, and strategic coherence. For the European Commission and Member States, the Resilience Governance Framework supports a more coherent approach to safeguarding food security as an essential societal function, linking national risk assessment, public-private cooperation, critical entity resilience, and crisis preparedness in operational terms. It contributes to the operationalisation of the EU's resilience agenda by clarifying how national risk assessment, public–private cooperation, critical-entity resilience, and food crisis preparedness can be connected in practice. For private businesses, the Framework offers a concrete value proposition: better anticipation of disruptions, clearer roles and expectations, more reliable channels for information exchange, proportionate responsibilities, stronger business continuity, and improved coordination with public authorities during periods of uncertainty.

In a world where food crises can be triggered by pandemics, geopolitical conflict, climate extremes, fertiliser dependencies, energy shocks, cyber incidents, infrastructure failures, or maritime chokepoints, resilience can no longer be treated as optional. It must be approached as a shared governance capability. The Resilience Governance Framework provides that capability: a structured, EU-relevant, and business-oriented pathway to strengthen preparedness, protect food security, and maintain food system continuity before future shocks escalate into systemic crises.

1 Introduction

1.1 WP3 Objectives and Tasks

WP3 aims to strengthen the resilience of European food systems through a data-driven, anticipatory, and governance-oriented approach. It generates actionable insights, analytical tools, and structured frameworks to support stakeholders in anticipating disruptions, managing risks, and safeguarding food security across governance levels. Specifically, WP3 focuses on: (i) anticipating future food system challenges through scenario analysis; (ii) assessing systemic risks, vulnerabilities, and resilience capacities; (iii)analysing the food loss and waste-food security nexus; and (iv) developing governance and management frameworks to support coordinated action and operational resilience.

WP3 is structured into five mutually reinforcing tasks, each addressing a key dimension of food system resilience.

T3.1 - Foresight Analysis for Future State Scenarios develops plausible future scenarios for food system security using foresight techniques and exploratory modelling. Key environmental, socio-economic, technological, and geopolitical drivers are identified and analysed through cross-impact analysis to capture interdependencies and stress conditions. Scenario bundles are validated and refined through stakeholder engagement, ensuring their relevance and credibility. These scenarios provide the anticipatory foundation for subsequent risk and resilience assessments.

T3.2 - Risk and Resilience Management provides the methodological backbone for systemic risk and resilience assessment under baseline and future scenarios. It analyses interdependencies across the food ecosystem, identifies vulnerabilities and critical nodes, and assesses resilience capacities at multiple system levels. Economic modelling supports the quantification of impacts from disruptions and resilience measures, enabling evidence-based prioritisation of interventions.

T3.3 - Food Loss and Waste – Food security nexus examines how food loss and waste drivers and interventions affect food security outcomes. It evaluates trade-offs between waste reduction and food system performance and identifies optimisation pathways. The task delivers the WASTE-SEC tool, supporting strategic decision-making by enabling stakeholders to compare interventions and prioritise actions that minimise food loss and waste without compromising food availability and access.

T3.4 - Resilience Governance Framework develops a Resilience Governance Framework to enhance cooperation and decision-making among public and private stakeholders. It clarifies roles, responsibilities, and interaction protocols for preparedness and crisis response, supporting coherent and timely action during food system disruptions.

T3.5 - Food Systems Resilience Management Framework delivers the Food System Resilience Management Framework (FSRM), providing practical guidance to operationalise resilience at

national and organisational levels. Implemented through the FSRM tool, it supports qualitative resilience assessment, strategic planning, and capacity building.

1.2 Purpose of the Document

The purpose of this document is to define, structure, and communicate a Resilience Governance Framework that responds to the complexity of contemporary food system while supporting the objectives of the EU Food 2030 initiative. While Food 2030 provides a visionary and holistic agenda for food system transformation, its broad scope can pose challenges for implementation, particularly where priorities, responsibilities, and accountability mechanisms are not clearly articulated. The Resilience Governance Framework is intended to help address this gap by offering a structured governance logics focused on enabling practical and coordinated actions.

The need for such a framework arises from the increasing interconnectedness of food systems and their exposure to a wide range of shocks and stresses, including climate change, geopolitical instability, market volatility, and public-health crises. These conditions underline the importance of governance arrangements that support openness, participation, accountability, effectiveness, and coherence. In response, the Resilience Governance Framework places emphasis on stakeholder agency, recognising that food system resilience depends on the capacity of diverse actors to make decisions, mobilise resources, cooperate effectively across sectors and governance levels.

The document clarifies both the conceptual foundations and the practical implications of a resilience-oriented governance approach. It describes the processes and mechanisms that enable inclusive and participatory governance, and outlines how roles, responsibilities, and cooperation among stakeholders are structured in the pre-crisis and during crisis. In this sense, the Framework serves as a reference guide to support the alignment of strategic priorities and coordinated interventions, contributing to more coherent preparedness and response to food system crises and reinforcing public confidence in food system governance.

It is important to note that this document does not provide detailed technical and operational implementation plans for food system interventions. Its focus is on governance—specifically on the relationships, decision-making processes, and cooperation mechanisms that enable effective action. Operational and management aspects are addressed separately in Deliverable D3.5, the Food Systems Resilience Management Framework, which focuses on implementation and operationalisation. Readers seeking detailed operational guidance are therefore referred to D3.5 and related SecureFood project outputs.

1.3 Intended Readership and Connection to Other Deliverables

This document is primarily intended for policymakers, public authorities, and stakeholders involved in food system governance, including those engaged in preparedness, crisis response, and the design and implementation of food security strategies at regional, national, and EU levels. Its scope also extends to private-sector actors, civil society organisations, and other non-institutional stakeholders, by clarifying expected roles and modes of interaction across the different phases of food system crises.

The Framework is also relevant for technical developers and project partners contributing to the SecureFood project. For this audience, it provides a common understanding of the cooperation mechanism proposed, as well as the roles, responsibilities, and decision-making pathways that underpin effective governance—from strengthening resilience in anticipation of crises to coordinating timely responses as crises unfold. Clarifying who should be informed, who holds decision-making authority, and who is expected to act at different stages is essential to ensure that governance arrangements are not only conceptually robust, but also practically usable.

The development of this document builds on several interconnected project activities that provide essential inputs to the Resilience Governance Framework. Foundational analyses from WP2—including regulatory assessment, identification of food-security drivers, and gap analysis—inform the governance context and strategic framing. Inputs from Tasks 2.2 and 2.3, focusing on food-security drivers, targeted interventions, user requirements, use cases, and KPIs, ensure that the Framework responds to the perspectives and needs of end users within the SecureFood project. Crisis scenarios developed in WP6 provide a practical lens to test the applicability of the Framework across diverse crisis contexts, while engagement activities under WP8 support the identification and involvement of relevant stakeholders. In turn, outputs from WP3, and in particular Task 3.4 on the SecureFood Resilience Governance Framework, contribute to several downstream activities. They inform policy recommendations, best practices, and guidance for public institutions and governance bodies involved in food-system regulation and crisis management, directly supporting policy-shaping activities under WP7. Selected outputs—such as the clarification of roles and responsibilities in the pre-crisis and during-crisis phases—may also feed into training and capacity-building materials, contributing to shared understanding among diverse stakeholder groups. Dissemination and communication activities under WP8 further support uptake by external audiences, enhancing the clarity, relevance, and usability of the Framework.

2 General Methodological Approach

The Resilience Governance Framework was developed using a structured and participatory methodological approach, designed to ensure relevance, inclusiveness, and alignment with the objectives of the SecureFood project, while supporting validation of the Framework. Stakeholder engagement was a central component of this approach, serving both to inform the design of the Framework and to test its assumptions, structure, and level of detail against real-world perspectives.

The process began with a comprehensive stakeholder-mapping exercise covering both internal and external actors. Internal mapping focused on project partners directly involved in Task 3.4, hereafter referred to as *end-users*. These actors are expected to apply and operationalise the governance concepts and cooperation mechanisms developed within the project.

In parallel, stakeholder mapping was extended to external stakeholder groups, building on the contact list developed under WP8 (Task 8.1 on liaison activities and stakeholder engagement). This list was further enriched through suggestions from end-users and included representatives of national and sectoral organisations, such as public authorities, industry federations, and sector-specific bodies at Member State level. Although the Grant Agreement required engagement only with the 22 end-users, the project deliberately exceeded this minimum requirement to broaden participation and incorporate a wider range of expertise and perspectives. Mapped stakeholders—both end-users and external stakeholders—were categorised according to their organisational profile and functional role within the food system. This enabled a more detailed understanding of stakeholder expectations, capacities, and potential contributions to resilience governance.

A core methodological element across all engagement activities was the use of concern assessment, drawing on the IRGC Risk Governance Framework. This approach recognises that stakeholder positions are shaped not only by technical considerations, but also by values, perceptions, and prior experience. Guided by this methodology, structured discussions were held to surface concerns, expectations, and areas of ambiguity, enabling the progressive emergence of a shared vision for the Framework. Concern assessment therefore functioned as a practical mechanism for embedding stakeholder agency into the governance design process.

In parallel with stakeholder engagement, an internal research process was undertaken to define the conceptual structure and analytical content of the Framework. This work focused on resilience as a dynamic process, the identification of food-system resilience capacities, and the governance principles required to support preparedness and effective crisis response. Relevant EU policy commitments and international standards were reviewed to ensure conceptual consistency and alignment with existing governance instruments. An in-depth analysis of stakeholder roles pre-crisis and during crisis phases was also conducted. Responsibilities across preparedness, response, and coordination were mapped and validated through targeted engagement activities. Feedback from end users and external stakeholders was systematically analysed and integrated into the final Framework, strengthening its relevance and internal coherence.

Finally, the effectiveness of the Resilience Governance Framework is assessed using three key performance indicators (KPIs) defined under WP2 and applied within Task 3.4. These KPIs measure: (i) the diversity of stakeholder participation across domains and geographies; (ii) the coverage of food-crisis scenarios requiring public–private cooperation; and (iii) the degree of trust and perceived usefulness of the Framework among end users. The first KPI evaluates inclusiveness by assessing representation across sectors, supply-chain stages, organisational types, and geographical contexts. The second KPI assesses scenario coverage by applying the Framework to four crisis scenarios developed under WP6 and evaluating whether roles, responsibilities, and cooperation mechanisms are adequately addressed. The third KPI captures trust-building and user confidence through surveys and workshops, with follow-up actions used to address identified gaps. Together, these indicators support validation of the Framework's robustness, usability, and relevance.

2.1 Stakeholder Engagement and Participatory Process

The SecureFood project was premised on the recognition that resilience in food systems cannot be engineered solely through technical recommendations or institutional mandates. Instead, it must emerge from accumulated knowledge, practices, and perspectives of the diverse actors who operate within the system every day. For this reason, the development of the SecureFood Resilience Governance Framework adopted a multi-stakeholder participatory process that engaged actors across the food chain, public authorities, research institutions, advisory bodies, NGOs, and civil society interests. Through a process combining surveys, workshops, structured consultations, and partner validation exercises, the Framework was progressively shaped by empirical evidence and the lived experience of diverse stakeholders. Participants repeatedly highlighted that resilience governance must be collaborative, transparent, and inclusive, especially given the cross sectoral nature of food system risk. Throughout the engagement cycle, stakeholders consistently argued that food system resilience requires a shared understanding of risks, cooperation mechanisms that operate pre-crisis and during crises, and clarity in how responsibilities are distributed among institutions and private actors. These contributions have shaped a Resilience Governance Framework that is co-owned, evidence based, and able to reflect the complexity of food system resilience challenges.

This section interprets the results gathered in the participatory process, showing how the evidence generated across 2024–2026 influenced the structure, logic, and operational detail of the governance model.

2.1.1 Overall Methodology of the Participatory Process

The participation methodology combined surveys, interactive workshops, structured consultations, and partner-specific role validation exercises, creating an iterative process where insights from earlier stages informed subsequent activities.

The process was supported by several engagement formats, including:

- Online survey (August 2024) collecting open-ended inputs and ranked priorities

- Interactive workshop (September 2024) with live polling and open discussions
- External Stakeholder Group (ESG) consultation (December 2024)
- Partner role-validation survey (June 2025) testing agreement and feasibility of proposed responsibilities
- Cooperation mechanisms and inter-stakeholder relation survey (January 2026) examining collaboration patterns and barriers

Across the activities, the participants landscape was notably diverse, reflecting the intention to capture the full spectrum of food system perspectives. The categories of stakeholders that actively participated include:

- Private sector (farmers, food producers and processors, retailers, logistic actors, and SMEs of varying sizes)
- Research institutions, universities, and technical experts
- NGOs, sector associations, and civil society perspectives
- Advisors and specialized actors (e.g., cybersecurity and technology partners)

Findings from each activity were synthesized and used to refine the roles and responsibilities of food system actors, structural components of the Resilience Governance Framework, crisis phases, and coordination and communication mechanisms. The diagram in Figure 1 illustrates an overview of the participatory process followed throughout the Framework development.



Figure 1. Diagram of the participatory process supporting framework development.

2.1.2 Description of Engagement Activities

A. **Initial Survey on Framework Expectations** – The survey explored foundational expectations for the Resilience Governance Framework. It served primarily as a diagnostic tool, offering a first picture of what system actors considered most

important in preparing for and responding to crises. Stakeholders' input suggested the need for clearly articulated roles and responsibilities, highlighting the perceived governance fragmentation as a barrier to resilience. Respondents also stressed the need to improve crisis response methods and to establish a shared understanding of how crises should be identified within the governance structure. What emerged clearly from this first exercise was the expectation that the Framework should achieve both clarity and adaptability. This stage set the normative frame for resilience governance, which would need to prioritize coordination and clarity before technical details.

B. Stakeholder Workshop – The workshop and facilitated discussion supplemented by live polling was participated by diverse food system actors, including retailers, researchers, food producers, and stakeholders familiar with crisis conditions. The results depict a complex landscape of challenges that actors face when attempting to anticipate and manage food system disruptions. Specifically, participants described the difficulty of predicting crises, frequently citing the "low visibility" of emerging threats and the challenge in interpreting weak early signals. Many highlighted that cooperation mechanisms across ministries and authorities remain unclear, resulting in uncertainty over who is responsible for coordination at various stages of crisis management. Stakeholders repeatedly emphasized the need for improved communication channels, investing in training and capacity building, and cultivating a shared culture of preparedness. The workshops also underlined sector specific concerns. Some actors noted that crisis impacts differ substantially across product categories, using the example of fresh products versus canned or processed goods to illustrate the need for differentiated approaches. Others stressed the need for a central crisis coordination mechanism—described at various points as a "leading institution", "central contact point", or "platform"—that could guide actors during emergency situations and help structure communication across levels of governance.

C. External Stakeholder Group (ESG) Consultation – The consultation provided an in-depth view into stakeholder expectations, concerns, and proposals across numerous dimensions of resilience governance. Participants argued that the Resilience Governance Framework should prioritize monitoring and preparation, with particular attention to the detection and interpretation of early warning signals. Several respondents stressed the importance of defining, with precision, what constitutes a crisis, as ambiguity in crisis definitions can generate delays and misalignment across actors. Moreover, responses articulated a clear expectation that public authorities should focus on monitoring, signalling, coordinating, and communicating, whereas private actors should concentrate on preparedness, internal response measures, and implementation. Participants frequently stressed the need for structured coordination mechanisms. Proposals included the creation of crisis cells, clearer communication pathways, and the strengthening of linkages between local, national, and EU governance levels. This was tied to requests for alignment with existing standards such as HACCP and ISO. Altogether, the consultation represented a major step in shaping the governance architecture and refining its core components.

D. Partner-Role Validation Survey – The survey served as a final validation step before consolidating roles and functions of main actors involved at the various governance levels. Stakeholders from multiple countries and organizational types offered both confirmation and constructive critique of the evolving framework. Partners generally

agreed with the responsibilities assigned to their categories, but many emphasized the need to contextualize expectations based on the organizational capacity. For instance, several respondents highlighted that SMEs, in particular, require responsibilities that reflect their limited resources and leverage. Others pointed out that competitiveness concerns, incentives, and sector-specific challenges must be addressed for the Resilience Governance Framework to be actionable. These results underscored the importance of designing support mechanisms with embedded capacity-building provisions into the Framework.

E. Cooperation Mechanism Survey – The final survey provided additional insight into the relational dynamics and the cooperation patterns supporting the food system resilience. It offered understandings into how frequently different stakeholders interact, what barriers they face in cooperation, and how they perceive their roles in ensuring resilience capacity. It became clear that cooperation patterns across stakeholder groups are uneven, and barriers persist due to resource constraints, unclear mandates or simply lack of inter institutional familiarity. This evidence reinforces a central conclusion that food system resilience requires a governance mechanism capable of building and maintaining relationships before crises occur.

2.1.3 Key Recommendations Emerging from the Participatory Process

Across all engagement stages emerge as food system resilience is constrained less by technical limitations and more by governance deficits. Stakeholders consistently highlighted the ambiguity, fragmentation, communication gaps, and unrealistic expectations as the key obstacles. This participatory process thus revealed the importance of clarifying roles and responsibilities, ensuring that tasks are proportionate to the capacities of different actors and that responsibilities between public and private sectors are well defined. Moreover, it highlights the importance of strengthening cooperation across governance levels, supported by clear communication channels and potentially by a central crisis leadership structure.

Participants promoted robust early warning systems and real time information mechanisms that leverage existing data. Additionally, many emphasized that the Resilience Governance Framework must remain inclusive, explicitly incorporating civil society perspectives and the needs of vulnerable groups. There was also broad recognition that crises vary widely in nature and severity, requiring differentiated responses and modular governance tools that can adapt to specific situations.

Training, communication, and capacity building were identified as essential components for enhancing preparedness across the system. Stakeholders also stressed that governance must evolve over time, with periodic review and post crisis learning. Finally, participants urged alignment with established standards and practices to maintain coherence and avoid duplications.

In summary, this analysis led to the following priorities for the Resilience Governance Framework:

- Clarify roles and responsibilities, with proportionate expectations for SMEs and a clear distinction between public and private sector functions.
- Strengthen coordination mechanisms, including the establishment of a dedicated leadership structure.
- Enhance early warning and real-time information systems, building on existing data flows while minimizing reporting burdens.
- Ensure inclusiveness explicitly by systematically integrating civil society, consumer perspectives, and a broad range of food-system actors.
- Enable differentiated responses aligned with the type and severity of crises.
- Strengthen preparedness through targeted communication, training, and capacity building initiatives.
- Align actions with existing standards and governance structures, avoiding duplication and parallel systems.

2.1.4 Stakeholder Engagement Evidence to Resilience Governance Framework Design

Table 1 provides mapping between the stakeholders' engagement activities conducted in the SecureFood (2024-2026) project and the core components of this Resilience Governance Framework. It presents an overview of how input from surveys, workshops, external consultations, and partner validation exercises informed the conceptual and operational architecture of the Framework. This section responds to the need – expressed repeatedly by stakeholders during the participatory process – for transparency in how their contributions shape governance outcome, reinforcing the openness, agency, and accountability underpinning the SecureFood governance approach.

Table 1. Mapping of stakeholders' engagement evidence and their influence on the core Resilience Governance Framework components.

Resilience Governance Framework Component	Stakeholders' Engagement Evidence	Influence on Framework Design
Crisis Identification & Early Warning	- Difficulties in anticipating crises. - Challenges in recognizing early signals across crisis types.	Adoption of shared definitions and integration of the early warning system into a defined governance structure, ensuring continuity between identification, response cooperation, and stakeholders communication during-crisis.
Roles & Responsibilities	- Need for clearer role allocation. - Demand for proportional expectations across actors.	Differentiation of responsibilities by actor types, with a clear distinction between public (monitoring,

		signalling, coordination) and private (preparedness, implementation) roles, ensuring proportionality for SMEs.
Coordination & Leadership	- Fragmented coordination structures. - Lack of clear crisis communication chains. - Uneven collaboration and persistent barriers.	Establishment of a permanent coordination function, with defined leadership roles and structured vertical and horizontal communication pathways.
Information Flow & Communication	- Need for real-time information exchange. - Preference for leveraging existing systems.	Integration of interoperable information channels, prioritizing clarity, and use of existing data infrastructures.
Inclusion & Representation	- Insufficient representation of vulnerable groups and civil society. - Limited awareness of participatory mechanisms.	Introduction of formal roles for civil society organisations, and systematic consideration of vulnerable groups in food crisis preparedness and response.
Cooperation Mechanism	- Weak inter-actor linkages and infrequent interactions. - Barriers related to mandates and resources.	Development of interaction pathways, identification of bottlenecks, and targeted measures to strengthen cooperation across public and private actors.

3 Resilience Governance Framework

To support a food system capable of withstanding shocks, adapting to change, and maintaining food security in the European Union, this document introduces a Resilience Governance Framework. The Framework sets out a structured approach based on defined principles, roles, and processes that guide public and private stakeholders in preparedness and crisis response. Its primary objective is to strengthen the resilience of the EU food system by supporting coordinated governance arrangements for the prevention and mitigation of food security risks. The Resilience Governance Framework is designed to foster cooperation between public and private actors at national and EU level, recognising safeguarding food security as a shared responsibility. Rather than focusing on individual organisations or isolated measures, the Framework emphasises system-level governance, providing a common logic for aligning responsibilities, decision-making processes, and cooperation mechanisms across the food system.

3.1 Vision and Objectives

Food security exists *"when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life"* (FAO, 2024). This definition highlights food security as a condition that is equitable, sustainable, and resilient over time. Since its formal articulation at the World Food Summit in 1996, the concept of food security has evolved in response to changing economic, environmental, and geopolitical conditions. Today, food security is widely understood as comprising six interrelated pillars:

- Food availability - the sufficient supply of food of appropriate quality;
- Food access – economic and physical access to food for all population groups;
- Food utilization - adequate diet, clean water, sanitation, and health care to achieve nutritional well-being;
- Food stability - reliable access and availability over time, including during shocks and seasonal fluctuations;
- Food sustainability - long-term stewardship of natural resources to meet present and future food needs;
- Food agency - the ability of people and communities to shape and engage with their food systems.

The addition of sustainability and agency in 2020 reflects an expanded understanding of food systems at incorporates environmental integrity, social equity, and long-term resilience (FAO, 2020). Despite this comprehensive framing, achieving food security remains a complex governance challenge. It requires public authorities, private operators, and civil-society actors to ensure continuity of essential food services under a wide range of conditions, including large-scale disruptions.

Food systems are best understood as interconnected networks encompassing the production, processing, distribution, consumption, and disposal of food (FAO, 2019). They include both food supply chains—through which food physically moves—and food environments, defined

as the physical, economic, political, and socio-cultural contexts in which food choices are made. Disruptions linked to conflict, health emergencies, environmental degradation, and climate change affect both supply chains and food environments, with consequences for public health, social stability, and economic performance (Bertolozzi-Caredio et al., 2023).
Recognising this systemic exposure, the EU classifies *"production, processing and distribution of food"* as one of the eleven critical sectors under the Directive on the Resilience of Critical Entities (European Parliament and The Council, 2022). Member States are therefore required to establish governance arrangements that protect critical food system functions and strengthen their large-scale operations, lastly ensuring their ability to withstand threats and continue functioning during crises. The strong interdependence of food system with other critical sectors, such as energy, transport, and digital infrastructure, further underlines the need for coordinated, cross-sectoral governance approaches to risk prevention and mitigation.

The Resilience Governance Framework is developed through a participatory process involving experts from key EU food supply chains (grain; milk and dairy; fish and aquaculture; fruit and vegetables), public authorities, industry associations, and civil-society organisations. It approaches food security holistically, grounded in all six pillars, and pursues the following core objectives:

- to establish a shared set of concepts and terminology for food-system resilience governance;
- to clarify roles and responsibilities of food-system actors in the pre-crisis and during-crisis phases;
- to promote structured cooperation within the food system and with other critical sectors;
- to support alignment between governance arrangements, scientific knowledge, and societal needs.

The Framework is intended to support Member States in developing or refining national food-system resilience governance arrangements in line with the CER Directive, while also enabling food-system actors to understand their position within the wider governance landscape and to participate effectively in coordinated preparedness and response.
To illustrate the application of the Framework across different types of disruptions, it addresses both short-term crises (e.g. conflicts, pandemics, environmental incidents) and longer-term challenges (e.g. climate change and resource scarcity) through a set of five illustrative case studies.

Section 3.2 introduces the concept of food system resilience, as a dynamic process structured around the pre-crisis and during-crisis phases. It outlines the essential components of a resilient food system and identifies the resilience capacities that constitute key areas of intervention for public and private actors. The section also situates these capacities within the current EU regulatory and policy landscape and relevant international standards.

Section 3.3 defines governance in the context of food security, distinguishing it from related concepts in other critical domains. The principles of good governance—openness, participation, accountability, effectiveness, and coherence—are introduced as the normative foundation of the Framework.

Section 3.4 presents the crisis-governance approach at the core of the Resilience Governance Framework. It maps food-system stakeholders and their evolving roles across preparedness and response phases, introduces a structured public–private cooperation mechanism at Member State level, and examines how power imbalances may affect cooperation effectiveness. The cooperation mechanism is described for both pre-crisis and during-crisis phases, detailing its governance structure and operational functions.

Finally, Section 4 applies the Resilience Governance Framework to a set of crisis scenarios reflecting vulnerabilities in the EU food system. Five case studies explore how different stressors affect specific food supply chains and propagate across the six pillars of food security. The Framework is applied through simulated crisis-management processes, illustrating stakeholder roles, coordination dynamics, and sequencing of actions at national and, where relevant, EU level.

3.2 Context and Background

3.2.1 Resilience in Food Systems

3.2.1.1 Definitions and Concepts of Resilience in the Food System

The concept of resilience, first discussed in ecology (Holling, 1973), describes the ability of the system to withstand shocks and stresses and recover after disturbance. Over time, this concept has been applied across various fields, including social infrastructures intersecting with the natural environment, physical sciences, and individuals' psychological development within behavioural sciences (Miles & Hoy, 2023). In the context of food systems, resilience refers to the system's ability to deal with shocks or stressors in a way that does not negatively irreversibly compromise its long-term functioning (Béné, 2020). Tendall et al. (2015) define food system resilience (FSR) as the "*capacity over time of a food system and its units at multiple levels, to provide sufficient, appropriate, and accessible food to all, in the face of various and even unforeseen disturbances*." Unlike a purely static notion of stability, FSR emphasizes persistence through change – a system's ability to adapt and maintain food security (availability, access, utilization, and stability) even when faced with disruptions.

Recent global events have underscored why resilience is crucial for food systems. The effects of climate change, with its increasing frequency of extreme weather related events (drought, flood, natural disasters), the outbreak of the COVID-19 pandemic, which disrupted supply chains worldwide, and the geopolitical conflicts like Russia's invasion of Ukraine (triggering price spikes in grain and energy markets) and the war on Gaza (causing current catastrophic shortage of food availability), have highlighted the vulnerability of food systems to shocks and stresses to levels at which they might cease to maintain their functions, affecting food availability, access and nutrition (Hassoun et al., 2025; Roosevelt et al., 2023). These events have underscored the importance of resilience, leading to renewed focus on the concept (Roosevelt et al., 2023) as we prepare for an era of compounding and unpredictable shocks.

Food system resilience must be, therefore, a dynamic and adaptive process to respond to temporal variations of the variables that might disrupt food systems. FSR also involves the capacity to anticipate threats, absorb shocks, recover from disruptions, and adapt or even transform in response to long-term stresses (Kc et al., 2024). This means that resilience is not just about bouncing back to the previous state (as in traditional engineering resilience); it often involves "bouncing forward"– making adjustments that improve the system's ability to handle future challenges. In practice, a resilient food system might adjust crop choices, diversify supply chains, or strengthen social safety nets pre-crisis hits (preparedness and prevention), and evolve new practices or policies during a crisis (response) to be better prepared next time (Roosevelt et al., 2023).

Finally, FSR must be considered a multi-scale process, recognising the various governance levels and the interactions among them—from local communities to national and global systems (Kc et al., 2024).

3.2.1.2 Key Components of a Resilient Food System

Fundamentally, a resilient food system must continue to deliver on food security and nutrition goals despite disturbances. In practical terms, experts often highlight three key components that such a system must uphold at all times (*Resilient Food Systems – A Proposed Analytical Strategy for Empirical Applications*, 2021; Tendall et al., 2015):

- *Sufficiency* - A food system is considered sufficient when it can consistently produce and provide enough food to meet the dietary needs of the entire population. This involves ensuring that there is an adequate quantity of food available at all times, whether through domestic production, imports, or food aid. It also means having the capacity to buffer against shortages caused by disruptions such as natural disasters, economic crises, or conflicts.
- *Appropriateness* - Appropriate food refers to food that is not only safe and nutritious but also culturally acceptable and suitable for the dietary needs of different population groups. This means that the food provided should meet the nutritional requirements of individuals, taking into account factors such as age, gender, health status, and cultural preferences. It also involves ensuring food safety and quality standards are met to prevent foodborne illnesses.
- *Accessibility* - Accessible food means that all individuals have both physical and economic access to sufficient, safe, and nutritious food. This involves ensuring that food is available in all regions, including remote and underserved areas, and that people have the financial means to purchase it. Accessibility also includes addressing barriers such as transportation, market infrastructure, and social inequalities that may prevent certain groups from obtaining the food they need.

True resilience means that all three conditions are sustained through adversity. A practical illustration: during a crisis, some countries may experience panic buying and temporary shortages. A resilient food system would have mechanisms like strategic goods reserves or diversified import sources to keep shelves stocked (*sufficiency*), would ensure that even processed or substitute foods remain fortified and safe (*appropriateness*), and might

implement emergency food distribution or cash-transfer programs to support those who lost income (*accessibility*). Indeed, the European Union's food contingency plan aims to guarantee a "*sufficient and varied supply of safe, nutritious, affordable food to citizens at all times*", effectively restating these three components as policy goals (Ensuring Global Food Supply and Food Security, 2025).

3.2.1.3 Resilience Capacities

The resilience of a system, regardless of its scale, is best evaluated through a holistic approach that emphasises the dynamic interactions among its individual components (Sgarbi, F. & Nadeu, E., 2023). This perspective recognises that system resilience emerges not merely from the sum of its parts, but from the complex interdependencies and feedback mechanisms that shape system behaviour under stress. Resilience capacities, in the context on food systems, refer to the diverse resources and attributes — both tangible and intangible — that actors develop, accumulate, and mobilise in response to crises or shocks. These capacities serve to strengthen overall resilience by supporting adaptive responses and recovery, ensuring that the system maintains functionality in the face of disturbance (Béné, 2020).

It is worth noting that, in complex socio-ecological systems such as food systems, resilience cannot simply be measured as an aggregate of individual resilience capacities, even though each component's resilience contributes to the system's overall capacity to function under stress (Roosevelt et al., 2023). This because risks and vulnerability are not equally distributed within a system and can impact its various components differently. Therefore, understanding the dynamics of food system resilience – especially for those who want to assess the resilience such as researchers, practitioners, and policy makers – requires a clear distinction between the resilience capacities and the resilience *per se*. Resilience capacities are typically assessed through quantitative or semi-quantitative indicators drawn from conventional socio-economic surveys or focus group discussions (e.g. economic, knowledge, social factors, etc.) (Béné et al., 2023). These indicators should be selected with explicit research objectives or hypotheses. In contrast, resilience is the *actual* ability of a system or its actors to recover from crises/shocks, and, ideally, to "bounce forward".

To operationalise food-system resilience under stress conditions, the Resilience Governance Framework identifies a set of core resilience-capacity domains that collectively support continuity of essential functions during shocks:

- ***Economic Capacity***: it refers to the financial resources and market mechanisms available to support food systems during periods of crisis. This includes households' economic resilience (income, savings, purchasing power) as well as broader market functions and trade networks. While lower poverty levels and higher incomes are commonly associated with increased FSR, greater food access through global food supply chains often introduces adverse externalities, including pollution, food waste, and biodiversity loss. Additionally, while reliance on global markets can help mitigate local shortages, it can increase exposure to volatility. Therefore, achieving resilience requires a strategic balance between fostering robust local production and maintaining flexibility in trade (Seekell et al., 2017).

- *Social Capacity*: it includes social capital, networks, and community cohesion, serving as the backbone of resilience. Communities with strong social network tend to collaborate, share resources, and provide mutual support, which are critical during times of crisis. For instance, local farmers should interact with multiple suppliers and retailers, building broad, redundant networks to ensure the continued movement and availability of food, even in the face of disruptions. Importantly, social capacity also require attention to equity and inclusion – shocks often disproportionately impact vulnerable populations (e.g. female-headed or financially insecure households, as seen in the aftermath of COVID-19 (Josephson et al., 2020)). Thus, empowering all segments of society and fostering inclusive support networks enhances overall resilience. In practical terms, this might mean maintaining local food banks, community kitchens, or farmer networks that activate in emergencies.
- *Physical and Infrastructure Capacity*: this covers the hard infrastructure and logistical systems critical for food production and distribution. It includes transportation networks (roads, ports, cold chains), storage facilities, irrigation systems, and other physical assets. A resilient food system relies on infrastructure that is robust (capable of withstanding disruptions) and has redundancies (backup options) (Roosevelt et al., 2023). Continuity of utilities like energy and water supply for food production is also part of this capacity. Strategies to enhance resilience often involve modernizing infrastructure – for example, climate-proofing storage facilities or digitizing supply chain management for better rerouting. During crises, the quality and adaptability of physical infrastructure are decisive factors in ensuring that food remains accessible, efficiently moving from points of production to those of greatest need.
- *Institutional and Governance Capacity*: Effective institutions, policies, and governance mechanisms are fundamental for sustaining FSR during periods of crisis. This dimension includes the presence of organizations and coordination mechanisms capable of rapid decision-making, clear communication, and decisive enforcement to safeguard food security. Governance capacity spans governmental bodies at multiple levels, international agencies, and public-private partnerships dedicated to food crisis management. Key elements include well-defined roles and responsibilities, the development and implementation of emergency plans (like national contingency plans for food security), and the ability to adapt policies in real-time (for instance, by temporarily adjusting import tariffs or mobilising strategic food reserves to buffer stocks. Equally important is the facilitation of inter-sectoral collaboration, as resilience often depends on effective cooperation among producers, industry stakeholders, civil society, and governing bodies. For example, the EU's establishment of the European Food Security Crisis preparedness and response Mechanism (EFSCM) (Contingency Plan for Ensuring Food Supply and Food Security in Times of Crisis, 2021), which brings together public and private actors to evaluate risks and coordinate responses, exemplifies institutionalised collaboration.
- *Informational Capacity*: The ability to collect, share, and use information is a distinct facet of resilience. Early warning systems, risk monitoring, and effective communication channels all fall under this capacity. A resilient food system prioritises investment in data infrastructure – tracking weather patterns, crop conditions, market fluctuations, and indicators of food insecurity in real time. With strong informational capacity, emerging threats (such as drought, supply chain disruptions, or disease

outbreaks) can be detected promptly and addressed with target interventions. The efficacy of such systems depends not only on technological tools, but also on the credibility of information sources and degree of trust among stakeholders. Rapid, clear communication from public authorities to producers and food businesses is essential during crises and adaptive responses are more effective. Furthermore, informational capacity involves institutional learning: after a shock, the lessons learned are documented and integrated into future planning. In the digital era, technologies such as satellite-based crop monitoring, mobile-accessible market information systems, and integrated food security dashboards (e.g., the EU's Food Security Dashboard (Directorate-General for Agriculture and Rural Development (European Commission), 2026)) are invaluable in enhancing transparency and coordination throughout the agri-food chain. These tools facilitate the timely identification of risks and support evidence-based decision-making, thereby strengthening the resilience of food systems (Uusikylä et al., 2024).

- *Environmental and Natural Resource Capacity*: it refers to the integrity and biodiversity of ecosystems that supports agriculture and fisheries, including vital resources such as soil, water, biodiversity, and climate stability. The biophysical and ecological attributes of a given region shape the quality, quantity, and diversity of potential food production. A resilient food system works with its environment to buffer shocks: for instance, healthy soils improve water retention during droughts, diverse cropping systems reduce vulnerability to pests and diseases, and conserved genetic diversity (seed banks, livestock breeds) enhance adaptive capacity in the face of environmental shifts. Thus, resilience and sustainability are intrinsically linked. Practices such as regenerative agriculture, strategic water management, and ecosystem restoration reinforce a food system's ability to withstand and recover from stressors. Additionally, minimising reliance on external inputs (e.g. fossil fuels, imported fertilizer) through environmentally sustainable approaches can reduce susceptibility to supply shocks (Sgarbi, F. & Nadeu, E., 2023).

In essence, adaptive capacities are the building blocks of resilience. A food system with diversified economic strategies, engaged communities, robust infrastructure, responsive institutions, reliable and transparent information flows, and environmentally sustainable practices is significantly better equipped to ensure sufficient, appropriate, and accessible food in the face of crises.

3.2.2 Food Crisis and Their Phases

According to the Global Report on Food Crises (GRFC): "*A **food crisis** occurs when rates of acute food insecurity and malnutrition rise sharply at local or national levels, raising the need for emergency food assistance*" (FSIN, 2023). In global terms, a food crisis typically means a large-scale acute food insecurity emergency, including famine in the most severe scenarios. Within highly developed contexts such as the European Union, a food crisis may involve a major supply chain disruption or pronounced price shocks threatening food security. According to the EU's contingency planning framework, a food security crisis is defined as an exceptional, unpredictable, and large-scale event or risk that have the potential to threaten the

EU food supply or food security (Contingency Plan for Ensuring Food Supply and Food Security in Times of Crisis, 2021).

Recent crises - including the COVID-19 pandemic, the 2022 Ukraine war, and the global price surges - have underscored the necessity of robust preparation for risks that threaten EU food supply and food security. Clearly defining the phases of a food crisis is essential: it enables policymakers and stakeholders to implement targeted preventive actions before disruptions occur, and to coordinate an effective response as events unfold. In crisis management, the disaster cycle used often includes four main phases: i) *prevention*, ii) *preparedness*, iii) *response*, and iv) *recovery*.

