D 3.1– Cross-impact based scenarios

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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
A1	Aquaculture scenario 1
A2	Aquaculture scenario 2
CIB	Cross-impact balance
DRS-I	Demand Risk Source-Impact
EC	European Commission
F1	Fish scenario 1
F2	Fish scenario 2
FV1	Fruits and vegetables scenario 1
FV2	Fruits and vegetables scenario 2
G1	Grain scenario 1
G2	Grain scenario 2
IPCC	Intergovernmental Panel on Climate Change
MDF1	Milk and dairy Finland scenario 1
MDF2	Milk and dairy Finland scenario 2
MDG1	Milk and dairy Greece scenario 1
MDG2	Milk and dairy Greece scenario 2
SRS-I	Supply Risk Source-Impact
ST	Sub task
T	Task
TIS	Total Impact Score
TLR-I	Transport/Logistics Risk-Impact
WP	Work Package

Executive Summary

This report "D 3.1 – Cross-impact based scenarios" presents a comprehensive foresight analysis and scenario development for the SecureFood project, based on the work carried out in T3.1. The analysis covers various food sectors across SecureFood case studies, including fish, aquaculture, grain, milk and dairy products, and fruits and vegetables. The primary objective was to utilize cross-impact balance analysis to develop consistent scenarios for each case study. Building upon the key drivers of food security per case study (T2.2), plausible evolutions were generated and their interactions evaluated. A full set of scenarios was created using the ScenarioWizard tool. The cross-impact analysis generated 594 scenarios, from which two high-impact, plausible scenarios for each case study were selected for further analysis. Additionally, those were validated in two workshops with the case studies' actors. In the workshops, the impacts on the supply chain of each scenario were also agreed and quantified.

For fish in Greece, the scenarios "Resilient Horizons" and "Steady Waters" focus on policies and initiatives to address economic and environmental challenges, emphasizing public health and sustainability. In Belgium's aquaculture sector, the scenarios "Balancing Innovation and Environmental Challenges" and "Facing Workforce and Environmental Challenges" highlight the sector's struggles with workforce issues, price volatility, and environmental challenges, stressing the need for effective recovery strategies. The grain sector in Ukraine is analysed through the scenarios "Path to Stability and Growth" and "War Challenges Amidst Progress," which explore the impacts of geopolitical conflicts on agricultural growth and supply chain stability. Each scenario underscores the importance of addressing supply chain vulnerabilities and implementing effective policies to mitigate risks.

The cross-impact balance analysis provided valuable insights into the vulnerabilities and resilience strategies of different food systems. Effective policies, technological innovations, and comprehensive education programs were identified as crucial elements in enhancing food systems resilience. The scenarios developed offer a foundation for future research and policy development, guiding efforts towards sustainable and resilient food systems. Additionally, the scenarios developed will be the starting point for SecureFood T4.1 Supply chain modelling for digital twin development, and will be aligned with the ones developed in T6.1 Case studies planning and evaluation strategy.

1 Introduction

1.1 WP3 Objectives and Tasks

This is the first deliverable of WP3, Food Systems vulnerabilities and interdependencies – Risk and resilience governance and management.

WP objectives are:

- Utilize foresight analysis and exploratory modelling to examine the future of food systems security.
- Develop and elaborate on the SecureFood Resilience Governance Framework and the Food Systems Resilience Management Framework.
- Evaluate interdependencies, vulnerabilities, risks, and resilience using innovative methodologies and models.
- Investigate the impact of drivers and interventions on food loss and waste streams, and optimize these streams in relation to food security both in the short and long term

To achieve the above, WP3 deploys the following tasks:

- Task 3.1: Foresight analysis and exploratory modelling for future state scenarios aims at implementing foresight analysis that will be guided by a scenario prognostic and building approach and includes: i) the definition of projections based on the identified food security drivers (T2.2), ii) the evaluation of projections' impact on the supply chain as well as on other projections via a cross impact matrix, iii) the creation of projection bundles and selection of consistent scenarios based on a cross-impact balance analysis, iv) development of respective stakeholder workshop(s) to validate the scenarios and quantify their overall impact on the supply chain and its probability.
- Task 3.2: Risk and Resilience Management focuses on developing methodologies and models for risk and resilience management. It includes identifying and analysing interdependencies among food supply chain actors, modelling and assessing these interdependencies using simulation models to understand triggering events and ripple effects, and developing mathematical models to assess risks induced by drivers on food value chains. The task will also perform what-if scenarios to analyse food systems' response to risks, using Mixed-Integer Linear Programming to support decision-making and benchmark interventions. Additionally, it will examine resilience through agronomic, economic, and social performance factors, using time-series data and stakeholder interviews, and apply macro- and micro-models to understand interactions and factors affecting food systems, running scenario calculations and assessing their impact.
- Task 3.3 Food Loss and Waste – Food security nexus aims to identify and quantify food loss and waste streams and analyse their impact on food security. This involves identifying critical points of food loss and waste generation along the supply chain, quantifying these streams using various methodologies, analysing the impact of drivers and interventions on food loss and waste streams, and defining optimal relations between food loss, waste, and food security. The task will develop the WASTE-SEC tool for estimating food loss and waste streams and making informed decisions for their management and reduction without compromising food security.
- Task 3.4 SecureFood Resilience Governance Framework aims to define a Resilience Governance Framework to enhance collaboration among stakeholders. This framework will foster inclusive and participatory governance processes, empowering stakeholders to engage in resilience-building activities. It will delineate stakeholders' roles,

responsibilities, and interactions before and during crises, ensuring appropriate methodologies for stakeholders' empowerment.

- **Task 3.5 Food Systems Resilience Management Framework** aims to develop a systematic approach for building resilience in the food ecosystem. This framework will address technical, organizational, and operational resilience, providing recommendations on preparedness, prevention, response, and mitigation measures. It will detail requirements for national and entity-level resilience plans and integrate framework principles into the FSRM tool for qualitative assessment of resilience indicators.

1.2 Purpose of the Document

This report D3.1 "Cross-impact based scenarios" is the main outcome of Task 3.1 "Foresight analysis and exploratory modelling for future state scenarios". It presents the results on the foresight analysis and selection of consistent impact-based scenarios for the different SecureFood case studies focusing on geographical level.

Firstly, the document presents an initial literature review on food security drivers (related to T2.2), projections and supply chain impacts (section 3).

Next (section 4), at case study level, most relevant security drivers and their projections are presented. Resulting from the cross-impact matrix, 2 scenarios were selected from the total generated (the ones with highest total impact score) for assessing their impact on the supply chain.

Finally, conclusions are presented in Section 5.

1.3 Intended Readership and Connection to Other Deliverables

This deliverable is primarily intended for SecureFood consortium members. Results can be also of interest of policymakers and R&D experts.

The scenarios described in this deliverable, as well as their supply chain impacts, will be used as reference in ST3.2.1 "Interdependencies in the food ecosystem" and in the scenarios for testing, demonstrating, and validating SecureFood solutions in T6.1 "Case studies planning and evaluation strategy".

Moreover, the outcomes of T3.1 and D3.1 provide a structured foundation for T4.1 "Supply chain modelling for digital twin development" by delivering a bundle of future state scenarios for food security across different supply chain use cases. This foresight analysis enables a systematic evaluation of the most influential factors shaping supply chain disruptions. Leveraging these pre-assessed drivers and their interdependencies, T4.1 will enhance its predictive modelling efforts by focusing on the most relevant variables. This targeted approach can improve the effectiveness of supervised machine learning techniques for forecasting disruptions and identifying optimal recovery strategies

2 Methodological Approach

To develop the necessary scenarios as part of Task 3.1, two key building blocks are required. The first involves conducting cross-impact balance analyses of the use case-specific drivers identified in Task 2.2. The second building block, which enhances the analysis, consists of narrative descriptions of the selected scenarios and their impacts on the supply chain. The following section outlines the methodology employed for these building blocks.