In the context of food crises, these phases are often described as:

i. **Pre-Crisis (Preparedness and Prevention)** – proactive strategies such as risk assessment, surveillance, communication, and the development of contingency plans aim to reduce vulnerability and enhance readiness.
ii. **During Crisis (Response)** – reactive interventions address immediate threats, with emphasis on rapid decision-making, resource allocation, and the protection of food security. This stage encompasses both the early-warning phase—where signals of impending crisis are detected—and the acute crisis phase, where impacts become pronounced.
iii. **Post-Crisis (Recovery and Learning)** – activities focused on restoring stability, evaluating outcomes, and incorporating lessons learned to strengthen future resilience.

It is also important to distinguish ***shocks*** from ***crises*** in the context of food systems. Shocks are generally understood as sudden, often short-term events—such as extreme weather episodes, temporary supply disruptions, or localized market disturbances—that can usually be absorbed or managed through existing capacities and routine response mechanisms. While shocks may act as triggers, a food crisis emerges when such events escalate, propagate across the system, or interact with underlying vulnerabilities, thereby overwhelming normal coping capacities and requiring coordinated, strategic intervention. The Resilience Governance Framework is therefore primarily concerned with food crises, rather than isolated shocks, and focuses on situations in which systemic impacts, uncertainty, and cross-sectoral dependencies necessitate structured governance arrangements and collective action at system level. Moreover, the Resilience Governance Framework is designed to address both the ***pre-crisis*** and ***during-crisis*** phases, recognising that effective safeguarding of food security depends on a combination of proactive preparation and dynamic, coordinated response mechanisms. Post-crisis recovery and long-term learning processes, while essential components of the crisis management cycle, fall outside the scope of this guidebook and are therefore not addressed in detail.

3.2.2.1 Phase 1: Pre-Crisis – Preparedness and Prevention

During this phase, emphasis is placed on systematically anticipating potential threats and implementing measures to reduce vulnerabilities within the food system. Robust preparedness strategies are critical to mitigating the effects of a crisis or, where possible, preventing its

onset altogether. Key components of the pre-crisis stage involve continuous risk assessment, comprehensive contingency planning, and proactive prevention initiatives.

- Risk identification and monitoring: well before a crisis becomes acute, authorities and organizations employ systematic surveillance to detect factors that could trigger food crises. This includes monitoring climatic variables (droughts, floods), geopolitical instability, market fluctuations (food prices, stock levels), supply chain vulnerabilities, animal/plant disease outbreaks, etc. Advances in technology have significantly enhanced early warning capabilities with tools such as satellite imagery and integrated data dashboards enabling real time analysis of emerging risks. For instance, the European Commission "Food Supply and Security Dashboard" aggregates critical data on markets, weather conditions, and crop status, providing timely alerts to inform both policymakers and stakeholders (Directorate-General for Agriculture and Rural Development (European Commission), 2026).
- Preventive and mitigation measures: reducing underlying vulnerabilities involves a multi-faceted approach, including the expansion of food reserves, diversification of import sources, reinforcement of infrastructure, and other long-term resilience measures. In the EU's context, much of this happens through policy tools and planning. The Common Agricultural Policy (CAP), for instance, offers a range of instruments—such as market safety nets, storage support measures, and insurance schemes—designed to stabilise markets and mitigate risks before disruptions occur. Strategic preparedness also extends to the development of alternative supply chains and the maintenance of strategic stockpiles. In response to observed global supply risks, EU expert groups under the EFSCM has recommended diversifying sources of critical inputs and considering strategic food stocks to buffer against external shocks. At the producer and industry levels, mitigation might mean adopting climate-smart farming practices, pest surveillance, or backup arrangements for fertilizer and energy supplies – all to lessen the chance that a shock (like a drought or energy crisis) escalates into a food crisis. In short, the pre-crisis phase is about shoring up the system's buffers.
- Contingency planning and capacity building: further reinforce the preparedness by ensuring that clear strategies and resources are in place in case a crisis does occur. Governments and organisations develop contingency plans, specifying responsibilities, communication protocols, and action checklists for various crisis scenarios. A relevant example is the EU Contingency Plan for Food Supply and Food Security published in late 2021, which outlines coordinated measures to be enacted if food supply threatened (EU Plan for Food Supply and Food Security in Times of Crisis, 2021), and catalysed the establishment of the EFSCM expert group for ongoing crisis readiness. Preparedness activities include conducting training sessions and simulation exercises to model food emergency situations, as well as establishing pre-arranged agreements for emergency food assistance or trade interventions. Building capacity can include stockpiling emergency food reserves, securing budget funds for crisis response, and educating stakeholders. Collectively, these targeted efforts are designed to ensure that when early warning indicators emerge, the system is equipped to respond swiftly and effectively.

The pre-crisis phase is thus characterised by the systematic strengthening of buffers and redundancies throughout the food supply chain.

A critical component bridging the pre-crisis preparedness and the onset of a crisis is the *early warning system*. Early warning systems consolidate the monitoring data and issue alerts when predefined risk thresholds are exceeded, signalling an impending crisis. The dissemination of early warnings marks the transition from preparedness to response, triggering the activation of contingency plans timely recognition and decisive action upon these alerts significantly enhance the capacity to contain and mitigate the adverse effects of food system disruptions at their earliest stages.

3.2.2.2 Phase 2: During the Crisis – Response

When a food crisis emerges, the system transitions into the "during-crisis" phase, dedicated to immediate response and active crisis management. This phase begins once adverse events begin to disrupt the food system beyond the capacity of standard prevention strategies. The priorities shift from preparation to urgent action: protection of life, the continuity of food supplies, and the prevention of further escalation. Effective crisis management relies on several key components: the rapid identification of crisis onset, timely activation of established emergency protocols, coordinated response measures, and adaptive problem-solving in real time.

Early detection mechanisms are crucial for recognizing when risk thresholds have been breached. Once a crisis is declared, contingency plans are swiftly enacted, ensuring that efforts across agencies and stakeholders are harmonized. Dynamic assessment and data-driven decision-making enable continuous adjustment of interventions, supporting both immediate relief and the recovery of food system functionality.

- Crisis Onset: this could be a formally recognised by governmental declaration or identified when indicators breach critical levels (e.g., rapid escalation in food prices or significant increases in malnutrition rates). At crisis onset, immediate structured intervention is essential. The initial priority is usually to assess the situation rapidly and activate the appropriate contingency plan. Authorities must promptly determine the severity and scope of the crisis, identify affected populations, and select the most effective response protocols. In the EU context, the European Food Security Crisis preparedness and response Mechanism (EFSCM) is activated without delay when an extraordinary threat is detected. This was demonstrated in March 2022, when the onset of the Ukraine conflict triggered acute disruptions in grain and energy markets; the EFSCM convened an emergency expert group meeting within days to assess the situation and coordinate response measures in real-time (*European Food Banks Federation – FEBA*, 2022).
- Response Measures: during a food crisis, authorities implement a suite of targeted interventions to address immediate threats and preserve systemic stability. For crises involving supply disruptions or surges in food prices, governments may intervene through market regulation—such as strategically releasing emergency food reserves, modifying tariffs, enforcing price controls, or issuing consumer subsidies—to ensure

continued access to affordable food. Export bans can also be enacted to prioritise domestic food security. A defining feature of this response phase is the high level of coordination among stakeholders. Within the European Union, the EFSCM serves as a central coordination platform, bringing together Member State officials and supply chain representatives to assess the crisis landscape and synchronise interventions. This collective approach ensures a shared situational awareness, encompassing critical issues such as stock levels, regional impacts, and industry insights, thereby fostering coherent and mutually reinforcing policy decisions. Transparent and timely communication during crises, together with flexibility and adaptability are part of effective crisis management.

Scientific literature highlights that resilient systems not only recover from shocks but can evolve through crisis by integrating lessons learned, thus "bouncing forward" to improved states (Huang et al., 2025). Nevertheless, during the acute phase, the primary objective remains the stabilisation of food supplies and the safeguarding of public health, with innovations introduced as necessary to address specific challenges and support future system enhancements. Scientific literature highlights that resilient systems not only recover from shocks but can evolve through crisis by integrating lessons learned, thus "bouncing forward" to improved states (Huang et al., 2025). Nevertheless, during the acute phase, the primary objective remains the stabilisation of food supplies and the safeguarding of public health, with innovations introduced as necessary to address specific challenges and support future system enhancements.

3.2.3 EU Commitment, National Plans, and International Standards

3.2.3.1 Overview of EU Legislation in Food Systems, Food Security and Food Crisis

Food security in the European Union is grounded in a comprehensive legal and policy architecture that encompasses international human rights, foundational treaties, and evolving strategic priorities. At the international level, Article 25 of "*Taking action for human rights in the twenty-first century*" (Droit, 1998) affirms the right to an adequate standard of living for health and well-being, explicitly including access to food. At the European Level, the *Treaty on European Union and the Treaty on the Functioning of the European Union* (Consolidated Versions, 2016), title III – Agriculture and Fisheries, Articles 38-44, establish the foundation for the CAP (*New Common Agricultural Policy*, 2022). The CAP aims to increase agricultural productivity, promote technical innovation, stabilize agricultural markets, support farmers' incomes, and ensure food supply. Recently, during the last two mandates of the European Commission (EC) under President Ursula von der Leyen, the EU has demonstrated a strong commitment to food security and sustainability. This is reflected in the Commission's key Priorities for 2019-2024, which introduced the European Green Deal (EGD) and, subsequently, the Farm to Fork Strategy (F2F). The F2F redefined food systems as central to climate action, biodiversity protection, and public health, building on established by the Paris Agreement during the United Nations Climate Change Conference (COP21) in Paris in 2016, and aligns with the objectives of the Sustainable Development Goals (SDGs) outlined in the 2030

Agenda for Sustainable Development. Furthermore, the F2F Strategy recognized the vulnerability of food systems and, therefore, the risk to food security posed by various crises (such as the recent Covid-19 pandemic) as well as both persistent and imminent threats. Regarding the pandemic's impact on food systems outputs (i.e., food security) and its components (supply chain activities from production to consumption) many challenges were faced including logistic disruptions, labour shortages, market losses, and shifts in consumption patterns, eventually creating the conditions for a potential food security crisis. In response, the EU committed to strengthening its coordination mechanisms by assessing the resilience of the current European food system and developing a "*Contingency Plan for Ensuring Food Supply and Food Security in Times of Crisis*" (COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A Competition Policy Fit for New Challenges, 2021). As outlined in the F2F Strategy, this commitment led to the establishment of "*European Food Security Crisis preparedness and response Mechanism* (EFSCM)".

The group of experts on EFSCM, established in compliance with the "horizontal rules" on the creation of commission experts groups (*Commission Decision C(2016) 3301 Final - Public Health*, 2016), is composed of national authorities from each EU Member State in the areas of agriculture, fisheries, aquaculture, health policy and food safety (*Proofing the EU Food Supply Chain against Crises*, 2025). The group of experts on EFSCM, established in compliance with the "horizontal rules" on the creation of Commission experts groups (*Commission Decision C(2016) 3301 Final - Public Health*, 2016), is composed of national authorities from each EU Member State in the areas of agriculture, fisheries, aquaculture, health policy and food safety. It also includes additional national authorities from non-EU countries (EFTA, Western Balkans, micro-states) whose food supply chains are highly integrated with that of the EU. In addition, up to 30 stakeholders' organisations – selected through a formal procedure – participate as members. These organizations operate in the same areas under the competence of national public authorities and in other domains related to the well-being of the food supply chain, including retail, food delivery and services, provision of inputs and production factors, processing, and food transport. Furthermore, 16 additional organizations participate as observers. The group is chaired by a representative of the European Commission. The EFSCM responds to requests from the Commission's departments (DG AGRI, DG MARE and DG SANTE) for consultations on advice and expertise regarding Union preparedness and response to food supply and food security crises. These consultations cover policy and programme implementation as well as coordination and cooperation mechanisms among Member States, non-EU countries, and relevant organisations. Specifically, EFSCM provides early monitoring, periodic reporting of threats, ongoing crisis evolution updates, post-crisis assessments, and lesson learned after crises. Nevertheless, the task of this expert group do not fall under Decision No 1313/2013/EU on "*EU Civil Protection Mechanism - European Civil Protection and Humanitarian Aid Operations*" (2013), which recognizes exclusive responsibility of the *Emergency Response Coordination Centre* (ERCC) for coordinating all assistance requests during activation of the Union Civil Protection Mechanism (UCPM), including in the event of food crises.

Building on this foundation, Commission's priorities for 2024–2029 continue to elevate food security as a strategic concern, especially in light of existing geopolitical instabilities – such as Russia-Ukraine war, Gaza war, Middle East tensions – and climate-related challenges. Together, these legal instruments and strategic initiatives shape the policy landscape through which the EU addresses food security—not only as a matter of agricultural policy, but as a multidimensional challenge involving health, environment, economy, and crisis management. One of the seven key priorities of this five-year period (2024-2029) – "*Sustaining our quality of life: food security, water and nature*" - is explicitly dedicated to food security. To face global challenges such as biodiversity loss and increasing climate variability, the EU aims to balance and renew the CAP's instruments in the near future (Proposal for a Regulation of the European Parliament and of the Council Establishing the Conditions for the Implementation of the Union Support to the Common Agriculture Policy for the Period from 2028 to 2034, 2025). These measures seek to build a competitive and resilient agriculture and food system while safeguarding biodiversity and supporting European farmers; on the other hand, the EC ensures to increase preparedness, adaptation to climate change and solidarity across the EU.

A second key priority of the 2024-2029 EC presidency – "*A new era for European defence and security*" - focuses on enhancing preparedness and crisis management. To achieve this objective, the EU developed the "European Preparedness Union Strategy", which identifies shortcomings in the current EU preparedness framework (JOINT COMMUNICATION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS on the European Preparedness Union Strategy, 2025) and proposes key actions to ameliorate foresight and anticipation, resilience of vital societal functions, population preparedness, public-private cooperation, civil-military cooperation, crises response, and resilience through external partnerships. These key actions are illustrated in Table 2. Overall, the strategy adopts an integrated, all-hazards approach, engaging relevant governmental actors at local, regional, national, and EU levels together with citizens, communities, civil society, businesses, social partners, and the scientific and academic communities. Finally, food supply chain activities – production, processing, and distribution – and the actors involved are recognized as "critical entities" under CER Directive 2022/2557 "*on the resilience of critical entities and repealing Council Directive 2008/114/EC*" (European Parliament and The Council, 2022), and, therefore, critical infrastructures shall be safeguarded and guaranteed at all times.

Food businesses of large industrial scale are recognized as critical entities for the provision of essential services according to CER Directive. In this context, Article 13 (Resilience measures of critical entities), implies that Member States shall translate the outcomes of national risk assessments into concrete measures that strengthen preparedness and ensure continuity of essential services, including food supply. On the matter of collaboration, governance and policy frameworks, it is also mandated that National Governments should provide notice on the establishment of a resilience governance framework, specifying roles and responsibilities of the parties involved, as well as laying down harmonized rules on resilience requirements and measures to foster collaboration between public authorities and the private sector. Moreover, Member States shall cooperate, especially in the assessment of cross-border risks. The Directive established also the *Critical Entities Resilience Group (CERG)* – constituted by representatives of the Commission and Member States, along with relevant stakeholders and

expert groups – supporting Commission and Member States in the capacity planning, the strategies definition and facilitating sharing of best practices. Ultimately, it is foreseen that the CERG shall convene periodically in a meeting and, at least once a year, shall engage in formal discussion with the *Cooperation Group* established under **NIS2 Directive 2022/2555** (Directive (EU) 2022/2555, 2022), on the matters concerning cybersecurity risks. Regarding the requirements for food and feed the (Commission Implementing Decision (EU) 2019/300, 2019) establishes a *general plan for crisis management in the field of the safety of food and feed*, which provides the procedural backbone for managing food safety emergencies, outlining roles, responsibilities, and escalation protocols to ensure rapid containment of health risks and continuity of supply.

Within the EU's research and innovation agenda, the key policy strategy outlining the future of governance to ensure a resilient, fair, healthy and environmentally sustainable food system in Europe is the Food 2030 policy framework (*Food 2030 - Research and Innovation - European Commission*, 2025). The European Commission's Directorate-General for Research and Innovation has defined a total of 11 systemic pathways addressing food systems transformation, which inform current policy initiatives – such as the Farm to Fork Strategy – as well as research and innovation framework programs, including Horizon Europe, Pillar II, Cluster VI "Food, Bioeconomy, Natural Resources, Agriculture & Environment". These pathways are based on the directions identified by scientific experts and provide guidance on future project objectives for food systems (European Commission. Directorate General for Research and Innovation., 2023). One of the eleven pathways for action, entitled "*Governance for food system Change*", centrally aims to define strategies to build resilience to better manage shocks and stresses. Achieving these objectives requires the definition of policies and actions across different scales and levels of governance. Consequently, the engagement of diverse actors across the food value chain is considered fundamental.

Table 2. Key Actions of the EU Preparedness Union Strategy.
(https://commission.europa.eu/topics/preparedness_en)

Crisis Functional Area	Key Action	Description
Foresight and Anticipation	1) Develop an EU comprehensive risks and threats assessment.	Develop a cross-sector, all-hazards EU risk and threat assessment integrating scientific analysis, real-time data, Copernicus data, national assessments, and intelligence via the Single Intelligence Analysis Capacity (SIAC), to be strengthened by 2025.
	2) Set up a 'crisis dashboard' for decision-makers.	Create a centralized dashboard integrating sectoral alert systems to improve coordination and inform decision-making at

		the College of Commissioners and Security College.
	3) Strengthen the Emergency Response Coordination Centre (ERCC).	Equip the ERCC to produce regular cross-sectoral risk briefings, analyse cascading effects, and build crisis scenarios.
	4) Develop an EU catalogue for training and a platform for lessons learned.	Develop training guidelines and an EU-wide plan for preparedness skills; create a platform to share lessons from past crises and exercises.
	5) Establish an EU Earth Observation Governmental Service (EOGS).	Launch EOGS to provide secure, persistent satellite sensing for crisis management, building on Copernicus and reinforcing EU monitoring capabilities.
Resilience of Vital Societal Functions	6) Embed preparedness by design into EU policies and actions.	Integrate preparedness into all EU legislation, policies, and programs; assess impacts on security, conduct regular policymaker training, and explore an EU Preparedness Law.
	7) Adopt minimum preparedness requirements.	Ensure full implementation of CER and NIS2 Directives; assess need for additional measures and propose minimum preparedness requirements with monitoring, aligned with NATO baselines.
	8) Revise the Union Civil Protection Mechanism.	Improve the UCPM's legislative framework to enhance effectiveness and coordination in high-impact emergencies.
	9) Propose an EU Stockpiling Strategy.	Develop a unified stockpiling strategy combining EU and Member State reserves for critical supplies (medical, energy, shelter, etc.), supported by public-private partnerships.
	10) Propose a Climate Adaptation Plan.	Present a European Climate Adaptation Plan using risk assessments and common scenarios to strengthen resilience across sectors and embed preparedness in policies.

	11) Ensure supply of water and other critical natural resources.	Propose a European Water Resilience Strategy; promote nature-based solutions and circular economy to secure water, soil, and raw materials.
Population Preparedness	12) Improve early warning systems.	Develop guidelines with Member States; use Copernicus and Galileo EWSS to enable timely space-based alerts to national authorities and the public.
	13) Increase awareness about risks and threats.	Launch an annual EU Preparedness Day; run awareness campaigns, develop communication guidelines, and use tools like EUvsDisinfo to counter disinformation.
	14) Develop guidelines to reach a population self-sufficiency of minimum 72 hours.	Propose guidelines for Member States to ensure citizens can be self-sufficient for 72 hours, including supply storage, shelter, and crisis planning, supported by public campaigns.
	15) Include preparedness in school education curricula and training of educational staff.	Develop curriculum guidelines starting from early education to teach preparedness, media literacy, and critical thinking; support teacher training via the European School Education Platform.
	16) Promote preparedness in youth programmes.	Add a preparedness priority in Erasmus+ and European Solidarity Corps to fund youth-led resilience, civic engagement, and crisis response initiatives.
	17) Attract talent to reinforce the EU's preparedness.	Explore measures to attract top research talent; use EU Talent Pool and Talent Partnerships to recruit skilled workers in critical preparedness sectors.
Public-Private Cooperation	18) Establish a public-private Preparedness Task Force.	Create a Task Force with industry, public authorities, and civil society to coordinate continuity management, share supply chain risks, and support crisis communication.
	19) Develop public-private emergency protocols.	Revise legal and operational frameworks to allow emergency flexibility (e.g., procurement); develop coordinated

		engagement protocols for critical private sector actors.
	20) Revise the public procurement framework.	Propose updates to the Public Procurement Framework to strengthen supply security during crises, based on lessons from past emergencies like COVID-19.
	21) Establish a European Centre of Expertise on Research Security.	Set up a Centre to support Member States and research actors in protecting R&I from foreign interference and hybrid threats, in line with Council recommendations.
Civil-military cooperation	22) Establish comprehensive civil-military preparedness arrangements.	Develop civil-military arrangements clarifying roles and responsibilities; strengthening coordination via SOPs, PESCO, and cooperation with NATO.
	23) Develop standards for civilian-military dual use planning and investment.	Identify dual-use infrastructure; define design standards that meet both civilian and military needs, including for transport, energy, and space, aligned with NATO where applicable.
	24) Organise regular EU exercises to promote comprehensive preparedness.	Organize EU-wide cross-sectoral exercises to test decision-making, coordination, and response under Articles 42(7) TEU and 222 TFEU; include private sector and international partners.
Crisis Response	25) Set up an EU crisis coordination hub.	Create a crisis coordination hub within the ERCC to enhance cross-sectoral situational awareness, support inter-institutional coordination, and link with EEAS/CRC.
	26) Boost rescEU – EU-level reserve of response capacities.	Expand and maintain rescEU reserves (firefighting, medical, CBRN, shelters, energy); assess need for new capacities like infrastructure repair and telecoms.
Resilience through external partnerships	27) Advance mutual resilience with candidate countries.	Associate candidate countries in EU preparedness initiatives and crisis frameworks through enlargement policy, focusing on hybrid, cyber, and FIMI threats.

	28) Integrate preparedness and resilience into bilateral partnerships and multilateral institutions.	Use Security and Defence Partnerships and CSDP missions to enhance cooperation; strengthen crisis communication with partners and support UN resilience efforts.
	29) Integrate preparedness and resilience into the cooperation with NATO.	Include preparedness in EU-NATO dialogues, briefings, and training; focus on military mobility, climate, cyber, space, and staff exchanges.
	30) Develop mutual resilience through external economic and development policies.	Use Global Gateway, NDICI, and trade partnerships to diversify supply chains, reduce dependencies, and build resilience in partner countries.

3.2.3.2 EU Strategic Frameworks and Mechanisms for Crisis Preparedness and Prevention

In response to EU's increasing vulnerability to global challenges, such as climate-related hazards and global supply chain disruptions, the need for a coordinated, forward-looking, and pro-active preparedness framework has become critical. Building on the provision given by the *Niinistö Report on Europe's civilian and military preparedness and readiness* (Niinistö, 2024), the European Preparedness Union Strategy (JOINT COMMUNICATION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS on the European Preparedness Union Strategy, 2025) addresses these challenges by establishing a comprehensive approach to enhance readiness, integrating governance, strengthening infrastructure protection, and promoting cross-border coordination, thereby increasing the EU's capacity to manage a wide range of risks, including those affecting food systems. In accordance with these provisions, particularly regarding the preparedness for food security crises, the *Directorate-General for Agriculture and Rural Development* manages and updates the "*Food Supply and Security dashboard*". As part of the EFSCM, this tool monitors data on food supply by category, product, Member State, marketing year, and month. It enables evaluation of food availability (including self-sufficiency and import dependency rates, import origins, and supply diversification) as well as food security indicators such as protein supply, consumer food inflation, household spending, and more. The dashboard also features a "*Food Alert System*", a collection of datasets related to food supply and security, updated monthly or weekly, which include information on crop growing conditions and quantitative crop yield forecasts in the EU (JRC MARS Bulletin), drought indicators (EDO map), freight costs (Freightos Baltic Index (FBX)), grains and oilseeds freight indices (International Grains Council),

food and fertilizers restrictions (Food and Fertilizer Export Restrictions Tracker), among others. In addition, periodic assessments of food supply and food security, combining both agrifood data portal and other resources (Eurostat), are published in Spring and Autumn every year since Autumn 2023 (*1st report on the State of Food Security in the EU*). The European Commission has also endorsed the concept of *Knowledge Centres*, as outlined in its *Communication on Data, Information and Knowledge Management* (2016). *The Disaster Risk Management Knowledge Centre (DRMKC)* and the *European Crisis Management Laboratory* bring together various EU services (JRC, CLIMA, REGIO, ENV, SANTE, ECHO) to facilitate the transfer of scientific knowledge into policy implementation. Policymakers and risk managers increasingly rely on this wealth of knowledge at all stages of the Disaster Risk Management (DRM) cycle. Thorough risk identification is further supported by the Joint Research Centre (JRC), which in 2023 published a comprehensive mapping and analysis of risks and vulnerabilities in the EU food supply chain (Bertolozzi-Caredio et al., 2023), based on stakeholder surveys with the aim to improve preparedness for future food crises. Finally, under the CAP, the EU has established a substantial budget (EUR 386.6 billion for the 2021-27 multiannual financial framework) to support farming activities and rural environments. This funding is distributed through the two CAP "pillars": the *European Agricultural Guarantee Fund (EAGF)* and the *European Agricultural Fund for Rural Development (EAFRD)*, in accordance with the Regulation (EU) 2021/2115.

3.2.3.3 EU Strategic Frameworks and Mechanisms for Crisis Response

When a crisis unfolds — driven by either social, political, economic, and biophysical factors— the EU activates coordinated mechanisms to ensure an effective and structured response. From the political stance, the European Union shall ensure consistent and coordinated decision-making, harmonized across EU institutions, Member States interested by the crisis event, plus other relevant stakeholders according to the specific case. Consequently, the European Council implemented the decision on the EU Integrated Political Crisis Response Arrangements (Council Implementing Decision (EU) 2018/1993 of 11 December 2018 on the EU Integrated Political Crisis Response Arrangements, 2018), which established the *Integrated Political Crisis Response (IPCR)*. At the strategic level, the management of crisis during the response phase, is reinforced by the European Preparedness Union Strategy, which, in addition to its provision on crisis preparedness requirements, have set up key actions and cross-sectoral solidarity mechanisms that remain active during emergencies.

The operational response at the onset of a crisis is coordinated through the *Emergency Response Coordination Centre (ERCC) - European Civil Protection and Humanitarian Aid Operations*, which serves as the EU's central hub for civil protection and crisis logistics. In the event of a disaster, the effected country may submit a request for assistance through the ERCC, which may subsequently lead to the activation of the *EU Union Civil Protection Mechanism*. The ERCC enables real-time monitoring and support to civil protection operations, resource mobilization, and cross-border assistance, particularly in cases of transport bottlenecks or infrastructure failure. Complementing this, the *rescEU* provides strategic reserves and emergency assets — including food, medical supplies, and transport capacity — that can be deployed at Union level to support Member States under severe stress.

To stabilize markets and protect consumers, the EU deploys a range of regulatory and economic tools, including the strategic release of public stocks, temporary tariff adjustments, targeted subsidies, and price monitoring. These interventions are guided by the CAP crisis clauses and supported by the EFSCM, which ensure consistent, transparent, and timely messaging to the public, industry, and international partners. This helps prevent panic buying, misinformation, and market speculation during periods of uncertainty. In parallel to internal market interventions, the European Union contributes to global crisis response through its participation in the *Agricultural Market Information System (AMIS)*— an inter-agency platform established in 2011 by the G20 to enhance transparency and policy coordination in global food markets. AMIS brings together the world's major producers, exporters, and importers of wheat, maize, rice, and soybeans — representing 80–90% of global trade in these staple crops — to monitor supply conditions, share data, and prevent destabilizing policy reactions during periods of market stress. During crises such as the COVID-19 pandemic and the war in Ukraine, AMIS played a crucial role in preventing export restrictions, reducing speculation, and coordinating policy responses among key players. The system operates through three components:

- The Global Food Market Information Group, which provides reliable, comparable market data.
- The Rapid Response Forum, where senior officials discuss emerging risks and potential actions.
- A Secretariat composed of ten international organizations (including FAO, WTO, World Bank, and IFPRI), which produces short-term market outlooks and analytical reports.

Besides this platform, other resources aim to support the wealth of the EU food system. Table 3 provides a summary of key EU legal, policy, and strategic resources across pre-crisis and during-crisis measures, offering the reader an at-a-glance overview of the main instruments already in place to support food security and food system resilience.

Table 3. Mapping of resources across pre-crisis and during-crisis measures.

Resource	Ref.	Pre-Crisis Measures	During-Crisis Measures
Arts. 38-44, TFEU (Food security)	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:12016E/TXT#d1e52251-1-1	Establishes the foundational objectives of the CAP.	Establishes the foundational objectives of the CAP.
Art.25 – Right to an Adequate Standard of Living (Human Rights)	https://unesdoc.unesco.org/ark:/48223/pf0000114686.locale=en	Right to adequate living standards and social protection, with special care for mothers and children.	Right to adequate living standards and social protection, with special care for mothers and children.
Common Agricultural Policy (CAP)	https://agriculture.ec.europa.eu/cap-my-	EU policy supporting farmers and ensuring	EU policy supporting farmers and ensuring

	country/cap-strategic-plans_en	stable, safe food production.	stable, safe food production.
European Agricultural Guarantee Fund (EAGF)	https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/european-agricultural-guarantee-fund-eagf_en	EU fund financing farmers' direct payments and market support.	EU fund financing farmers' direct payments and market support.
European Agricultural Fund for Rural Development (EAFRD)	https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/european-agricultural-fund-rural-development-eafrd_en	Supports rural development, agricultural competitiveness, and resource sustainability.	
The European Green Deal and the Farm to Fork strategy (2019–2024)	https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en	Strengthens sustainability and resilience of the EU food system to reduce vulnerabilities.	
EC Priorities (2024–2029)	https://commission.europa.eu/priorities-2024-2029_en	Strengthening EU preparedness by focusing on security, resilience, and quality of life.	Coordinated EU action to protect citizens and essential systems in crisis situations.
Critical Entities Resilience (Directive (EU) 2022/2557)	https://eur-lex.europa.eu/eli/dir/2022/2557/oj/eng	Strengthens the resilience of critical entities to ensure continuity of essential services.	Ensures continuity of essential food supply through reinforced crisis measures.
EU Preparedness Union Strategy	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52025JC0130	Strengthens anticipation and preparedness to prevent crisis scenarios.	Fast, coordinated EU action.

Niinistö Report	https://commission.europa.eu/topics/defence/safer-together-path-towards-fully-prepared-union_en	Highlights the need to shift from crisis response to resilience through whole-of-society cooperation.	Highlights the need to shift from crisis response to resilience through whole-of-society cooperation.
Emergency Response Coordination Centre (ERCC)	https://civil-protection-humanitarian-aid.ec.europa.eu/what/civil-protection/emergency-response-coordination-centre-ercc_en		Coordinates rapid emergency assistance to keep essential support flowing during a crisis.
rescEU	https://civil-protection-humanitarian-aid.ec.europa.eu/what/civil-protection/resceu_en	Protects citizens from disasters.	Manages emerging risks.
Contingency plan for ensuring Food supply and food security (COM/2021/689)	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0689	Strengthens early monitoring and preparedness to avoid food supply disruptions.	Enables coordinated EU action through the EFSCM to stabilize the supply chain.
European Food Security Crisis preparedness and response Mechanism (EFSCM)	https://agriculture.ec.europa.eu/document/download/824dccba-ede7-4a6a-baf9-83fb52091ad8_en?filename=efscm-recommendations-guidelines-crisis-communication-on-food-supply-security_en.pdf	Ensures clear, aligned messaging among all actors to prepare for potential uncertainty.	Communication to avoid uncertainty and to maintain public trust.
State of Food Security in the EU	https://webgate.ec.europa.eu/circabc-ewpp/d/d/workspace/SpacesStore/3d8755a5-094d-4688-8562-f06a68f78863/download	Provides early insights into emerging risks to strengthen EU food system preparedness.	

EFSCM - Recommendations to mitigate risks and vulnerabilities in the EU food supply chain	https://agriculture.ec.europa.eu/document/download/0aa5e189-1b78-4b27-a22a-c41caa451848_en?filename=efscm-recommendations-ways-to-mitigate-risks-and-vulnerabilities_en.pdf	Supports early action to reduce vulnerabilities in the food supply chain.	
EFSCM – Crisis Communication Guidelines	efscm-recommendations-guidelines-crisis-communication-on-food-supply-security_en.pdf		Emphasises the importance of transparent and evidence-based communication during a crisis.
Food 2030	Food 2030 - Research and innovation - European Commission	Supports research and innovation to build sustainable, climate-resilient, and healthy food systems, strengthening preparedness across the entire food chain.	Guides evidence-based responses by mobilizing R&I solutions that enhance food system resilience, safety, and continuity under stress.
Integrated Political Crisis Response (IPCR)	https://www.consilium.europa.eu/en/policies/ipcr-response-to-crises/#ipcr		Coordination of response at political-level; analytical reports and 24/7 liaison among stakeholders.

3.2.3.4 National Commitments and Resources Supporting Food Security Crisis Management and Food System Resilience

The objective of this section is to present an analysis of existing national mechanisms and resources, including country plans, strategies, policies, tools (e.g. dashboards, national agrifood market statistics, warning systems), as well as relevant organisations, agencies, and their governance, which altogether contribute to building national food system resilience. The countries covered by this analysis are sixteen and correspond to the countries represented by the SecureFood project partners. The pre-crisis stage includes national instruments and resources aimed at building preparedness to emergencies and crisis, complemented by prevention actions and strategies to reduce risks to food security. The during-crisis stage, in turn, covers country level arrangements for response and crisis management once a crisis has occurred. To facilitate readability and guide the reader, only the main findings are presented in the section below and consolidated in Table 4.

Drawing on the recommendations and guidelines issued by the EFSCM expert group on national food crisis preparedness and response mechanisms, this section describes how national measures and instruments have been analysed in relation to the EFSCM framework. This framework was applied as the analytical reference for structuring and interpreting the assessment of each country's measures. In this context, the main EFSCM recommendations and guidelines, together with the overarching EU framework for safeguarding food security (Ensuring Global Food Supply and Food Security, 2025), can be organised into three main building blocks: (i) national food security risks assessment plans, (ii) preparedness and risks prevention strategies, and (iii) national crisis communication mechanism. National food security risks assessment plans refer to formally defined process for identifying threats that generate risks and vulnerabilities affecting food supply and food security. These risks may differ in nature and can be broadly categorized as biophysical and environmental, economic and market-related, socio-cultural, geopolitical, informational, and supply-chain-performance-related (EFSCM, 2024). According to the National Preparedness Survey conducted by the EFSCM in 2024 (EFSCM, 2025), each country is expected to develop a risk assessment plan encompassing the tools, indicators, and analytical frameworks used to monitor vulnerabilities in national food systems and anticipate potential disruptions. Countries may rely on a wide range of instruments, such as import-dependency ratios, levels of strategic or privately held stocks, self-sufficiency indicators, and other relevant metrics, with the objective of assessing exposure to shocks and mapping vulnerabilities along food value chains. Several countries complement these indicators with sector-specific observatories, public-private data-sharing mechanisms, or national balance sheets (e.g. for cereals), while others use real-time monitoring tools or national statistical systems to track market developments.

Preparedness and risk prevention strategies refer to the measures put in place before a crisis occurs with the aim of reducing vulnerabilities in food supply chains. In line with EFSCM recommendations on risk mitigation and supply sources diversification, Member States are expected to develop comprehensive preparedness schemes, including the establishment of reserves or stockpiles (EFSCM, 2024). These strategies also include the diversification of import and supply sources, the strengthening the of domestic production resilience, and the monitoring of dependencies on critical agricultural inputs. Furthermore, EFSCM guidance highlights the importance of public-private cooperation to ensure preparedness across the entire agri-food chain, including shared monitoring systems, regular stakeholder engagement, and the development of redundancy mechanisms in logistics and storage to mitigate potential bottlenecks. In addition, overarching national policies and strategies, such as food poverty action plans, food loss and waste strategies, or broader systemic transformation approaches, are also considered relevant instruments for enhancing systemic resilience at national level.

Finally, crisis communication mechanisms require the advance definition of clear roles, communication channels, and procedures to ensure coordinated and timely information-sharing among public authorities, food supply chain actors, and citizens. According to EFSCM guidelines (EFSCM, 2023), effective crisis communication must be rapid, make use of advanced technologies when available (e.g. mobile-based early alert systems), and be factual and transparent, supported by continuous monitoring of public concerns and media dynamics. Communication messages should be tailored to the needs of different stakeholder groups and

disseminated through multiple, accessible channels, while proactively addressing misinformation.

To facilitate comparability and support a structured overview of national approaches, the main elements emerging from the assessment of countries' measures across the three EFSCM building blocks are synthesised in Table 4.

Table 4. National measures for food security risks, preparedness strategies, and crisis communication.

Country	National risks assessment (including food security risks)	Preparedness and Risk prevention strategies	Crisis Communication
Finland	Finland assesses food and water security risks through the National Emergency Supply Agency (NESA), analysing geopolitical, environmental, and economic conditions from international to household level.	It maintains reserve stockpiles funded by the Security of Supply Fund, conducts sectoral preparedness planning, and reinforces agricultural resilience through measures such as the National Climate Adaptation Plan and the CAP Strategic Plan.	Authorities guide citizens via the 112 Suomi app and coordinate secure information sharing through the HVO Extranet, with food sector pools providing situational updates and the Port Pool tracking logistics in real time.
Ireland	Ireland identifies food safety, food security, and food supply risks within its National Risk Assessment, which lists them among the strategic risks for the country and recognizes vulnerabilities from supply chain disruptions and food chain contamination.	Ireland strengthens preparedness through Food Vision 2030, whole-of-government food poverty actions, the National Food Waste Prevention Roadmap, and operational measures such as maintaining school meals.	Ireland is establishing a national Public Warning System using Cell Broadcast alerts for rapid emergency communication and operates an Inter-Agency Protocol for food crisis communication coordinated by Food Safety Authority of Ireland (FSAI).
United Kingdom	The UK conducts statutory food security assessments through the triennial Food Security Report, analysing availability, supply sources, chain resilience, household security and climate-related risks.	Preparedness relies on the UK Government Food Strategy and wider resilience measures, supported by governance reforms under the UK Resilience Framework strengthening risk analysis, Local Resilience Forums, and departmental responsibilities.	During emergencies, the Department of Environment, Food and Rural Affairs (DEFRA) leads communication on food supply disruptions; the Food Standards Agency informs safety and contamination risks.
Germany	Germany integrates food security risks into its national risk assessment through scenarios such as food chain contamination and disruption to critical supply chains, carried out by the Federal Office of Civil Protection and Disaster Assistance (BBK).	Germany strengthens preparedness through the Good Food for Germany strategy, household stockpiling guidance, state grain, and staple reserves. Federal Office for Agriculture and Food (BLE) monitoring of agricultural markets, and citizens-tools like the *Vorratskalkulator* for calculating personal emergency food supplies.	Emergency communication relies on alerts via radio, internet, and the NINA-app integrated into the *Modular Warning System* (MoWaS), with BBK and authorities providing guidance and updates through official channels including the BBK website and social media.

Belgium	Belgium identifies food supply failure as a societal risk through the National Crisis Centre, while the Federal Public Service Economy (FPS Economy) monitors national food availability and potential disruptions.	Resilience is supported through the Flemish Food Strategy, the Food Policy Network, and local food councils, alongside National Crisis Centre guidance on preparedness and rules for managing food supply disruptions.	Crisis communication is led by the National Crisis Centre, which provides clear information to stakeholders and operates BE-Alert to rapidly notify citizens during emergencies.
Austria	Austria assesses security-relevant risks through the National Situation Report, supported by the project "Collection Standardization and Attribution of Robust Disaster Event" (CESARE) event data and food balance sheets, while identifying the need to safeguard essential supply chains through diversification and protected routes.	Resilience is strengthened through Vision 2028+ and "Meine Region" policies promoting regional supply chains, CAP measures, climate adaptation actions, and the Federal Crisis Security Act enhancing national preparedness and coordination.	Crisis communication is coordinated through the National Crisis and Disaster Management system (SKKM), with the Federal Alarm Centre issuing warnings and operating AT-Alert as the main public alert and information channel.
France	France maps essential goods and monitors supply disruption risks through the General Secretariat for Defence and National Security (SGDSN), while the National Food Council (CNA) provides experience-based feedback from major food crises to inform national policy.	Resilience is strengthened through the National Strategy for Food, Nutrition and Climate—promoting territorial food systems, agroecology, short supply chains, and sustainable logistics—alongside reinforced food aid structures, collective catering access points, and the Secretariat-General for National Defence and Security (SGDSN) preparedness guidance.	Crisis communication is supported by SGDSN public guidance such as '*Tous responsables*' and by the Directorate-General of Civil Security and Crisis Management (DGSCGC), whose COGIC operates national alert systems including FR-Alert, complemented by public instructions on emergency kits and official safety measures.
Italy	Italy assesses food security risks through the National Risk Assessment developed under the Civil Protection Code and complemented by the National Climate Adaptation Plan, which identifies agri-food production as a priority sector exposed to climate-related risks.	Include climate adaptation actions for agriculture (water management, soil protection, crop diversification, regional planning), official agri-food statistics and supply balance monitoring by the Italian National Institute of Statistics (ISTAT) and Italian Institute for Agri-food Market Services (ISMEA) – respectively a public research	Civil protection procedures defined in national emergency planning, with predefined intervention models and communication protocols coordinated by the Civil Protection Department to guide institutions, local authorities, volunteer groups, and private actors during emergencies.

		entity and a public economic body – and broader resilience investments through the National Recovery and Resilience Plan targeting logistics and competitiveness of agri-food and related sectors.	
Portugal	Portugal assesses risks to food and nutrition security through its National Risk Assessment led by the National Emergency and Civil Protection Authority (ANEPC), supported by official food balance data that helps identify vulnerabilities in national food availability.	Key strategies include multisectoral coordination through National Council for Food and Nutritional Security (CONSANP) and the national food waste action plan, alongside land preservation under the National Agricultural Reserve to safeguard long-term food production.	During crises, communication and coordination are led by ANEPC and supported by the 'ID CRISIS' project, which strengthens national food control systems and emergency response capacities.
Spain	Spain assesses food system vulnerabilities through official agrifood statistics and food safety monitoring, supported by the Spanish Agency for Food Safety and Nutrition (AESAN) risk assessments and national analyses on production, trade, and supply pressures.	Key strategies include the National Food Strategy and the Food Loss and Waste Law, which strengthen supply resilience through sustainable production, waste reduction, mandatory prevention plans, and improved redistribution systems.	Crisis communication is coordinated through civil protection systems, including ES-Alert, enabling national and regional authorities to issue timely emergency messages and coordinate actions during food related disruptions.
Turkey	Turkey assesses risks linked to natural hazards, market instability, and vulnerable populations, supported by early warning systems, hazard analyses and resilience studies highlighted in national and international frameworks.	Key measures include the WFP Country Strategic Plan, the National Food Literacy Strategy, agricultural resilience initiatives, and private sector preparedness programs that strengthen adaptation, insurance coverage, and community resilience.	During crises, communication is led by the Disaster and Emergency Management Presidency (AFAD) and the Turkish Red Crescent, which issue alerts and disseminate information through official TV, social media, and the Red Crescent's Communication Centre.
Cyprus	Cyprus assesses food security risks through its National Risk Assessment, which identifies climate-related threats to agriculture, water management, and fisheries, supported by national data and civil defence planning.	Key strategies include the CAP 2023–2027 plan to strengthen small and medium farms, and strong water resource management by the Water Development Department through irrigation systems, desalination, and drought planning.	During crises, communication and response are coordinated by Cyprus Civil Defence, supported by the Crisis Management Centre Ltd., which provides operational solutions for managing ongoing food supply disruptions.

Greece	Greece assesses risks to food security through official agricultural data and climate related analyses, supported by national climate services that identify vulnerabilities affecting agriculture and food production.	Key strategies include the CAP 2023–2027 plan and Greece 2.0 investments, which promote sustainable agriculture, innovation, aquaculture development, and improved climate resilience across the food system.	During crises, the Ministry of Climate Crisis and Civil Protection strengthens communication through upgraded alert systems, emergency communication stations, and improved coordination among national and regional authorities.
Slovenia	Slovenia assesses risks to food security through national data systems and by identifying vulnerabilities linked to climate impacts, natural disasters and market instabilities affecting food supply.	Long-term strategies include CAP 2023–2027 measures, the Food Safety and Quality Strategy, and national commodity reserves, which support resilience through sustainable production, reduced waste, and strategic stockpiling.	During crises, communication and coordination are led by the National Disaster Management System and the Strategic Commodity Reserves Agency, ensuring clear guidance on reserve releases and emergency support.
Ukraine	Ukraine identifies risks to food and agriculture through laws on state reserves and climate policy, assessing vulnerabilities linked to climate impacts, resource management, and ongoing conflict.	Risk prevention relies on long-term strategies such as the Agriculture and Rural Development Strategy 2030, which promotes climate-smart practices, strengthens institutions, and mobilizes resources to enhance food system resilience.	During crises, Ukraine works within the EU Civil Protection Mechanism to coordinate assistance, ensuring clear communication on the provision of humanitarian support, agricultural recovery measures, and essential services to affected populations.
Czech Republic	Czech Republic identifies risks related to supply chain disruptions and relies on detailed national assessments to prepare for potential shortages of food and water during emergencies.	The country strengthens resilience through long-term strategies such as the Food Safety and Nutrition Strategy 2030 and the CAP Plan, and by maintaining state-owned reserves of essential food commodities.	During crises, communication is coordinated by the Administration of State Material Reserves through the “Economic Measures for Emergencies” (HOPKS) system, which supports the dissemination of operational and economic information.

Across the sixteen countries analysed, national risk assessment plans related to food security display a notable degree of heterogeneity. Variations are observed both in the formal recognition of food security risks, and when such risks are formally identified, in the depth and scope with which countries assess risks and vulnerabilities affecting their national food system. A limited number of countries – namely the United Kingdom, Portugal, Finland, and Spain – demonstrate a structured and explicit approach to food security risk assessment. In particular, the UK conducts a triennial Food Security Report, while Portugal embeds food and nutrition security within its National Risk Assessment. Finland integrates food and water security into its broader security-of-supply framework through the NESA, analysing vulnerabilities across geopolitical, environmental, and socio-economic dimensions. Spain, in turn, relies on a continuous system of agri-food statistics, food safety monitoring and AESAN risk assessments, resulting in a relatively comprehensive national overview of food system pressures.
Other countries – including Italy, France, Belgium, Greece, Slovenia, and Czech Republic – adopt more systemic approaches, in which food security is addressed within broader national risk management or civil protection frameworks rather than through dedicated food-system-specific risk assessments. Austria incorporates food-related considerations within its assessment of security-relevant risks, supported by extensive data systems such as CESARE and food balance sheets that feed into the Annual National Situation Report. France maps essential goods and potential supply disruptions through the SGDSN, complemented by experience-based feedback provided by the CNA. Belgium identifies food supply failure as a societal risk through its National Crisis Centre, while Italy addresses food security indirectly through the National Risk Assessment and the National Climate Adaptation Plan, which recognises agri-food production as a climate-sensitive sector. Cyprus and Greece similarly integrate food-related risks within agricultural and climate-related national assessment systems, whereas Slovenia frames food system risk primarily in relation to climate impacts, natural disasters, and market instability. Czech Republic places particular emphasis on preparedness for food and water shortages through targeted national emergency risk assessments. Finally, Ukraine identifies food and agriculture-related risks through legislation on state reserves and climate policy, reflecting the combined influence of climate impacts, resource pressures, and ongoing conflict, while Turkey relies on hazard analyses, early warning systems, and resilience studies focusing on natural disasters, market volatility, and vulnerable populations.

With regards to preparedness and risk prevention, countries combine strategic planning, reserve systems, climate adaptation measures, and governance reforms to strengthen food system resilience. Many rely on long-term policy frameworks — such as CAP Strategic Plans and national food strategies (e.g. Finland, UK, France, Slovenia, and Greece), as well as Vision 2028+ in Austria (Federal Ministry of Agriculture and Forestry, Climate and Environmental Protection, Regions and Water Management, 2026) and Food Vision 2030 in Ireland (Department of Agriculture, Food and the Marine, 2026). Climate adaptation is explicitly mainstreamed in Finland, Italy, Greece, Slovenia, and Turkey, while food waste reduction and circularity approaches are emphasised in Belgium, Portugal, and Spain. Strategic reserves and stockpiling mechanisms are prominent in Finland, Germany, Austria, and Czech Republic, whereas Ireland and Portugal place greater emphasis on social protection measures and food poverty prevention. Several countries also rely on institutional coordination platforms (e.g.

Portugal's CONSANP and Belgium's Food Policy Network) and supply-chain monitoring (e.g. Germany's BLE and Italy's ISMEA). Overall, a common pattern emerges combining policy frameworks, resilience investments, and coordinated planning, with differences in the relative weight assigned to reserve systems, social measures, environmental adaptation, and governance arrangements.

Finally, crisis communication across the analysed countries is predominantly coordinated by national civil protection authorities through established public alert systems (e.g. BE-Alert, AT-Alert, FR-Alert, ES-Alert, NINA/MoWaS, and 112 Suomi), enabling rapid, multi-channel dissemination of information to the public. Shared features include standardised procedures, coordinated messaging, and clearly defined institutional roles. Differences arise in the degree of sector-specific involvement (e.g. DEFRA/FSA in the UK, SGDSN in France, and the Turkish Red Crescent), the integration of logistics and supply-chain intelligence (particularly in Finland and Czechia), and the emphasis placed on food control and institutional coordination (e.g. Portugal and Cyprus). Overall, while alerting architectures are broadly comparable, national approaches differ in the extent to which food system expertise, advanced technology, and multi-agency cooperation are embedded within crisis communication frameworks.

Overall, the comparative analysis highlights clear asymmetries in how countries conceptualise and assess food system and food security risks. While some countries operate data-driven and recurrent assessment mechanisms, many rely on broader multi-hazard frameworks in which food security represents one thematic component among others. This unevenness points to differing levels of institutional maturity in relation to food security risk assessment, as well as to variations in national priorities across Europe.

3.2.3.5 ISO Standards Contributing to food security and Food System Resilience

In addition to the EU strategies, plans, and regulatory frameworks discussed earlier, international standards play a significant role in shaping the operational and strategic context for food system resilience and food security. Among these, the International Organization for Standardization (ISO) stands out as a globally recognised, independent, non-governmental organisation that brings together national standards bodies from 175 countries (International Organization for Standardization, 2026). ISO's primary mission is to promote harmonization and consistency in standards worldwide. Its standards provide guidelines and best practices that enable organisations —both public and private— to enhance quality, reliability, and safety across products, processes, and systems. They also incorporate principles of continual improvement, supporting organisations in managing threats, disruptions, and systemic risks.

Although there is currently no ISO standard exclusively dedicated to food security or food system resilience, several standards address relevant dimensions of these objectives from both operational and strategic perspectives. Table 5 summarises the most pertinent standards, covering areas such as food safety management, risk management, business continuity, emergency preparedness, and supply chain resilience. The table organises these standards according to the responsible technical committee (TC) and subcommittee (SC), followed by the ISO standard number, its title, and a brief description of its scope and purpose. Among the

standards listed, some are developed as Technical Specifications (TS), which provide guidance where full international consensus for a standard has not yet been achieved. Others are Technical Reports (TR), which serve as informative references rather than prescriptive requirements. Together, this combination of normative standards and guidance documents provides organisations with both formal requirements and flexible tools for practical implementation.

In the context of food security and resilience, three ISO technical committees are particularly relevant:

- ISO/TC 34 – Food Products aims to build confidence among stakeholders in the feed and food sector by developing food safety management system standards, establishing harmonised terminology, and ensuring that testing and analysis methods are reliable and reproducible. The committee also promotes fair trade practices through common product specifications that facilitate cross-border consistency. Within TC 34, Subcommittee SC 17 – Management systems for food safety develops key standards such as ISO 22000, ISO 22002-100, and ISO 22005, which set requirements for food safety management systems, prerequisite programs, and traceability across the food chain.
- ISO/TC 292 – Security and Resilience focus on strengthening organisational resilience and security across sectors. Its standards provide frameworks for business continuity, emergency management, and supply chain security, supporting organisations in preparing for, responding to, and recovering from disruptive events. Within this committee, Subcommittee SC 1 – Emergency Management develops guidance on incident management, public warning, and capability assessment.
- ISO/TC 262 – Risk Management develops standards that support organisations systematically identifying, analysing, and managing risk across all activities, including decision-making related to accidents, disasters, and technical system failures, as well as response and recovery from major disruptions. Its flagship standard, ISO 31000:2018, establishes principles and processes for effective risk management, which underpin resilience strategies across multiple sectors, including food.

Table 5. ISO Standards relevant to food security and resilience, grouped by technical committees and subcommittees, with corresponding titles and scope descriptions.

ISO TC/SC	ISO Standard	Title	Description
ISO TC 34/SC 17 Management systems for food safety	ISO 22000:2018	*Food safety management systems — Requirements for any organization in the food chain.*	Standardization of food safety management across the entire food supply chain, including human and animal food, and propagation material (i.e., any plant part used to grow new plants such as seeds, bulbs, etc.).
	ISO 22002-100:2025	*Prerequisite programs on food safety — Requirements for the food, feed and packaging supply chain.*	Specifies prerequisite programs to support FSMS across various sectors of the food and feed chain.
	ISO 22005:2007	*Traceability in the feed and food chain — General principles and basic requirements for system design and implementation.*	Provides a framework for designing and implementing traceability systems in feed and food chains to enhance safety and recall efficiency.
ISO/TC 292 Security and Resilience	ISO 22300:2021	*Security and resilience – Vocabulary.*	Defines key terms and definitions used across ISO/TC 292 standards.
	ISO/TS 22375:2018	*Security and resilience – Guidelines for Complexity Assessment Process.*	Offers guidance for assessing complexity in security and resilience contexts.
	ISO 22397:2014	*Societal security – Guidelines for establishing partnering arrangements.*	Provides guidance for organizations on establishing partnering arrangements, enabling them to manage multiple relationships effectively in preparation for events that impact societal security.
	ISO 22301:2019	*Security and resilience – Business continuity management systems – Requirements.*	Specifies requirements for establishing, implementing, and maintaining a business continuity management system (BCMS).

	ISO/TS 22318:2021	*Security and resilience – Business continuity management systems – Guidelines for supply chain continuity.*	Provides guidance on ensuring continuity of critical supply chains.
ISO/TC 292/SC 1 Emergency Management	ISO 22320:2018	*Security and resilience – Emergency management – Guidelines for incident management.*	Guidance on managing incidents effectively through coordination, communication, and resource management.
	ISO 22322:2022	*Security and resilience – Emergency management – Guidelines for public warning.*	Covers development and implementation of effective public warning systems.
	ISO 22325:2016	*Security and resilience – Emergency management – Guidelines for capability assessment.*	Helps assess emergency management capabilities and identify improvement areas.
	ISO/TR 22351:2015	*Societal security – Emergency management – Message structure for exchange of information.*	Recommends standardized message formats for interoperable information sharing during emergencies.
	ISO 22396:2020	*Security and resilience – Community resilience – Guidelines for information sharing between organizations.*	Promotes community resilience through inter-organizational information exchange.
	ISO 22316:2017	*Security and resilience – Organizational resilience – Principles and attributes.*	Outlines core principles and attributes that support organizational resilience.
	ISO 22336:2024	*Security and resilience — Organizational resilience — Guidelines for resilience policy and strategy.*	Provides guidance on developing resilience policies and strategic frameworks.
	ISO/TS 22360:2024	*Security and resilience – Crisis management – Concepts, principles, and framework.*	Defines foundational concepts and a framework for crisis management.
	ISO 22361:2022	*Security and resilience – Crisis management – Guidelines.*	Offers guidance on managing crises at strategic and operational levels.

	ISO 28000:2022	*Security and resilience – Security management system – Requirements.*	Specifies requirements for a security management system (SeMS), especially in supply chains.
	ISO 28001:2007	*Security management systems for the supply chain – Best practices for implementing supply chain security, assessments, and plans – Requirements and guidance.*	Guidance on securing supply chains through risk assessment and prevention planning.
	ISO 28002:2011	*Security management systems for the supply chain – Development of resilience in the supply chain – Requirements with guidance for use.*	Focuses on building resilience within supply chains against disruptions.
ISO/TC 262 Risk Management	ISO 31000:2018	*Risk management – Guidelines.*	Provides principles, framework, and process for effective risk management across all types of organizations and risks.

In line with Article 16 of the CER Directive (EU) 2022/2557, the application of European and international standards and technical specifications can support the implementation of resilience measures by critical entities. In the context of critical food sector, ISO standards offer structured management system approaches that complement the Directive's requirements by supporting the establishment a shared terminology, consistent practices for risk management, business continuity, emergency management, and supply chain resilience. Against this background, Table 6 presents the ISO standards that are most relevant to CER-driven resilience obligations in the food domain, providing reference points that can be used by both competent authorities and food operators to design, implement, and continuously improve resilience arrangements.

Table 6. Core ISO Standards supporting CER-driven resilience in the food sector

ISO Standard	Key Principles	Relevance to Critical Food Sector
ISO 31000:2018 – Risk Management Guidelines	Provides principles and guidance for the governance and management of risk. It supports the integration of risk considerations into leadership, planning, operations, and decision-making, using a structured, inclusive, and continually improving approach. The standard sets expectations for establishing a risk management framework (including roles, accountability, and resources) and applying a consistent process to identify, analyse, evaluate, and treat risks, with ongoing monitoring, review, and learning.	The CER Directive requires a risk-based approach underpinning both national risk assessments and entity-level resilience measures. ISO 31000 offers a recognised method to structure these assessments, define risk criteria, and document risk treatment decisions. Within the critical food sector, its application supports the identification of critical assets and single points of failure (e.g., sites, utilities, logistics nodes, and key suppliers), the assessment of cascading dependencies, and the prioritisation of proportionate resilience measures and investments. It also strengthens governance by clarifying accountability for risk ownership, ensuring consistent reporting, and enabling continuous improvement through regular review and lessons learned.
ISO 22301:2019 - Business Continuity Management Systems (BCMS)	Specifies requirements for establishing, implementing, maintaining, and continually improving a Business Continuity Management System (BCMS). It	For critical food entities, ISO 22301 operationalises key CER expectations on maintaining essential services by requiring demonstrable continuity

	provides a governance-based approach to ensure continuity of prioritized activities through defining scope and continuity objectives; conducting business impact analysis and risk assessment; establishing continuity strategies and plans; implementing response structures; and validating arrangements through exercises, audits, management review, and corrective actions. The standard emphasises leadership commitment, clear roles and accountability, documented arrangements, competence and awareness, and continual improvement.	arrangements proportionate to risk. It supports the structured identification of time-critical processes (e.g., production, cold chain, quality control, distribution), definition of recovery objectives, and establishment of response and recovery plans for high-impact scenarios (e.g., contamination events, utility failures, workforce shortages, transport disruptions). It also strengthens governance by embedding accountability, evidence-based decision-making, and regular testing and review, enabling competent authorities and operators to demonstrate preparedness, monitor performance, and drive continual improvement of resilience measures.
ISO 22316:2017 – Organizational Resilience (Principles and Attributes)	Provides guidance (non-certifiable) on the principles and attributes that enable organisational resilience as a sustained governance capability. It emphasises: a shared purpose and strategic priorities; leadership commitment and effective decision-making under uncertainty; an adaptive culture supported by trust, accountability, and learning; situational awareness and horizon scanning; effective internal and external communication; robust resource and information management; and the systematic development of partnerships and networks. The standard encourages organisations to review and strengthen these attributes over time through	For critical food entities, ISO 22316 supports a governance approach that complements CER requirements by strengthening the organisational conditions needed to implement and sustain resilience measures. It helps embed resilience into strategy, policies, and management practices (rather than treating it as a stand-alone compliance activity), clarifies leadership accountability for preparedness and response, and reinforces a culture of learning and continuous improvement through reviews and post-incident lessons learned. Its emphasis on stakeholder relationships and partnership arrangements is particularly relevant for managing cross-sector dependencies (e.g., energy, transport, packaging, and

	assessment, stress testing, and continual improvement.	key suppliers) and for enabling structured public–private cooperation and information exchange during the pre-crisis and crisis phases. Used alongside ISO 31000 and ISO 22301, ISO 22316 provides the organisational resilience foundation that supports consistent decision-making and continuity of essential activities within the food supply chain.
ISO/IEC 27001:2022 – Information Security Management Systems (ISMS)	Leading standard for information security governance. It specifies requirements for establishing, implementing, maintaining, and continually improving an Information Security Management System to protect the confidentiality, integrity, and availability of information. Relevant resilience elements include risk assessment and treatment, security controls, incident management, supplier and third-party security, access management, and business continuity arrangements for information and technology services.	While the CER Directive focuses on physical and organisational resilience, it explicitly recognises the interdependencies between physical and cyber threats and the need for alignment with cybersecurity obligations (e.g., under NIS2). In the critical food sector, information and operational technology (e.g., logistics platforms, production control systems, and traceability solutions) are essential to maintaining continuity of operations. Applying ISO/IEC 27001 supports a structured approach to identifying and managing cyber and information risks, strengthening preparedness and response capabilities, and enabling secure information exchange with suppliers, customers, and public authorities. This, in turn, contributes to continuity of essential services and reinforces trust and coordination across the food supply chain during both pre-crisis and crisis phases.

Taken together, the ISO standards discussed in this chapter provide a coherent and complementary toolbox to support the implementation of CER-driven resilience obligations in the food sector. While standards on risk management, business continuity, organisational

resilience, and information security establish the governance and systemic foundations required under the Critical Entities Resilience Directive, the resilience of food systems also relies on the effective application of more sector-specific ISO standards.

In this respect, additional ISO standards developed within ISO/TC 34, although primarily focused on food safety rather than food security, play a critical and enabling role for food system resilience. By strengthening prevention, control, and traceability arrangements, these generate system-wide benefits that support continuity of operations, effective crisis management, and the maintenance of public trust. As defined by the FAO's AGROVOC Multilingual Thesaurus, food safety is: "a science-based discipline, process or action that prevents food from containing substances that could harm a person's health" (FAO, 2025b). Consistently, ISO 22000:2018 defines food safety as: "the assurance that food will not cause an adverse health effect for the consumer when it is prepared and/or consumed in accordance with its intended use".

ISO 22000:2018 provides the requirements for Food Safety Management Systems (FSMS) applicable to any organization operating within the food chain. An FSMS represents a structured framework of policies, processes, and controls designed to ensure food safety from production to distribution and consumption. It integrates preventive measures (such as hazard analysis and risk-based thinking) with operational controls and continual improvement practices. Core FSMS elements – including Prerequisite Programs (PRPs), Operational Prerequisite Programs (OPRPs), Critical Control Points (CCPs), and HACCP principles – provide the foundation or identifying, preventing, and controlling hazards. From a systemic perspective, food safety directly supports the utilization pillar of food security, which concerns the ability to achieve the nutritional well-being trough safe and adequate food (FAO, 2006). Consequently, the adoption of food safety standards should be viewed not as a parallel or isolated compliance activity, but as a complementary and reinforcing element of food system resilience. When applied alongside broader resilience and governance standards, these more specialised ISO instruments contribute to preparedness and response capacity, reduce vulnerability during crises, and support the overarching objective of safeguarding food security under stress conditions.

3.3 Principles of Good Governance for Resilience and Food Security

Governance is a central concept in political science, public administration, and public policy. It was once closely tied to government and the exercise of power by political leaders, but since the 1980s its meaning has evolved significantly (Kjaer, 2004). Contemporary understandings of governance extend beyond the rule of law enforced by authorities. At national level, governance refers to the structures and processes through which collective decisions are made, involving both governmental and non-governmental actors. Similarly, at global level, governance describes how state and non-state actors interact to shape and implement collectively binding decisions, even in the absence of a central authority (Florin & Bürkler, 2017).

Governance can be linked to the specific domain or function to which it applies and can be virtually implemented across all areas of human activity. In the business context, for example, corporate governance refers to the structured set of rules, practices, and processes through

which an organisation is directed and controlled (Operato et al., 2025). It involves actors such as shareholders, boards of directors, and executive management, and focuses on how they interact to take strategic and operational decisions. When defining company strategy, for instance, the board sets priorities, while departments such as finance, operations, and legal collaborate to assess feasibility, risks, and regulatory compliance through established coordination mechanisms. These structures and interactions constitute the core of corporate governance.

Within the EU, governance systems are already established in several critical sectors, such as energy. EU energy governance aims to support strategic planning, monitoring, and reporting, helping Member States meet the objectives of the EU's 2030 energy and climate strategy and to comply with international commitments under the Paris Agreement (European Commission, 2025b). This governance system is built around integrated national energy and climate plans (NECPs), complemented by long-term strategies for clean, affordable, and renewable energy. The Regulation on the Governance of the Energy Union (Regulation (EU) 2018/1999 of the European Parliament and of the Council, 2018) places strong emphasis on cooperation - both among Member States and the European Commission - as a core mechanism to ensure coherence between national actions and EU-wide objectives.

In the context of the food system, establishing a robust resilience governance framework is equally essential. According to the Eurostat's report Key figures on the European food chain (Eurostat, 2025e), approximately 12.1 million enterprises operate within the EU food system, generating total added value exceeding EUR 1 trillion. These activities span primary production, food and beverage processing, wholesaling, retailing, and food services. Coordinating such a complex and interconnected system – across Member States, between public and private actors, and among multiple sectors – is critical not only to ensure the efficient functioning of markets, but also to mitigate risks related to supply-chain disruptions, food safety incidents, and environmental degradation. As such, food security governance represents a strategic priority for the EU, contributing to the protection of the food system as critical infrastructure and ultimately strengthening its long-term resilience for businesses and citizens alike.

Against this background, the Resilience Governance Framework presented in this document aims to advance a structured approach to food security governance in the EU. The Framework is designed to support both public and private stakeholders at national and EU level by clarifying role and responsibilities, while proposing a cooperation mechanism to facilitate the operational implementation of relevant EU legislation, including the Critical Entities Resilience (CER) Directive. These objectives are pursued by anchoring the Framework in recognised principles of good governance, which are intended to guide stakeholder actions across prevention, preparedness, response, and adaptation phases.

Drawing on the definition of good governance developed by the Commission of the European Communities (Commission of the European Communities, 2001), the Resilience Governance Framework is based on five core principles:

1. Openness. This principle requires actors involved in decision-making processes to operate transparently, using clear, understandable, and inclusive language. In the

context of this guidebook, "decisional bodies" refer to European, national, regional, and local actors, including both public and private stakeholders, who have the function of safeguarding food security.

2. Participation. This principle recognises that reliable, high-quality, and legitimate outcomes depend on the active involvement of a broad range of stakeholders. These actors differ in roles, responsibilities, expertise, and levels of engagement, and their inclusion enables the integration of diverse perspectives, enhances transparency, and strengthens the legitimacy of the decision-making processes.
3. Accountability. This principle emphasises the need for clearly defined and agreed roles and responsibilities across decision-making, planning, implementation, monitoring, and review processes. Each stakeholder is responsible for fulfilling its mandate and collaborating with others to achieve food security, while being entitled to appropriate support from other actors where this does not compromise their own responsibilities.
4. Effectiveness. This principle highlights the importance of timely and effective actions, particularly related to crisis management. It underscores the role of clearly defined objectives, forward-looking assessments, and lessons learned from past experience. It also emphasizes structured mechanisms, such as interaction protocols for stakeholder cooperation and feedback, that support decision-making at the most appropriate level, ensuring responsiveness in complex and evolving situations.
5. Coherence. This principle stresses that policies and actions must be consistent, understandable, and mutually reinforcing. Coherence requires leadership and a strong sense of shared responsibility, ensuring that actions undertaken by individual stakeholders contribute to a common direction and do not undermine collective objectives related to food security.

These five principles have guided the development of the Resilience Governance Framework. The first three (openness, participation, and accountability) have informed the stakeholder mapping, the clarification of roles and responsibilities, and the design of participatory processes that integrate stakeholder perspectives into food security governance (described in Section 2.1). The remaining two (effectiveness and coherence) are reflected in the proposed cooperation mechanism, which is intended to enable both preventive and transformative adaptation to crisis scenarios, while ensuring that all actors work in a coordinated manner towards shared food security objectives.

3.4 Crisis Management

In the context of food systems, crisis situations frequently extend beyond individual organisations, affecting entire communities, countries, or even regions. Their management therefore requires coordinated, strategic, and adaptive responses at scale, involving multiple stakeholders with distinct roles and responsibilities. These actors must operate through established cooperation mechanisms to preserve the viability and integrity of the food system as a whole.

Recent events demonstrate that developed regions, including the EU, are not immune to food-related crises. In 2024, the European Food Safety Authority (EFSA) documented at least 336

foodborne outbreaks with strong evidence linked to bacteria, bacterial toxins, viruses and parasites across 22 European countries, resulting in 8,813 infections, 765 hospitalizations and 20 fatalities (EFSA, 2025). Similarly, highly pathogenic avian influenza A(H5) has been present in Europe since autumn 2020 and continues to cause outbreaks (EFSA et al., 2025). Between 2021 and 2022, it led to the culling of approximately 47.7 million birds and triggered significant disruptions to international trade flows, raising concerns related to market stability and supply shortages (European Parliament, 2023). Other events have affected food security more broadly. The Ukraine-Russia war disrupted grain exports (European Parliament, 2022b); the 2022 drought substantially reduced EU crop yields (European Commission & Joint Research Centre, 2022), with estimated revenue losses of EUR 25-30 billion (Pinke et al., 2024); and the COVID-19 pandemic exposed severe vulnerabilities in agri-food supply chain (Di Marcantonio et al., 2022; European Court of Auditors, 2020). Together, these events illustrate how escalation can occur rapidly, affect multiple communities within short timeframes, and require responses that go beyond standard operational procedures.

Insights from a JRC report (Matthews, 2021) help to position such situations within the broader crisis management context. Crises are characterised by high levels of complexity and uncertainty, often exceeding normal organisational capacities and predefined response mechanisms. They therefore require adaptive decision-making under conditions of incomplete information and evolving risk. Moreover, their resolution may extend over long periods, highlighting the need for sustained action over time.

Crisis management, as defined by ISO 22361:2022, is the "*coordinated activities to lead, direct and control an organization with regard to crisis*" (International Organization for Standardization, 2022), emphasising an organisation-centric perspective. This view is consistent with the crisis management cycle described by the JRC (Matthews, 2021), which distinguishes the phases of risk assessment, prevention and mitigation, preparedness, response, recovery and learning. While these phases provide a comprehensive framework for understanding how crises evolve and are addressed, the present document does not analyse them individually. Instead, within this document crisis management is approached from a system-centred perspective, focusing on how a food security crisis can be guided towards resolution. The emphasis is placed on the components that enable effective crisis management at system level, notably a designed cooperation mechanism that supports interaction and joint action among stakeholders within the food system. While the causes of food security crises vary and their resolution often requires context-specific measures, particularly at organizational level, a common strategic backbone can be identified for managing crises at system level. This backbone is the focus of the following sections.

Accordingly, the following sections describe the three core components of the crisis-governance:

(i) mapping food system stakeholders and their roles in governance, to identifying relevant actors involved in managing a food security crisis.
(ii) public-private responsibilities in food crisis management, to clarify mandates and accountabilities; and

(iii) the cooperation mechanism, which enables coordinated and effective action across the crisis management cycle.

3.4.1 Mapping Food System Stakeholders and Their Role in Governance

A structured qualitative methodology was applied to identify and analyse the main stakeholder groups involved in the Governance of the European food system across the two phases of the crisis cycle: the preparedness and prevention phase (pre-crisis) and the response phase (during a crisis). This process, integrated with the participatory activities described in Section 2.1, ensured a comprehensive assessment of the actors contributing to food system resilience, their institutional mandates, and their responsibilities. The classification draws on the (EU Plan for Food Supply and Food Security in Times of Crisis, 2021) and has been adapted to the objectives of the SecureFood project, incorporating insights from end-users and the External Stakeholder Group (ESG).

Food system governance in the EU reflects a multi-level, multi-actor architecture. Public authorities at EU National level provide the legislative, regulatory, supervisory, and crisis-coordination functions that safeguard the functioning of the Single Market and ensure system-wide coherence. Private sector operators provide the operational backbone of the food system by ensuring continuity of production, processing, logistics, retail, and the supply of critical inputs. Advisory and technical service providers support operators – particularly SMEs – by enhancing analytical and preparedness capacities. Civil society organizations, consumer associations, and representative bodies convey societal expectations, support vulnerable groups, and facilitate structured engagement between institutions and the public. Research institutions and academia serve as knowledge actors, offering evidence-based assessments, modelling, and methodological innovation essential for risk analysis and crisis decision-making. International organizations complement EU efforts by supporting global monitoring, cross-border coordination, and international food security initiatives.

Table 7 presents the consolidated stakeholder mapping, reflecting the high-level categories engaged in food system governance and conceptualized as critical actors within the Resilience Governance Framework. Each group contributes distinct roles that, in Section 3.4.2, are then categorised into public and private actors and further detailed in terms of their responsibilities during preparedness and crisis response.

Table 7. Stakeholder mapping in relation to food system governance.

Stakeholder Group	Description and Role in Food System Governance
EU Institutions and Member State Authorities	Includes EU institutions (e.g. European Commission, Council of the EU, European Parliament, specialised agencies such as EFSA and JRC) and national competent authorities responsible for agriculture,

	fisheries and aquaculture, **food safety, health, transport, energy, digitalisation, civil protection, market surveillance,** and other relevant areas. They provide regulatory oversight, policy direction, scientific assessment, and crisis coordination. EU institutions ensure Union-level coherence and safeguard the Single Market, while Member States implement preparedness and response measures at national level.
Private Sector Operators (Food System Operators and Input Providers)	Comprise economic operators active along the food supply chain, including primary produces, processors, manufacturers, wholesalers, retailers, logistics and transport companies, and suppliers of critical inputs (fertilisers, feed, packaging, energy, ICT services). They are responsible for operational continuity, risk management, vulnerability assessments, and implementation of mitigation measures. Their timely reporting of disruptions and coordination with authorities is essential for maintaining essential food flows.
Workers and Labour Representatives	Includes the workforce operating across the food system and their representative organizations. Labour unions advocate for safe working conditions, protect workers' rights, and support the continuity of essential services. A resilient and protected workforce is indispensable to sustaining production, processing, logistics, and retail activities during crises.
Private Sector and Supply Chain Associations	Represents trade associations, cooperatives, producer organizations, industry federations, and retail associations. These bodies act as intermediaries between authorities and operators, providing sector-wide intelligence, supporting preparedness dissemination, and coordinating member responses. They contribute structured input to risk reviews and policy consultations and facilitate information exchange during disruptions.
Consumers and Consumers Associations	Consumers influence demand patterns and contribute to resilience through informed

	purchasing and behavioural adjustments. Consumer associations represent the interests of end-users, promote fair practices, and support transparency. They contribute to governance by identifying affordability and access challenges, especially during crises, and by communicating guidance to the public.
Civil Society Organizations (Including Food Aid, Sustainability and Advocacy Groups)	Comprises NGOs, non-profits, and community-based organizations engaged in food assistance, sustainability advocacy, and community resilience. They act as important channels for social perspectives, monitor impacts on vulnerable populations, ad often serve as first respondents during crises. They support participatory governance and reinforce the distributive dimension off crisis response.
Advisors, Service Providers and Enabling Actors	Includes consultancies, risk-management firms, supply-chain analytics, cybersecurity experts, financial services, and technical service providers supporting food system operators. They offer analytical tools, contingency planning support, and operational guidance, particularly for SMEs with limited internal capacity. Their expertise helps translate regulatory expectations into practical preparedness and response measures.
International Organizations and Third Countries	Includes bodies such as FAO, WHO, WTO, and cooperation partners outside the EU. They contribute to global monitoring, crisis-response coordination, and international food security efforts. Their role supports cross-border risk assessment, trade stability, and humanitarian response during major disruptions.
Research Institutions, Academia, and Scientific Networks	Comprises universities, public research bodies, technical institutes, and scientific networks. They produce evidence-base analysis, modelling, foresight, and early-warning methodologies that support EU and national authorities. During crises, they contribute rapid assessments and scenario

	modelling that inform decision-making and help anticipate cascading effects.