2.1 Cross-impact balance analysis

2.1.1 Introduction to cross-impact balance analysis

In order to construct the scenarios that will be developed for the project case studies, a Cross-Impact Balance Analysis of the food security drivers identified in Task 2.2 and the literature review presented in Section 3 was performed.

Cross-Impact Balance Analysis is a method developed by Weimer-Jehle (2006), that is aimed at analysing impact networks. It was decided to work with the Cross-Impact Balance Analysis method because it allows to structurally select scenarios that are consistent, from the millions of possible scenarios.

In this method, the process begins by identifying factors that significantly influence the subject under examination, either directly or indirectly. These factors are referred to as 'descriptors' in Cross-Impact Balance Analysis, but within this project, they are termed 'drivers.' Each driver can have various variant states, representing different possible developments. For instance, a driver like 'Oil prices' could have variant states depicting different price trends. Once the drivers are selected, the direct impact of each variant is evaluated against all other variants on a one-to-one basis, which can be positive, negative, or neutral. This impact evaluation is typically conducted by consulting experts. The relationships between the descriptors form a network of influences, which can be either partially or fully connected. Figure 1 illustrates a simplified impact network among three descriptors.

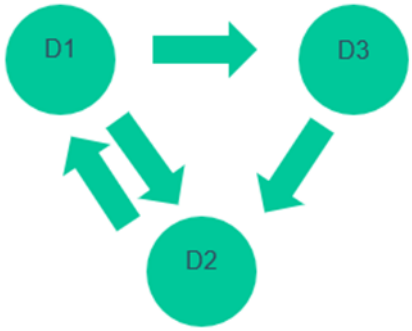

Figure 1 Simple impact network[1]

The impact matrix that is the result of this evaluation is then checked for internally consistent assumption bundles in the context of scenario analysis. Checking the scenarios for internal consistency takes place in two steps, because the role of each descriptor as both the source

[1] Figure based on Weimer-Jehle (2010)

and the target of influence is investigated. Only when the causal relations between the evolutions of each of its drivers do not contradict, a scenario is considered as consistent. This means that the scenarios produced will consist of mutually supporting assumptions. In Cross-Impact Balance Analysis, consistent scenarios are scenarios for which each of the selected variant states are most strongly supported by the sum of the influences of the other descriptors. If an alternative variant state produces a higher influence than the one under consideration, the assumption is considered inconsistent, and another variant state will be selected. Figure 2 illustrates this principle. From the selected variants, all but '5. Oil price' are consistent, because none of the alternatives produce a higher impact score than the selected assumptions. For the oil price descriptor, a price of 35-50$ yields a higher impact score than the selected assumption of 20-35$.

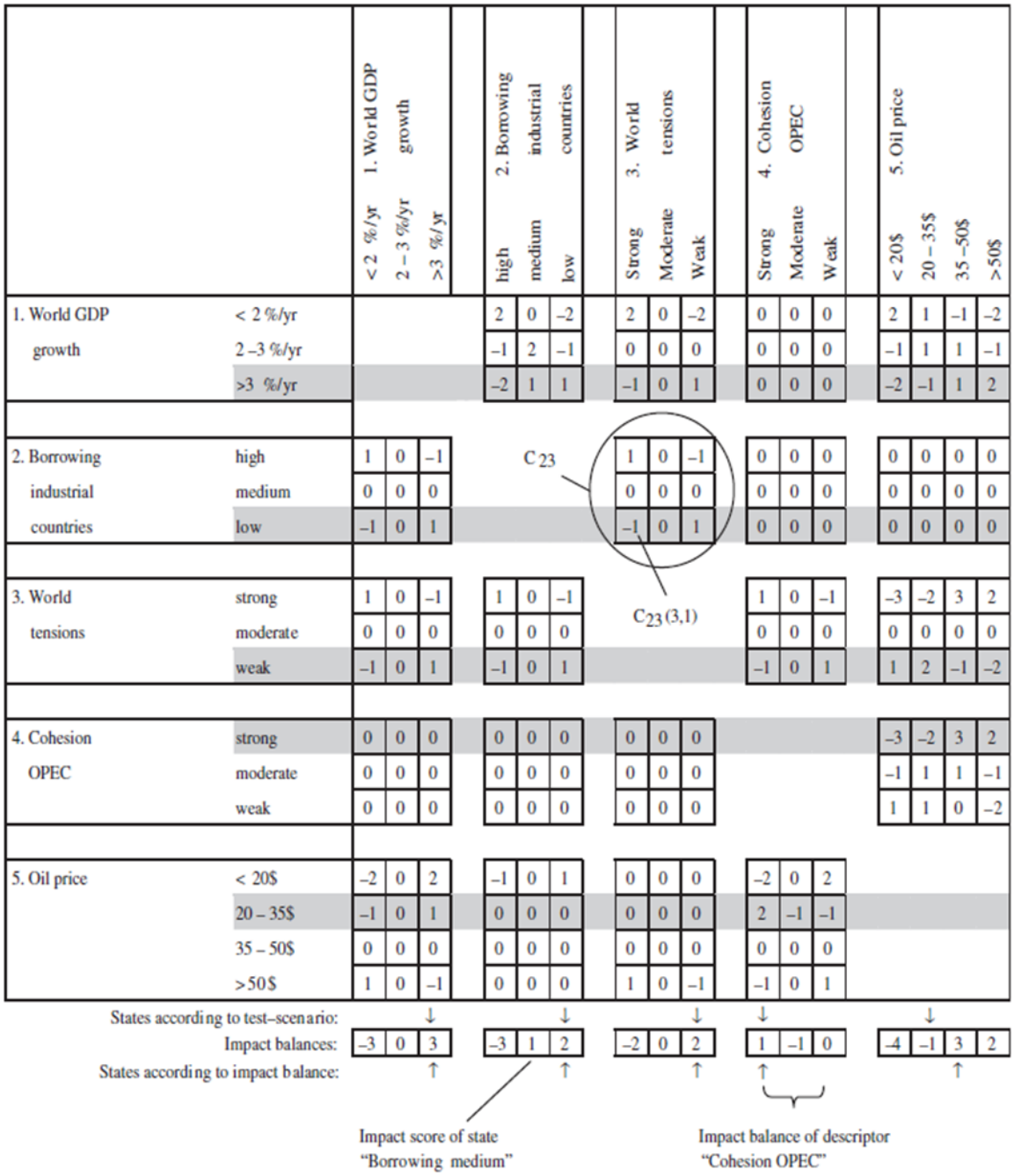

Figure 2 Example of a cross-impact matrix[2].

2.1.2 Cross-Impact Balance Analysis for SecureFood case studies

The cross-impact balance method described in the previous section was used to develop the future scenarios for all case studies.

[2] Reprinted from "Cross-impact balances: A system-theoretical approach to cross-impact analysis" by Weimer-Jehle (2006), pp. 334-361.

In an earlier phase of the project (Task 2.2), a long list of food security drivers under five main categories (Biophysical and Environmental; Technology, Innovation, and Supply Chain; Market and Economic; Political and Institutional; Socio-cultural and Demographic) was identified (SecureFood D2.1, Table 2).

In WP2, Sectors represented in the project (i) grain, (ii) milk and dairy, (iii) fruits and vegetables, and (iv) fish and aquaculture were asked to complete a questionnaire to calculate for the Risk Index (1-27) for each driver, calculated based on the assessment of Likelihood, Vulnerability, and Potential Impact for each case study.

Initially in Task 3.1, one driver (the one with higher Risk Index) was selected per main category. Afterwards, three variants representing future evolutions of the driver were defined (positive, negative, intermediate evolutions).