3.4.2 Public-Private Responsibilities in Food Crisis Management

Building on the stakeholder mapping presented in Section 3.4.1, this section operationalises the Resilience Governance Framework by structuring the previously identified stakeholder groups into two categories: public sector actors and private sector actors. For the two categories, it is detailed their specific mandates, capacities, and responsibilities within a crisis-resilience context.

To ensure coherence with the EU crisis preparedness and the EFSCM governance model, responsibilities are distinguished across two phases of the food-crisis cycle: the preparedness and prevention phase (pre-crisis) and the response phase (during a crisis). This structured approach clarifies how competent authorities, specialised EU bodies, operators, representative organisations, and enabling actors contribute to monitoring, early warning, coordination, and operational continuity. It also integrates proportionality requirements, particularly for SMEs, ensuing responsibilities are aligned with actors' capabilities and regulatory obligations.

1. Public Sector

Public actors hold regulatory, supervisory, coordination, or strategic mandates. Their functions relate primarily to oversight, early warning, risk assessment and analysis, policy direction, and crisis coordination.

1.1 European Commission

The European Commission provides strategic leadership for the governance mechanism and acts as the central coordinator at Union level.

In the preparedness phase, the Commission is responsible for establishing and maintain the overall governance structure and ensuring the integration of cross-sector intelligence relevant to food system risks. This includes the consolidation of inputs from energy, transport, digital, health, and market surveillance systems, as well as the development of harmonised methodologies ad guidance for Member States. The Commission further facilitates structured engagement with supply chain actors, promotes joint exercises, and monitor progress in strengthening systemic resilience across the Union.

During a crisis, the Commission assumes a central operational coordination role, and it activates the relevant structures. It ensures effective cross-border coordination, issues crisis-response recommendations to Member States, mobilises relevant Union instruments, and safeguards the functioning of the Single Market. The Commission also ensures that decision-making is informed by coherent risk assessment and provides transparent communication to all stakeholders.

1.2 Member States and National Competent Authorities

Member States retain primary responsibility for national preparedness and response measures.

As mandated by Article 9 of Directive (EU) 2022/2557 on the resilience of critical entities (CER Directive), Member States should designate a dedicated Food Sector Resilience Authority (e.g. a unit in the Agriculture or Civil Protection Ministry) as the competent authority responsible for the implementation of the Directive in the food sector. Article 9 also requires Member States to designate a national Single Point of Contact (SPOC) to liaise with the EU's Critical Entities Resilience Group (CERG) and coordinate cross-border resilience information sharing. In addition, Article 4 requires Member States to adopt a national strategy for enhancing the resilience of critical entities. This strategy must set strategic objectives and priorities, identify and define critical entities, and establish a Resilience Governance Framework clarifying roles and responsibilities of authorities, critical entities, and other relevant stakeholders. It must also describe risk-assessment processes, measures to enhance resilience, mechanisms for public–private cooperation, and coordination with cybersecurity authorities under Directive (EU) 2022/2555 (NIS2). These obligations apply specifically to entities formally designated as *critical entities* under the Directive and do not extend automatically to the entire food sector.

In the preparedness phase, Member States and competent authorities are responsible for coordinating food-system resilience activities, maintain national risk assessments, and prepare national contingency plans aligned with Union guidance (e.g. enabled by National Focal Points). Member States are expected to the functioning of early-warning and monitoring systems at national level and to maintain effective coordination across their relevant administrative authorities, including those responsible for agriculture, food safety, transport, energy, digitalisation, and civil protection.

When a disruption emerges, competent authorities are responsible for rapid and accurate reporting to the Commission and for activating their national coordination structures. They implement the measures defines in national contingency plans and apply mitigation measures recommended at Union level. Member States must ensure that national actions remain proportionate, preserve the integrity of the Single Market, and do not create unjustified barriers to the free movement of goods. They also support private operators in removing logistical bottlenecks and facilitate access to civil protection or emergency support where needed.

1.3 EU Agencies and Cross-Sector Bodies

Specialised EU agencies contribute to sector-specific expertise and analytical capacities both pre- and during crises.

In the preparedness phase, agencies such as EFSA, ECDC (European Centre for Disease Prevention and Control), HERA (Health Emergency Preparedness and Response Authority), ACER (European Union Agency for the Cooperation of Energy Regulators), ENISA (European Union Agency for Cybersecurity), ERA (European Research Area) and others provide scientific assessments, surveillance insights, cybersecurity guidance, energy market intelligence, and transport system information. Their contributions support the development of multi-risk assessments and cross-sector dependency analyses.

During crises, these agencies supply real-time intelligence and technical analysis, enabling integrated situational awareness. They may also activate sector-specific response mechanisms where disruptions originate from their respective domains, ensuring coherence with broader Union crisis-management structures.

1.4 Research Institutions and Academia

Research institutions and academia are considered 'knowledge actors' and typically classified under the public or semi-public domain. This category includes universities, research centres, and scientific networks providing analytical, technical, and situational insights that complement the roles of public authorities and private operators.

In the preparedness phase, research institution and academia contribute through independent scientific analysis, methodological development, and foresight. Their work supports the identification of systemic vulnerabilities, cross-border dependencies, climate risks, and socio-economic impacts. They assist the Commission, EU agencies, and Member States in developing modelling tools, resilience indicators, and early-warning methodologies, and participate in expert groups and advisory boards.

During the crisis, knowledge institutions support rapid analysis and scenario modelling, supplying real-time insights on the evolution of risks and the potential effectiveness of response measures. They assist with technical interpretation of data, modelling of cascading impacts, and validation of assumptions. Their analytical neutrality ensures that crisis decisions are evidence-based and proportionate.

2. Private Sector

Private actors are economic operators or representative organisations engaged in the production, processing, distribution, transportation, retail, or supply of food and agricultural inputs. Their responsibilities include operational preparedness, continuity planning, implementation of mitigation measures, and provision of information. However, these responsibilities should be designed and applied in a way that is proportionate to the organisational capacity of different actors. In particular, SMEs may face constraints in terms of resources, expertise, and access to information. For this reason, governance mechanisms should take into account these limitations by ensuring that expectations remain realistic, adaptable, and aligned with sector-specific characteristics.

2.1 Food System Operators and Input Providers

Private operators carry primary responsibility for operational continuity, risk management, and implementation of mitigation measures. This includes producers, processors, transport and logistic actors, wholesalers, retailers, input suppliers, and other relevant economic operators.

In the preparedness phase, operators are expected to maintain suitable risk-management systems, undertake vulnerability assessments, and ensure business-continuity arrangements that correspond to the scale and nature of their operations. Operator designated as critical entities under EU law CER Directive must comply with relevant EU legislation, strengthened requirements concerning cybersecurity, contingency planning, and resilience of physical and digital infrastructure.

As per CER Directive Art. 13, each critical food business shall establish a documented Resilience / Business Continuity Plan covering emergency response, business continuity, and recovering strategies. It is recommended this be developed in line with ISO 22301 (Business

Continuity Management Systems (BCMS)) standards to facilitate regular audits and continual improvement. Critical food operators should also identify positions critical to resilience and conduct background verification and vetting for staff in sensitive or mission-critical roles (e.g. key supply chain managers, IT system administrators), in accordance with national law and in line with Article 14 of the CER Directive.

Proportionality is essential in the case of SMEs. While all operators contribute to resilience efforts, SMEs are not expected to fulfil the same level of administrative or analytical requirements as large or vertically integrated operators. Their responsibilities focus on basic continuity planning and the timely communication of disruptions, supported by simplified templates, technical guidance, and administrative assistance provided by national authorities.

During a crisis, private operators are required to implement operational measures to mitigate disruptions, adjust production or logistic flows, and cooperate with national authorities in ensuring continuity of essential supplies. They must supply timely information on emerging bottlenecks, operational constraints, or supply-chain gaps, while respecting confidentiality and competition rules.

As mandated by CER Directive Art. 15, during a crisis critical food supply entities should notify the designated authority (i.e. the national competent authority / SPOC) within 24 hours of ay disruptive incident and submit a detailed incident report within one month.

Operators also contribute to coordinated distribution or prioritization effort when EU-level mechanisms (EFSCM / alert platforms) are activated.

*2.2 Advisors and Service Providers, **and Enabling Actors***

This category includes specialised consultancies, risk-management firms, technical service providers, and supply-chain advisory companies. Their responsibilities relate to technical assistance, analytical services, operational planning and crisis-specific guidance, addressing preparedness and response needs across the food system.

In the preparedness phase, advisory firms support food system operator – especially SMEs who lack in-house analytical capacities, playing a complementary and enabling role. They indirectly contribute to a broader governance effort by raising operators' preparedness maturity levels and ensuring that risk-management approaches are aligned with systemic vulnerabilities identified at EU level. For SMEs, whose obligations must remain proportionate, advisors often act as key intermediaries capable of translating regulatory expectations into practical, scalable procedures.

During a crisis, advisors act as enablers of operational resilience for the private sector, supporting both large-scale ad SMEs to implement EU-coordinated crisis response measures effectively and consistently.

2.3 Stakeholder Organisations, Associations, and Civil Society

This category includes the private representative bodies, such as producer organisations, cooperatives, retail federations, industry associations, consumer and civil society platforms, and NGOs involved in food assistance or representing vulnerable consumers.

In the preparedness phase, these organizations facilitate knowledge transfer to their members, support awareness-raising activities, and provide structured input on vulnerabilities affecting operators or consumers, including those related to affordability or access. They also participate in consultations, working groups, and annual reviews of systemic risks.

During crises, stakeholder organisations act as key intermediaries between authorities and food system actors, disseminating information, facilitating operational communication, and identifying impacts on vulnerable groups. Their role strengthens the social and distributive dimension of crisis response and supports the targeting of measures to those most affected.

Table 8 distinguishes these actors along the public-private axis and by specifying their operational responsibilities pre- and during a food-system crisis.

Table 8. Operational responsibilities of public and private actors in preparedness and crisis response.

Public Sector	Responsibilities in Preparedness and Prevention (pre-crisis)	Responsibilities in Response (during crisis)
European Commission	- Established and maintains the resilience governance structure. - Issues implementation guidance to Member States. - Coordinates cross-sector monitoring. - Facilitates information exchange, ensuring confidentiality safeguards. - Supports Member States in addressing structural vulnerabilities and supply-chain dependencies.	- Issues coordination recommendations, guidance and temporary measures ensuring Single Market integrity. - Facilitates links with other critical sector mechanisms (HERA, ACER, ENISA, UCPM). - Coordinates communication to Member States and stakeholders. - Mobilises Union instruments (UCPM, crisis reserves). - Monitors implementation of measures and prepares post-crisis evaluation.
Member States and National Competent Authorities	- Designate a dedicated Food Sector resilience Authority as the competent authority for the food sector and national Single Point of Contact (SPOC) for cross-border resilience matters. - Conduct national risk assessments, including climate,	- Provide rapid, accurate, and harmonised situation reporting to the Commission and activate national coordination measures. - Activates the Crisis Response Task Force. - Implement measures defined in national contingency plans and apply mitigation actions.

	geopolitical and supply chain risks. - Develop and maintain national contingency plans aligned with EU guidance. - Ensure monitoring and early-warning capabilities at national level (inputs, logistics, markets, critical entities), and effective inter-authority coordination (agriculture, food safety, transport, energy, digital, civil protection). - Facilitate information exchange with domestic food system operators.	- Ensure proportional, non-discriminatory national measures that preserve Single Market functioning. - Support operators in implementing continuity measures and removing bottlenecks (transport corridors, cross-border flows). - Coordinate with civil protection bodies for logistical and emergency support where needed.
EU Agencies and Cross-Sector Bodies	- EFSA: provides scientific assessments on food chain risks and emerging hazards. - ECDC/HERA: ensures surveillance links when disruptions stem from health emergencies. - ACER/ENTSO -E/G: shares intelligence on energy supply conditions relevant to food production and logistics. - ENISA: provides cybersecurity guidance for digitalised supply chain components. - ERA/EMSA/Transport bodies: inform on transport system capacity, bottlenecks, and vulnerabilities.	- Provide real-time intelligence and assessment and issue technical recommendations to the EU institutions. - Support cross-sector situational awareness and multi-risk impact modelling. - Mobilise sector-specific response capacities when disruptions originate from respective domains.
Research Institutions and Academia	- Generate scientific evidence on supply-chain vulnerabilities, systemic risks, critical dependencies, climate-related impacts on food production and logistics, geopolitical and market volatility, resilience indicators and monitor methodologies. - Support the development of early-warning methodologies,	- Rapid assessments of emerging risks and cascading effects. - Scenario modelling to support crisis escalation decisions. - Synthesise real-time data to support forecasting and dynamic risk modelling. - Monitoring social impacts ensuring crisis response

	predictive models, scenario-based foresights. - Participation in expert groups and advisory functions. - Provide professional training programmes and knowledge-transfer initiatives.	measures remain social balanced and equitable.

Private Sector	Responsibilities in Preparedness and Prevention (pre-crisis)	Responsibilities in Response (during crisis)
Food System Operators	- Maintain risk-management and business-continuity arrangements proportionate to the scale and nature of operations, including vulnerability assessments and contingency procedures. - Where designated as critical entities (under CER Directive), establish and maintain a documented Resilience / Business Continuity Plan covering emergency response, business continuity and recovering strategies; alignment with ISO 22301 is recommended. - Share relevant information with competent authorities on potential supply interruptions and critical dependencies, following secure and confidential reporting channels. - Participate, as appropriate, in voluntary preparedness exercises and scenario-based workshops to test continuity and coordination arrangements. - Strengthen cybersecurity and physical resilience in line with NIS2/CER obligations (where designed as critical entities).	- Implement operational mitigation measures to maintain essential supply flows (e.g., rerouting supplies, adjusting production, securing alternatives inputs and capacity). - Provide timely, targeted, and accurate information to competent authorities on emerging bottlenecks and operational constraints (e.g., capacity, stock levels, logistics limitations), using agreed secure channels and respecting confidentiality and competition rules. - Cooperate with authorities to support continuity of essential supplies and, where applicable, implement agreed prioritization, allocation, or distribution measures. - For entities designated as critical (under CER Directive), notify the designated authority/SPOC within 24 hours of any disruptive incident and submit detailed incident report within one month. - Maintain and adapt cyber- and physical-security measures against heightened risks.

	- Apply proportionality for SMEs: focus on basic continuity planning and timely communication of disruption, supported by simplified reporting templates, sector-specific guidance and administrative assistance provided by national authorities.	- Contribute to coordinated EU-level response mechanisms when activated (e.g. ESCM/alert platforms), including sectoral coordination initiatives.
Advisors and Service Providers	- Support operators – especially SMEs – by providing risk mapping and business-continuity planning, supply-chain modelling, stress testing, scenario planning, preparedness training and simulation exercises, implementation guidance on EU-level preparedness requirements. - Support to sector organizations in producing harmonised contingency templates.	- Real-time supply-chain analysis, risk interpretation, and operational impact assessments. - Identification of feasible mitigation scenarios (alternative routes, product substitution, inventory optimization). - Technical support in prioritising production, logistics and resources allocation. - Guidance for companies (particularly SMEs) on applying emergency derogations, reporting obligations, and temporary EU-level measures. - Facilitating data consolidation for associations and operators required to provide information to authorities.
Stakeholder Organizations and Civil Society	- Represent the interests of producers, processors, retailers, consumers, and vulnerable groups. - Provide insights on structural vulnerabilities and social impacts. - Support dissemination of preparedness guidance to members. - Contribute to annual risk reviews and participatory assessments.	- Facilitate communication to food system actors and communities. - Provide bottom-up intelligence on disruptions' social impacts. - Support coordination for vulnerable population groups.

3.4.3 Public-Private Cooperation Mechanisms

This section develops a conceptual exercise aimed at designing an EU-level cooperation mechanism to safeguard food security. The objective is to bring coherence to existing analytical tools, regulatory requirements, and crisis management practices currently applied across the EU food system. At present, while a wide range of instruments already contribute to food security risk management, they typically operate under different institutional mandates, time horizons, and sector-specific logics. As a result, they are not always harmonized to support coordinate, system-level action across the EU food system.

The cooperation mechanism proposed here does not seek to replicate or replace these existing tools. Rather, it provides a structured framework through which existing and future tools can be embedded within a single, EU-level crisis management architecture. From this perspective, analytical and operational tools are treated as inputs to a broader governance process for EU food security, organized across preparedness and response phases and activated through defined roles and leadership arrangements. The mechanism is designed to translate risk intelligence into coordinated decision-making and implementation involving both public and private actors.

In this sense, the proposed cooperation mechanism is intended to support the implementation of the CER Directive (discussed in Section 3.2.3) with specific reference to the "*production, distribution and consumption of food*". It illustrates how CER provisions can be operationalized within the institutional framework of the EU and its Member States by linking current scientific knowledge, regulatory requirements, and crisis management practices within a coherent and integrated governance approach.

The section is structured as follows. First, the concept of cooperation is defined, clarifying the shared objectives of public-private partnership envisaged under the Resilience Governance Framework, together with expected benefits and inherent challenges. Second, an excursus addresses power imbalances, which - although not explicitly covered by the CER Directive – can significantly affect the effectiveness of institutionalised cooperation mechanisms. Finally, the functioning of the proposed cooperation mechanism is articulated for both the pre-crisis and during-crisis phases, highlighting the governance enablers of cooperation and the linkages with the CER Directive, other relevant EU legislation, and supporting international standards, whose use is explicitly encouraged under the Directive.

The Concept of Cooperation

Food security crises are complex and multi-dimensional, driven by political, socio-economic, and biophysical factors, and propagating through highly interconnected value chains and governance levels. Addressing such crises therefore requires coordinated action among the food system stakeholders (Table 7), whose mandates, resources, and capacities differ but whose outcomes are mutually interdependent. These interdependencies are commonly analysed within the field of Inter-Organizational Relationships (IOR), defined as "*the study of strategic alliances, joint ventures, partnerships, networks, and other forms of relationship between organizations*" which draws *"contributions from a wide variety of disciplines, theoretical bases, and sectorial interests.*" (Cropper et al., 2008). IOR provides a framework

for understanding how organizations form linkages, share resources, and align objectives to achieve common goals.

Within the IOR literature, *coordination*, *cooperation*, and *collaboration* are related but distinct modes of inter-organizational engagement. Following Castañer & Oliveira (2020), these concepts can be distinguished along five dimensions: attitude (predisposition or willingness to engage), behaviour (observable actions and interactions), outcome (consequences of actions), goal, and time horizon. For the purpose of this report, the terms are defined as follows:

- *Coordination* refers to attitudes, behaviours, and outcomes related to deliberation, negotiation, and agreement on a common goal;
- *Cooperation* refers to attitudes, behaviours, and outcomes related to the joint implementation of a common goal;
- *Collaboration* refers to voluntarily supporting other partners in achieving a shared or individual goal.

By definition, cooperation builds on coordination: agreement on *what* should be achieved precedes joint action on *how* it is achieved. In this report, safeguarding food security in EU food systems is treated as the shared goal of the IOR involving public and private stakeholders. This assumption is supported by the systemic risks outlined in previous sections, as well as by established EU policy agendas and the scientific literature. Food security cannot be reduced to market logic or treated as a source of competitive advantage (Rimhanen et al., 2023). Rather, it represents a shared mission on which the stability of businesses, communities, and the food system depends.

Accordingly, even if this shared goal has not yet been formally endorsed or codified, this section focuses on cooperation understood as sustained and structured joint action between public and private actors engaged in a partnership directed towards safeguarding food security. In this context, attitudes reflect mutual recognition of interdependence and legitimacy; behaviours include concrete practices such as information sharing, joint risk assessments, and contingency planning; and outcomes relate to enhanced buffer capacities, continuity of essential food flows, and more timely and proportionate crisis responses.

By contrast, collaboration, as commonly defined in the IOR literature, is not considered the most suitable conceptual framing for the governance arrangement examined here, as it is typically premised on a high degree of voluntariness. Safeguarding food security in the EU is not discretionary. As outlined in Section 3.4.2, actors across the food system hold defined roles and responsibilities in both pre-crisis and during-crisis phases, limiting the extent to which engagement can be characterised as voluntary. For this reason, the following sections focus on operationalising cooperation by clarifying shared objectives, stakeholder motivations, expected benefits, and the challenges that must be addressed to ensure effective and durable governance arrangements.

Shared Objectives Guiding Cooperation Across Governance Levels

The shared objectives to be agreed upon can be articulated across three interlinked and hierarchical levels: the societal level, the supply chain level, and the organizational level. These levels reflect a progression from the broadest public interest objective to more operational

and entity-specific objectives. Once *agreement* is reached across these levels, the subsequent cooperation mechanism can support their joint and coherent achievement.

At *societal level*, agreement on the shared objective corresponds to safeguarding food security as a public mission and common good, in line with the governance principles outlined in the previous sections. From this perspective, coordinated action among public authorities and private actors aims to ensure that disruptions within the food system do not translate into widespread or prolonged adverse impacts on populations, particularly with respect to food availability, access, utilisation, and stability.

At *supply chain level*, this overarching objective is translated into a shared commitment to safeguarding food supply continuity. For food system operators, this is reflected in the sustained functioning of interconnected stages of production, processing, transport, storage, and distribution. Cooperation at this level therefore focuses on anticipating and addressing bottlenecks and cascading effects through aligned actions, prioritisation of essential goods, and timely exchange of information. In this regard, recent EFSCM recommendations (EFSCM, 2023) highlight common preparedness principles for strengthening the resilience of the EU food supply chain, including mutual trust, transparency, and continuous risk monitoring.

At *organizational level*, the shared objective is operationalised through safeguarding business continuity. For individual food system operators, this primarily concerns the continuity of core activities and critical relationships, often concentrated on immediate (Tier 1) suppliers and clients. Ensuring that organisations can continue to deliver products and services at predefined acceptable levels represents a necessary condition for both supply chain continuity and societal food security. At this level, joint risk assessments, contingency planning, and structured exchanges with competent authorities contribute to maintaining operational capacity and supporting recovery.

Taken together, cooperation enables a system-centred perspective that aligns shared objectives across societal, supply chain, and organisational levels. By explicitly addressing these three layers, the public-private cooperation mechanism supports coherent action across actors, tiers, and governance levels.

Rationale for Cooperation in Crisis Management and Resilience

Engagement in structured cooperation mechanisms is primarily driven by the expectation of clear and tangible benefits in terms of risk reduction, predictability, and more effective crisis management. For both public authorities and private actors, coordinated approaches help reduce systemic risks and economic costs associated with fragmented responses, market distortions, or unaligned interventions, particularly under conditions of uncertainty and cascading effects. One of the central benefits of cooperation lies in improved access to timely, relevant, and trusted information. Evidence shows that food system resilience is strengthened when stakeholders share information and align decision-making processes, enabling earlier detection of emerging risks and more coherent actions in the pre-crisis and during-crisis stages (HLPE, 2022). Enhanced shared situational awareness increases transparency and supports proportionate interventions across governance levels.

Cooperation also facilitates access to financial and risk sharing mechanisms (Stoeva et al., 2024), which are particularly critical during crises. Coordinated governance frameworks can ease access to emergency funding, insurance instruments, and other support measures, thereby reducing delays in implementation and limiting operational and economic exposure for both public authorities and food system operators. These enabling conditions reinforce willingness to cooperate by lowering barriers to collective action. Cooperation also facilitates access to financial and risk sharing mechanisms (Stoeva et al., 2024), which are particularly critical during crises. Coordinated Resilience Governance Frameworks can ease access to emergency funding, insurance instruments, and other support measures, thereby reducing delays in implementation and limiting operational and economic exposure for both public authorities and food system operators. These enabling conditions reinforce willingness to cooperate by lowering barriers to collective action.

Beyond immediate crisis management, structured cooperation generates broader structural benefits. For private actors, improved visibility across supply chains enhances predictability, supports long-term investment decisions, and contributes to corporate reputation. For public authorities, coordinated mechanisms improve policy coherence and effectiveness, while reducing duplication of efforts (UNEP, FAO, and UNDP, 2023). Finally, cooperation fosters conditions conducive to innovation and learning, as the exchange of knowledge, data, and operational experience enables the joint development of solutions that cannot be achieved in isolation. Collective initiatives can also support cost sharing and risk reduction, contributing to longer-term resilience and transformation of the food system (Stoeva et al., 2024).

Key Challenges to Public-Private Cooperation in Crisis Management

Despite the expected benefits, cooperation mechanisms face several structural challenges that can limit their effectiveness if not adequately addressed. A key persistent barrier is reluctance to share data, particularly among private actors who may have concerns related to confidentiality, competitive disadvantage, or potential misuse of information. In addition, unclear data governance arrangements – especially with regard to data ownership, access rights, and permitted uses – can further discourage openness and undermine trust among participants (FAO, 2021, 2025a).

Asymmetries in capacities and resources represent a further challenge to effective cooperation. Stakeholders with limited financial, technical, or organisational capacity may encounter difficulties in engaging meaningfully in cooperation processes, leading to uneven participation, and potentially reinforcing the influence of better-resourced actors. If left unaddressed, such imbalances can weaken inclusiveness and erode trust within cooperation mechanisms (UN Food Systems Summit, 2025). Addressing these challenges requires deliberate trust-building efforts, robust data governance, and participation mechanisms that take differences in capacity into account. When these enabling conditions are in place, cooperation can act as a powerful driver of resilience, supporting not only more effective crisis response but also longer-term innovation and system transformation. Power-related dimensions of cooperation are examined in greater detail in the following section "*Power Imbalances in Public-Private Cooperation for Food Security*".

A further challenge concerns the alignment of priorities among public and private actors. While public authorities may prioritise long-term resilience, sustainability objectives, or social protection, private actors often prioritise business continuity and investment security. In volatile or rapidly evolving contexts, these differences may become more pronounced. Without explicit alignment on shared objectives, cooperation risks losing both effectiveness and strategic direction. For this reason, agreement on the shared objectives constitutes a necessary pre-condition for the IOR to deliver its intended outcomes.

Power Asymmetries in Public-Private Cooperation for Food Security

The effectiveness of the IOR in achieving the shared objectives across societal, supply chain and organizational levels ultimately depend on whether participating actors can engage, contribute, and exercise their roles in practice. Differences in resources, influence, and access to information can generate power asymmetries that condition cooperation in both preparedness and crisis response.

Building on Castells (2016), power is understood as the relational capacity of certain actors to influence others' decisions in ways that advance their own interest, values, or priorities. Evidence from multi-stakeholder partnerships suggests that uneven power relations can result in responses that insufficiently reflect the needs of lower-power groups or shift disproportionate implementation costs onto them (Gray et al., 2022). At the same time, participatory governance architectures remain indispensable for addressing grand challenges such as food security, where complexity and interdependence require broad stakeholder involvement to develop effective solutions (Ferraro et al., 2015).

In EU and global food systems, power asymmetries can emerge both across stakeholder categories and within them and may intensify as cooperation moves from preparedness into crisis response. Across categories, asymmetries reflect differentiated economic roles and functional positions along food value chains, as well as unequal capacity to shape operating conditions for others. This includes the role of "parameter-setting" actors that influence standards, technologies, prices, or requirements adopted throughout the chain (Gereffi et al., 2005). Within categories, market concentration can reinforce power asymmetries by enabling a limited number of actors to shape markets, innovation trajectories, and governance agendas. Such dynamics have been documented in sectors such as seeds and agrochemicals (Clapp, 2021), as well as livestock genetics, animal pharmaceuticals, and farm machinery (ETC Group & International Panel of Experts on Sustainable Food Systems, 2017), and are associated with increased vulnerability for smaller-scale producers (Clapp, 2021).

In essence, three interrelated forms of power asymmetries may manifest within a public-private cooperation mechanism and compromise its functioning:

i. *participation power,* referring to the uneven capacity of actors to engage in collective decision-making and to sustain involvement over time.
ii. *informational power*, referring to control over and access to data relevant for crisis management.
iii. *agenda-setting power*, concerning the ability to define priorities, frame risks, and delimit feasible response options.

Addressing these asymmetries requires that cooperation mechanisms embed differentiated safeguards and design features for each dimension of power. In this regard, participation power can be mitigated through structured, recurring forums with clear rules for representation, facilitation, and decision-making. Practically, calibrated seats at the decision tables should be designed so that the SMEs perspectives are consistently present. Where appropriate, private sector associations may hold an explicit representational mandate for SMEs, while advisors or technical service providers may be tasked with enabling their participation (e.g., through preparation of inputs, support in understanding technical requirements, and simplified reporting procedures). Given that farmers are often structurally "low power" actors (Claeys et al., 2025; Rimhanen et al., 2023), dedicated assemblies within the mechanism can help consolidate their voice , reduce fragmentation, promoting unity, and peer learning.

Concerning informational power, shared situational awareness depends on the capacity of public authorities to aggregate and interpret heterogeneous data, much of which is held by private food system operators. When data access is uneven, delayed, or selective — whether due to divergent goals, incentives, behaviours, capacity gaps, or the nature of public–private relationships (Aben et al., 2021; Karaba et al., 2023) — response measures may be delayed or inadequately targeted. Addressing this requires robust data governance frameworks that clarify purpose limitation (i.e. which decisions information supports), access tiers, confidentiality safeguards, secure reporting channels, and harmonised data sharing modalities in terms of timing, formats, and aggregation levels. In the literature, there is support to contract-based clauses to structure data gathering and sharing in public-private partnerships (Aben et al., 2021). Such contractual provisions can clarify actors' obligations regarding data provision, quality, and timeliness, but informational transparency must remain bidirectional: while private operators are expected to provide timely and accurate data to public authorities, these authorities should ensure feedback loops that translate aggregated intelligence into actionable guidance. Importantly, in the exchange of information, brokering and synthesis functions should be institutionally anchored. Acting as intermediaries, private sector associations, independent advisors, or service providers should bridge informational, technical, and trust gaps to reduce dependence on single sources and limit selective disclosure (Eitan et al., 2025). However, efforts to mitigate food security risks should not translate into increased surveillance against private actors - a concern raised in the literature on business-to-government data sharing (Verhulst, 2024).

Finally, beyond participation and information, the cooperation mechanism must also address agenda-setting power. In food security crises, agenda-setting power is particularly salient, as compressed timelines, information asymmetries, and confidentiality constraints can narrow deliberation and privilege the perspectives of better-resourced actors. Public EU and National Competent Authorities retain the mandate to oversee response measures, preserve Single Market functioning, and mobilise crisis instruments, but they rely heavily on information and operational feedback from large private food system operators. To mitigate such asymmetries, cooperation arrangements should rely on criteria for risk prioritisation (i.e., what is framed as 'urgent'), agreed in preparedness phase and activated during food security crises. Such criteria can help structure agendas and deliberation around shared dimensions (e.g. scale of disruption,

exposure of vulnerable groups, cross-sector spillovers). In this respect, ISO 31000:2018 provides useful guidance for risk criteria setting (International Organization for Standardization, 2023b), a process in which the perspectives of farmers, SMEs, and civil society organizations should receive particular consideration or they may otherwise remain underrepresented in applied mitigations strategies.

Enablers of Cooperation in Crisis Management

Once formal agreement on shared objectives is achieved, food crisis management can be operationalised through structured cooperation. Cooperation mechanisms thus constitute the operational core of crisis management: it is through preparedness for, and response to, food crises that food security is safeguarded, and where disrupted, stabilised. The expected outcome of cooperation is a resilient food system capable of maintaining its core functions despite disturbances. This outcome is achieved by strengthening and mobilising food system resilience capacities (as introduced in Section 3.2.1.3). These capacities define the operational boundaries within which preparedness, prevention, and response actions can be designed and implemented in a coordinated and proportionate manner.

The cooperation mechanism underpinning this framework is designed to operate across both the pre- and during-crisis phases. Actions unfold within a continuous risk management process involving multiple stakeholders and forming a cumulative and iterative trajectory. While closely connected, these two phases are separated by a transition moment corresponding to crisis detection. Crisis detection can be understood as a sequence of decision points through which emerging risks are identified, recognised, and interpreted in their immediate context, communicated across the food system, and translated into collective mobilisation (Comfort, 2007). At this transition point, governance shifts from predominantly anticipatory measures to response-oriented interventions. This dynamic, which lies at the core of crisis management cycle supporting the Resilience Governance Framework, is illustrated in Figure 2.

Across the crisis management cycle, four cross-cutting elements are essential to ensure that shared objectives can be achieved through cooperation:

i. leadership,
ii. information sharing,
iii. trust, and
iv. interoperability

Together, these elements - here defined as enablers of cooperation - structure how actors exchange information, align the timing of interventions, and plan and deploy resources across organisational and system boundaries. The crisis management literature consistently highlights that failures in any of these dimensions are causes of cooperation breakdowns and delayed responses in complex multi-actor crises (Ansell & Gash, 2008; Boin & Bynander, 2015; Latusek & Vlaar, 2018).

Overall, the cooperation mechanism conceptualised operates under the guidance of a *leading authority*, responsible for monitoring actions, ensuring coherence among stakeholders, and maintaining alignment with the shared mission of safeguarding food security as an essential

service. In line with the institutional roles outlined in previous sections and with the requirements set out in Article 4 and 9 of the CER Directive, leadership is exercised by public authorities. Consistent with ISO 31000:2018, this leadership function includes setting strategic direction, integrating risk management into governance processes, approving resource allocation, and ensuring continuous monitoring and learning across all phases of crisis management. Within this governance architecture, EU institutions provide overall strategic guidance for the cooperation mechanism, supported by Member States and National Competent Authorities in translating strategic orientations into national-level implementation. This concludes overseeing the allocation of agreed resources and enabling effective engagement of both public and private actors. In this context, the National Focal Point (NFP) represents a designated public authority responsible for facilitating two-way information and intelligence exchange between individual Member States and EU institutions, including the EU Commission, as well as coordinating reporting, policy alignment, and compliance with relevant EU and international frameworks. Taken together, these leadership functions ensure coherence between strategic direction, the availability of operationally relevant inputs, and the overall resilience of national and EU food systems.

Within the cooperation mechanism, *information sharing* enables actors to develop and maintain a shared understanding of evolving food security risks across preparedness and response phases. This requires timely and reliable data flows on emerging threats, impacts, and response measures, supported by clear agreements regarding what information is shared, by whom, under which conditions, and through which technical arrangements. Evidence from inter-organisational crisis management studies show that information sharing is most effective when procedures, communication channels, and solid partnerships are established before a crisis occurs, reducing uncertainty and enabling faster collective action once response measures are required (Kapucu, 2006). In food system contexts, this implies linking early-warning and risk monitoring activities with traceability mechanisms so that disruptions can be identified and addressed effectively across the supply chain (Aung & Chang, 2014).

Trust underpins cooperation by shaping actors' willingness to rely on shared information, accept joint decisions, and align actions under conditions of uncertainty and time pressure. Research shows that the quality of inter-organisational cooperation is often driven more by non-binding relational factors such as trust than by formal legal arrangements alone (Marana et al., 2018). At the core of cooperative information sharing lies trust, identified by EFSCM as a prerequisite for effective crisis communication and coordination (EFSCM, 2023). Trust enables private sector operators to disclose information on supply conditions and contingency measures, while allowing consumers' organizations and labor representatives to relay behavioral trends, workforce disruptions, and early signals of stress. Under conditions of high uncertainty, reliable information flows and the involvement of trusted stakeholder organizations are essential for sustaining consumer confidence and preventing destabilizing behavioral responses (Loh et al., 2023), (Muhammed T & Mathew, 2022). Trust is not generated instantaneously during crises; it develops over time through repeated interaction, transparency in decision-making, and clarity regarding roles and expectations. In the absence of sufficient trust, formal coordination arrangements are unlikely to translate into effective cooperation, particularly when response measures require rapid mobilisation and shared responsibility.

Interoperability enables cooperation to move from information exchange to coordinated action. It encompasses not only technical compatibility between information systems, but also to alignment of data definitions, shared semantic understanding, and legal and organisational arrangements – including standards, contractual provisions, and regulatory frameworks – that facilitate or constraint joint use of information and resources across actors (Allen et al., 2014; Schneider et al., 2025). Experience from emergency response contexts shows that even when information is available, cooperation may fail if these conditions are not in place (Truptil et al., 2008). In food system governance, interoperability is therefore essential to enable measures such as rerouting supplies, activating reserves, or adjusting market interventions to be implemented consistently and without delay across multiple jurisdictions.

Importantly, where these four enablers are in place, the IOR can also better contain and counterbalance the power asymmetries illustrated in the previous section (participation, informational and agenda-setting power). For instance, information sharing broadens access to crisis-relevant data and supports shared situational awareness for all stakeholders, regardless of size or role; leadership by public authorities and trusted arrangements enable sustained participation among the mechanism, including that of lower-capacity actors; interoperability ensures that shared information and agreed decisions can be applied across organizations and jurisdictions, thereby preventing coordination failures and reducing the scope for more powerful actors to shape priorities.