In order to be able to differentiate regional differences in the sectors studied, in Task 3.1 the case studies were split into their geographical value chains:

i) Grain in Ukraine (partners: UCAB; UAC, MINAG, COSMO, NULES, EKP)
ii) Milk and dairy in Greece (partners: ELGO and ROUS)
iii) Milk and dairy in Finland (partners: LUKE)
iv) Fruits and vegetables in Portugal (partners: MC)
v) Fish in Greece (partners: ELGO)
vi) Aquaculture in Belgium (partners: BIG)

During dedicated online workshops with the various value chains, the drivers and their variants were validated and enriched. In some instances, additional drivers and corresponding variants were added to the initial list. The drivers and variants were also customized to fit the specific characteristics of each value chain.

The various future states were then evaluated on a range between -3 and +3, with the following measurements (section 2.1.3):

+3 Strongly Promote Influence
+2 Promote Influence
+1 Weakly promote influence
0 No Influence
-1 Weakly hinder influence
-2 Hinder influence
-3 Strongly Hinder Influence

2.1.3 Elicitation of interactions between driver-states

An important step in assessing the consistency of scenarios consists of eliciting the interactions (causal relations) between each of the drivers. An exercise per value chain (six in total) was held to discuss the cross-impacts the drivers have on each other. Results are presented in Annex A.

Afterwards, the case study-specific tables were uploaded into the ScenarioWizard[3] tool available on-line, an open-source software designed by Dr. Weimer-Jehle for applying Cross-Impact Balance Analysis. Based on this input, the software generated a total of 594 consistent scenarios in the case studies considered (max inconsistency = 2). Annex B of this report shows all the generated scenarios for each use case:

- B.1. Fish (Greece)
- B.2. Aquaculture (Belgium)
- B.3. Grain (Ukraine)
- B.4. Milk and Dairy (Greece)
- B.5. Milk and Dairy (Finland)
- B.6. Fruits and Vegetables (Portugal)

In section 4, we select the two scenarios with the highest impact score and describe them using a narrative text and descriptor consistency table showing the projections and variants used in the selected scenarios. The total impact score is metric recommended to assess the overall logical strength of the scenarios, i.e., the scenarios with more and strong promoting impacts between descriptors and few hindering impacts. The total impact score is a global measure of the plausibility of a scenario (Weimer-Jehle, 2023).

2.2 Scenario impacts on the Supply Chain

Two workshops were organized to validate the two scenarios selected per case study, and to quantify the impacts of the projected scenarios created using the Cross Impact Balance approach.

The first workshop took place in person during the consortium meeting in Zaragoza on January 26, 2025 (Figure 3). It included representatives and end-users from the following case studies: Milk and Dairy in Greece and Finland, and Grain in Ukraine. The second workshop was held online on February 7, 2025, with representatives and end-users from the Fish (Greece), Aquaculture (Belgium), and Fruits and Vegetables (Portugal) case studies.

Figure 3 In person workshop organized to quantify scenario impacts on the Supply Chain

[3] https://scenariowizard.org/public/login/ScW.php

In both instances, participants were asked to reach a consensus on the probability and impact of the various risks affecting the different stages of the supply chain. The quantification was conducted using a Likert scale from 1 to 5, as follows:

- For likelihoods:

0. not relevant/feasible

1. Very Low (0-20%)

2. Low (20%-40%)

3. Neither high nor low (40%-60%)

4. High (60%-80%)5. Very High (80%-100%)

- For Impacts (severity of disruption):

0. not relevant/feasible

1. Very Low

2. Low

3. Neither high nor low

4. High

5. Very High

3 Literature Review

3.1 Food security drivers

This section summarizes main security drivers deducted from the EU commission staff working document containing an analysis of food security drivers (EC, 2023). It highlights main drivers for food security and thereby extracts potential future projections of such drivers, including the potential developments of these projections in the form of scenario variations.

The extracted drivers and related variations will be discussed and aligned with the food sectors identified in Task 2.2 (also aligned with the sectors of the case studies planned in the SecureFood project): grain, fruits/vegetables, fish and aquaculture products, milk and dairy products.

3.2 Projections from literature reviewed

The identified European food security drivers consist of seven main categories that affect the ability of food systems to deliver healthy and sustainable diets. These are the following (EC, 2023):

1. Economic and market projections.
2. Food value chain performance,
3. Political and institutional.
4. Socio cultural.
5. Demographic.
6. Bio-physical and environmental.
7. Research, innovation and technology.

The following sections explain how the drivers are elaborated into projections and scenarios.

3.2.1 Economic and market projections

The food sector is highly dependent on both import and export activities. Trade barriers as import/export bans, taxes may hinder the capacity of the food sector to produce and deliver to market. In particular, the exacerbating geopolitical crisis is increasing the adoption of trade barriers and import/export bans.

The imported commodities belonging to the food sector, that are expected to be affected by this trend are (EC, 2023):

- Tropical goods
- Fishery
- Aquaculture
- Agricultural intermediate inputs, e.g., vegetable proteins (soya), cereals (maize) as these are used to feed livestock.
- Mineral fertilizers are necessary for agricultural production. Main import countries are Russia and Belarus

The EU market exports affected are the following:

- High value elaborated food products

- Primary and first processed food products, e.g., cereals (wheat) and animal products (dairy and meat)

The following drivers have been identified as part of the economic and market trends:

- A. Commodity Speculation.
- B. Energy Inputs Prices

A. Commodity Speculation. Speculation in food commodity markets is often used to increase market liquidity and availability of products, hence hedging import risks. However, this practice, if excessively applied may lead to increased market prices. Some regions, e.g., wealthier regions, are able to absorb prices volatility but not developing countries or poorer/vulnerable segments of populations. The possible variations of this trend are the following:

- A1. Risk averse supply chains/hedging. Market volatility, changes in global food supply and demand, or geopolitical events. Increased speculation can lead to price fluctuations, which can impact food security by making food prices less predictable. At the same time, speculations lead to increased storage putting under pressure storage assets of supply chains and increasing the risk for food loss/waste. Regulatory frameworks can be developed by governments to subside the sector and thereby control market prices.
- A2. Risk seeking supply chains. Despite market volatility, supply chains will not hedge against risks, preferring to keep lean and Just-In-Time operations. Market prices will not be affected.
- A3. Risk neutral. No speculation is needed, e.g., dietary changes could be used to switch demand towards low-price commodities.

B. Prices of energy inputs. The whole food chain relies on energy prices, starting from farming activities, transport (fuel prices), production, and distribution (electricity prices). Increased energy prices may lead to increased supply chain costs, and therefore higher market prices. Shifts in energy sources may impact this trend. In fishing, the increased fuel prices have been a particular concern for fishing activities leading to idle vessels. Hence, potential impacts may be like those described for the speculation trend. The potential variations are the following:

- B1. Stable prices increment. Increased global demand for energy, depletion of fossil fuel resources, or policies aimed at reducing greenhouse gas emissions. Increased energy prices can raise the cost of food production, potentially impacting food security.
- B2, No change.
- B3. Stable prices decrement. if new sources of energy are discovered, energy efficiency improves, or renewable energy technologies become more cost-effective. Decreased energy prices could lower the cost of food production, potentially improving food security.
- B4. Highly volatile prices. Fluctuations in energy prices can make it difficult for farmers to plan and budget for their energy costs. This could impact food production and prices.

C. Pesticides dependency. There is an overall misuse of pesticides in the EU, which is known to impact pollinators and then threaten ecosystem services. Some pesticides cumulate in the environment and enter the food value chain. There is an overall need to reduce the use of pesticides for crop protection by means of precision agriculture e.g., and genomic techniques

or organic farming, agro-ecology and nature-based farming practices. The potential variations that we may identify for this trend are the following:

- C1. Increased dependency. No technology development available will allow reduced use of pesticides. Regulatory changes may favour the increment of pesticides usage.
- C2. No change. There will not be any technological or regulatory change that will affect the usage of pesticides.
- C3. Decreased dependency. Part of this trend is characterized by technology and regulatory dominance, i.e., Technology advancement will be achieved and contribute to a decreased dependency, e.g., precision agriculture, genomic techniques or organic farming. Changes in regulations or farmers reduction may lead to different usage of pesticides (increased dependency), or through the adoption of agro-ecology or nature-based farming practices

D. Workers' availability. The agricultural sector has always been challenged to find skilled labour, for several reasons, e.g., job attractiveness, decreasing population of rural areas, and work seasonality. Migration is seen as a positive support in solving labour shortage. Technological changes may shift the types of ski9lls required for the existing workforce, hence leading to shortage.