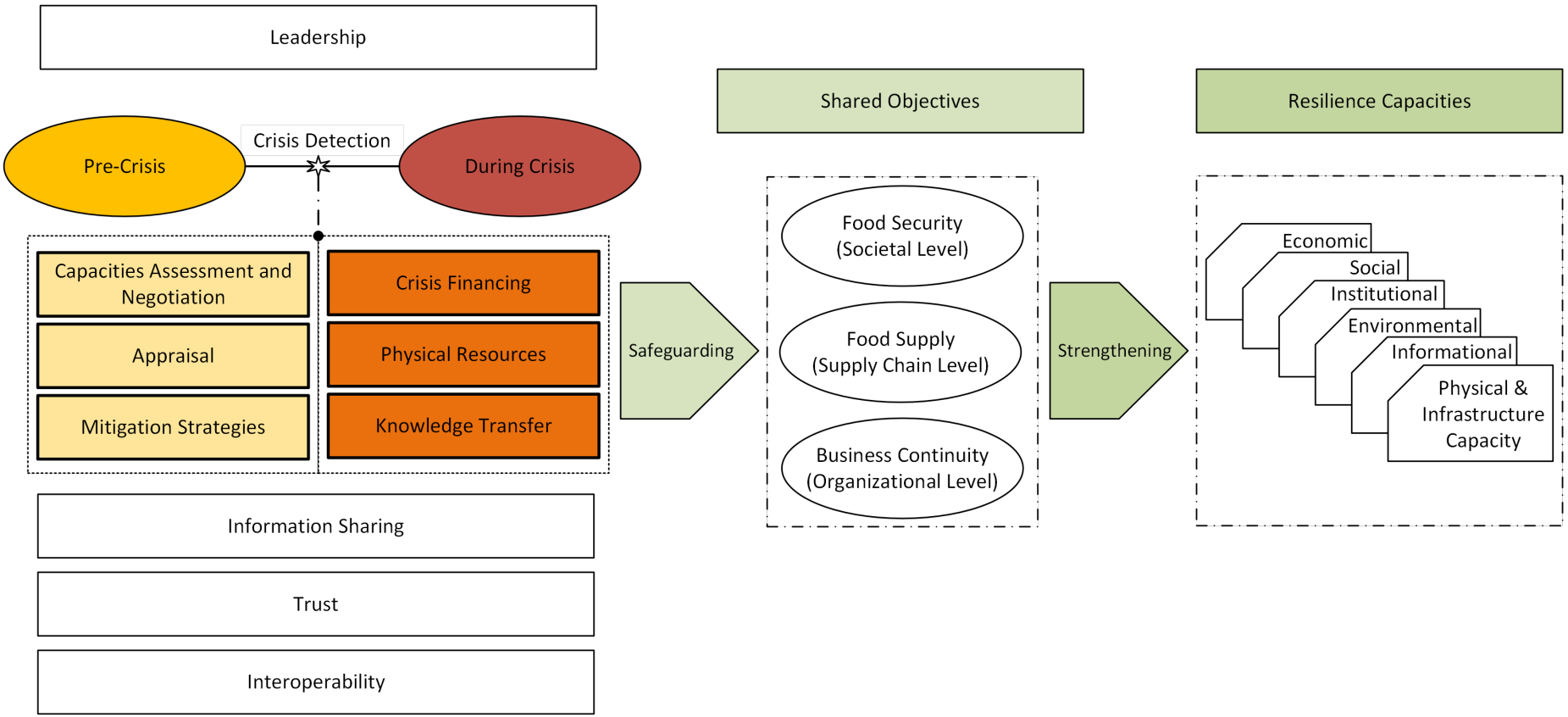


Figure 2. Structure of the cooperation mechanism across the pre-crisis and during-crisis phases, enabled by information sharing, trust, and interoperability, and guided by public leadership to strengthen food system resilience capacities.

3.4.3.1 Pre-Crisis Cooperation Flow: Guidelines for Preparedness and Prevention

The cooperation flow illustrated in Figure 3 describes how public and private actors engage, during the pre-crisis phase of preparedness and prevention, in a structured sequence of cooperative actions under the strategic guidance of EU institutions and Member State authorities. This phase precedes the onset of a food crisis and focuses on anticipatory measures aimed at reducing systemic vulnerabilities and strengthening food system resilience capacities.

The pre-crisis cooperation flow is embedded within the EU's broader preparedness architecture and contributes to the implementation of the CER Directive, while also operationalising key principles set out in the *European Preparedness Union Strategy*, notably those relating to structured public-private cooperation, two-way information sharing, and coordinated preparedness across critical sectors. While the Strategy envisages cross-sectoral public-private *Preparedness Task Force*, the cooperation flow presented here provides a food-system-specific governance architecture, translating preparedness principles and CER-related requirements into concrete processes, roles, and interactions tailored to the sector. Interdependencies with other critical sectors are explicitly considered, while decision-making responsibility remains anchored within the food system perimeter defined in this framework.

Overall, pre-crisis cooperation unfolds through sequenced and interlinked processes that progressively consolidate analytical inputs, operational knowledge, and implementation feedback generated by public and private actors. The objective is to validate and implement risk mitigation strategies that strengthen food system resilience capacities, and that subsequently inform the definition and adoption of national provisions by Member States.

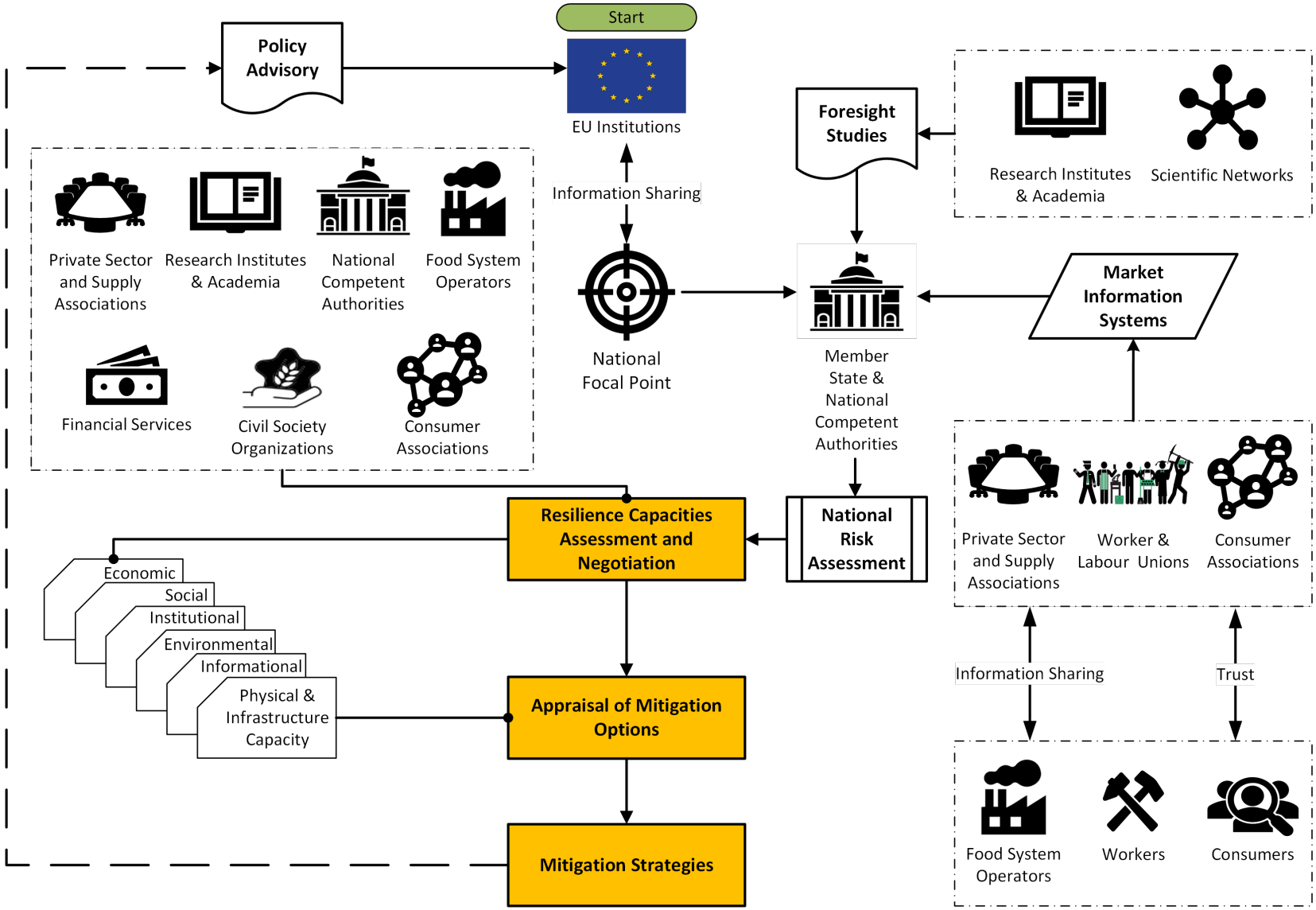


Figure 3. Cooperation flow diagram for the pre-crisis phase.

Pre-Crisis Cooperation Flow: Key Processes and Decision-Making Steps

Effective pre-crisis cooperation relies on shared analytical foundation. As shown in Figure 3, the cooperation flow is supported by three complementary analytical and informational instruments: foresight studies, market information systems and dashboards, and national food system risk assessments. These instruments provide the evidence base upon which collective interpretation, deliberation, and decision-making are built. They are primarily led by public authorities, with contributions from EU and national agencies, academia and research institutions, private R&D organizations, service providers, associations, and other enabling actors.

Foresight studies and market information systems together constitute the upstream intelligence feeding national risk assessments. Their respective purposes, time horizons, and governance characteristics are summarised in Table 9.

Table 9. Analytical and informational instruments feeding national risk assessments.

Dimension	Foresight studies	Market information systems and dashboards
Purpose	Support food system risk assessment by identifying medium- to long-term drivers, emerging risks, and potential shock pathways.	Support food system risk assessment by identifying short-term drivers, stress signals, and emerging disruptions.
Time horizon	Medium to long term.	Short term.
Updates frequency	Periodic (e.g., annual or multi-annual), with scope adaptable to needs.	Regular short cycles (e.g., monthly, quarterly) with annual consolidation.
Leading authority	Public authority	Public authority
Contributors	• EU and national agencies. • Academia and research institutions. • Private R&D organizations.	• Private sector operators. • Private sector and supply chain associations. • Consumer associations. • Workers and labours unions. • Advisors, technical service providers and enabling actors.
Role of intermediaries	No formal role foreseen in the mechanism.	Central (aggregation, brokering).
Role of public authority	Collect, synthesise, and translate analyses for supporting risk assessment process.	Consolidate brokered outputs, ensure confidentiality and data protection.
Data sources	Research, modelling, expert assessments.	Operational and market data (prices, stocks, logistics, inputs).
Data sensitivity	Generally low to moderate.	Often high (commercial and operational sensitivity).

Foresight studies focus in identifying medium- to long-term drivers, emerging risks, and potential shock pathways relevant to food security. They may be undertaken at EU level – examples include studies performed by the JRC on food system risks and vulnerabilities (Bertolozzi-Caredio et al., 2023), as well as EFSA's *Annual Report on Emerging Risks and Horizon Scanning* (EFSA, 2026) – as well as at Member State level to reflect national specificities while contributing to a coherent EU-wide understanding of evolving risks. To be operationally effective, foresight outputs must be synthesised and translated by designated public authorities into formats usable for the risk assessment. Interoperability is therefore essential, ensuring alignment of concepts and formats to allow timely integration and comparison.

Market information systems and dashboards provide complementary short-term intelligence by monitoring stress signals, such as market conditions, input availability, prices, logistics performance, and other indicators relevant to food supply stability. These systems consolidate data from multiple sources to generate timely signals supporting preparedness and early action. Given the high sensitivity of much of the underlying data, especially the one originated from private entities, aggregation and brokering functions – often performed by intermediaries – are required prior to public-level consolidation, supported by clear confidentiality safeguards and predictable use of shared information.

Drawing jointly on foresight outputs and market monitoring, national food system risk assessments are conducted by designated National Competent Authorities, in accordance with CER requirements. In line with the CER Art.5, these assessments should follow an all-hazards approach, consider cross-sectoral and cross-border dependencies, and be conducted at least every four years, with updates to address emerging or rapidly evolving threats. Under the same Directive, a voluntary template has been developed to support the reporting of national risk assessment outcomes. For guidance purpose, this template – illustrated with food system-specific examples – is provided in ANNEX B. These assessments integrate longer-term structural insights with near-real-time evidence to evaluate the likelihood and potential impacts of disruptions, as well as national capacities to absorb and respond to stress. Methodological alignment with ISO 31000 supports consistency across Member States, while links to ISO 22301:2019 facilitate coherence with business continuity planning by critical food sector entities.

At EU level, analytical outcomes may be discussed and interpreted through advisory bodies such as the EFSCM, supporting shared situational awareness, exchange among Member States, and the formulation of guidance and recommendations that feed back into successive risk-assessment cycles.

At the core of the cooperation flow, three closely connected cooperative processes follow, translating risk knowledge into preparedness decisions:

1. Resilience capacities assessment and negotiation (*"Where do strengths and vulnerabilities lie across the food system's resilience capacities?"*)
2. Appraisal of mitigation options (*"What could be done for each resilience capacity, and with what implications?"*), and

3. Definition of coherent risk mitigation strategies (*"What coherent strategy could be established, based on that appraisal, to be validated and implemented at EU level?"*)

Together, these processes form the tactical backbone of pre-crisis cooperation at the national level.
During the resilience capacities assessment and negotiation step, cooperation focuses on establishing a shared analytical ground across participating actors. Because resilience capacities are multi-actor and multi-level constructs (i.e., from local to global scales) (Béné et al., 2023; HLPE, 2022), their assessment cannot be treated as a purely technical exercise. This stage constitutes the interface between strategic risk intelligence and capacity-focused analysis. Negotiation is therefore envisaged as a structured alignment process, aimed at reconciling differing interpretations and perceptions of risks affecting the food system. Involved stakeholders include academia and research institutions, National Competent Authorities (e.g. ministries and local governments), service providers, insurers, civil society organizations, food system operators, and intermediaries such as supply chain and private sector associations, which can be entitled to represent private organizations. Particular attention is required to ensure that the perspectives of SMEs and vulnerable groups are adequately reflected, in order to limit power asymmetries. The expected output of this stage is a shared and detailed '*resilience capacity register*', intended as a structured inventory documenting strengths and vulnerabilities across national food system resilience capacities, developed through multi-actor deliberation following the national risk assessment.

Building on this register, stakeholder engage in the appraisal of mitigation options through capacity-specific decision tables. Each table brings together a targeted set of public and private actors whose mandates and expertise are directly relevant to the capacity under consideration. In this respect, the appraisal tables follow the same cooperation principles underpinning Article 19 of the CER Directive, which promotes structured coordination and exchange of information across the Critical Entities Resilience Group. Balanced participation - including representation of SMEs – is essential to ensure feasibility and prevent distortions arising from power concentration. Table 10 details the composition and rationale of these decision tables.

Table 10. Decision tables for the appraisal of mitigation options across resilience capacities in the pre-crisis phase.

Resilience capacity	Actors sitting at the appraisal table	Rationale for inclusion
Economic capacity	• Member State and National Competent Authorities (agriculture, economy). • Private food system operators, including large firms and SMEs. • Supply chain and trade associations, including SMEs representatives. • Consumer associations. • Insurers, financial mediators, and risk advisors.	Appraisal of market, affordability, and economic stability measures requires market intelligence, operator feasibility assessments, and consumer perspectives. Inclusion of SMEs alongside larger firms limits power asymmetries.
Social capacity	• Member State and National Competent Authorities (labour, social affairs, health). • Workers and labour unions. • Civil society and food-aid organisations. • Consumer associations. • Research institutions.	Social mitigation options directly affect workforce continuity, equity, and access. Affected groups and representatives must therefore be involved to assess feasibility and social implications.
Physical and infrastructure capacity	• Member State and National Competent Authorities (transport, energy, civil protection). • Private food system operators, including large firms and SMEs. • Supply chain associations. • Technical service providers (logistics).	Mitigation options (e.g. rerouting, prioritisation, redundancy) depend on technical and operational feasibility known to operators and infrastructure specialists.
Institutional and governance capacity	• Member State and National Competent Authorities, National Focal Points (NFPs). • EU agencies. • Stakeholder organisations.	Options concern coordination mechanisms, legal flexibilities, and institutional readiness, requiring public authority leadership and governance expertise.

	• Research institutions.	
Informational capacity	• Member State and National Competent Authorities (food safety, cyber and digital). • EU and national institutions and agencies. • Private food system operators, including large firms and SMEs. • Supply chain associations, including SMEs representatives. • Technical service providers (data and tech). • Research institutions.	Appraisal of information-sharing, early-warning, and reporting options requires practitioners generating data and intermediaries handling aggregation and confidentiality.
Environmental and natural resource capacity	• Member State and National Competent Authorities (environment, agriculture, water). • Primary producer and environmental associations. • Civil society organizations. • Research institutions. • Insurers, risk and sustainability advisors.	Environmental mitigation options require scientific grounding and practitioner insight to balance productivity, sustainability, and long-term resilience objectives.

The appraisal process produces a concise portfolio of mitigation options for each resilience capacity, describing objective, expected effectiveness, indicative resource requirements, and potential cross-capacity or cross-sector implications. To support comparability and aggregation, outputs are documented using harmonised reporting template. For guidance purpose, a draft proposal of this reporting template is provided in **Annex B** National Risk Assessment

B.1 Guidance on Voluntary Common Reporting Template

Directive (EU) 2022/2557 on the Resilience of Critical Entities (CER Directive) establishes a harmonised framework to strengthen the resilience of *critical infrastructure sectors*, including *production, processing, and distribution of food*. To support Member States in implementing the Directive's requirements – such as conducting all-hazards risk assessments – the European Commission issued a *Voluntary Common Reporting Template*" in September 2025. The template contains a structured form for Member States to report the results of their national risk assessments per sector and subsector as defined in the Directive's Annex. While its use is voluntary, Member States are strongly encouraged to apply the template to ensure that information submitted to the Commission pursuant to Article 5(4) of the Directive is consistent, comparable, and transparent across countries.

For guidance purposes, this Annex reproduces the sections of the template and illustrates their application with food-system-specific examples, in accordance with the scope and objectives of the present Resilience Governance Framework.

Table 21. Key components of the CER "Voluntary Common Reporting Template" (Annex to the CER Directive guidelines) and their significance for the food production and technology sector.

Template Section	Template Subsection	Purpose (as per CER Template)	Food Sector Relevance	Governance and Implementation Implications
Identification Parameters *Member State: ---* *Competent Authority: --* *Reporting Period: ---* *Sector/Subsector: ---*	-	Records which sector/subsector the risk info pertains to, ensuring separate reporting for each critical sector in line with the Directive's Annex.	Food supply is treated as a distinct critical sector - includes a checkbox for "Production, processing and distribution of food." Identification of the responsible ministry (e.g. Agriculture/Food) and	Requires coordination among food, safety, security, and emergency authorities to ensure that food-sector risks are assessed and reported as a dedicated critical-infrastructure area.

			reporting period ensures accountability and traceability of food sector assessments at national level.	
Section 1: Types of Risk Identified	-	Checklist of all-hazards threat categories (natural, man-made, technical/technological, and compounded risks) with examples. Multiple boxes can be ticked; space to elaborate on specific "other" risks.	Captures the full spectrum of food-system threats: e.g. natural (droughts, animal diseases), man-made (contamination, terrorism, strikes), technical (factory accidents, IT failures), etc. It forces recognition of emerging risks, including climate-related hazards or emerging technology-related vulnerabilities. By listing "Cyber risks" and "Emerging digital technologies" as risks categories, it also highlights the increasing role of cybersecurity and technology governance in agri-food resilience.	Supports an integrated resilience perspective across domains traditionally addressed separately in the food sector (food safety, food security, infrastructure protection). For example, droughts, animal disease outbreaks, cyber incidents affecting logistics software, or disinformation triggering panic buying can be assessed within a single national risk framework, improving coherence of preparedness measures and inter-authority coordination.
Section 2: Outcome of the Risk Assessment	*2.1 - Vulnerabilities & Dependencies*	Checklist of vulnerability factors: cross-sector, cross-border, and supply-chain dependencies; reliance on specific entity categories; employee/security	Reflects the highly interconnected nature of food systems, including dependence on energy and transport, on imports or single suppliers, on digital systems (e.g. refrigeration monitoring, logistic software), and on	Enables identification of critical dependencies such as reliance on imported feed, single large processing plants, refrigerated logistics, or digital inventory systems. In practice, this information is often drawn from consultations with operators and associations and can inform resilience measures such as diversification of

		shortcomings; etc., with prompts to elaborate.	concentrated production or processing assets. It highlights where technological and supply-chain innovations (such as diversification, stockpiling, IoT monitoring) are needed to reduce vulnerabilities.	suppliers, redundancy in logistics routes, or backup power for cold storage facilities. This section implies that large food companies identified as critical entities must perform their own risk assessment: for example, when a Member State fills out "vulnerabilities - supply chain dependencies" for the food sector, it likely gathered that information from industry consultations or from companies themselves (e.g. a milling company might report it depends on one rail line). Those companies can expect follow-up: competent authorities may require evidence of mitigation (like alternative suppliers or stockpiles) consistent with the identified risks. Food sector businesses, especially those using advanced technology (e.g. precision agriculture or blockchain traceability), should be prepared to demonstrate how those technologies improve resilience or, if they introduce new risks, how those are managed.
	2.2 - Potential Impact of Disruption	Checklist of possible impact areas: assesses potential economic, social, health, environmental, and security impacts of service disruption,	Highlights the systemic consequences of food-supply disruptions, including price volatility (food prices strikes, trade losses), public-health impacts (nutrition and hunger concerns), and	Supports assessment of cascading impacts, such as how disruptions in grain processing could affect food prices, animal feed availability, or trade balances. The explicit consideration of impacts extending to multiple Member States helps anticipate scenarios requiring EU-level coordination and

		including multi-country effects.	potential social instability, with explicit consideration of cross-border relevance. Includes a checkbox for disruptions affecting "*six or more Member States*", underscoring that a food crisis can quickly become a pan-European issue.	alignment with mechanisms such as the EFSCM or IPCR.
	2.3 - Impact Severity Rating	A standardised scale of disruption severity (five levels from *Relatively Insignificant* to *Severely Significant*) to summarise the overall impact magnitude.	Enables comparative assessment of the significance of food-system disruptions relative to other critical sectors, guiding prioritisation and resource allocation.	A high severity rating for the food sector may justify the designation of additional food-sector entities as critical and increased focus on resilience investments (e.g. mandatory contingency planning, stock-management measures), while lower ratings must be supported by evidence of existing mitigation capacity.
Section 3: Additional Insights Relating to the Types of Risks Identified and the Outcomes of the Risk Assessment	*3.1 - Methodology* *3.2 - Best Practices* *3.3 - Lessons*	Free-text sections to describe the risk assessment process, highlight noteworthy practices, and capture lesson learned.	Encourages reflection and information-sharing specific to food sector resilience, including use of standards, modelling tools, drills, and public-private cooperation mechanisms, reflecting sectoral complexity and perishability.	Enables Member States to document practical experiences, such as the use of ISO 22301-aligned business continuity planning, sector-specific stress-testing exercises, or early-warning systems for crop failures. Over time, this can support peer learning through CERG exchanges and inform the wider uptake of effective practices across the EU food sector.
Section 4: Complementary Information	-	Open section for contextual explanations or additional information relevant to Article 5(4) reporting.	Provides flexibility to address food-sector-specific aspects not captured elsewhere, including coordination mechanisms,	Can be used by Member State to discuss coordination with the European Food Security Crisis preparedness and response Mechanism (EFSCM) or to note how food safety regulator frameworks were integrated into the

			sensitive data references, or links to complementary frameworks.	resilience assessment. Any technical annexes or sensitive data (e.g. national stock levels or results from stakeholder consultations) could be referenced, potentially including technology-related analyses (e.g. digital twin modelling outputs).

Annex C National Resilience Capacities and Mitigation Strategy Template

'. Overall, the reporting template is intended to function as a cluster document supporting the formulation of the "*Strategy on the resilience of critical entities*" required of Member States under the CER Directive (Article 4).

The mitigation options are consolidated across resilience capacities by designated National Competent Authorities, ensuring internal coherence and alignment with EU objectives. This consolidation step is presented in Part C of the proposed template (ANNEX C). The resulted '*National Resilience Capacities and Mitigation Strategy Reports*' are assessed by EU Institutions to shape Union-level food-system resilience priorities, while Member States remain individually responsible for translating agreed orientations into national plans and measures complemented where necessary by additional actions addressing context-specific risks.

3.4.3.2 During-Crisis Cooperation Flow: Guidelines for Crisis Response

The cooperation flow illustrated in Figure 4 describes how public and private stakeholders interact once a food crisis unfolds, through a structured sequence of actions aimed at managing impacts, safeguarding essential food services, and stabilising food system. Building on the preparedness arrangements described in the pre-crisis phase, the during-crisis cooperation flow operationalises crisis response through coordinated processes of *situation assessment*, *decision-making*, and *resources mobilisation* under the leadership of public authorities.

The flow follows the same underlying logic as the pre-crisis phase – progressing from information inputs to collective interpretation and coordinated action – while adapting to the urgency, uncertainty, and time constraints that characterise crisis conditions. In this phase, cooperation shift from anticipatory planning to response-oriented execution, ensuring that information, decisions, and resources circulate effectively across governance levels as the crisis evolves.

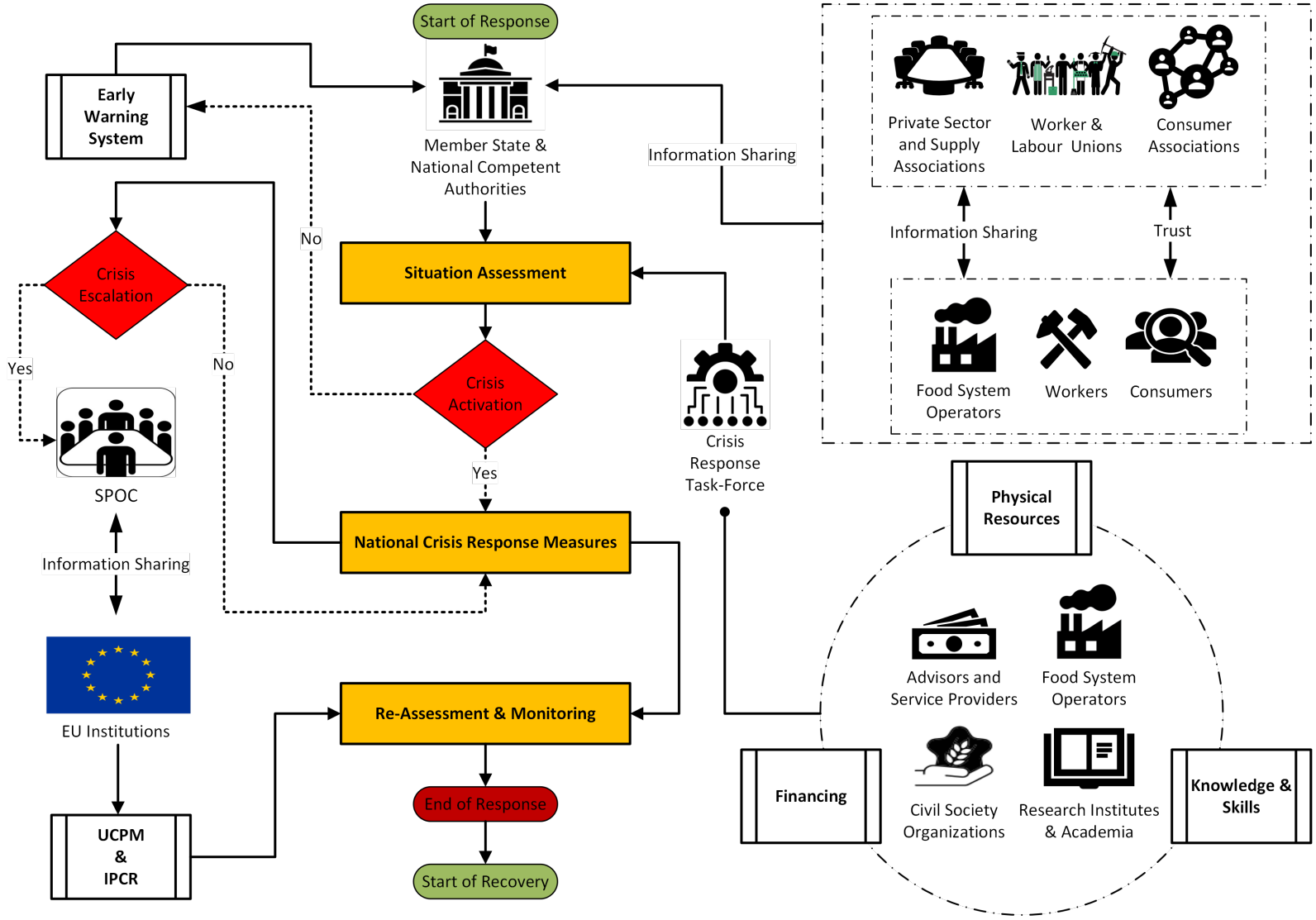


Figure 4. *Cooperation flow diagram for the during-crisis phase.*

During-Crisis Cooperation Flow: Key Processes and Decision-Making Steps

Within this during-crisis cooperation flow (Figure 4), information functions as the primary operational input that enables situation assessment, decision-making, and the mobilisation of response measures. As the crisis evolves, the effectiveness of collective action depends on the ability of actors to exchange, interpret, and act upon timely and relevant information across the governance levels. An effective information sharing during the crisis phase therefore represents a central element of the cooperation mechanism.

During a food crisis, cooperation is designed to support stakeholders by enabling clear, coordinated, and continuous information exchange across governance levels. The mechanism supports circular and iterative communication flows: early signals, operational constraints, and emerging risks move bottom-up towards decision-makers, while guidance, coordination functions, and targeted national response measures are communicated top-down to food system operators, workers, vulnerable communities, and consumers. A schematic representation of the information sharing arrangements during crisis is provided in Figure 5. By prioritising clarity of roles, structured coordination arrangements, and real-time information exchange, the mechanism addresses fragmentation of actions, unclear responsibilities, and communication gaps that would otherwise delay response measures. During an ongoing crisis, communication becomes immediate, frequent, and largely unscheduled, with an emphasis on early identification and management of emerging risks. This operational mode supports the continuity and reliability of information flows and contributes to maintaining essential food services under conditions of uncertainty and systemic stress, in line with the CER Directive (EU) 2022/2557.

Given the central role of information in crisis response, the cooperation mechanisms explicitly addresses risks related to disinformation, particularly affecting consumers who may rely on non-official channels, including social media (Muhammed T & Mathew, 2022). The information sharing framework therefore recognises the role of private sector associations in supporting trusted engagement with consumers (Dore et al., 2020) and in influencing behavioural responses during crises (Larivière et al., 2025). It also takes into account informal community-level mechanisms of self-aid and mutual aid that emerge during emergencies (Carstensen et al., 2021).

In this context, timely, transparent, and coherent information flows across governance levels are essential to enable coordinated responses under rapidly evolving risk conditions. Two-way communication and feedback mechanisms further support adaptive decision-making by enabling emerging signals and operational challenges to be communicated upward. As a result, cooperation during food crises expands into multi-stakeholder arrangements involving consumers, private sector operators, workers' representatives, and civil society organisations (CSOs). These actors contribute to shared situational awareness through contextualisation, validation, and structured reporting of crisis-related developments (Figure 5), in line with EU and Member State recommendations on transparency, trust-building, and coordinated communication, as articulated within the *European Food Security Crisis preparedness and response Mechanism* (EFSCM).

Intermediary actors - such as consumer associations, supply-chain associations, labour representatives, and CSOs - play a critical bridging role between public authorities and individual food system actors, including consumers, workers, and vulnerable communities. In performing this role, they are expected to apply internationally recognised standards related to information security, responsible information use, and awareness (e.g. ISO/IEC 27001:2022 "*Information Security Management Systems*", see Section 3.2.3.5). Their contribution helps limit exposure to misinformation and information distortion that could otherwise undermine continuity and stability of essential food services under the CER Directive. In line with EFSCM guidance, consumer associations act as trusted intermediaries by contextualising official messages, correcting misleading content, and translating complex information into clear and accessible guidance. CSOs further strengthen inclusive and accessible dissemination of verified information, particularly for vulnerable groups. Evidence from the COVID-19 pandemic highlights the role of CSO-led communication networks in reducing informational vulnerability among marginalised group (Denniss & Lindberg, 2025).

Overall, the cooperation mechanism ensures that consumers, civil society organisations, workers representatives, and private-sector associations contribute meaningfully to shared situational awareness, thereby enhancing the legitimacy, responsiveness, and effectiveness of public interventions during food crises.

Operationally, the **early-warning** mechanism supports the timely activation of response and management measures once a warning is triggered. If a crisis is detected and confirmed, Member States activate a proportionate crisis response, including initial mobilization of physical resources, financial support, and knowledge transfer where needed. In parallel, the national Single Point of Contact (SPOC) facilitates the exchange of essential information on the status of the ongoing crisis, consistent with established European and International crisis-communication arrangement (European Parliament and The Council, 2021, 2022), (UNHCR, 2025). In line with Art. 15 of CER Directive, the cooperation framework incorporates incidents notification and reporting procedures: critical entities in the production, processing and distribution of food submit an initial notification to then National Competent Authority within 24 hours after becoming aware of a significant incident (or one with the potential to significantly disrupt essential services), followed by a detailed report within one month. Where impacts extend beyond national boundaries and threaten food provision in six or more Member States, the National Competent Authority contacts the European Commission and the affected Member States through the national SPOC. In this context, critical entities may draw on recognised international standards for risk and emergency management, such as ISO 31000:2018 "*Risk Management – Guidelines*" and ISO 22301:2019 "*Business Continuity Management Systems*" (see Section 3.2.3.5).

Within this framework, during-crisis cooperation pivots on two closely connected operational components: (i) *situation assessment* and (ii) *national crisis response measures* with associated resources mobilization.

Situation assessment is led by National Competent Authorities (e.g. Ministries of Agriculture, Energy, Health, etc.) in consultation with a *Crisis Response Task Force*. Together, they assess impacts on food system resilience capacities (i.e., economic, social, physical and infrastructure,

etc). The specific characteristics of the food crisis scenario (e.g., affected sectors, impacted commodities, actors, geographic scope) determine the composition of the Task Force, which is convened immediately by the Member State authority. Drawing on a consolidated pool of actors from private sector operators (i.e., food system operators, input providers), advisors and service providers, civil society organizations, research institutes and academia, the Task Force provides scenario-specific expertise. The initial situation assessment informs early prioritization and supports decisions on the scale and type of resource mobilization required. Where cross-border or escalating crises occur, response coordination relies on rapid information exchange between EU institutions and affected national SPOCs, with the leading EU institution facilitating communication with Member State Authorities.

As long as national capacities remain sufficient, the National Competent Authority calibrates response efforts and mobilises resources accordingly. Pre-agreed financial instruments (i.e., disbursements, insurance premiums), physical assets (essential raw materials, equipment, human resources, and experts), and expertise are activated and deployed across cooperating stakeholders. Public and private stockpiles of staple food supplies may be released to ensure food-supply continuity and market stability, as exemplified by national stockpiling mechanisms such as those operated in Finland (National Emergency Supply Agency, 2026). Collectively, financing instruments and the mobilization of physical and knowledge resources constitute the core of the **National Crisis Response Measures**. In parallel, organizations are expected to operationalise recognized standards related to supply chain management and resilience (e.g., ISO 28002:2011 – "*Security Management Systems for the Supply Chain*", see Section 3.2.3.5). Throughout the crisis, monitoring systems remain active and updates are reported through high-frequency meetings until the end of the acute phase (Yılmaz & Gül, 2017). Meeting frequency therefore departs from the regular schedules of the pre-crisis, enabling near-real-time tracking of crisis developments and rapid collective decision-making. This setting enables Member State Authorities, together with National Competent Authorities and the Crisis Response Task Force, to conduct continuous and iterative **re-assessment** of the situation.

When national capacities are exceeded or the crisis has significant cross-borders relevance, the European Commission, may activate EU-level crisis coordination frameworks, including IPCR and Union Civil Protection Mechanism (ERCC, rescEU), assuming formal leadership in accordance with the Council Recommendation on "coordinate a response at Union level to disruptions of critical infrastructure with significant cross-border relevance" (The Council of The European Union, 2024). This enables escalation of response effort through the mobilisation and allocation of resources from public and private entities across Member States and, where appropriate, from the international community.

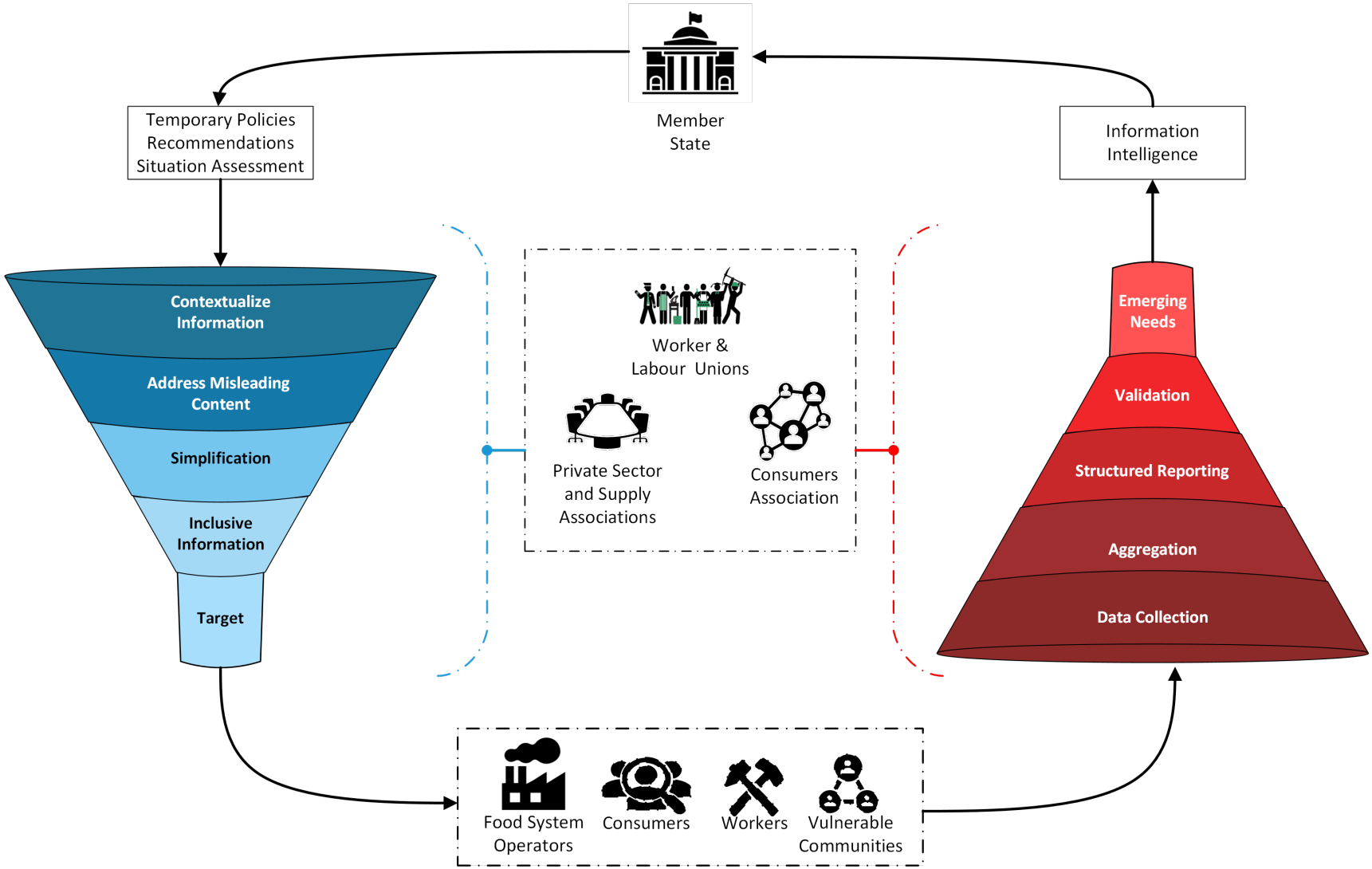


Figure 5. During-crisis information sharing framework.