- D1. Successful migration policy. This scenario considers policy changes aiming to favour migration and thereby the integration of workforce in farming activities. This includes higher wages and fair working conditions.
- D2. Too restrictive policies. Future policies do not favour work integration, education, or skilling of workers for the farming sector. Worker availability decreases.

E. Farm income. The farm income comes as the difference between production/supply costs and sales revenues, i.e., landing prices. The fishing sector seems to be highly dependent on fuel costs. While farming depends on energy production, natural hazards etc. A decrease of farm income may have important impacts like increase of fraud activities for survival purposes, or bankruptcy leading to a halt of production (reduced farming viability). Farmers' higher input costs could be compensated by increased market prices (see impacts above). However, for the livestock sector it seems to be more challenging to increase prices, hence leading to a reduced income. In this respect, biogas production systems could provide an additional income to compensate for the losses in the food sector.

- E1. Increased farm income. It occurs due to factors such as increased market prices, decreased production costs, or additional income streams (like biogas production).
- E2. No change.
- E3. Decreased farm income. If production costs increase (due to higher energy or input costs), market prices decrease, or there are disruptions due to natural hazards.

F. Access to finance. Access to liquidity and capital is important to secure workers, equipment and ensure viable operations. This is especially important since the supply chain requires companies to loan capital before payments from the upstream are realized. Other trends like climate change, reduction of fertilizers may require investments in new technologies. Facilitating access to finances reduces the possibility for less sustainable activities and fraud cases. As for some of the previous cases, wealthier regions could easily arrange subsidies or favourable economic conditions to finance necessary investments. Digital technologies can facilitate the access to financial services and fintech in remote / rural areas.

- F1. Increased access to diversified financial products (including climate resistance support). Innovative financial products, or increased availability of alternative models, e.g., crowdfunding, peer-to-peer lending, and investments. Improved access to funds for investing in climate-resilient crops or farming practices. Access to specific funds to face climate change could be developed and made available to the sector.
- F2. Restricted access to finance instruments. This could happen if lending conditions tighten, interest rates rise, or if farmers have difficulty meeting lending criteria.
- F3. No change in access to financial instruments.

G. Consumer food prices. This trend determines what consumers can buy in correspondence of different quality levels. In general consumer prices continue to rise with impacts on poor/vulnerable segments of the population. Increased prices result in dietary choices with more calorie dense but poor in nutrients food, leading to health-related issues: nutrient deficiencies, obesity, and other diet related diseases. The possible variations of this projection are the following:

- G1. Rising food prices. This could occur due to factors such as increased production costs, higher demand, trade barriers or tariffs, or disruptions in the supply chain.
- G2. No change.
- G3. Falling food prices. If there are improvements in agricultural productivity, decreases in input costs, or increases in the efficiency of the food supply chain (technology or better planning/management).
- G4. Prices Volatility. This would create uncertainty in planning and demand and therefore increase situations of supply-demand mismatches.
- G5. Differential prices. Different types of food (e.g., grains, meat, fruits, vegetables) may not all trend in the same direction. For example, the prices of certain types of food might increase due to dietary trends or changes in production costs.

H. Household income. The household income determines the capacity that consumers have to buy quantity and quality of food from what is available from the market. Household income may depend on several factors, one of these being the price of the food and type of dietary followed by a country/ region. It is intriguing that data shows a link between higher income and less healthy eating habits. Especially those layers of the population with limited means often consume cheaper, energy dense, and nutrient poor diets. The possible future changes are the following:

- H1. Household income improved. In this situation the household income will increase. This could occur due to effective fiscal policy measures or improved savings or lowered interest rates/inflation.
- H2. Household Income Stability. EU households have a stable income.
- H3. Household income worsened. Events like global crises and pandemics may affect income negatively. Likewise, inflation and lack of adoption of fiscal policy measures may ultimately reduce household income.

3.2.2 Food supply chain performance

Food is highly perishable and for this reason the supply chain needs to be highly performing. It must have assets capacity, e.g., production equipment, storage, vehicles etc. to transform raw materials into final food products, but at the same time it has to ensure cost-efficient processes in order to guarantee adequate incomes to supply chain stakeholders, while keeping pricing stable to attract consumer demand. In particular, considering the perishability of the

products, lean management principles and coordination among actors are essential. The most important trend determining the level of performance of supply chains is digitalization.

Digitalization in the context of the food industry's supply chain involves the transformation of all available supply chain information into a digital format. This process is not just about digitizing physical documents, but also about capturing, analysing, and utilizing data to drive decision-making. For instance, consider a farm-to-fork supply chain. Digitalization can start right from the farm where sensors can be used to monitor soil conditions, weather patterns, and crop health. This data can be analysed to optimize farming practices, leading to improved cost efficiency. Next, during the transportation of food products, GPS and IoT devices can track the location and condition of the products in real-time. This enhances the resilience of the supply chain by allowing for quick responses to any disruptions or delays. In terms of regulatory compliance, digitalization can help maintain detailed records of every step in the food supply chain. This is particularly important in the food industry where safety regulations are stringent. Digital records can provide proof of compliance and can be easily accessed during audits or provide better transparency to final consumers. Finally, digitalization supports agility in the food supply chain. With the rise of online grocery shopping and delivery services, the ability to quickly respond to changes in demand has become crucial. Digital tools can provide real-time insights into consumer behaviour, enabling the supply chain to adapt swiftly.

In this context, we predict a rise of online grocery shops and delivery services to ensure customer fulfilment. From a network design perspective, food supply chains can become more cost-efficient and resilient through the adoption of micro-fulfilment centres. These centres are not meant for long-term storage but are temperature-controlled storage locations for having products ready to pick, pack and ship.

Supply chains will incorporate sustainable practices like precision agriculture, ensuring water use as well as reduced dependence from fertilizers. Additional measures will be considered to reduce food loss and waste. In particular, circular economy principles are utilized to prevent food waste or to ensure that scraps are recycled into new materials or products.

The possible projections variations that we have identified are the following:

- **I1. Supply chains performance strong growth.** In this scenario, food supply chains are able to successfully implement AI/automation technologies in combination with lean, resilient strategies. the result is that supply chains will be more cost-effective leading to sustainable economic margins.
- **I2. Supply chain performance moderate growth.** The implementation of new technologies and cost-efficient strategies is not fast and fully successful, leading to operational disruptions, loss of sales and market shares.
- **I3. Supply chain performance loss of growth.** The supply chains will steadily become obsolete in responding to demand, shrinking margins and thereby failing to deliver. The long-term impacts consist of bankruptcies and market exits of main players.

3.2.3 Bio-physical and environmental.

The report identifies five trends in this category, all of them affecting food security at the macro level.

J. Climate change

Changes in weather patterns induced by climate change impact negatively on the food production in Europe and it is expected this impact will worsen in the future. Additionally, the largest socio-economic and food security impacts are expected in regions where the natural resources needed for production are under stress.

Possible evolutions of this driver considered are two:

- J1. Slow increase, and
- J2. Strong increase of the climate change impacts on the food security ecosystem.

K. Environmental pollution

Degradation of natural resources negatively affects food security. The report explores how ozone air pollution, airborne particulate matter, nitrogen discharge due to fertilizers, pesticides, other chemical products and micro and macro plastics affect food production.

Two possible evolutions are considered:

- K1. Decrease of environmental pollution in Europe, given different European policies and strategies such as the European Green Deal or the Zero Pollution Action Plan for air, water and soil.
- K2. Increase of environmental pollution and its negative effects, if policies don't succeed.

L. Soil health

Intensive agriculture with high chemical inputs and the spread of persistent pollutants affects soil health. Additionally, urbanization also negatively affects soil health that becomes less fertile, less resilient to erosion and extreme weather events, taking up to centuries to recover.

Thus, two variants have been considered:

- L1. Slow degradation.
- L2. Quick degradation of soil health.

M. Pests and diseases

Pests and diseases negatively impact both food production and availability. Rising temperatures can promote the spreading of pests and invasive alien species. Human mobility and international trade also expose crops and animals to alien/emerging pathogens and invasive pests. The report states that food security in the EU is not endangered by animal diseases, however they can also negatively affect the EU has been proved by recent animal crises.

Thus, the following variants have been considered:

- M1. No change, and
- M2. Increase.

N. Biodiversity

Biodiversity favours food security in different ways. It increases biomass provision, filtration of pollutants, protection from natural hazards, and maintenance of habitats. Genetic diversity improves the resilience to climate change, pests and diseases.

Two variants have been considered taking into consideration strategies such as the EU's biodiversity strategy for 2030:

- N1. Biodiversity loss, and
- N2. Biodiversity restoration.

3.2.4 Research, innovation and technology.

Agricultural productivity needs to sustainably increase by near a 30% to meet the Zero Hunger ambitions. To do so, research, innovation and technology are crucial.

In this category, two trends are identified, affecting the food supply chain level of the food system.

O. Research, innovation and technology. Two future variants have been considered for this trend:

- O1. Growing investment and
- O2. Reducing investment in R&D.

P. Intensity of production. The variants considered are_

- P1. Intensive farming, as it currently is.
- P2. Sustainable intensification, an approach using innovations to increase productivity on existing agricultural land with positive environmental and social impacts (FAO definition).

3.2.5 Socio-cultural drivers

Q. Generational Renewal

The Eurostat census on EU agriculture in 2020 revealed that the number of farms in the EU decreased by 25% over the past decade. Meanwhile, the average size of the remaining farms continued to grow. However, the food sector struggles to attract young people compared to other industries. Currently, only about one in five EU farm managers are under 45 years old, and the proportion of young farmers in the overall population is declining. Additionally, access to land and credit remains a barrier for those entering the sector. Encouraging well-trained young individuals to pursue farming and fishing is crucial for the sustainability of food production and Europe's future food supplies.

- **Q1. Strong increment of young workers.** Notable increase of young workers through the usage of education, training, financial support, engaging communities and promoting entrepreneurship.
- **Q2. Moderate increment of young workers.** Some supporting activities are being driven but results are slightly successful.
- **Q3. No increment of young workers.** Governments do not enact any type of supporting activities, hence leading to lack of generation renewal.

R. Food choices

This driver focuses on the problem of ensuring sustainable, healthy diets and eating patterns. The trends that we examine show that consumers have a preference towards animal and processed food products, which typically are the product types that produce most environmental, economic and social consequences. The consequences can be seen mostly in the rising of non-communicable diseases like obesity, diabetes and cancer. Available statistics show that in the EU there is a prevalence of diets composed of energy, i.e., red meat, saturated fats, sugar and sodium. The opposite consumption of fruit, vegetables, legumes, nuts whole grain and dietary fibre and potassium are lower. Another important fact is that the most vulnerable segments of the population, e.g., low-income households, do not have access to sustainable food choices. According to statistics, 40% of population in Croatia, Greece, Bulgaria and Romania cannot afford a healthy diet.

The variants for this descriptor are the following:

- **R1. Strong increment of healthy and sustainable food consumption.** This variant explains that the proportion of the EU population consuming health and sustainable food increments and is better balanced with energy food (e.g., red meat).
- **R2. Medium increment.** In this scenario, the increment is moderate meaning that despite the increment, there is still a gap between people heating energy good versus healthy / sustainable one.
- **R3. Decrement of healthy food consumption.** In this case the consumption of food consumption decrements leading to an increased gap compared with the proportion of population eating energy food.

3.2.6 Political and institutional drivers

Two trends at the macro level of food security in the EU are identified.

S. Governance and legislative framework

Food security is a complex ecosystem with a variety of actors interacting. Instruments available are international initiatives, legally binding rules, soft regulations, economic instruments, education and information.

Two variants are considered:

- **S1. Increment and enhancement** of legislative measures, and
- **S2. Reduction** of legislation.

T. Conflicts

Conflicts (i.e., wars) disrupt food production and other supply chain activities. They also impact on food accessibility and availability. Although the global number of war-related deaths has been decreasing since 1946, conflict and violence are on the rise. Many of today's conflicts involve non-state actors like political militias, criminal organizations, and international terrorist groups. Key factors driving these conflicts include unresolved regional tensions, the erosion of the rule of law, weak or compromised state institutions, illicit economic activities, and resource scarcity worsened by climate change[4].

Thus, the following variants have been defined for this trend:

- T1. Slow increase of conflicts.
- T2. Strong increase in the number of conflicts.

3.2.7 Demographic drivers

Demographic trends play a vital role in long-term food security. As the global population grows, the demand for food and agricultural products rises. Changes in the age structure of the population can influence eating habits and, consequently, the types of food demanded. Additionally, the movement of people between rural and urban areas is anticipated to result in dietary changes.

The following variants have been defined for this trend:

- Population decreases: The EU-27's population is projected to peak in 2026 and then gradually decrease (UN DESA, 2022).
- Population increases: EU migration and asylum policies could potentially lead to an increase in Europe's population in the future

[4] UN. A new era of conflicts, 2022

3.3 Supply Chain Impacts

Based on the literature review (Section 3), different risks and their potential impacts were identified for the following main stages of the supply chain:

- Supply/farm,
- Transport and logistics,
- manufacturing/processing, and
- Demand.

3.3.1 Supply Farm risks and impacts

Table 1 outlines various risk sources originating at the supply side of food supply chains and their impacts on supply chains. Supply uncertainty, whether it involves overproduction or underproduction, leads to stock-outs and sales losses, triggering recovery strategies (Krstić et al., 2024, Azizsafaei et al., 2021, Prakash et al., 2017). Operational risks, such as machine or human errors causing delays in supply operations (e.g., collection, harvesting, transport, etc.), result in a temporary *supply stop, causing stock-outs and sales stoppage* for a shorter period (Krishnan et al., 2021). Disease outbreaks can have long-term effects on supplies, causing *supply halts, stock-outs, and sales stoppages,* significantly impacting *business operations* (Azizsafaei et al., 2021). Quality issues lead to the suspension of selected batches, resulting in *temporary and specific stock-outs* (Azizsafaei et al., 2021, Prakash et al., 2017). IT faults cause temporary *slow-downs in productivity*, leading to short-term delays that can be recovered with emergency shipments (Xiao et al., 2009). Infestations lead to *stock-outs and sales losses*, triggering recovery strategies to address the issue. Unintentional contamination incidents cause long-term *supply halts*, push for traceability on market-delivered contaminated batches, and activate reverse logistics and disposal processes, leading to *health injuries and deaths* (Septiani et al., 2016, Beker et al., 2016). Intentional contamination with chemical additives propagates downstream, resulting in customs control and penalties, health injuries and deaths, and overall business disruption (Beker et al., 2016).

Table 1. Supply/farm risks (SRS-I, Supply Risk Source Impact).

Code	Risk source	Impacts
SRS-I 1	Supply uncertainty (over-/under- production)	Stock-outs and sales losses, triggers recovery strategies
SRS-I 2	Operational (machines or human errors causing delays in supply operations, e.g., collection, harvesting, transport etc.)	Supply stop, stock-outs and sales stop but for shorter period.
SRS-I 3	Diseases	May affect supplies for longer term with significant effects on the business. Supply halt, stock-outs and sales stop.
SRS-I 4	Quality	Selected batches supply stop, leading to selected and temporary stock-outs
SRS-I 5	IT faults	Productivity temporary slow-down. Short term delays that can be recovered with emergency shipments
SRS-I 6	Infestation	Stock-outs and sales losses, triggers recovery strategies
SRS-I 7	Unintentional Contamination Incidents	Long-term supply halt, push on traceability on market delivered contaminated batches, activates reverse logistics and disposal processes, health injuries and deaths
SRS-I 8	Intentional Contamination with chemical additives	It propagates downstream: Customs control and penalties, health injuries and deaths, business disruption
SRS-I 9	Accidents	Temporary production stop or slow-down, labour injuries / deaths, legal investigations.