4 Application of the Resilience Governance Framework in Food System Crises

This section illustrates how the Resilience Governance Framework can be applied in practice to analyse and manage food-system crises. Through a set of scenario-based applications, the Framework is used to examine how governance processes, stakeholder roles, and cooperation mechanisms function when food systems are exposed to stress. The objective is not to predict future events, but to test the relevance, coherence, and usability of the Framework across different crisis contexts and food supply chains.

4.1 Food System Crisis Scenarios – SecureFood Case-Studies

The identification of food-system crisis scenarios focused on situations in which existing governance arrangements and preparedness measures may be insufficient to address systemic disruption. Scenarios were developed using the four food supply chains analysed within the SecureFood project as primary reference points. This process was informed by a vulnerability assessment based on survey responses collected under WP2 and WP3, which provided insight into sector-specific exposure to risks and interdependencies.

In addition, feedback from project partners' demonstration presentations was systematically reviewed to identify critical challenges specific to each supply chain. To ensure coherence across the project, the selected scenarios were aligned with those developed under WP6. Where supply chains were exposed to similar external stressors, scenarios were consolidated into a single analytical case. While WP6 initially identified six scenarios, this consolidation resulted in five food-system crisis scenarios reflecting the most significant vulnerabilities observed across the project. The scenarios used to apply and test the Resilience Governance Framework are:

- Water pollution affecting the aquaculture supply chain in Greece;
- Prolonged drought and heatwaves affecting the fruits supply chain in Portugal;
- Prolonged drought and heatwaves affecting milk and dairy supply chain in Finland;
- Increases in energy and fertilizer prices affecting the grain supply chain in Ukraine;
- Geopolitical conflict affecting the grain supply chain in Ukraine.

Each scenario is therefore defined by the interaction between an external stressor and a specific supply chain under investigation. These supply chains rely on primary production activities, which are inherently exposed to environmental external stressors. Their dependence on natural capital and ecosystem services such as water availability and quality, soil fertility, and climatic conditions increases exposure to environmental degradation and climate-related hazards. External stressors affecting natural resources can therefore propagate along the supply chains, amplifying risks not only for production but also for processing, distribution, and marketing activities. At the same time, the analysed supply chains are also exposed to human and economy-induced stressors, including geopolitical instability, market volatility, and input price shocks. These stressors contribute to compound and cascading food security risks, underscoring the need for governance mechanisms that address resilience-building strategies in an integrated manner.

In the subsequent sections, each scenario is analysed to explore its implications for governance during food system crises and to demonstrate the application of the Resilience Governance Framework on situation assessment, decision-making and coordinated actions, both at national and EU level.

4.1.1 Water Pollution Affecting the Aquaculture and Fish Supply Chain

Aquaculture represent a significant component of the EU food system, contributing to food availability, nutrition, and employment. In 2023, aquaculture production in the EU amounted to approximately 1.1 million tonnes, with an estimated value of EUR 4.8 billion (Eurostat, 2025d). Production is geographically concentrated in a limited number of Member States, with Spain, France, Greece and Italy jointly accounting for more than two-thirds of total EU aquaculture output by volume. Greece, in particular, plays a central role in EU marine aquaculture, especially in the production of sea bass and sea bream. Capture fisheries also remain an important source of seafood supply at EU level. In 2024, fish landings generated an estimated EUR 5.5 billion in value, with total catches of around 3.2 million tonnes (*Eurostat*, 2025d), mostly made in the north-east Atlantic area (DG for Maritime Affairs and Fisheries (European Commission), 2025). In addition to domestic production, EU is a major participant in global seafood markets. It is the second largest global traders of fishery and aquaculture products in value terms and, at the same time, a net importer, reflecting structural supply–demand imbalances. Imports therefore play a key role in ensuring the availability and diversity of seafood products for EU consumers. These products are an important source of high-quality protein and contribute to balanced and healthy diets. Average seafood consumption in the EU amounts to 23.7 kg per capita per year (live weight equivalent), which is approximately 3 kg higher than the global average (DG for Maritime Affairs and Fisheries (European Commission), 2025).
While these figures illustrate the broader importance of seafood systems, the application of the Resilience Governance Framework is this scenario focuses specifically on aquaculture, rather than on fisheries. This analytical choice reflects the strong dependence of aquaculture operations on local water quality conditions, infrastructure, and regulatory decisions, making them particularly suitable for testing governance arrangements related to environmental stressors, crisis response, and public–private cooperation at national level.

The aquaculture supply chain constitutes a complex network extending from primary producers (fish farmers) through processors, distributors (including cold-chain logistics), retailers, and ultimately to consumers. It relies on a range of supporting services, including feed manufacturers, veterinary and health services, monitoring authorities, and organisations responsible for food safety, traceability, and sustainability assurance. A schematic representation of the core aquaculture supply chain and its key interdependencies is provided in Figure 6.

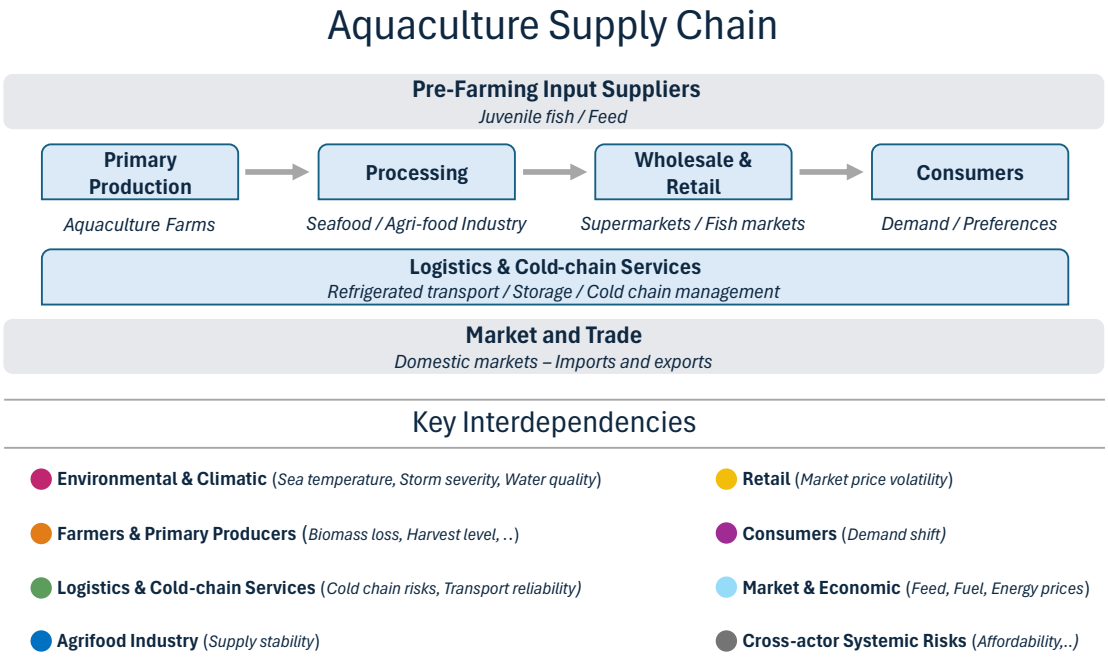


Figure 6. Schematic overview of the core aquaculture supply chain and its main sequence of activities. The lower part of the figure highlights key interdependencies and systemic risk factors that may become critical in the event of disruptions—such as water pollution—and that can trigger cascading effects across the system. For a detailed analysis of these interdependencies, see SecureFood Deliverable D3.2.

While economically significant, aquaculture systems are highly vulnerable to disruptions, in particular those related to the degradation of natural capital and ecosystem services (Brink et al., 2011). Water pollution arising from agricultural runoff, industrial effluents, urban wastewater discharges, or accidental contamination events can rapidly degrade water quality in freshwater and marine environments, directly affecting fish health, growth rates, and survival. Such events may trigger disease outbreaks, mass mortalities, contamination of aquaculture products, and precautionary closures of r aquaculture facilities by competent authorities. These impacts can propagate along the supply chain while also undermining food safety, consumer confidence, and international trade flows.

Several incidents in Europe over recent years have exemplified these vulnerabilities. The 2002 Prestige oil spill off the coast of Galicia, Spain, contaminated approximately 2,300 km of Atlantic coastline, causing mass mortality of marine life and seabirds. The spill led to a six-month fishery closure and a sharp decline in Galician seafood exports, resulting in an estimated EUR 76 million loss for the regional fishing sector (Surís-Regueiro et al., 2007). The recovery plan issued by the Spanish government to face this disaster amounted to EUR 12.5 billion (WWF European Policy Office, 2003). More recently, in 2022, the Oder River ecological disaster, caused by industrial saline wastewater discharges, triggered a toxic algal bloom that affected around 300 km of river across Poland and Germany (European Commission, 2023). Fishing activities were halted, leaving processors and distributors without supply.

Although these examples illustrate large-scale events, it should be noted that far smaller disruptions can severely affect local supply chains. If water pollution continues to worsen due to mismanagement and other compounding factors, such events are likely to become routine rather than exceptional. When water pollution occurs, it can simultaneously affect multiple pillars of food security. Table 11 summarises how water pollution in an aquaculture and fish supply chain impacts the six pillars of food security.

Table 11. Impacts of water pollution on the six pillars of food security in the context of aquaculture and fish supply chain.

Food Security Pillar	Impact of Water Pollution on Aquaculture and Fish Supply Chain
Availability	Fish production including catches drop due to disease outbreaks or mass mortality in polluted waters, reducing food availability.
Access	Market supply shortages and fishery closures lead to higher prices and reduced access to affordable fish, especially for communities relying on local catch. More imported supply may be needed to fill the gap.
Utilization	Food safety and nutrition are compromised as contaminated fish (with toxins or pathogens) are unfit for consumption, undermining dietary quality and consumer trust. Public health warnings or bans may be issued to prevent unsafe fish from reaching plates.
Stability	The shock may cause volatility in supply and incomes: short-term disruption can further cascade into longer-term shortages and livelihood crises.
Sustainability	Ecosystem damage from pollution (e.g. habitat destruction, loss of biodiversity) undermines the long-term productive capacity of the aquaculture system. Fisheries and farms may take years to recover, leading to persisting uncertainties.
Agency	Small-scale farmers, fishers, and local communities lose autonomy as external contamination forces them out of operation. Without a voice in upstream pollution control, they depend on government and broader society to resolve the crisis.

4.1.1.1 Application of the Resilience Governance Framework – Water Pollution in Greece

Water pollution represents an increasingly significant risk to Greek agrifood, fisheries, and aquaculture systems. Aquaculture occupies a strategically important position in the Greek food system and rural and coastal economies. Greece is the leading European producer of sea bream, and aquaculture production is overwhelmingly marine-based, with 98% of output originating from coastal and island farming systems (EUFOMA, 2026). In 2023, total aquaculture production reached nearly 154,000 tonnes, with a total value of EUR 774.8 million (Hellenic Aquaculture Producers Organisation, 2024). The sector supports significant employment, with more than 4 000 workers (Hellenic Statistical Authority, 2023). These

figures highlight both the economic relevance of aquaculture and its centrality to national food security and regional development. (EUFOMA, 2026). In 2023, total aquaculture production reached nearly 154,000 tonnes, with a total value of EUR 774.8 million (Hellenic Aquaculture Producers Organisation, 2024). The sector supports significant employment, with more than 4 000 workers recorded in the latest national survey conducted in 2022 (Hellenic Statistical Authority, 2023). These figures highlight both the economic relevance of aquaculture and its centrality to national food security and regional development. (EUFOMA, 2026). In 2023, total aquaculture production reached nearly 154,000 tonnes, with a total value of EUR 774.8 million (Hellenic Aquaculture Producers Organisation, 2024). The sector supports significant employment, with more than 4 000 workers (Hellenic Statistical Authority, 2023). These figures highlight both the economic relevance of aquaculture and its centrality to national food security and regional development. (EUFOMA, 2026). In 2023, total aquaculture production reached nearly 154,000 tonnes, with a total value of EUR 774.8 million (Hellenic Aquaculture Producers Organisation, 2024). The sector supports significant employment, with more than 4 000 workers recorded in the latest national survey conducted in 2022 (Hellenic Statistical Authority, 2023). These figures highlight both the economic relevance of aquaculture and its centrality to national food security and regional development.

Meanwhile, Marine spatial planning policies are currently under discussion at the national level (Ministry of Rural Development and Food, 2022), underscoring growing needs regarding the environmental and spatial sustainability of aquaculture. As regulatory frameworks expand and climate-related pressures intensify, aquaculture operators are increasingly required to manage regulatory compliance, adopt innovation, and address environmental risks in crisis-prone production environments (Hellenic Aquaculture Producers Organisation, 2024). The response to such challenges is embedded within the broader Greece's CAP National Strategic Plan (2023–2027), led by the Ministry of Rural Development and Food, which prioritizes sustainable agriculture, climate resilience, biodiversity protection, and long-term food security through interventions in rural development, direct payments, and market support. A central strategic objective is to strengthen cooperation among farmers, producer groups, and other actors, including researchers, to promote innovation adoption and knowledge. During recent crises, such as COVID-19, CAP direct payments proved fundamental in supporting agrifood micro-enterprises. However, persistent financing needs —especially for working capital and machinery— continue to require complementary public–private instruments (European Commission & European Investment Bank, 2020). Furthermore, under the National Recovery and Resilience Plan 'Greece 2.0', initiatives targeting the Greek Civil Protection, further strengthens crisis communication, early warning systems, and inter-institutional coordination for effective crisis and emergency management through public co-financed expenditures to renovate current systems (Hellenic Republic, Ministry of National Economy and Finance, 2024).

Table 12 represents the application of the Resilience Governance Framework, building on the during-crisis cooperation flow illustrated in Figure 4, identifying stakeholders involved, their responsibilities and the flow of actions.

Table 12. Application of the Resilience Governance Framework affecting the aquaculture supply chain in Greece, triggered by water pollution.

During-crisis component	Stakeholders	Responsibilities	Flow of Actions
Early warning system and situation assessment	General Secretariat for the Protection of Critical Entities of the Ministry of Citizen Protection (Member State Public Authority)	• Provide coordination of the initial situation assessment. • Ensure sector-specific focus by contacting the relevant National Competent Authorities.	1. The General Secretariat receives warning notification on increasing water pollution levels along the coastal areas of the Rhodes Islands. 2. The General Secretariat activates the early warning protocol by convening the *ad hoc* Crisis Response Task Force and starting coordination for the initial situation assessment.
	Ministry of Rural Development and Food of Greece (National Competent Authority)	• Validate incident notifications. • Collaborate with the ad hoc Crisis Response Task Force. • Lead technical assessment.	3. The Ministry responds to the notification by joining the *ad hoc* Crisis Response Task Force and providing technical inputs to develop the first structured situation assessment.
	Crisis Response Task Force: aquaculture operators (food system operators), marine and environmental research institutes, Advisors and Service Providers, CSOs	• Detect and report water pollution incidents in the impacted area. • Provide immediate operational judgment.	4.Cross-check water quality data and contact impacted food system operators. 5.Confirm abnormal water parameters at cage sites. 6. The leading Member State Public Authority (The General Secretariat) decide to activate crisis response.

National crisis response measures	Ministry of Climate Crisis and Civil Protection, Ministry of Rural Development and Food of Greece (National Competent Authorities)	• Lead national crisis response operations. • Calibrate mobilisation of all resources. • Maintain monitoring.	7. National Competent Authorities formally activate national crisis response, unlock emergency resources, deploy inspectors to affected farms, and organise high-frequency coordination meetings.
	Crisis Response Task Force	• Provide sector-specific technical, operational input on the resources sharing mechanism.	8. The Task Force operationalizes support to the impacted stakeholders and resources are mobilized accordingly.
Re-assessment & Monitoring	Crisis Response Task Force and National Competent Authorities	• Convene in frequent meetings for briefing on the crisis development.	9. After continuous monitoring, during the last situation re-assessment, it is decided upon the request for EU intervention.
	Private sector and supply associations, Worker and labour Unions, Consumer associations	• Maintain a "two-ways" crisis communication channel to convey trustworthy information to their members. • Collect and provide actionable intelligence to Member State Authority for monitoring the public situation.	10. Small aquaculture farms impacted experience operational and financial disruptions, reduced production, market access barriers, cash-flow constraints. 11. Aquaculture workers need re-assurance on their job security during crisis in case of prolonged shut-down of the business activities. 12. Addressing consumer complaints about food safety concerns related to fish products.

Crisis escalation (EU-level cooperation, if applicable)	General Secretariat for the Protection of Critical Entities of the Ministry of Citizen Protection and National Competent Authorities	• Assess sufficiency of national capacity. • Contact EU institutions.	13. The SPOC transmits updated reports to the European Commission and schedules regular information exchanges. SPOC states that crisis is deemed to be escalated, since national capacities are overwhelmed.
	European Commission (EU institution)	• Activate EU-level crisis coordination frameworks (i.e., UCPM, IPCR).	14. Upon notification, the Commission escalate the response effort, via activation of current European framework for response, in particular expertise on aquaculture and environmental pollution are mobilized from EU agencies and other countries scientific institutes.

4.1.2 Prolonged Drought and Heatwaves Affecting the Fruit and Vegetables Supply Chain

The EU is one of the world's leading producers of fruit and vegetables. In 2023, the EU harvested around 59.8 million tonnes of vegetables (including pulses) and 41.2 million tonnes of fruit and nuts (excluding grapes) (European Commission, 2024). This combined output had an estimated value of EUR 68 billion, representing 12.6% of the total value of EU agricultural production. In 2024, vegetables production increased to 63.8 million tonnes, while fruit production remained stable at a comparable level (DG for Agriculture and Rural Development (European Commission), 2025b). From a trade perspective, the EU is a net importer of fruit, with an annual deficit of around 10 million tonnes, while it remains a net exporter of vegetables, with a surplus of about 1 million tonnes (DG for Agriculture and Rural Development (European Commission), 2025b).

Around 2.2 million farms are dedicated to primary production of fruit and vegetables in the EU, the majority of which are family farms, where at least 50% of labour is provided by family members (Eurostat, 2025b). After harvest, fruit and vegetables are typically transported to packing houses or processing facilities, such as plants producing canned, frozen, or dried products. Given their high perishability, efficient logistics and cold-chain systems are essential to maintain food quality and reduce losses. Products then move through wholesale and retail channels (including supermarkets and local markets) before reaching consumers. Fruit and vegetables are central to healthy diets, providing essential vitamins, minerals, and dietary fibre.

However, according to the latest available data (DG for Agriculture and Rural Development (European Commission), 2025c), average consumption in the EU is about 350 g per person per day, which remains below the recommendation of 400 g/day by the World Health Organization, indicating room to improve dietary patterns.

The supply chain is supported by a range of input and service providers, including seed and plant nurseries, irrigation and water management services, fertilizer and agro-chemical suppliers, agricultural advisory services, and insurance services. Together, these actors contribute to the productivity, resilience, and sustainability of the fruit and vegetables sector. Figure 7 provides a general representation of the fruit supply chain.

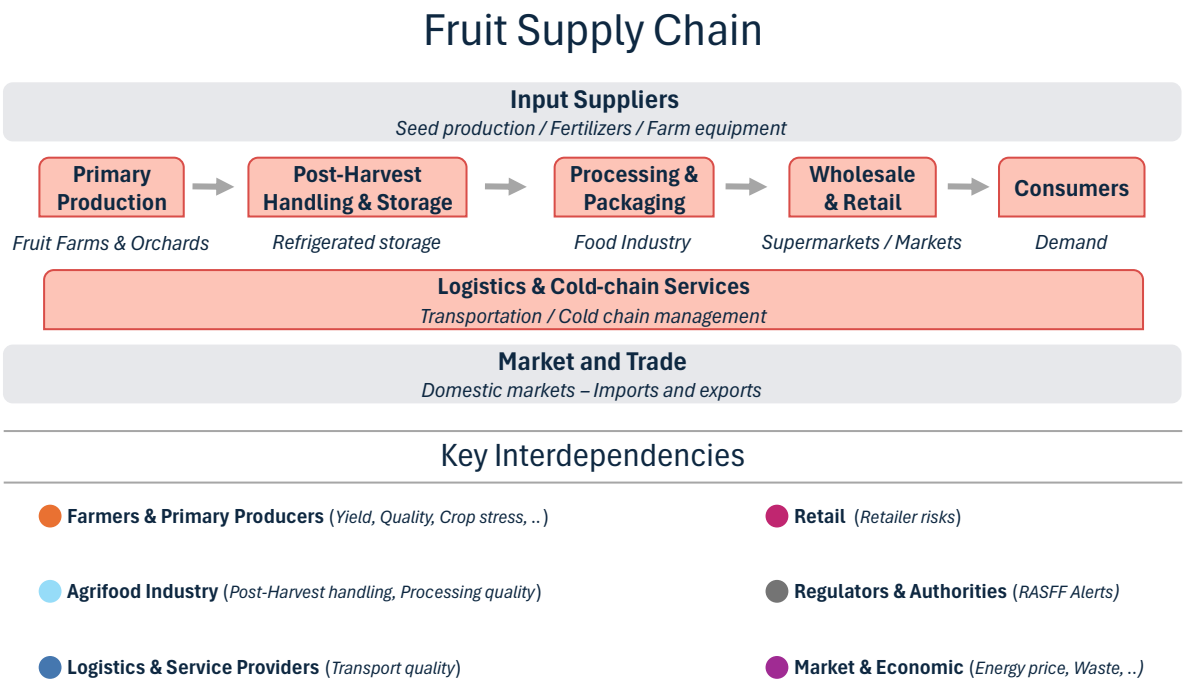


Figure 7. Schematic overview of the core fruit supply chain and its main sequence of activities. The lower part of the figure highlights key interdependencies and systemic risk factors that may become critical in the event of disruptions—such as extreme weather events—and that can trigger cascading effects across the system. For a detailed analysis of these interdependencies, see SecureFood Deliverable D3.2.

As with all primary production activities, this supply chain is highly dependent on natural capital and is therefore particularly vulnerable to environmental stressors, most notably climatic extremes. Prolonged droughts and heatwaves represent the major threats to agricultural production across Europe. Insufficient rainfall and extreme temperatures degrade growing conditions in fields and orchards, exposing crops to water scarcity and heat stress that impair plant growth and fruit set. As a result, yields can decline sharply, and in severe cases entire harvests may be lost or fields left fallow. Hot and dry conditions can also trigger secondary impacts. Stressed crops become more susceptible to pests and plant diseases, while the risk of wildfire increases, threatening cropland and infrastructure. In addition, water scarcity can lead competent authorities to impose irrigation restrictions or bans to prioritize essential uses, further limiting farmers' ability to protect crops.

Recent events in Europe illustrate these vulnerabilities. In 2017, a severe drought and heatwave affected large parts of Italy, with rainfall around 80% below average and exceptionally high temperatures. Approximately two-thirds of Italian farmland was impacted, with major losses in fruit, vegetable, tomato, and olive production. Many orchards and fields were severely damaged, resulting in estimated losses of around EUR 2 billion for the agricultural sector (Rossi et al., 2023). Emergency measures were implemented in several regions, and EU support was requested. More recently, the Europe-wide drought of 2022, one of the most severe in decades, affected multiple countries simultaneously. By mid-2022, nearly half of EU territory was exposed to drought risk, and major rivers such as the Po and the Rhine reached historically low levels. In several production areas, fruit and vegetable yields fell by up to 50% (European Association of Fruit and Vegetable Processors, 2022). Horticultural regions in Spain, Italy, France, and Hungary were particularly affected, with significant losses in summer fruits such as peaches, apricots, and melons. Northern European countries, including Belgium, the Netherlands, and Poland, also experienced drought-related damage (European Association of Fruit and Vegetable Processors, 2022). Compounding this, many farmers across Europe were unable to irrigate water-intensive crops such as carrots, spinach, and peas due to water-use restrictions (Biella et al., 2025). In some regions, extreme heat meant that irrigation itself risked damaging crops, as water applied to heat-stressed plants caused leaf burn. Finally, it is important to note that during 2022 reduced rainfall negatively impacted not only EU agriculture. Indeed, the energy sector was also affected as reduced hydropower generation due to low river flows contributed to a decline in countries' energy reserve levels. These levels fell by around 52% in Portugal, 47% in Serbia, 29% in Spain, and 25% in Italy, compared to the same period (January-June) of the previous year (Toreti et al., 2022). With climate change, such extreme events are expected to become more frequent and intense, increasing the likelihood of cascading impacts across sectors.

When extreme weather events like drought and heatwaves occur, they can simultaneously affect multiple pillars of food security. Table 13 illustrates how drought and heatwaves in the fruit and vegetables supply chain impact the six pillars of food security, highlighting the challenges that a resilience governance approach must address.

Table 13. Impacts of prolonged drought and heatwaves on the six pillars of food security in the context of fruit and vegetables supply chain.

Food Security Pillar	Impact of Drought and Heatwaves on Fruit & Vegetables Supply Chain
Availability	Crop production declines due to widespread water stress, reduced yields, or outright crop failure. Domestic availability of fruit and vegetables is reduced.
Access	Supply shortages increase market prices, reducing economic access to fresh produce, particularly for low-income households. Shortfalls may necessitate increased imports, further amplifying price pressures.
Utilization	Diet quality and nutritional outcomes may decrease as fresh produce becomes scarcer or of lower quality. Reduced variety and quantity

	can undermine micronutrient intake, while heat-stressed produce may spoil faster or have lower nutrient density.
Stability	Extreme events cause immediate supply shocks, while repeated events or long recovery periods (e.g. replanting orchards) contribute to long-term instability. Farmers face income losses, and recurrent climate shocks undermine year-to-year supply reliability.
Sustainability	Severe droughts degrade soil health through erosion and loss of organic matter and deplete surface and groundwater resources. Heat stress can kill perennial crops and reduce long-term productive capacity, requiring years for recovery.
Agency	Farmers and local communities may lose decision-making autonomy under climate stress, particularly where water allocation is externally imposed. Small-scale producers are especially vulnerable and may become dependent on public support.

Accordingly, the interaction between the fruit & vegetables supply chain and drought and heatwaves serves as an appropriate crisis scenario for applying the during-crisis cooperation mechanism within the Resilience Governance Framework.

4.1.2.1 Application of the Resilience Governance Framework – Prolonged Droughts and Heatwaves in Portugal

Portugal is increasingly exposed to prolonged droughts and heatwaves, intensifying risks across agri-food supply chains, particularly in the climate-sensitive fruit & vegetables sector. Within this context, orange production represents a key component of the Portuguese agri-food system. According to Our World in Data *(Global Change Data Lab, 2025b)*, Portuguese orange exports reached approximately 170,000–190,000 tonnes between 2020 and 2023, highlighting both the sector's economic relevance and its exposure to climate-related supply disruptions.

In the event of a crisis affecting the orange supply chain in Portugal, response activities fall under the authority of the Ministry of Home Affairs, with the National Emergency and Civil Protection Authority coordinating protection and relief operations on mainland. National response capacity is further strengthened through the 'ID CRISIS' project, led by the Economic and Food Safety Authority, which focuses on preparedness, capacity building, technological reinforcement of food control systems, and enhanced emergency response capabilities. This crisis response architecture is complemented by institutional and policy frameworks aimed at strengthening longer-term food and nutritional security. The National Council for Food and Nutritional Security provides a multi-sectoral and inter-ministerial platform coordinating policies on food access, nutrition, and sustainability in collaboration with civil society. Further support is provided by the National Strategy and Action Plan to Combat Food Waste, coordinated by the National Commission, while structural resilience is reinforced through the National Agricultural Reserve, which safeguards land suitable for agricultural production. Monitoring instruments such as the Portuguese Food Balance Sheet, produced by the National Institute of Statistics, support assessments of food availability and stability, while national risk

assessment remains the responsibility of National Authority for Emergency and Civil Protection.
Table 14 represents the Resilience Governance Framework application, building on the during-crisis cooperation flow illustrated in Figure 4, identifying stakeholders involved, their responsibilities and the flow of actions.

Table 14. Application of the Resilience Governance Framework affecting the fruit & vegetables supply chain in Portugal, triggered by prolonged droughts and heatwaves.

During-crisis component	Stakeholders	Responsibilities	Flow of Actions
Early warning system and situation assessment	Instituto Português do Mar e da Atmosfera (Public Istitution)	• Monitor climatic conditions. • Issue early warnings on drought and heatwaves.	1. Instituto Português do Mar e da Atmosfera issues a drought and heat stress alert for southern Portugal, flagging potential risks for citrus production in the country.
	Direção-Geral de Alimentação e Veterinária (National Competent Authority)	• Lead technical assessments. • Validate notifications from critical entities.	2. Direção-Geral de Alimentação e Veterinária consolidates technical data from food and agricultural operators, validates sector-specific notifications, and coordinates technical emergency response measures with relevant authorities.
	Regional agricultural services of Algarve. (Public Authority)	• Coordinate territorial data collection. • Support field-level assessments.	3. Regional agricultural services of Algarve mobilises local agronomists to assess orchard conditions and transmits standardised reports to Direção-Geral de Alimentação e Veterinária.
National crisis response measures	Ministério da Agricultura e Alimentação (Public Authority)	• Formally activate national response measures. • Provide strategic direction and inter-ministerial coordination.	4. Following confirmation of the crisis phase, the Ministry activates national drought response measures for the orange sector and coordinates

			alignment with water and environmental authorities.
	Direção-Geral de Alimentação e Veterinária (National Competent Authority)	• Lead technical coordination of animal and plant health response measures. • Maintain continuous situational updates. • Issue technical guidance to food system operators.	5. Direção-Geral de Alimentação e Veterinária establishes a technical situation reporting mechanism, coordinates regular exchanges with sector operators within its mandate, and disseminates updated technical guidance on sanitary and phytosanitary response measures.
	Ad hoc Crisis Response Task Force: growers, irrigation advisors, agronomic researchers, packers/distributors, insurance providers	• Support operational coordination. • Consolidate sector-specific response measures.	6. The Task Force meets with high frequency to review incoming field data, align adaptive measures (e.g. irrigation prioritisation, harvesting adjustments), and submit consolidated recommendations to Direção-Geral de Alimentação e Veterinária.
Re-assessment & Monitoring	Crisis Response Taskforce and National Competent Authorities	• Convene in frequent meetings for briefing on the crisis development.	7. After continuous monitoring, during the last situation re-assessment, it is decided upon the request for EU intervention.
	Private sector and supply associations; Worker and labour Unions; Consumer associations	• Provide ongoing feedback on market conditions, labour impacts, and consumer effects. • Monitor effectiveness of response measures across the supply chain. • Identify emerging secondary impacts and signal need for adjustment.	8. Supply associations monitor supply chain and price dynamics; labour Unions report on workforce availability and conditions; consumer associations track availability and price trends. Consolidated feedback is transmitted to Direção-Geral de Alimentação e Veterinária to support continuous

			re-assessment and adjustment of measures.
Crisis escalation (EU-level coordination, if applicable)	Ministério da Agricultura e Alimentação (Public Authority)	• Assess the adequacy of national response capacity. • Authorise escalation to EU-level coordination when national measures are insufficient.	9. Following evidence that impacts on orange production exceed national mitigation capacity; the Ministry authorises escalation and mandates Direção-Geral de Alimentação e Veterinária to initiate EU-level coordination.
	Direção-Geral de Alimentação e Veterinária (National Competent Authority)	• Provide consolidated technical assessment. • Prepare and validate escalation request documentation.	10. Direção-Geral de Alimentação e Veterinária consolidates updated production, market and risk data and prepares a formal escalation dossier for transmission to EU institutions.
	Centro Nacional de Cibersegurança (SPOC)	• Serve as the formal interface with EU institutions. • Ensure structured and consistent information exchange.	11. The SPOC transmits the validated escalation request to the European Commission and schedules regular coordination exchanges. Mobilisation of EU experts follow.

4.1.3 Prolonged Drought and Heatwaves affecting the Milk and Dairy Supply Chain

Milk and dairy products represent one of the defining features of the European Union's cultural heritage and food excellence. In 2024, EU farms produced 161.8 million tonnes of raw milk (mostly cows' milk), making the EU the world's largest milk producer (Eurostat, 2025c). Around 70% of this milk was processed into dairy products in the same year, with dairy produce including 10–11 million tonnes of cheese and 2.3 million tonnes of butter (Eurostat, 2025c). The EU boasts a rich tradition of cheeses and dairy specialties. In fact, over 300 cheeses and other dairy products are registered under Protected Designation of Origin and Protected Geographical Indication schemes, from Parmigiano Reggiano to Roquefort, underscoring the continent's diversity of historically rooted craftsmanship (European Commission, 2026; European Dairy Association (EDA), 2024a). These products are not only embedded in culinary culture and regional identities but are also economically significant. In market terms, the dairy sector is one of the EU's highest-value agri-food industries. Recent estimates place the value of the EU dairy market at around EUR 171 billion in 2025 (or $204 billion) (Mordor Intelligence

Inc, 2026), with dairy products contributing EUR 18 billion to the EU's trade surplus (European Dairy Association (EDA), 2024b).

The milk and dairy supply chain spans from primary production to final consumption, supported at each stage by specialized services. Approximately 20 million dairy cows were kept in the EU in 2023 (DG for Agriculture and Rural Development (European Commission), 2025a) across 530,000 dairy farms (DG for Agriculture and Rural Development (European Commission), 2025d). Milk production is geographically widespread, as all EU Member States produce milk; however, Germany alone accounts for around 22% of total EU output (DG for Agriculture and Rural Development (European Commission), 2026b). Together with France, the Netherlands, Italy, and Poland, these countries produce around two-thirds of all EU milk (DG for Agriculture and Rural Development (European Commission), 2024). Once milk is collected (typically daily) via insulated milk tankers, it enters the processing stage. The EU has an extensive dairy processing industry, comprising around 12,000 processing facilities (FoodDrinkEurope, 2023) which transform raw milk into a wide range of products. Many processors are organized as cooperatives, handling a large share of milk collection and processing, thereby leveraging economies of scale while ensuring farmer participation. This stage also depends on a robust cold chain to maintain product quality and food safety from the point of milking through to distribution. After processing, dairy products (and milk intended for direct consumption) move through distribution and retail networks, with refrigerated transport supplying wholesalers, supermarkets, local retailers, and food service providers. Per capita dairy consumption in Europe is among the highest in the world: the average milk supply per person is more than twice the global average (FAOSTAT, 2026), reflecting dairy's central role in European diets. The supply chain is supported by upstream and downstream inputs and services, including feed production (e.g. silage maize, hay, alfalfa, compound feeds and supplements), veterinary and breeding services, water supply and irrigation, specialized equipment manufacturing (such as milking systems and cooling tanks), waste management and by-product utilization, quality assurance and food safety testing, and increasingly, e-groceries and home-delivery platforms. Figure 8 provides a general representation of the milk and dairy supply chain.

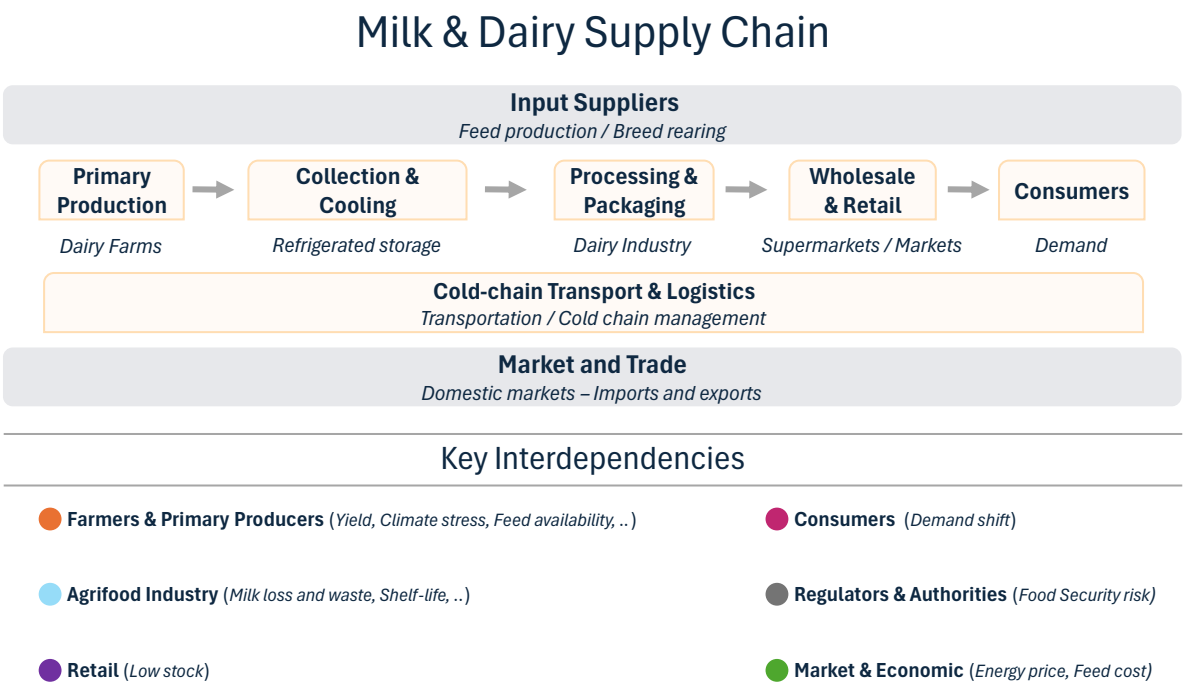


Figure 8. Schematic overview of the core milk & dairy supply chain and its main sequence of activities. The lower part of the figure highlights key interdependencies and systemic risk factors that may become critical in the event of disruptions—such as extreme weather events—and that can trigger cascading effects across the system. For a detailed analysis of these interdependencies, see SecureFood Deliverable D3.2.

As with the fruit & vegetables supply chain (see Section 0), the milk and dairy supply chain is exposed to climate extremes. Dairy production relies not only on livestock but also on the cultivation of feed crops, making it vulnerable to prolonged droughts and heatwaves. These extremes pose a dual threat: they directly impair cattle health and productivity, while simultaneously degrading the availability and quality of feed and water resources.

Dairy cows are highly sensitive to heat. During heatwaves, they experience physiological stress that reduces feed intake (i.e., dry matter intake) and milk yield, with observed losses slightly below 20% (Chen et al., 2024). Heat stress also lowers milk protein content, affecting both its nutritional and economic value (Chen et al., 2024; Hayes, 2020). Concurrently, droughts impact pasture growth and fodder crop yields. These disruptions have already materialized in recent years. In 2018, parts of Northern and Central Europe experienced such severe drought that grass growth collapsed in many regions, with farmers in several countries unable to take even a second cut of hay or silage, leading to a critical shortage of fodder (European Milk Board, 2018; O'Donovan, 2020). Feed grain harvests, including maize, dropped by up to 50% in some regions, forcing farmers to purchase expensive supplemental feed or reduce herd sizes (Reuters, 2018).

These primary impacts can propagate through the supply chain. In 2022, the pan-European drought and heatwave, also discussed in Section 0, scorched pastures, dried up water sources, and forced the suspension of PDO-certified Salers cheese production in France due to the

unavailability of fresh pasture (TIME, 2022). EU-wide milk production stagnated, marking a rare halt in growth after a decade of steady increases. In addition, food safety and quality also become concerns under extreme heat: elevated temperatures accelerate bacterial growth in raw milk and dairy products if any cold-chain failure occurs, while drought-related dust or contaminant exposure may contribute to milk quality issues as linked to increasing somatic cell counts.

Regarding food security, prolonged droughts and heatwaves can affect all six of its pillars within the milk and dairy supply chain. Table 15 provides an overview of these impacts.

Table 15. Impacts of drought and heatwaves on the six pillars of food security in the context of the milk & dairy supply chain.

Food Security Pillar	Impact of Drought and Heatwaves on Milk & Dairy Supply Chain
Availability	Milk output falls or stagnates under heat and drought pressure. Heatwaves cause physiological heat stress in dairy cows, reducing dry matter intake and, in turn, milk yield. In parallel, drought reduces pasture growth and fodder crop yields, tightening feed availability. In severe cases, local milk supply collapse in affected areas.
Access	Market supply shortages lead to higher prices for milk and dairy products, making them less affordable for consumers. Low-income households struggle as fresh milk, butter, and cheese become more costly. If domestic output falls, more imports (e.g. milk powder) may be needed to meet demand, which can further amplify price pressures and put dairy access at risk.
Utilization	Nutrition and food safety are compromised. Reduced availability or affordability of milk and dairy products can worsen dietary quality, especially for groups like children or the elderly. Heat-related spoilage and quality issues of products may also arise.
Stability	Besides high volatility in supply and farm incomes, drought and heatwaves cause immediate milk supply shocks and can trigger long-term disruptions: farmers forced to cull cows or exit dairying will not recover production quickly, leading to prolonged dips in output. Repeated or multi-year events erode confidence, as each new extreme event can compound the last, preventing full recovery. This results in an unstable year-to-year supply, with alternating surpluses and shortages.
Sustainability	Ecosystem and resource degradation undermines long-term production. Severe droughts degrade pastures (soil desiccation, lost plant cover) and deplete water tables. The damage to forage crops and soil health can take multiple seasons to heal, reducing the land's productive capacity for years. Moreover, frequent climate stress may push dairy farms out of certain areas entirely (e.g. regions becoming too arid for pasture), challenging the long-term sustainability of dairy production in those locales.

Agency	Small dairy producers lose autonomy and become dependent on external support. When drought or heatwave strikes, farmers often have little control: herd management decisions (like culling or buying feed) are forced by the crisis. Water use may be restricted by authorities, and feed must be sourced from volatile markets. Small-scale and family farmers, in particular, can be economically devastated and rely on government aid or debt to survive.

In summary, prolonged drought and heatwave events represent a critical stress-test for the milk and dairy supply chain. They threaten every aspect of the chain, from on-farm production and animal welfare to feed supply, processing continuity, and consumer prices. Crucially, such events can occur simultaneously across multiple EU Member States, creating the conditions for an EU-wide, system-level disruption. Therefore, this crisis scenario for applying the during-crisis cooperation mechanism within the Resilience Governance Framework is explored in the next section.

4.1.3.1 Application of the Resilience Governance Framework – Prolonged Droughts and Heatwaves in Finland

Finland is increasingly exposed to prolonged droughts and heatwaves, exacerbating vulnerabilities across agri-food supply chains. Milk and dairy production constitute a pillar of the Finnish agri-food system, with strategic importance further strengthened by a growing export orientation. **Prolonged droughts and heatwaves could reduce forage availability and quality, increase feed prices, and generate heat stress and water scarcity for dairy livestock, leading to uneven declines in milk quantity and quality across farms, economic strain for producers, and emerging risks of supply chain disruption.** According to FAO datasets processed by Our World in Data (Global Change Data Lab, 2025a), Finland's milk exports reached approximately 153,000–231,000 tonnes between 2020 and 2023, underscoring the sector's economic relevance and its dependence on resilient production capacity and well-functioning supply chains. In the event of a food crisis, the NESA plays a central coordinating role by reinforcing structured cross-sector cooperation and adapting operational and financial planning to ensure continuity of supply (National Emergency Supply Agency, 2026). In parallel, public authorities intensify cross-sector coordination and activate contingency measures aimed at safeguarding food security. Crisis preparedness and response are supported by established policy and information-sharing mechanisms, notably the 112 Suomi App for official emergency communication and the HVO Extranet, through which sectoral pools provide real-time situational updates to support decision-making.

As for the previous case-studies presented, Table 16 outlines the Resilience Governance Framework, building on the during-crisis cooperation flow illustrated in Figure 4, identifying the stakeholders involved, their responsibilities and flow of actions.

Table 16. Application of the Resilience Governance Framework affecting the milk and dairy supply chain in Finland, triggered by prolonged droughts and heatwaves.

During-crisis component	Stakeholders	Responsibilities	Flow of Actions
Early warning system and situation assessment	Finnish Meteorological Institute	• Monitor climatic conditions. • Issue heatwave and drought alerts.	1. Finnish Meteorological Institute issues repeated heat and drought warnings indicating increased risk for livestock production and feed availability.
	Ministry of Agriculture and Forestry (National Competent Authority)	• Provide strategic oversight. • Set sectoral priorities for assessment. • Lead technical assessment. • Validate notifications from critical entities. • Convene an ad hoc Task Force.	2. Following Finnish Meteorological Institute alerts, the Ministry instructs competent authorities to prioritise impacts on milk yield, feed supply and animal welfare. 3. The National Competent Authority validate reports from dairy operators on heat stress and feed shortages and activate an ad hoc Crisis Task Force within 24 hours.
	Ad hoc Crisis Response Task Force: farmers, feed suppliers, veterinarians, processors, researchers	• Coordinate cross-sector dairy response actions. • Agree on joint mitigation measures.	4. The Task Force exchanges real-time operational data, assesses cross-sector impacts, and agrees on coordinated mitigation actions to safeguard dairy production and animal welfare.
National crisis response measures	Ministry of Agriculture and Forestry (National Competent Authority)	• Formally activate national response measures. • Ensure strategic coordination across sectors.	5. The Ministry confirms the crisis phase and mandates intensified coordination between the authorities, the NESA and food system operators.
	NESA (Public Authority)	• Mobilise resources. • Coordinate inter-sectoral pool of resources.	6. NESA mobilises feed, energy and logistics pools, assesses resource reallocation options and activates secure information-sharing channels.

	Crisis Response Task Force.	• Coordinate sector-specific operational measures. • Consolidate field feedback.	7. The Task Force meets daily, aligns feed sourcing and heat mitigation practices, and submits consolidated recommendations to authorities and NESA.
Re-assessment & Monitoring	Crisis Response Taskforce and National Competent Authorities	• Convene in frequent meetings for briefing on the crisis development.	8. After continuous monitoring, during the last situation re-assessment, it is decided upon the request for EU intervention.
	Private sector and supply associations; Worker and labour Unions; Consumer associations	• Monitor effectiveness of response measures. • Provide feedback on market impacts, labour conditions, and consumer effects. • Identify emerging secondary risks and signal need for adjustment.	9. Supply associations track milk volumes, processing capacity, and price trends; labour unions report on workforce availability and working conditions; consumer associations monitor retail availability and price developments. Consolidated feedback is transmitted to authorities to support continuous re-assessment and adjustment of measures.
Crisis escalation (EU-level coordination, if applicable)	Ministry of Agriculture and Forestry (Public Authority)	• Assess adequacy of national response capacity. • Authorise EU-level escalation.	9. The Ministry determines that national measures are insufficient and authorises escalation to EU coordination.
	National SPOC	• Act as formal interface with EU institutions.	10. The SPOC submits consolidated documentation to the European Commission and coordinates follow-up exchanges.
	European Commission (EU Institution)	• Activate EU-level coordination and information-sharing mechanisms.	11.The Commission aligns market monitoring, facilitates information exchange and coordinates with affected Member States.

4.1.4 Increase in Energy and Fertilizer Prices Affecting the Grain Supply Chain

Note on terminology. In this case study, grain (i.e., wheat) and other cereals are treated as intrinsically linked components of the same supply system. For this reason, the terms 'grain' and 'cereals' are used as functionally equivalent. When relevant distinctions arise, the specific cereal type is explicitly stated and discussed in more detail.

The grain supply chain in Europe is large and multifaceted. Each year, fields from the Atlantic coast to the Black Sea produce around 300 million tonnes of cereals (DG for Agriculture and Rural Development (European Commission), 2026a). This equates to about half a tonne of cereals for every EU citizen annually. In some EU Member States, such as Denmark, per-capita output reaches around 1.1 tonnes per year, largely destined for animal feed and export (Danish Agriculture & Food Council, 2023; World Bank, 2026a). All 27 EU Member States grow cereals, covering tens of millions of hectares across diverse climates in an area comparable to the size of Spain. The broad geographic distribution supports a wide range of crops: common wheat, maize and barley (together about 85% of output (Eurostat, 2025a)), as well as rye, oats, rice and smaller volumes of buckwheat, millet and quinoa. This diversity reflects regional dietary patterns and provides a degree of resilience to the overall supply.

The EU cereal sector is economically significant. According to the latest data from the Eurostat, the value of EU cereal production amounted to approximately EUR 64.4 billion in 2021 (Eurostat, 2023). Countries like France, Germany and Poland dominate production, accounting for more than half of total output (France ~64 Mt, Germany ~42 Mt, Poland ~35 Mt (World Bank, 2026a)), but cereal farming is widespread, with over half of all arable land in the EU used for this production (Fertilizers Europe, 2023).

After harvest, grain moves through a structured chain involving on-farm storage, collection points, cooperatives, and commercial handlers. Grain is dried, stored, blended, and graded before moving through transport networks to processors, feed manufacturers, and export terminals. This infrastructure is essential for managing the seasonality of production and ensuring that grain can be redistributed efficiently across regions with surplus or deficit. Downstream, the processing and manufacturing stage channels cereals into a wide range of uses. Wheat is milled into flour for bread, pasta and baked goods that form part of daily diets across Europe. Barley is malted for the brewing and distilling industries. Maize, wheat and barley feed Europe's livestock systems through the production of compound feeds, which links the cereal sector directly to the supply of pork, poultry, and dairy products. Grain also supports industrial uses, including starch, bioethanol, and other bio-based products. A network of input and service providers underpins this chain: seed breeders, fertilizer manufacturers, agro-chemical suppliers, farm machinery companies, storage and logistics operators, commodity exchanges, and financial and advisory services. Through these pathways, this production contributes directly and indirectly to a substantial share of Europe's food economy and rural employment. Figure 9 provides a general representation of the grain supply chain.

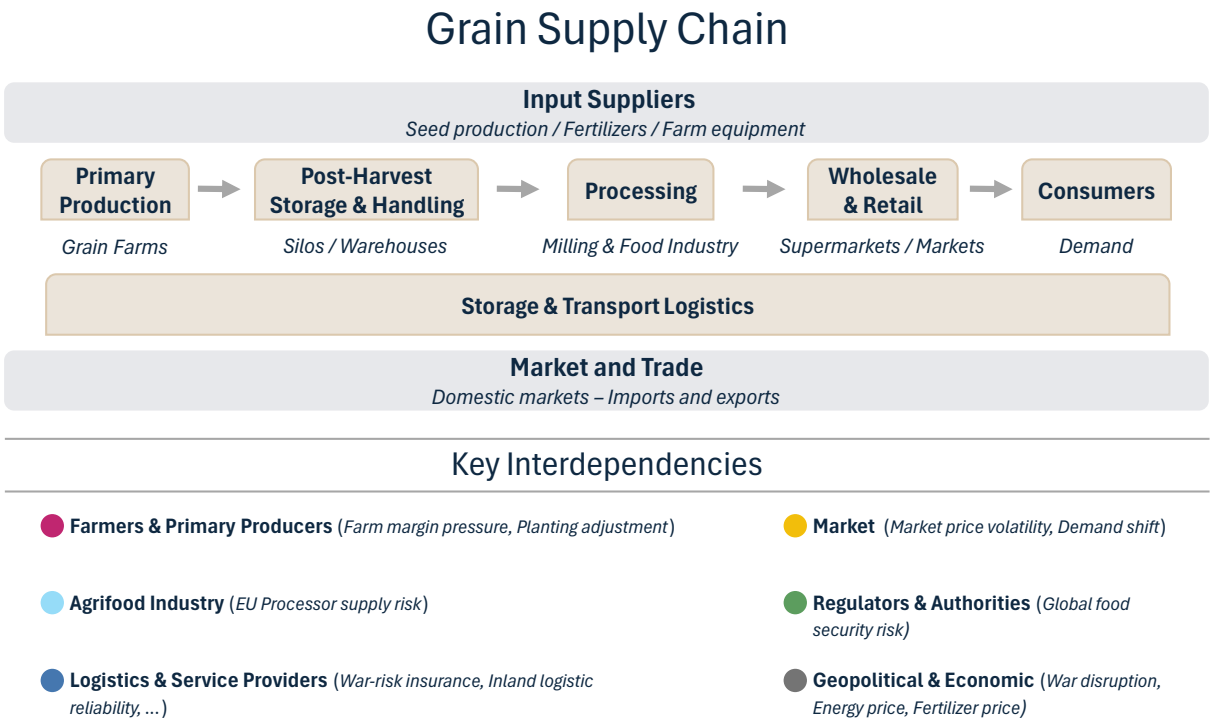


Figure 9. Schematic overview of the core grain supply chain and its main sequence of activities. The lower part of the figure highlights key interdependencies and systemic risk factors that may become critical in the event of disruptions—such as increase in fertilizers price or geopolitical conflict—and that can trigger cascading effects across the system. For a detailed analysis of these interdependencies, see SecureFood Deliverable D3.2.

Productivity of the EU cereal sector is comparatively high, as yields per hectare are well above the global average (World Bank, 2026b). However, both production levels and yields are increasingly challenged by a range of external stressors. In addition to the environmental stressors already discussed in the previous scenarios, rising fertilizer and energy prices pose substantial challenges to grain production across the EU countries. The grain sector is highly dependent on energy and fertilizers, so sharp increases in these input prices act as a severe systemic external stressor. Modern cereal farming relies on fuel (diesel for tractors/combines, electricity for drying and storage) and especially on synthetic fertilizers (nitrogen, phosphate, potassium) to achieve high yields. Fertilizer production itself is tightly coupled with natural gas (the key feedstock for nitrogen fertilizer), which directly links grain agriculture to energy markets. When energy costs surge, fertilizer prices tend to follow.

A clear illustration of this dependence occurred after the start of the war in Ukraine in 2022, when natural gas prices spiked dramatically and caused fertilizer prices to rise by around 149% compared with the previous year (DG for Agriculture and Rural Development (European Commission), 2026c). This energy shock led to the widespread curtailment of EU fertilizer production: over 70% of European ammonia production capacity was shut down due to unaffordable gas costs, leaving farmers dependent on expensive imports (Fertilizers Europe, 2022; World Bank, 2023). Faced with fertilizer prices several times higher than normal, many farmers had no choice but to cut back their application (World Bank, 2023). These disruptions

also produced knock-on effects across the wider food chain, as reduced ammonia output led to shortages of industrial CO_2, a by-product used in food processing, cold-chain logistics, and livestock slaughtering (Schmidhuber, 2022). Overall, the situation raised concerns about impacts on global food security (Broom, 2023). Even after natural gas prices eased from their 2022 peak, fertilizer markets remained unstable. According to the FAO's 2024 *Fertilizer Market Developments* report (Antip, 2024), nitrogen fertilizer prices in 2024 were still tied to gas market fluctuations, and phosphate fertilizers even increased year-on-year despite lower ammonia costs. This volatility, driven largely by trade restrictions such as export curbs and tariffs, continued to reshape global fertilizer flows and affects affordability for farmers across Europe and beyond. In summary, Table 17 provides an overview of how increases in energy and fertiliser prices relate to the six pillars of food security in the context of the grain supply chain, offering a framework for interpreting their potential system-level impacts.

Table 17. Impacts of increases in energy and fertilizer prices on the six pillars of food security in the context of the grain supply chain.

Food Security Pillar	Impact of Increases in Energy and Fertilizer Prices on Grain Supply Chain
Availability	Production drops as farmers reduce fertilizer application and/or cultivated area due to high costs. Lower input use leads to lower yields and smaller harvests, directly reducing the domestic availability of cereals. In extreme cases, some farmers cease grain farming, further shrinking output.
Access	Grain shortages and higher production costs drive up market prices for cereals and derived foods. As staples become more expensive, economic access to food is reduced, particularly for poorer households. Countries or regions reliant on imports may face especially high prices on global markets, putting affordable access at high risk.
Utilization	Nutritional quality of grain-based foods may decline. Insufficient fertilization can result in cereals with lower nutrient content, affecting dietary quality. If grain supplies tighten or certain uses (e.g. feed) are prioritized, consumers might substitute with less nutritious foods.
Stability	The food supply becomes volatile and unreliable. Spiking input prices lead farmers to cut production, triggering a supply shock and product price spike, followed by a correction when input costs fall, i.e., a boom–bust cycle. This cycle is driven by external shocks, making cereal-supply fluctuations unpredictable and hard to manage. Such volatility destabilises year-to-year production and prices, limiting farmers' ability to invest in future production.
Sustainability	High input costs or unstable markets can force farmers out or deter new entrants, reducing the workforce and increasing risks of land abandonment or monocropping. This erodes long-term productive capacity and crop diversity, compromising the resilience and sustainability of grain production for future generations.

Agency	Input-price crises can erode the agency of EU communities that depend on the grain supply chain. Farmers, especially small and medium producers, may lose autonomy as they are forced to rely on government aid, emergency schemes, or collective purchasing just to access essential inputs, limiting their ability to act independently. Wider society is also affected: consumers, processors, and local food systems have little influence over volatile input markets or policy responses, leaving them dependent on external interventions to stabilise supply and prices. This diminishes local decision-making and adaptive capacity across the system.

Therefore, the interaction between the grain supply chain and surges in energy and fertilizer prices constitutes a critical systemic stress scenario for the EU food system. Because grain production underpins not only staple foods but also livestock feed, industrial inputs and export markets, disruptions in this sector propagate rapidly across multiple value chains. Input price shocks challenge the stability, economic viability and long-term sustainability of the EU in its entirety. As demonstrated by recent crises, such events can transcend national borders and generate cascading impacts on food security. Accordingly, this scenario provides a relevant context for applying the Resilience Governance Framework.

4.1.4.1 Application of the Resilience Governance Framework – Energy and Fertilizer Prices Increase in Ukraine

Benefiting from exceptional agro-climatic conditions and extensive fertile land, Ukraine is among the world's leading producers and exporters of wheat, maize, and barley (European Parliamentary Research Service, 2024). Prior to Russia's invasion, cereals accounted for more than half of the country's sown area and formed the backbone of its export-oriented agricultural model. By 2021, agriculture represented 41% of total Ukrainian exports, with maize and wheat alone generating more than USD 11 billion in export revenues (European Parliamentary Research Service, 2024). The sector is dominated by medium- and large-scale agricultural enterprises capable of delivering high volumes at competitive costs, positioning Ukraine as a key supplier to the EU, the Middle East, Africa, and Asia, and reinforcing its role as a stabilising actor in global grain markets.

Since the escalation of the war in 2022, Ukraine's agrifood sector has been exposed to multiple, overlapping crisis risks that threaten production stability, trade flows, and food security at both national and global levels. Within this broader conflict context, the increase in energy and fertilizer prices represents the primary stressor analysed under Scenario 4. According to UN Trade & Development (UNCTAD, 2026), disruptions to energy flows, particularly natural gas, have rapidly translated into higher prices for nitrogen-based fertilizers. Rising freight rates and war-risk insurance premiums have simultaneously increased transport and trade costs along grain supply chains, amplifying pressure on food prices and international trade flows. Building on this, the Financial Times highlights that due to the recent conflict escalation in the Persian Gulf, fertilizer prices increased by over 26% in March 2026 alone, pushing farmers to further

reduce fertilizer use, delay planting, or accept lower yields, thereby tightening global grain supply and exacerbating an already existing grain insecurity in import-dependent countries (Hanieh, 2026). In parallel with these market-driven disruptions, the armed conflict has generated acute humanitarian needs within Ukraine. While not an EU Member State, Ukraine is a Participating State in the Union Civil Protection Mechanism (UCPM) and has benefited from the mobilisation of rescEU capacities, including the provision of power generators, medical equipment, temporary shelter units, water-treatment facilities, and specialised assets for public-health risk containment. Concurrently, EU humanitarian funding supports essential needs such as food provision, water and sanitation, and direct cash assistance. The FAO Emergency and Early Recovery Response Plan (2025–2026), implemented in close collaboration with the Ministry of Agrarian Policy and Food of Ukraine, allocated USD 53 million to restore cereal and livestock production, with the dual objective of improving food availability and generating income, thereby reducing long-term reliance on humanitarian aid (FAO, 2022). Complementing this, the Ukraine Interim Country Strategic Plan (2025–2027) by the World Food Programme focuses on food assistance for conflict-affected populations, restoration of agricultural livelihoods, strengthening national food systems, and the integration of school meals and social protection mechanisms (Adrienne, 2024).

Together, these developments provide the contextual basis for the present case study and inform the first of the two disruptors analysed for Ukraine. Geopolitical instability as a second disruptor is examined in Section **Error! Reference source not found.**. Table 18 applies the Resilience Governance Framework, building on the during-crisis cooperation flow illustrated in Figure 4, identifying the stakeholders involved, their roles and responsibilities and flow of actions.

Table 18. Application of the Resilience Governance Framework affecting the grain supply chain in Ukraine, triggered by an increase in energy and fertilizer prices.

During-crisis component	Stakeholders	Responsibilities	Flow of Actions
Early warning system and situation assessment	Cabinet of Ministries of Ukraine (Member State Public Authority)	• Provide coordination of the initial situation assessment. • Ensure sector-specific focus by contacting relevant National Competent Authorities.	1. The Cabinet receives early warnings on sharp increases in fertilizer and fuel prices impacting grain producers nationwide. 2. Following aggregated alerts, the Cabinet formally forms and convenes an ad hoc Crisis Response Task Force.
	Ministry of Agrarian Policy and Food, Ministry of Energy, Ministry of	• Validate incident notifications. • Convene an ad	3. Upon receiving formal notifications, National Competent Authorities validate cost-increase reports, assess

	Infrastructure (National Competent Authorities)	hoc Crisis Response Task Force. • Lead technical and economic assessment.	exposure of grain production and storage, and formally convene the ad hoc Crisis Response Task Force.
	Crisis Response Task Force: grain producers (food system operators), input suppliers, logistics and storage operators, agronomic advisors, agricultural economists and research institutes	• Detect and report market and operational disruptions. • Provide immediate operational judgement.	4. Cross-check fertilizer and fuel price data with suppliers and farm-level evidence. 5. Confirm abnormal cost pressure affecting sowing plans, input application rates, and cash-flow at farm level. 6. The leading Member State Public Authority decides to activate the crisis response mechanism.
National crisis response measures	Ministry of Agrarian Policy and Food, Ministry of Energy, Ministry of Economy (National Competent Authorities)	• Lead national crisis response operations. • Calibrate mobilisation of national instruments. • Maintain continuous monitoring.	7. Authorities formally activate national crisis response measures, unlock relevant financial and market instruments, coordinate access to strategic reserves (where applicable), and establish high-frequency coordination meetings. 8. Task Force operationalises support to impacted stakeholders and national resources are mobilised accordingly.
	Crisis Response Task Force	• Provide sector-specific technical, operational input on mitigation and resource coordination mechanisms.	Continuous provision of consolidated recommendations on cost-mitigation options, operational adjustments, and short-term risk management for grain production and storage.
Re-assessment & Monitoring	Crisis Response Task Force and National Competent Authorities	• Convene in frequent meetings for briefing on crisis evolution.	9. Following continuous monitoring and a formal situation re-assessment, authorities evaluate whether national response capacity

		• Update impact and risk assessments.	remains sufficient or whether international support is required.
	Private sector and supply associations, Workers' and labour unions, Consumer associations	• Maintain a two-way crisis communication channel. • Convey intelligence on socio-economic and market impacts.	10. Small and medium grain farms face rising production costs, reduced fertilizer use, delayed planting, and liquidity constraints. 11.Agricultural workers seek reassurance on employment stability amid reduced operational margins. 12. Consumer associations raise concerns over increasing prices of grain-derived food products.
Crisis escalation (EU-level cooperation, if applicable)	National Competent Authorities & National SPOC	• Assess sufficiency of national capacity. • Contact EU institutions through structured channels.	13. The SPOC transmits updated crisis reports to the European Commission and schedules regular information exchanges on grain market stability and input cost pressures. Crisis escalates and impact several European countries food security and supply of cereals.
	European Commission (EU Institution)	• Activate EU-level crisis coordination frameworks.	14. Upon notification, the Commission activates EU-level coordination mechanisms, supports information sharing among Member States, and aligns analytical and policy responses related to grain markets. Temporary Policies ensure commodities imports from Ukraine are not restricted, meanwhile IPCR mechanism is activated to guarantee coherent and unified political response across all Member State mostly affected by this crisis.

4.1.5 Geopolitical Conflict affecting the Grain Supply Chain

As detailed in Scenario 4, the EU grain supply chain relies on a highly integrated system of production regions, logistic infrastructures and cross-border exchanges. This structural configuration applies equally in this scenario.

The EU is typically a net exporter of cereals, with countries like France and Romania shipping substantial volumes of wheat and other cereals to global markets each year (European Commission, 2025a), while Member States with large livestock sectors such as Spain and the Netherlands depend on steady imports of feed. Italy also routinely supplements its durum wheat supply through imports during years of domestic shortfall (European Commission, 2025a; World Integrated Trade Solution (World Bank), 2024). These intra-EU and extra-EU flows align regional production with sectoral demand and underpin price stability within the single market. Trade therefore constitutes one of the most critical components of the grain supply system, and its disruption during episodes of geopolitical conflict can rapidly undermine the functioning of the entire chain. Grain sector performance depends not only on exports, which support farm income and help balance market conditions, but also on the predictable import of raw materials, inputs and intermediate goods. Transport corridors, maritime routes, border crossings, and customs systems form the logistical backbone of these exchanges; any instability affecting these mechanisms can constrain market access, inflate transaction costs, fragment supply chains and generate price spikes in both domestic and international markets.

Geopolitical conflict represents a higher-level external stressor compared to the input cost shocks described in Scenario 4. While increases in energy and fertilizer prices can occur independently, geopolitical conflict often amplifies and extends disruptions far beyond input markets. Armed confrontations, diplomatic tensions, and regional crises can displace established trade routes, disrupt transportation systems, generate insurance and security constraints, and prompt governments to adopt restrictive trade measures. These changes can reverberate widely, with effects that permeate logistical networks and market coordination, even in regions geographically distant from the conflict itself.

Recent geopolitical events illustrate these dynamics clearly. Following the outbreak of conflict in Ukraine in 2022, maritime insecurity in the Black Sea, the introduction of sanctions, and the diversion of export routes disrupted grain movements, causing delays, bottlenecks along alternative corridors, increased risks for shipping, and heightened uncertainty for sectors reliant on imported supplies (European Parliament, 2022a; UNCTAD, 2022). Export restrictions introduced by major fertilizer suppliers, including China's limits on nitrogen and phosphate exports to safeguard domestic supply (Gu, 2024) and EU sanctions affecting Belarusian fertilizers (European Council, 2025), further disrupted global circulation patterns, tightening availability and complicating procurement strategies. Nonetheless, in 2022 the EU adopted emergency measures allowing temporary derogations from CAP greening and land-use obligations, including a short-term exemption from crop-rotation and fallow-land requirements, with the aim of maximising cereal production in response to food-security risks linked to the war (European Commission, 2022). While these measures helped stabilise production in the short term, broader disruptions persisted, underscoring the structural and enduring nature of geopolitical risk. In 2023, wider geopolitical tensions such as those following the outbreak of

the Israel–Hamas conflict introduced renewed uncertainty around key maritime and energy-related chokepoints. Attacks on commercial vessels and rising insecurity in the Red Sea and the Bab-el-Mandeb Strait forced carriers to suspend or reroute services, diverting traffic from the Suez Canal to longer routes around the Cape of Good Hope (Notteboom et al., 2024). These developments disrupted established logistics chains, raised freight and insurance costs, and triggered contingency planning at both Member State and EU levels (Europen Parliament, 2024).

For the EU grain supply chain, such instability is particularly consequential. Europe depends on predictable maritime flows for both exports of cereals and imports of key inputs. Disruptions to chokepoints like the Black Sea, Suez Canal, or Red Sea can delay shipments of grain to global markets, slow the arrival of essential inputs, increase costs across transport and processing stages, and constrain the capacity of operators to plan procurement and delivery. Therefore, the cumulative effects are disruptive. Table 19 summarizes the impacts of geopolitical conflict on the six pillars of food security in the EU grain supply chain.

Table 19. Impacts of geopolitical conflict on the six pillars of food security in the context of the grain supply chain.

Food Security Pillar	Impact of Geopolitical Conflict on Grain Supply Chain
Availability	Geopolitical conflict can disrupt international trade flows, constrain access to export and import corridors, and slow the movement of grain, thereby limiting overall supply availability.
Access	Conflict-driven disruptions in transport and trade can raise costs throughout the supply chain, including freight, insurance, and input prices, reducing the affordability of staple foods for both producers and consumers.
Utilization	Supply instability and price increases generated by geopolitical conflict can undermine the ability of food systems to deliver consistent, nutritionally adequate grain-based foods, contributing to risks of undernutrition where access to staples is constrained.
Stability	Geopolitical instability introduces volatility into food and commodity markets, creating unpredictable fluctuations in supply, prices, and transport reliability.
Sustainability	Geopolitical conflict can pressure to adopt short-term measures aimed at maximising production. This may conflict with long-term objectives for soil protection, biodiversity conservation, and sustainable resource use.
Agency	Conflict reduces the ability of supply-chain actors (farmers, processors, traders, and governments) to control decisions, as emergency measures, restrictions, and security interventions reshape the operational and policy environment.

Unlike other external stressors, geopolitical conflict has the capacity to simultaneously affect trade routes, input availability, market functioning, and policy responses across multiple regions. These interconnected effects challenge not only operational continuity in the short term but also the long-term resilience and governance of the food system. As such, this scenario underscores the importance of robust risk-management frameworks that address cross-border interconnections and enable coordinated action among public and private actors at both Member State and EU levels.

4.1.5.1 Application of the Resilience Governance Framework – Geopolitical Conflicts in Ukraine

The second crisis affecting the Ukrainian grain sector is driven by geopolitical conflict, directly linked to Russia's invasion. According to FAO's country brief on Ukraine – Global Information and Early Warning System – landmine contamination, labour shortages, damaged infrastructure, and restricted access to agricultural land continue to constrain cultivation and harvesting, comparing to pre-war averages. War-related damage to storage and distribution infrastructure further limits the sector's capacity to move grain efficiently, while export volumes remain significantly below pre-conflict levels. In parallel, depressed international prices have reduced export competitiveness and farm-gate revenues. The European Parliamentary Research Service highlights that the targeting and blockade of export routes serve not only to weaken Ukraine's economy but also to exert pressure on global food markets, underscoring the geopolitical significance of the grain sector amid armed conflict (European Parliamentary Research Service, 2024).

Consistent with the approach adopted across all case studies, Table 20, building on the crisis cooperation flow outlined in Figure 4, applies the Resilience Governance Framework, identifying the key stakeholders involved, clarifies their responsibilities and outlining the flow of actions.

Table 20. Application of the Resilience Governance Framework affecting the grain supply chain in Ukraine, triggered by geopolitical conflict.

During-crisis component	Stakeholders	Responsibilities	Flow of Actions
Early warning system and situation assessment	Cabinet of Ministries of Ukraine (Member State Public Authority)	• Provide coordination of the initial situation assessment. • Ensure sector-specific focus on grain production, storage, and export continuity by contacting relevant	1. The Cabinet receives early warnings on intensified hostilities disrupting grain production areas and key logistics corridors (ports, rail, inland routes). 2. Following receipt of alerts, the Cabinet formally forms and convenes the ad hoc Crisis Response Task Force.

		National Competent Authorities.	
	Ministry of Agrarian Policy and Food of Ukraine, Ministry of Infrastructure, Ministry of Economy, Ministry of Defence (National Competent Authorities)	• Validate incident notifications. • Convene an ad hoc Crisis Response Task Force. • Lead technical, logistical, and market assessment.	3. Upon receiving formal notifications, authorities validate reports on corridor disruptions, storage damage, and export bottlenecks, and immediately convene the ad hoc Grain Crisis Response Task Force.
	Crisis Response Task Force: grain producers (food system operators), port/rail/inland logistics operators, traders/processors, agronomic and logistics advisors, research institutes, CSOs	• Detect and report operational and security-related disruptions. • Provide immediate operational judgement.	4. Cross-check field reports on production constraints, storage accessibility, and transport corridor status. 5. Confirm abnormal disruptions affecting harvest operations, stock movements, and export capacity. 6. The leading Member State Public Authority decides to activate the national crisis response mechanism.
National crisis response measures	Ministry of Agrarian Policy and Food of Ukraine, Ministry of Infrastructure, Ministry of Economy (National Competent Authorities)	• Lead national crisis response operations. • Calibrate mobilisation of all available instruments. • Maintain continuous monitoring.	7. Authorities formally activate national crisis response, prioritise grain sector continuity, unlock emergency instruments, coordinate protection and rerouting of logistics corridors, and establish daily high-frequency coordination meetings.
	Crisis Response Task Force	• Provide sector-specific technical and operational input. • Support coordination of resources, routing,	8. The Task Force operationalises support to impacted stakeholders, aligns alternative storage and transport arrangements, and supports rapid decision-making by authorities.

		and storage solutions.	
Re-assessment & Monitoring	Crisis Response Task Force and National Competent Authorities	• Convene in frequent meetings for briefings on crisis evolution. • Re-assess capacity and risk.	9. Following continuous monitoring and a formal situation re-assessment, authorities determine that national mitigation options are stretched and consider requesting international support.
	Private sector and supply associations, workers' and labour unions, consumer associations	• Maintain two-way crisis communication channels. • Convey socio-economic and market intelligence.	10 Grain producers and traders experience severe operational disruptions, stock accumulation, liquidity stress, and export delays. 11. Agricultural and logistics workers report safety concerns, workforce shortages, and operational risks in conflict-affected areas. 12. Consumer and civil society organisations raise concerns regarding domestic grain availability and food price stability.
Crisis escalation (EU-level cooperation, if applicable)	General Secretariat / National Competent Authorities and National SPOC	• Assess sufficiency of national capacity. • Contact EU institutions through structured channels.	13. The SPOC transmits validated and updated situation reports to the European Commission and schedules regular cross-border information exchanges on grain market stability and logistics security.
	European Commission (EU institution)	• Activate EU-level crisis coordination frameworks.	14. Upon notification, the Commission activates EU-level crisis coordination mechanisms, aligns Member State information sharing, and facilitates coordinated responses related to grain flows and food security.

			15. Partners mobilise agreed analytical expertise, logistical coordination support.

5 Concluding Insights and Recommendations

5.1 Key Governance Insights

The Resilience Governance Framework confirms that food system resilience cannot be addressed solely through technical, operational, or sector-specific measures. Food systems operate as interconnected networks of resources, actors, infrastructures, supply chains, food environments, and essential services, exposed to shocks and stresses including climate change, geopolitical disruption, market volatility, public health crises, water pollution, input shortages, and environmental degradation. This systemic character makes governance a central condition for safeguarding food security. The classification of food production, processing, and distribution under the Critical Entities Resilience (CER) framework reinforces the need for structured governance arrangements that clarify how public and private actors interact to protect essential food supply functions. The Resilience Governance Framework explicitly position food systems within the CER Directive and provides Member States and food system actors with a governance logic to strengthen the resilience of critical food-sector entities. It further demonstrates that food system resilience depends on multiple, interdependent capacities: economic, social, physical and infrastructure, institutional and governance, informational, and environmental and natural resource capacities. These capacities are unevenly distributed across actors and territories, requiring governance arrangements that support coordinated assessment, prioritisation, and mobilisation at system level, rather than isolated actions by individual organisations.