3.3.2 Transport/logistics risks and impacts

Table 2 describes how various risk sources originating during transport or logistics operations result into impacts on supply chains. Operational issues, such as machine or human errors causing delays in supply operations (e.g., collection, harvesting, transport, etc.), lead to operational problems related to the *collection, transport, and consignment of cargo* (Xiao et al., 2009). Perishability results in cargo losing quality and perishing, making it unusable and necessitating disposal (Wicaksono and Illés, 2022). Quality loss, due to delays or accidents, causes the cargo to lose quality but remain usable (Septiani et al., 2016). Delays, caused by traffic, congestion, or other traffic-related issues, result in shipment delays. Cargo loss occurs due to accidents during transport, leading to the loss of cargo (Wu et al., 2017). Theft results in the cargo being stolen during transport, leading to a loss of value (Urciuoli et al., 2010). Contamination of cargo during transport or temporary storage also poses a significant risk.

Table 2. Transport / logistics risks (TLR-I, Transport/Logistics Risk-Impact)

Code	Risk source	Impacts?
TLR-I 1	Operational (machines or human errors causing delays in supply operations, e.g., collection, harvesting, transport etc.)	Operational problems related to collection, transport and consignment of cargo
TLR-I 2	Perishability (dispose)	The cargo lose quality and perish. It cannot be used and therefore must be disposed.
TLR-I 3	Quality Loss	Due to delays or accidents, the cargo loses quality, but it can still be used
TLR-I 4	Delays	Due to traffic, congestion or other traffic related issues, the shipment is delayed
TLR-I 5	Cargo loss	Due to accidents, the cargo is loss during transport
TLR-I 6	Theft	Cargo is stolen during transport. Loss value
TLR-I 7	Cargo is contaminated during transport/temporary storage	

3.3.3 Manufacturing/processing risks and impacts

Table 3 expounds various risk sources generating within manufacturing/processing of food and their impacts on supply chains. Inventory excesses or stockouts, caused by supply disruptions and uncertainty, lead to *inventory costs, late deliveries to customers, and sales loss* (Krstić et al., 2024, Xiao et al., 2009). Faults in information technology systems are typically short-term but slow down productivity, causing *delays, backlogs, and the risk of perishability (Nyamah et al., 2017)*. Human error results in *quality problems in batches*, leading to *late*

deliveries to selected customers and potential reverse logistics to collect batches from the market (Nyamah et al., 2017, Zhao et al., 2017). Late deliveries can cause food to *perish during storage or transport, leading to market stockouts and contract penalties (Azizsafaei et al., 2021).*

Storage issues, including food deterioration, spoilage, or contamination, as well as mislabelling, can lead to *health injuries or deaths* (Song and Zhuang, 2017). Equipment failure causes operational *disruptions, late market deliveries, and contract penalties*. An equipment stop may also lead to *perishability* as food cannot be processed, amplifying market deliveries *delays and stockouts*. Minor accidents can involve employees working in the manufacturing facility or transport operations, leading to *temporary production or transport halts* (Xiao et al., 2009).

Table 3. Manufacturing/processing risks (MRS-I, Manufacturing Risk Source-Impact)

Code	Risk source	Impacts?
MRS-I1	Inventory excesses or stockouts (supply disruptions, uncertainty)	Inventory costs, late deliveries to customers, sales loss
MRS-I2	Faults in information technology systems	Normally short term. Slowing down productivity causing late, backlogs and the risk of perishability.
MRS-I3	Human error	Quality problems in batches leading to late deliveries to selected customers. It may cause reverse logistics to collect batches from market.
MRS-I4	Late deliveries	Food may perish during storage/transport, market stock outs and contract penalties.
MRS-I5	Storage	Food deterioration/perishability, spoilage or contamination leading, mislabelling leading to health injuries or deaths.
MRS-I6	Equipment failure	Operational disruptions, late market deliveries, contract penalties. Equipment stop may lead to perishability as food cannot be processed amplifying market deliveries and stockouts.
MRS-I7	Minor accidents	It can involve employees working in the manufacturing facility or transport operations. Production/transport temporary stops. Late deliveries are determined. Yet these could be easily solved with extra shipments.

3.3.4 Demand risks and impacts

Finally, Table 4 outlines various demand risk sources and their impacts on supply chains. Poor demand forecasts can result in *pessimistic forecasts causing stock-outs and loss of sales*, while optimistic forecasts generate *excesses and waste* (Xiao et al., 2009, Krstić et al., 2024). Demand uncertainty peaks can be caused by extreme events like pandemics, wars, and natural hazards. Inventory excesses lead to high *inventory costs and waste, whereas stock-outs result in lost sales*. Market failures due to contamination lead to untraceable quality problems in the upstream supply, causing *monetary losses, penalties, brand damage, and health impacts, including injuries and deaths* (Song and Zhuang, 2017, Beker et al., 2016). Regulatory risks involve balancing tax revenues with public health risks, leading to potential health impacts and deaths (Dome and Prusty, 2020). Perishability and cargo loss result in *wasted or disposed cargo (Prakash et al., 2017).*

Table 4. Demand risks (DRS-I, Demand Risk Source-Impact)

Code	Risk source	Impacts?
DRS-I1	Poor demand forecasts (demand forecasts)	Pessimistic forecasts result in stock-outs, hence loss of sales. Optimistic forecasts generate excesses and waste. Peaks in demand uncertainty could be cause by extreme events, e.g., pandemics, wars, natural hazards etc.
DRS-I2	Inventory excesses or stockouts	Excesses generates high inventory costs and waste. Stock-outs are lost sales. They can be generated by RRS-I1 but also from other risks manifesting in supply and manufacturing stages.
DRS-I3	Market failure due to contamination (lack of transparency)	Quality problems that cannot be traced backwards in upstream supply. Monetary losses (lost sales, reverse logistics and disposal), penalties, brand image. Health injuries and deaths.
DRS-I4	Regulatory risks	Tax revenues traded off with public health risks. Impacts on health and deaths.
DRS-I5	Perishability/Cargo loss	Cargo perish/is lost and needs to be wasted /disposed

4 Case studies projections and Cross-Impact scenarios

4.1 Fish Projections

The outcome of the workshop consists of the following eight refined projections, where 3-4 variations agave been developed, in total 25 projections.

- **F.A Labour shortage (e.g., due to aging, increased cost, pandemics etc).** Labour shortages in the fishery sector is known to be challenging due to lack of available and qualified workers to meet the industry's demands as well as the coastal locations of many fish farms. Without an adequate number of qualified workers, the industry may struggle to meet the growing demand for seafood products, which could impact both local and global markets.
    - **F.A1** Effective policies and initiatives, such as subsidies for training and automation, lead to a rejuvenation of the workforce and improved productivity in the sector.
    - **F.A2** Temporary improvements in labour availability through seasonal workers or automation, but fundamental issues such as an aging workforce and high labour costs remain unresolved.
    - **F.A3** Aging workforce and lack of labour due to high costs and inadequate training programs worsen production capacity.
- **F.B Market price volatility.** Market price volatility in the fishery sector refers to unpredictable changes in the prices of fish, e.g., prices rising or falling sharply, creating uncertainty for producers and consumers alike. In particular, the sector is threatened by fluctuating prices of energy.
    - **F.B1** Energy (oil) and feed prices are stable and consequently the fish market price is not affected and remain stable.
    - **F.B2** Prices fluctuate periodically due to global supply and demand factors (energy, transport etc.), but the changes are justified and manageable through adaptive business strategies.
    - **F.B3** Significant price volatility, driven by speculation and external market shocks (feed, energy, transport etc.), disrupts business planning and causes uncertainty in production costs and revenues.
- **F.C Climate Change impacting the environment (e.g., Marine invasive species).** Climate change refers to the alteration of temperatures and weather events that are going to take place in the coming years/decades. In relation to the fish market, the major risk related to climate change is the possible growth of invasive species.
    - **F.C1** Invasive species grows because of climate change. As a consequence, fish biodiversity is significantly reduced leading to fish supply scarcity.
    - **F.C2** Invasive species grows moderately because of climate change. As a consequence, fish biodiversity is moderately reduced leading to a moderate fish supply scarcity.
    - **F.C3** Despite climate change, there is no impact on invasive species growth. Consequently, fish native species are not affected with no impact on fish supply.
- **F.D Research and Innovation in the sector.** Research and innovation in the fishery sector are driving several advancements, particularly in the areas of electrification of vessels and the development of traceability and certification tools. Electrification of