A recurrent governance gap identified throughout the analysis concerns the lack of clarity and consistency in roles, responsibilities, and interaction pathways across EU, national, sectoral, and organisational levels. Stakeholders involved in the participatory process repeatedly highlighted fragmented coordination structures, unclear crisis-communication chains, and uneven cooperation patterns as barriers to effective preparedness and response. The Framework addresses this gap by distinguishing public and private responsibilities across the pre-crisis and during-crisis phases, assigning strategic leadership, coordination, monitoring, early warning, and crisis communication to public authorities, while positioning private operators as responsible for operational continuity, vulnerability assessments, mitigation measures, and timely reporting of disruptions. The need for such explicit articulation highlights that existing arrangements remain insufficiently harmonised across Member States. The analysis also reveals significant heterogeneity in national maturity and approaches to food security risk assessment, preparedness strategies, and crisis governance. While some Member States have dedicated and structured food system risk assessment mechanisms, others address food security implicitly within broader civil protection, national risk, or climate adaptation frameworks. This heterogeneity limits comparability, shared learning, and coordinated preparedness at EU level.

Public–private cooperation emerges as central for effective food crisis management. The Resilience Governance Framework shows, however, that cooperation is often constrained by uneven interaction patterns, unclear mandates, limited inter-institutional familiarity, and barriers linked to resources, incentives, and capacity. By distinguishing coordination, cooperation, and collaboration, the Framework defines the cooperation as the joint

implementation of a shared objective, reflecting the fact that safeguarding food security is not discretionary but constitutes a shared mission involving public authorities, private operator, associations, civil society, workers, consumers, research institutions, and enabling actors. Effective cooperation require alignment across three interconnected levels of shared objectives: societal food security, supply chain continuity, and organisational business continuity. Misalignment across these levels can weaken crisis management, particularly when public priorities relating to social protection and essential service continuity diverge from private priorities centred on business continuity and investment security.

The Resilience Governance Framework further identifies proportionality and capacity differentiation as core governance requirement. SMEs, small producers, and other lower-capacity actors often lack the resources required for extensive risk assessment, business continuity planning, data reporting, or participation in complex cooperation mechanisms. The Framework therefore differentiates expectations for SMEs, emphasising simplified reporting, basic continuity planning, timely communication of disruptions, and access to technical guidance and support through national authorities, associations, advisors, and enabling actors. At the same time, capacity asymmetries are recognised as a source of power imbalance within the cooperation mechanisms, potentially limiting participation, influence, visibility of risks affecting farmers, SMEs, small-scale producers and vulnerable communities.

Finally, the Framework highlights the need to systematically integrate civil society perspectives, consumer, workers, and vulnerable groups into food system resilience governance. Vulnerable groups include consumers at risk of food insecurity, small producers exposed to market and environmental shocks, and workers affected by employment or safety disruptions during crises. The Resilience Governance Framework responds by assigning structured roles to consumer associations, civil society organisations, food aid organisations, workers and labour representatives, stakeholder organisations as intermediaries for communication, representation, intelligence gathering, and support thereby strengthening inclusiveness, situational awareness, and legitimacy of preparedness and response measures.

5.2 Recommendations for Food System Actors

1. Role of the Resilience Governance Framework as a common reference architecture

Food system actors are encouraged to draw on the Resilience Governance Framework as a common reference architecture to support the organisation of preparedness and crisis-response governance. The Framework provides a coherent structure to clarify roles and responsibilities, identify relevant stakeholders, and organise cooperation mechanisms across the food system, linking food-security objectives to the system's resilience capacities.

In the context of the CER Directive, the Framework can function as an enabling governance tool, supporting—but not replacing—legal obligations. It assists Member States in translating CER requirements into a food-system-specific governance logic, particularly in relation to risk assessment, preparedness, resilience measures, information sharing, reporting, and public–private cooperation.

Application of the Framework should remain proportionate to the role, scale, and capacity of actors. For SMEs and small producers, this implies simplified guidance, templates, and support through associations, intermediaries, advisors, and competent authorities. For vulnerable groups, it implies explicit consideration within preparedness planning and crisis-response arrangements.

2. Use Annex B and Annex C as complementary reporting instruments under the CER Directive

The Resilience Governance Framework recommends the combined and coordinated use of Annex B and Annex C to support a comprehensive, transparent, and non-overlapping implementation of the CER Directive. Annex B provides the analytical foundation by structuring the identification, assessment, and reporting of food-system risks, vulnerabilities, and potential impacts in accordance with Article 5. Annex C builds on this foundation by supporting the subsequent stages of governance, namely the appraisal of mitigation options, the prioritisation of actions, and the consolidation of national resilience strategies, in line with Article 4.

By explicitly linking risks identified under Annex B to mitigation measures and preparedness decisions documented under Annex C—without duplicating risk analysis—the two annexes together ensure traceability, accountability, and coherence across the resilience cycle. Their combined use supports iterative learning, strengthens preparedness, and facilitates consistent dialogue and policy orientation between Member States and EU institutions.

3. Strengthen food-system risk assessment through cross-sectoral and capacity-based analysis

Member States should strengthen food-system risk assessment by systematically considering cross-sectoral dependencies and cascading effects, in line with the all-hazards logic of the CER Directive. Risk assessment should reflect the interdependencies between food systems

and energy, transport, water, digital infrastructure, inputs, labour, finance, and markets, rather than focusing on isolated hazards or single supply chains.

The Resilience Governance Framework supports this objective by linking national risk assessments with foresight, market monitoring, and resilience-capacity appraisal. This integrated approach enables competent authorities to translate risk-assessment outcomes into coherent preparedness strategies and proportionate resilience measures, while allowing flexibility to adapt procedures to national contexts and existing governance arrangements.

4. Establish structured public–private cooperation before and during crises

Food-system resilience depends on structured and sustained public–private cooperation, established in advance of crises and maintained throughout preparedness and response phases. Public authorities should retain leadership for strategic coordination, risk assessment, crisis activation, and public communication. Private operators should contribute operational intelligence, continuity arrangements, vulnerability information, and timely disruption reporting.

Associations, cooperatives, advisors, service providers, civil-society organisations, consumer organisations, workers' representatives, and research institutions should be recognised as enabling and intermediary actors, supporting inclusive participation, capacity building, and information flows. This cooperation model directly supports CER implementation by operationalising governance arrangements, incident reporting, coordination, and escalation where national capacities are exceeded or cross-border impacts arise.

5. Develop trusted and interoperable information-sharing arrangements

Member States and food-system actors should develop trusted and interoperable information-sharing arrangements to support preparedness and crisis response. These arrangements should clarify what information is shared, by whom, for what purpose, through which channels, and under which confidentiality safeguards.

Public authorities should ensure that information provided by private actors is handled securely and proportionately, while private actors should receive aggregated and actionable feedback to support decision-making. Intermediaries such as sectoral associations, cooperatives, advisors, and technical service providers should be used to support data aggregation, brokering, and translation, particularly for SMEs and small producers.

6. Embed proportionality, capacity support, and inclusion

Resilience governance will be effective only if it reflects differences in capacity across food-system actors. Applying uniform requirements risks over-burdening SMEs and small producers and weakening participation. Member States and sectoral organisations should therefore embed proportionality into preparedness, reporting, cooperation, and response arrangements.

This includes simplified templates, targeted guidance and training, association-led reporting, advisory support, and accessible participation formats. Capacity-aware governance also helps reduce power imbalances in cooperation mechanisms and improves representation of farmers, SMEs, workers, and vulnerable communities in preparedness and response decisions.

7. Ensure learning and feedback into future preparedness

Although the Resilience Governance Framework focuses on pre-crisis and during-crisis phases, governance arrangements should support continuous learning. Monitoring, documentation of decisions, and structured stakeholder feedback during crises should be used to inform updates of national risk assessments, resilience-capacity appraisals, mitigation strategies, and cooperation mechanisms.

By enabling feedback loops between crisis response and preparedness planning, the Framework supports continuous improvement in CER implementation and strengthens long-term food-system resilience.

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Annex A Glossary

A.1 Definitions of Key Terms and Concepts

(NOTES: Abbreviations and Acronyms used within the text are not included in this list).

Accountability: a principle requiring clearly defined and agreed roles and responsibilities across decision-making, planning, implementation, monitoring, and review processes. Each stakeholder is responsible for fulfilling its mandate and collaborating with others to achieve food security, while receiving appropriate support where this does not compromise the responsibilities of other actors.

Agenda-setting power: the ability to define priorities, frame risks, and delimit feasible response options.

Appraisal of mitigation options: a cooperative process through which public and private actors assess possible mitigation options for each resilience capacity, considering their objective, expected effectiveness, indicative resource requirements, and potential cross-capacity or cross-sector implications.

Appropriateness: a component of a resilient food system referring to food that is safe, nutritious, culturally acceptable, and suitable for the dietary needs of different population groups.

Attitudes: in the context of cooperation, attitudes refer to mutual recognition of interdependence and legitimacy among public and private actors involved in safeguarding food security.

Behaviours: in the context of cooperation, behaviours include concrete practices such as information sharing, joint risk assessments, and contingency planning.

Business continuity: the ability of an organisation to continue delivering products and services at predefined acceptable levels during disruption, supporting both supply chain continuity and societal food security.

CER Directive: Directive (EU) 2022/2557 on the resilience of critical entities, which aims to enhance the resilience of critical entities providing essential services and establishes rules on Member State strategies, risk assessments, designation of critical entities, resilience measures, incident notification, supervision, enforcement, cooperation, and reporting.

Coherence: a principle requiring policies and actions to be consistent, understandable, and mutually reinforcing. Coherence requires leadership and a strong sense of shared responsibility, ensuring that actions undertaken by individual stakeholders contribute to coordinated food security objectives and do not undermine collective outcomes.

Collaboration: a mode of inter-organisational engagement referring to voluntarily supporting other partners in achieving a shared or individual goal.

Concern assessment: a methodological component inspired by the IRGC Risk Governance Framework, used to consider stakeholders' values, perceptions, socio-emotional concerns, and cultural ambiguity. In the Resilience Governance Framework, concern assessment supports the integration of stakeholder experiences, priorities, and expectations into the framework design.

Contingency planning and capacity building: The development of plans, capacities, and resources to ensure an effective response to potential crisis situations.

Contract-based clauses: formal provisions in public–private agreements specifying conditions for data sharing, quality, and use, including safeguards on confidentiality.

Cooperation: a mode of inter-organisational engagement referring to attitudes, behaviours, and outcomes related to the joint implementation of a common goal. In this framework, cooperation refers to structured joint action between public and private actors directed towards safeguarding food security.

Coordination: a mode of inter-organisational engagement referring to attitudes, behaviours, and outcomes related to deliberation, negotiation, and agreement on a common goal.

Crisis: an abnormal or extraordinary event or situation that threatens an organisation, community, or system and requires a strategic, adaptive, and timely response to preserve its viability and integrity.

Crisis communication mechanism: predefined roles, communication channels, and procedures that ensure coordinated, timely, factual, transparent, and accessible information sharing among public authorities, food supply chain actors, and citizens during a food crisis.

Crisis escalation: the process through which a food crisis is referred to EU-level coordination mechanisms when national capacities are exceeded or when the crisis has significant cross-border relevance.

Crisis management: coordinated activities to lead, direct, and control an organisation or system with regard to crisis. In this document, crisis management is approached from a system-centred perspective, focusing on coordinated action across the food system.

Crisis onset: the point at which a food crisis is formally recognised, either through an official governmental declaration or when key indicators exceed critical predefined levels.

Crisis Response Task Force: an ad hoc, scenario-specific multi-stakeholder body convened by the relevant Member State authority or National Competent Authority during a food crisis. Its composition depends on the crisis scenario and may include food system operators, input providers, advisors, service providers, civil society organisations, research institutions, and academia. It supports situation assessment, provides technical and operational expertise, and informs early prioritisation and resource mobilisation.

Critical Entities Resilience Group (CERG): the group established under the CER Directive to support the European Commission and Member States in capacity planning, strategy definition, cooperation, and sharing of best practices on the resilience of critical entities.

Critical entity: a public or private entity designated by a Member State under Directive (EU) 2022/2557 as providing one or more essential services whose disruption would significantly affect vital societal functions, economic activities, public health, public safety, or the environment.

Decisional bodies: European, national, regional, and local actors, including both public and private stakeholders, involved in decision-making processes related to safeguarding food security.

Definition of coherent risk mitigation strategies: the consolidation of mitigation options across resilience capacities by designated National Competent Authorities to ensure internal coherence, alignment with EU objectives, and support for national preparedness measures.

During-crisis phase (response): the phase in which reactive interventions address immediate threats, with emphasis on rapid decision-making, resource allocation, continuity of food supplies, and the protection of food security. This phase includes the warning phase, where signals of an impending crisis are detected, and the acute crisis phase, where impacts become pronounced.

Early detection mechanisms: mechanisms, indicators, and monitoring arrangements used to recognise when food security risk thresholds have been breached and when established contingency or response protocols should be activated.

Early warning system: a system that consolidates monitoring data and issues alerts when predefined risk thresholds are exceeded, signalling a potential or impending food crisis and supporting the timely activation of contingency plans, response measures, and management actions.

Economic capacity: the financial resources and market mechanisms available to support food systems during periods of crisis, including household economic resilience, market functions, trade networks, and the ability to balance local production, trade flexibility, and exposure to volatility.

Effectiveness: a principle highlighting the importance of timely and effective action, particularly in crisis management. It requires clearly defined objectives, forward-looking assessments, lessons learned from past experience, and structured mechanisms that support decision-making at the most appropriate level.

Emergency: sudden, urgent, usually unexpected occurrence or event requiring immediate action.

Environmental and natural resource capacity: the integrity and biodiversity of ecosystems supporting agriculture and fisheries, including soil, water, biodiversity, and climate stability. These biophysical and ecological attributes shape the quality, quantity, and diversity of potential food production and influence the long-term resilience of food systems.

Essential service: a service that is necessary for the maintenance of vital societal functions, economic activities, public health, public safety, or the environment, and whose disruption or unavailability would have significant consequences.

Food access: the affordable and equitable distribution of food, ensuring that all individuals have both physical and economic access to sufficient, safe, and nutritious food, including in remote or underserved areas and during periods of disruption.

Food agency: the ability to improve the rights and capabilities of people to feed themselves and to engage with and shape their food system.

F*ood availability:* the availability of sufficient quantities of food of appropriate quality.

Food crisis: a situation that occurs when rates of acute food insecurity and malnutrition rise sharply at local or national levels, raising the need for emergency food assistance.

Food environment: the physical, economic, political, and socio-cultural context in which people interact with the food system and make food-related decisions, including purchasing decisions.

Food security: a condition that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

Food security crisis: an exceptional, unpredictable, and large-scale event or risk with the potential to threaten food supply or food security. Within the Resilience Governance Framework, a food security crisis refers to a situation in which systemic impacts, uncertainty, and cross-sectoral dependencies require structured governance arrangements and collective action at system level.

Food stability: adequate access to and availability of food at all times, despite sudden shocks, such as economic or climatic crises, or cyclical events, such as seasonal food insecurity.

Food supply chain: the logistical and operational pathway through which food moves from production to consumers, including production, processing, transport, storage, distribution, retail, and related input and service providers.

Food sustainability: the practices that contribute to long-term regeneration of resources to ensure that current food needs are met without compromising the food needs of future generations.

Food system: an interconnected network of resources, actors, infrastructures, processes, and activities involved in the production, processing, distribution, consumption, and disposal of food.

Food system operators: private economic actors active along the food supply chain, including primary producers, processors, manufacturers, wholesalers, retailers, logistics and transport companies, and suppliers of critical inputs.

Food systems resilience: the capacity over time of a food system and its units at multiple levels to provide sufficient, appropriate, and accessible food to all in the face of various and even unforeseen disturbances.

Food utilization: the use of food through adequate diet, clean water, sanitation, and health care to reach a state of nutritional well-being where all physiological needs are met.

Foresight studies: analytical instruments that support food system risk assessment by identifying medium- to long-term drivers, emerging risks, and potential shock pathways relevant to food security.

Governance: the structures and processes through which collective decisions are made and implemented, involving governmental and non-governmental actors. In the context of food security, governance refers to the arrangements through which public and private actors coordinate, cooperate, and take decisions to safeguard food security and strengthen food system resilience.

Governance enablers of cooperation: cross-cutting elements that enable public–private cooperation in food crisis management across preparedness and response phases. In this framework, they consist of leadership, information sharing, trust, and interoperability, which structure how actors exchange information, align the timing of interventions, and plan and deploy resources across organisational and system boundaries.

Incident notification: the reporting process through which critical entities notify the designated National Competent Authority or Single Point of Contact of a disruptive incident that significantly disrupts, or has the potential to significantly disrupt, the provision of essential services. In line with the CER Directive, the Framework refers to an initial notification within 24 hours after becoming aware of such an incident, followed by a detailed report within one month.

Information sharing during crisis: the process by which timely and relevant information functions as the primary operational input for situation assessment, decision-making, and mobilisation of response measures during a food crisis.

Information sharing: the process through which actors exchange, interpret, and use information to develop and maintain a shared understanding of evolving food security risks, impacts, and response measures across preparedness and response phases.

Informational capacity: the ability to collect, share, interpret, and use information through early warning systems, risk monitoring, data infrastructure, communication channels, and institutional learning to support evidence-based decision-making and coordinated action.

Informational power: control over and access to data relevant for crisis management.

Input providers: actors supplying critical inputs to the food system, including fertilisers, feed, packaging, energy, ICT services, and other inputs required for production, processing, logistics, and distribution.

Institutional and governance capacity: the institutions, policies, roles, responsibilities, coordination mechanisms, communication arrangements, and decision-making processes that enable rapid and coherent action to safeguard food security during crises.

Intermediaries: actors such as supply chain associations, trade associations, cooperatives, producer organisations, industry federations, consumer associations, labour representatives, civil society organisations, advisors, and service providers that bridge public authorities and individual food system actors. They support information aggregation, dissemination of preparedness guidance, structured input to risk reviews, and communication during disruptions.

Interoperability: the ability of different systems, organisations, data definitions, legal arrangements, and operational procedures to work together. In food system governance, interoperability enables information exchange to be translated into coordinated action across actors, sectors, and jurisdictions.

Inter-Organizational Relationships (IOR): study of strategic alliances, joint ventures, partnerships, networks, and other forms of relationships between organizations.

Leadership: the guidance exercised by a leading public authority responsible for monitoring actions, ensuring coherence among stakeholders, setting strategic direction, enabling resource allocation, and maintaining alignment with the shared mission of safeguarding food security as an essential service.

Market information systems and dashboards: analytical and informational instruments that support food system risk assessment by monitoring short-term drivers, stress signals, market conditions, input availability, logistics performance, prices, stocks, and emerging disruptions.

National Competent Authorities: national authorities responsible for sector-specific governance, risk assessment, preparedness, monitoring, technical assessment, crisis coordination, and response measures within their areas of competence, including agriculture, food safety, transport, energy, digitalisation, health, and civil protection.

National crisis response measures: response measures activated by National Competent Authorities during a food crisis, including mobilisation of financial instruments, physical assets,

expertise, stockpiles, and other resources required to stabilise food supply and maintain food security.

National Focal Point (NFP): a designated public authority responsible for facilitating two-way information and intelligence exchange between individual Member States and EU institutions, including the European Commission, and for coordinating reporting, policy alignment, and compliance with relevant EU and international frameworks.

National food system risk assessment: an assessment conducted by designated National Competent Authorities to evaluate food system risks, vulnerabilities, dependencies, likelihood and potential impacts of disruptions, and national capacities to absorb and respond to stress.

National Resilience Capacities Report: a structured report consolidating resilience capacity assessments and mitigation options across food system capacities, intended to support the formulation of national resilience strategies under the CER Directive.

Openness: a principle requiring actors involved in decision-making processes to operate transparently, using clear, understandable, and inclusive language.

Outcomes: in the context of cooperation, outcomes include enhanced buffer capacities, continuity of essential food flows, and more timely and proportionate crisis responses.

Participation: a principle recognising that reliable, high-quality, and legitimate outcomes depend on the active involvement of a broad range of stakeholders with different roles, responsibilities, expertise, and levels of engagement.

Participation power: the uneven capacity of actors to engage in collective decision-making and sustain involvement over time.

Partnering: association with others in an activity or area of common interest in order to achieve individual and collective objectives.

Physical and infrastructure capacity: the hard infrastructure and logistical systems required for food production and distribution, including transport networks, storage facilities, cold chains, irrigation systems, utilities, and other physical assets needed to maintain food accessibility during disruptions.

Post-crisis phase (recovery and learning): activities focus on restoring stability, evaluating outcomes and incorporating lessons learned to strengthen future resilience.

Power: the relational capacity of certain actors to influence others' decisions in ways that advance their own interests, values, or priorities.

Power imbalance / power asymmetry: a condition in which differences in resources, influence, authority, participation capacity, or access to information affect the ability of actors to engage in cooperation mechanisms on equal terms.

Pre-crisis phase (preparedness and prevention): the phase preceding the onset of a food crisis, during which proactive strategies such as risk assessment, surveillance, communication, contingency planning, preventive measures, and capacity building aim to reduce vulnerabilities and enhance readiness.

Preventive and mitigation measures: actions aimed at reducing underlying vulnerabilities and preventing shocks from escalating into food crises, including diversification of supply sources, reinforcement of infrastructure, strategic reserves, alternative supply chains, climate-smart practices, and other long-term resilience measures.

Public-private cooperation: structured joint action between public authorities and private actors directed towards safeguarding food security, maintaining continuity of food supply, and supporting coordinated preparedness and crisis response.

Re-assessment and monitoring: the continuous and iterative review of crisis developments, impacts, response measures, and resource needs through frequent updates and coordination meetings during the acute crisis phase.

Resilience: the ability of a system to withstand shocks and stresses and recover after disturbance. In the context of food systems, resilience refers to the system's ability to deal with shocks or stressors without irreversibly compromising its long-term functioning.

Resilience capacity: the resources and attributes, both tangible and intangible, that actors develop, accumulate, and mobilise in response to crises or shocks. In the Resilience Governance Framework, resilience capacities include economic, social, physical and infrastructure, institutional and governance, informational, and environmental and natural resource capacities.

Resilience capacity assessment and negotiation: a cooperative process through which public and private actors jointly interpret national risk assessment outcomes, align perceptions of risks, and identify strengths and vulnerabilities across food system resilience capacities. The expected output is the Resilience Capacity Register.

Resilience Capacity Register: a structured inventory documenting strengths and vulnerabilities across national food system resilience capacities, developed through multi-actor deliberation following the national risk assessment.

Resilience Governance Framework: the structured set of principles, roles, responsibilities, and cooperation processes designed to support stakeholders in preparing for and responding to food crises, with the objective of strengthening food system resilience and safeguarding food security.

Response measures: measures adopted by critical entities to prevent, protect against, respond to, resist, mitigate, absorb, accommodate, and recover from incidents that may disrupt the provision of essential services. In the context of the Resilience Governance Framework, resilience measures include risk-management, business-continuity, emergency-response,

physical and digital resilience, and recovery arrangements proportionate to the scale, role, and risk profile of food system actors.

Risk identification and monitoring: systematic surveillance and analysis used before a crisis becomes acute to detect factors that could trigger food crises, including climatic variables, geopolitical instability, market fluctuations, supply chain vulnerabilities, and animal or plant disease outbreaks.

Self-sufficiency: Ability of a country or region to meet its own food needs through domestic production, and it varies significantly across nations.

Shared objectives: agreed objectives that guide cooperation across societal, supply chain, and organisational levels, including safeguarding food security, ensuring food supply continuity, and maintaining business continuity.

Shock: a sudden, often short-term event, such as an extreme weather episode, temporary supply disruption, or localised market disturbance, which can usually be absorbed or managed through existing capacities and routine response mechanisms. A shock may escalate into a food crisis when it interacts with underlying vulnerabilities and overwhelms normal coping capacities.

Single Point of Contact (SPOC): the national contact point designated under the CER Directive to liaise with the Critical Entities Resilience Group and coordinate cross-border resilience information sharing. During a food crisis, the SPOC facilitates the exchange of essential information between national authorities, EU institutions, and affected Member States.

Situation assessment: the rapid process led by National Competent Authorities, in consultation with a Crisis Response Task Force, to assess the scope, severity, affected sectors, geographic reach, and impacts of a food crisis on food system resilience capacities.

Small and medium-sized enterprises (SMEs): food system operators with limited financial, administrative, technical, or organisational capacity compared with larger operators, for which preparedness, reporting, and continuity expectations should be proportionate and supported through simplified templates, technical guidance, and intermediaries.

Social capacity: social capital, networks, and community cohesion that support collaboration, resource sharing, mutual assistance, equity, and inclusion during crises.

Stakeholder: person or organization that can affect, be affected by, or perceive themselves to be affected by a decision or activity.

Sufficiency: a component of a resilient food system referring to the ability to consistently produce and provide enough food to meet the dietary needs of the population, whether through domestic production, imports, or food aid, while maintaining capacity to buffer against shortages caused by disruptions.

Supply chain continuity: the sustained functioning of interconnected stages of food production, processing, transport, storage, and distribution during disruptions.

Trust: an enabler of cooperation that shapes actors' willingness to rely on shared information, accept joint decisions, and align actions under conditions of uncertainty and time pressure. In the Framework, trust is built through repeated interaction, transparency, clarity of roles, and credible information-sharing arrangements.

Vulnerable groups: population groups or food system actors that may be disproportionately affected by food crises, including consumers at risk of food insecurity, small producers, workers affected by disruptions, and communities with limited access to food, resources, information, or support.

Whole-of-government: agencies working across portfolio boundaries to jointly achieve integrated responses to the issues of policy development, program management and service delivery.

Annex B National Risk Assessment

B.1 Guidance on Voluntary Common Reporting Template

Directive (EU) 2022/2557 on the Resilience of Critical Entities (CER Directive) establishes a harmonised framework to strengthen the resilience of *critical infrastructure sectors*, including *production, processing, and distribution of food*. To support Member States in implementing the Directive's requirements – such as conducting all-hazards risk assessments – the European Commission issued a *Voluntary Common Reporting Template*" in September 2025. The template contains a structured form for Member States to report the results of their national risk assessments per sector and subsector as defined in the Directive's Annex. While its use is voluntary, Member States are strongly encouraged to apply the template to ensure that information submitted to the Commission pursuant to Article 5(4) of the Directive is consistent, comparable, and transparent across countries.

For guidance purposes, this Annex reproduces the sections of the template and illustrates their application with food-system-specific examples, in accordance with the scope and objectives of the present Resilience Governance Framework.

Table 21. Key components of the CER "Voluntary Common Reporting Template" (Annex to the CER Directive guidelines) and their significance for the food production and technology sector.

Template Section	Template Subsection	Purpose (as per CER Template)	Food Sector Relevance	Governance and Implementation Implications
Identification Parameters *Member State: ---* *Competent Authority: --* *Reporting Period: ---* *Sector/Subsector: ---*	-	Records which sector/subsector the risk info pertains to, ensuring separate reporting for each critical sector in line with the Directive's Annex.	Food supply is treated as a distinct critical sector - includes a checkbox for "Production, processing and distribution of food." Identification of the responsible ministry (e.g. Agriculture/Food) and reporting period ensures accountability and	Requires coordination among food, safety, security, and emergency authorities to ensure that food-sector risks are assessed and reported as a dedicated critical-infrastructure area.

			traceability of food sector assessments at national level.	
Section 1: Types of Risk Identified	-	Checklist of all-hazards threat categories (natural, man-made, technical/technological, and compounded risks) with examples. Multiple boxes can be ticked; space to elaborate on specific "other" risks.	Captures the full spectrum of food-system threats: e.g. natural (droughts, animal diseases), man-made (contamination, terrorism, strikes), technical (factory accidents, IT failures), etc. It forces recognition of emerging risks, including climate-related hazards or emerging technology-related vulnerabilities. By listing "Cyber risks" and "Emerging digital technologies" as risks categories, it also highlights the increasing role of cybersecurity and technology governance in agri-food resilience.	Supports an integrated resilience perspective across domains traditionally addressed separately in the food sector (food safety, food security, infrastructure protection). For example, droughts, animal disease outbreaks, cyber incidents affecting logistics software, or disinformation triggering panic buying can be assessed within a single national risk framework, improving coherence of preparedness measures and inter-authority coordination.
Section 2: Outcome of the Risk Assessment	*2.1 - Vulnerabilities & Dependencies*	Checklist of vulnerability factors: cross-sector, cross-border, and supply-chain dependencies; reliance on specific entity categories; employee/security shortcomings; etc., with prompts to elaborate.	Reflects the highly interconnected nature of food systems, including dependence on energy and transport, on imports or single suppliers, on digital systems (e.g. refrigeration monitoring, logistic software), and on concentrated production or processing assets. It	Enables identification of critical dependencies such as reliance on imported feed, single large processing plants, refrigerated logistics, or digital inventory systems. In practice, this information is often drawn from consultations with operators and associations and can inform resilience measures such as diversification of suppliers, redundancy in logistics routes,

			highlights where technological and supply-chain innovations (such as diversification, stockpiling, IoT monitoring) are needed to reduce vulnerabilities.	or backup power for cold storage facilities. This section implies that large food companies identified as critical entities must perform their own risk assessment: for example, when a Member State fills out "vulnerabilities - supply chain dependencies" for the food sector, it likely gathered that information from industry consultations or from companies themselves (e.g. a milling company might report it depends on one rail line). Those companies can expect follow-up: competent authorities may require evidence of mitigation (like alternative suppliers or stockpiles) consistent with the identified risks. Food sector businesses, especially those using advanced technology (e.g. precision agriculture or blockchain traceability), should be prepared to demonstrate how those technologies improve resilience or, if they introduce new risks, how those are managed.
	2.2 - Potential Impact of Disruption	Checklist of possible impact areas: assesses potential economic, social, health, environmental, and security impacts of service disruption,	Highlights the systemic consequences of food-supply disruptions, including price volatility (food prices strikes, trade losses), public-health impacts (nutrition and hunger concerns), and potential social instability,	Supports assessment of cascading impacts, such as how disruptions in grain processing could affect food prices, animal feed availability, or trade balances. The explicit consideration of impacts extending to multiple Member States helps anticipate scenarios requiring EU-level coordination and

		including multi-country effects.	with explicit consideration of cross-border relevance. Includes a checkbox for disruptions affecting "*six or more Member States*", underscoring that a food crisis can quickly become a pan-European issue.	alignment with mechanisms such as the EFSCM or IPCR.
	2.3 - Impact Severity Rating	A standardised scale of disruption severity (five levels from *Relatively Insignificant* to *Severely Significant*) to summarise the overall impact magnitude.	Enables comparative assessment of the significance of food-system disruptions relative to other critical sectors, guiding prioritisation and resource allocation.	A high severity rating for the food sector may justify the designation of additional food-sector entities as critical and increased focus on resilience investments (e.g. mandatory contingency planning, stock-management measures), while lower ratings must be supported by evidence of existing mitigation capacity.
Section 3: Additional Insights Relating to the Types of Risks Identified and the Outcomes of the Risk Assessment	*3.1 - Methodology* *3.2 - Best Practices* *3.3 - Lessons*	Free-text sections to describe the risk assessment process, highlight noteworthy practices, and capture lesson learned.	Encourages reflection and information-sharing specific to food sector resilience, including use of standards, modelling tools, drills, and public-private cooperation mechanisms, reflecting sectoral complexity and perishability.	Enables Member States to document practical experiences, such as the use of ISO 22301-aligned business continuity planning, sector-specific stress-testing exercises, or early-warning systems for crop failures. Over time, this can support peer learning through CERG exchanges and inform the wider uptake of effective practices across the EU food sector.
Section 4: Complementary Information	-	Open section for contextual explanations or additional information relevant to Article 5(4) reporting.	Provides flexibility to address food-sector-specific aspects not captured elsewhere, including coordination mechanisms, sensitive data references,	Can be used by Member State to discuss coordination with the European Food Security Crisis preparedness and response Mechanism (EFSCM) or to note how food safety regulator frameworks were integrated into the resilience assessment. Any technical

			or links to complementary frameworks.	annexes or sensitive data (e.g. national stock levels or results from stakeholder consultations) could be referenced, potentially including technology-related analyses (e.g. digital twin modelling outputs).

Annex C National Resilience Capacities and Mitigation Strategy Template

C.1 Template for Appraising Mitigation Options and Consolidating Food-System Resilience Strategies

This template supports the appraisal of mitigation options and the consolidation of food-system resilience measures following the completion of the national risk assessment. It is intended to complement, not duplicate, the national risk assessment reporting presented in ANNEX B. The template therefore does not require Member States to repeat risk identification, likelihood assessment, impact assessment, or severity rating. Instead, it uses the outcomes of the national risk assessment as inputs for structured decision-making, resilience-capacity appraisal, and the development of coherent mitigation strategies. The template is aligned with the logic of the Resilience Governance Framework developed in this deliverable. It operationalises the Framework's emphasis on resilience capacities, public-private cooperation, proportionality, information sharing, trust, interoperability, and safeguards against participation, informational, and agenda-setting power asymmetries. It also supports the implementation of the CER Directive by helping Member States translate risk-assessment outcomes into resilience measures, governance arrangements, prioritised actions, and strategy inputs relevant to the national strategy on the resilience of critical entities. The template may be used by the responsible National Competent Authority, in cooperation with other relevant public authorities, critical entities, food system operators, intermediaries, civil society organizations, research institutions, advisors, and other actors involved in the relevant resilience-capacity decision table.

PART A – Administrative and decision-table information

Completed by the responsible National Competent Authority for each resilience-capacity decision table

A1. Member State

Insert Member State

A2. Responsible National Competent Authority

Insert name of the authority, mandate, contact function, and date(s) of deliberation.

A3. Food system resilience capacity addressed

☐ Economic capacity ☐ Social capacity ☐ Physical and infrastructure capacity ☐ Institutional and governance capacity ☐ Informational capacity ☐ Environmental and natural resource capacity

A4. Risk assessment reference

Provide only the reference code, title, or section number of the relevant risk already documented in the national risk assessment / Annex B. Do not repeat the risk description, likelihood, impact, or severity assessment.

- Risk assessment reference ID / section:

- Related sector or subsector:
- Date of latest national risk assessment:
- If the risk is new or materially changed after completion of the national risk assessment, indicate whether an update of the national risk assessment is required:

A5. Decision-table participants and representation safeguards

List the actors involved in the appraisal process and explain how balanced participation was ensured.

- Public authorities involved:
- Critical entities or food system operators involved:
- SMEs or SME representatives involved:
- Intermediaries involved:
- Consumer, worker, civil society, or vulnerable-group representatives involved:
- Research institutions, advisors, or service providers involved:
- Measures used to address participation, informational, or agenda-setting power asymmetries:

PART B – Appraisal of mitigation options and resilience measures

Completed for each mitigation option identified by the decision table.

B1. Mitigation option identification

- Option title / ID:
- Short description:
- Vulnerability or capacity gap addressed:
- Link to national risk assessment reference:

B2. Type of mitigation

Select all that apply.

☐ Regulatory ☐ Financial ☐ Operational ☐ Technical ☐ Organisational ☐ Communication
☐ Training / capacity building ☐ Information-sharing / data governance ☐ Other:

B3. Objective and expected contribution

- Objective of the mitigation option:
- Expected contribution to the targeted resilience capacity: ☐ Low ☐ Medium ☐ High
- Justification:

B4. Resources and implementation conditions

- Estimated implementation cost:
- Human resources required:
- Technical resources required:
- Financial resources required:
- Legal or administrative conditions:
- Time to implementation: ☐ Short term: ≤ 1 year ☐ Medium term: 2–3 years ☐ Long term: > 3 years

B5. Proportionality and feasibility

Assess whether the proposed measure is feasible and proportionate for the actors expected to implement it.

- Feasibility for large operators / critical entities:
- Feasibility for SMEs and small producers:
- Support required to ensure proportional implementation:

B6. Information-sharing and confidentiality arrangements

Indicate whether implementation requires information exchange between public and private actors, the expected level of aggregation, confidentiality safeguards, and any intermediary or brokering function.

- Information required for implementation:
- Information provider(s):
- Information recipient(s):
- Level of aggregation required:
- Confidentiality or commercially sensitive data concerns:
- Role of intermediaries or data-brokering functions:
- Interoperability requirements:

B7. Potential unintended effects and spillovers

- Potential cross-capacity spillovers:
- Potential cross-sector spillovers:
- Potential cross-border implications:

PART C – Consolidation of Resilience Measures for the National Strategy

Completed once per national submission by the responsible National Competent Authority, based on six resilience-capacity decision tables

C1. Responsible authority for consolidation

- Responsible National Competent Authority:
- Other authorities involved:
- Date of consolidation:

C2. Summary of proposed resilience measures

Provide a high-level synthesis only. Do not repeat the full appraisal of each mitigation option.

C3. Strategic objectives and priorities supported

Explain how the proposed measures support the national strategy on food resilience.

- Food security (availability, access, utilization, sustainability):
- Continuity of essential food services (stability):
- Public–private cooperation (agency):
- Cross-sector and cross-border resilience:
- Protection of vulnerable groups:

C4. Priority ranking of measures

Provide a numbered list of prioritised measures, based on expected contribution to food system resilience, feasibility, urgency, proportionality, and resource requirements.

C5. Requested or recommended EU-level support, where relevant

Select all that apply.

☐ Policy guidance ☐ Funding or financial support ☐ Regulatory adaptation or clarification
☐ Coordination support ☐ Technical expertise ☐ Cross-border facilitation ☐ Other:

PART D – Lessons from mitigation appraisal and strategy design

Completed once by the responsible Member State Competent Authority. This part focuses on lessons arising from mitigation appraisal, decision-making, participation, and strategy consolidation. It does not duplicate lessons from the national risk assessment.