fishing vessels reduces environmental impact by lowering emissions and noise pollution. Traceability and certification tools ensure the origin and quality of fisheries, promoting sustainable practices and providing consumers with detailed information about seafood products.

  - F.D1 Research and Innovation will bring to market traceability and certification tools to ensure origin and quality of fisheries. Electrification of vessels not achieved.
  - F.D2 Research and Innovation will bring to market electrified vessels but not traceability and certification tools to ensure origin and quality of fisheries.
  - F.D3 Research and Innovation will bring to market electrified vessels as well as traceability and certification tools to ensure origin and quality of fisheries.
  - F.D4 Research and Innovation will not manage to bring to market electrified vessels or certification tools to ensure origin and quality of fisheries.

- F.E Appropriate food education and awareness. Food education and awareness play a crucial role in shaping consumer behaviour towards sustainable food practices. When there are significant improvements in public educational initiatives, it leads to widespread consumer awareness, driving positive changes in consumer behaviour. In cases where education and awareness programs are lacking or ineffective, consumers have minimal understanding of the benefits of sustainable practices, perpetuating unsustainable consumption patterns. Therefore, educational initiatives are essential for promoting sustainable practices and ensuring informed consumer choices.
  - F.E1 Significant improvements in public educational initiatives result in widespread consumer awareness about sustainable food practices, driving positive changes in consumer behaviour.
  - F.E2 Moderate improvements in awareness campaigns cause intermittent changes in consumer choices, but knowledge gaps remain.
  - F.E3 Education and awareness programs are lacking or ineffective, leading to minimal understanding among consumers about the benefits of sustainable aquaculture, perpetuating unsustainable consumption patterns.
- F.F Geopolitical Conflicts. Geopolitical conflicts arise from political, economic, territorial, or cultural differences between countries or regions. These disputes can lead to military confrontations, economic disruptions, and humanitarian crises. Examples include the Russia-Ukraine conflict, the middle East crisis and trade tensions between the United States and China.
  - F.F1 International geopolitical conflicts in, near or even far from Europe (e.g. Ukraine, Middle East, Africa or Asia) will reduce, and stability will be back
  - F.F2 International geopolitical conflicts in, near or even far from Europe (e.g. Ukraine, Middle East, Africa or Asia) will continue but not reduce nor escalate.
- F.G Pandemics and Human Health.
  - F.G1 Pandemics and Human health are under control and do not disrupt food sector operations (production, transport etc)
  - F.G2 Pandemics and Human health occasionally occur in a regional scale affecting a fraction of the food sector operations and for a limited time.
  - F.G3 Pandemics and Human health occur often regionally or globally (such as covid) disrupting the food sector operations.
- F.H Illegal Fishing. Illegal fishing refers to fishing activities that violate the laws and regulations of the fishery sector. Examples of illegal fishing activities can include fishing without proper authorization, using prohibited gear, exceeding catch limits, or fishing

in restricted areas. Often illegal fishing result into overfishing, i.e., depleting marine resources and therefore causing substantial environmental damage. From an economic viewpoint it creates unfair competition against regular/legal business entities.

- F.H1 Overfishing / illegal fishing is negligible, respecting the seasons that every species is allowed to be fished protecting fish availability, offering balance in the aquatic environment.
- F.H2 Overfishing / illegal fishing is occurring occasionally, putting pressure on specific aquatic environments that are not monitored effectively, reducing the fishing repository slowly.
- F.H3 Overfishing / illegal fishing is occurring frequently, without any effective regulation. Excessive pressure on the aquatic environment occurs with varieties drastically being decreased or even vanished.

The Cross-Impact scenario analysis generates a total of 86 scenarios (max inconsistency accepted = 2). The scenarios are given in Table 23 of this report), with total impact scores between 0 and 53. Among these scenarios we further select and describe the 2 scenarios with highest total impact score:

- F1 Resilient Horizons: Suffering Economic Volatility and Environmental Challenges
- F2 Steady Waters: Economic volatility and Environmental Shifts

4.1.1 F1 Resilient Horizons: Suffering Economic Volatility and Environmental Challenges

This scenario considers effective policies and initiatives (F.A1) as the backbone of society, driving progress and innovation. However, the scenario is not without its challenges. Significant price volatility due to fluctuations in oil prices and other indirect supplies, such as feed (F.B3), creates economic instability and uncertainty.

In this scenario, the growth of invasive species affecting fisheries (F.C1) becomes a pressing issue, threatening local ecosystems and the livelihoods of those who depend on them. To combat these challenges, research focuses on developing digital traceability certificates and electrification (F.D3), ensuring transparency and sustainability in various industries.

Public educational initiatives see significant improvements (F.E1), empowering individuals with the knowledge and skills needed to navigate this complex scenario. Conflicts and wars are contained and reduced (F.F1), fostering a more peaceful global environment.

Occasional pandemics occur (F.G2), but they are limited in scale and cause only moderate disruptions, thanks to effective containment measures and public health initiatives. Meanwhile, overfishing and illegal fishing are negligible (F.H1), preserving marine biodiversity and ensuring the long-term sustainability of fisheries.

In this scenario, the balance between progress and challenges is delicate, but with effective policies, innovative research, and a commitment to education and sustainability, society can navigate these complexities and strive for a better future.

Table 5. "F1 Resilient Horizons: Suffering Economic Volatility and Environmental Challenges", descriptor consistency with projections and selected variants (Total Impact Score, TIS=53).

Projection	Selected Variants in scenario
F.A. Labour Shortage	-F.A1 Effective policies and initiatives
F.B. Market Price Volatility	-F.B3 Significant price volatility due to fluctuation of oil prices and other indirect supplies eg feed
F.C. Climate change impacting the environment	-F.C1 Favour growth of invasive species affecting fisheries
F.D. Lack of research and Innovation	-F.D3 Research will develop both digital traceability certificates and electrification
F.E. Lack of appropriate FOOD education	-F.E1 Significant improvements in public educational initiatives
F.F. Geopolitical Instability	-F.F1 conflicts and wars are contained and reduced
F.G. Pandemic and human health	-F.G2 There are occasional pandemics occurring but in limited scale and with moderate disruptions
F.H. Illegal Fishing	-F.H1 Negligible over-/illegal fishing

4.1.2 F2 Steady Waters: Navigating Economic and Environmental Shifts, in stable geopolitical conditions

In this scenario, effective policies and initiatives (F.A1) are at the forefront, driving positive change and innovation. However, the world faces significant price volatility due to fluctuations in oil prices and other indirect supplies, such as feed (F.B3), which creates economic instability and uncertainty.

The growth of invasive species affecting fisheries (F.C1) becomes a major concern, threatening local ecosystems and the livelihoods of those who depend on them. To address these challenges, research focuses on developing digital traceability certificates and electrification (F.D3), ensuring transparency and sustainability in various industries.

Public educational initiatives see significant improvements (F.E1), empowering individuals with the knowledge and skills needed to navigate this complex scenario. The current geopolitical situation remains stable (F.F2), providing a sense of security and predictability.

Occasional pandemics occur (F.G2), but they are limited in scale and cause only moderate disruptions, thanks to effective containment measures and public health initiatives. Meanwhile, overfishing and illegal fishing are negligible (F.H1), preserving marine biodiversity and ensuring the long-term sustainability of fisheries.

In this scenario, the balance between progress and challenges is delicate, but with effective policies, innovative research, and a commitment to education and sustainability, society can navigate these complexities and strive for a better future.

Table 6. "F2 Steady Waters: Navigating Economic and Environmental Shifts, in stable geopolitical conditions", descriptor consistency matrix with projections and selected variants (Total Impact Score, TIS=53).

Projections	Variants
F.A. Labour Shortage	-F.A1 Effective policies and initiatives
F.B. Market Price Volatility	-F.B3 Significant price volatility due to fluctuation of oil prices and other indirect supplies e.g., feed
F.C. Climate change impacting the environment	-F.C1 Favor growth of invasive species affecting fisheries
F.D. Lack of research and Innovation	-F.D3 Research will develop both digital traceability certificates and electrification
F.E. Lack of appropriate FOOD education	-F.E1 Significant improvements in public educational initiatives
F.F. Geopolitical Instability	-F.F2 the current geopolitical situation remains stable
F.G. Pandemic and human health	-F.G2 There are occasional pandemics occurring but in limited scale and with moderate disruptions
F.H. Illegal Fishing	-F.H1 Negligible over-/illegal fishing

4.1.3 Supply chain impacts

Supply chain impacts have been assessed for the both scenarios selected for the fish use case. Results of the impacts analysis are reported in Figure 4 and Figure 5.

F1 impacts on supply chains

The supply chain impacts that scored the highest (5 points, on Likert scale), are the following (Figure 4):

- **SRSI-8.** Accidents at suppliers, leading to Temporary production stop or slow-down, labour injuries / deaths, legal investigations.
- **TLRI-1.** Operational problems related to collection, transport and consignment of cargo and originated from machine or human errors during transport.
- **TLRI-2.** Loss of cargo quality and waste/dispose during transport.
- **TLRI-7.** Cargo contaminated during transport or temporary storage.
- **MRSI-1.** Inventory costs, late deliveries and sales loss due to fluctuations of production/supply at the manufacturing stage.
- **MRSI-5.** Food deterioration/perishability, spoilage or contamination, mislabelling leading to health injuries or deaths.
- **MRSI-6.** Operational disruptions, late market deliveries, contract penalties. Equipment stop may lead to perishability as food cannot be processed amplifying market deliveries and stockouts.
- **DRSI-3.** Quality problems that cannot be traced backwards in upstream supply. Monetary losses (lost sales, reverse logistics and disposal), penalties, brand image. Health injuries and deaths.
- **DRSI-5.** Cargo perish/is lost and needs to be wasted /disposed.

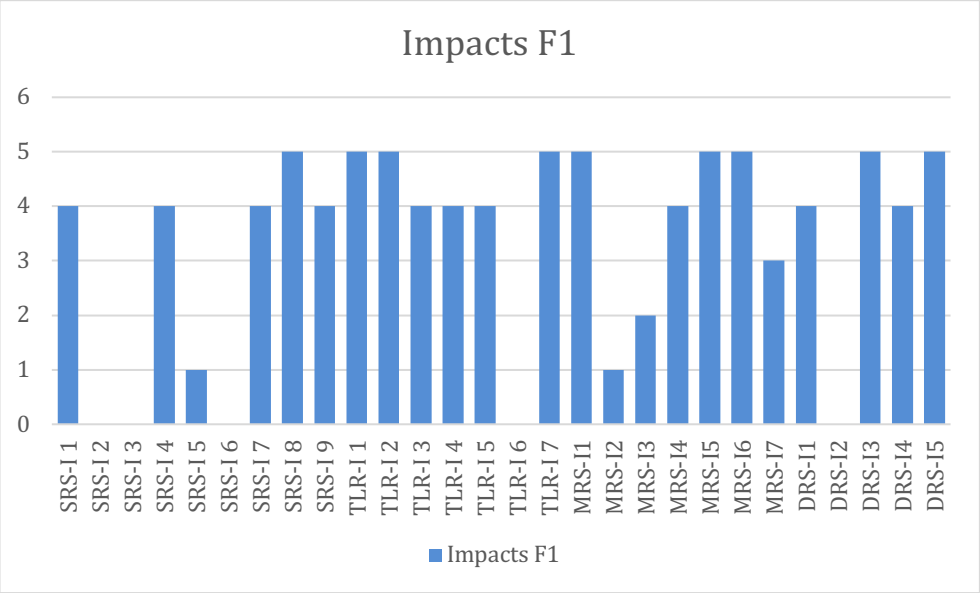

Figure 4. Supply chain impacts of F1 scenario.

F2 impacts on supply chains

The supply chain impacts that scored the highest (5 points, on Likert scale), are the following (Figure 5):

- **SRSI8.** Accidents at suppliers, leading to Temporary production stop or slow-down, labour injuries / deaths, legal investigations.
- **TLRI2.** Loss of cargo quality and waste/dispose during transport.
- **TLRI7.** Cargo contaminated during transport or temporary storage.
- **MRSI1.** Inventory costs, late deliveries and sales loss due to fluctuations of production/supply at the manufacturing stage.
- **MRSI5.** Food deterioration/perishability, spoilage or contamination, mislabelling leading to health injuries or deaths.
- **MRSI6.** Operational disruptions, late market deliveries, contract penalties. Equipment stop may lead to perishability as food cannot be processed amplifying market deliveries and stockouts.
- **DRSI3.** Quality problems that cannot be traced backwards in upstream supply. Monetary losses (lost sales, reverse logistics and disposal), penalties, brand image. Health injuries and deaths.
- **DRSI5.** Cargo perish/is lost and needs to be wasted /disposed.

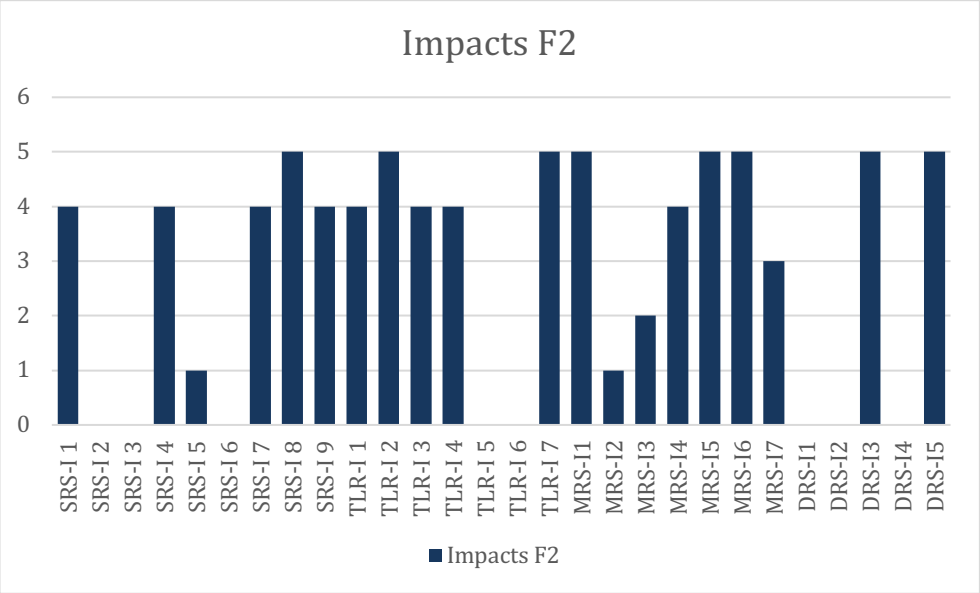

Figure 5. supply chain impacts of F2 scenario.

4.2 Aquaculture

As a result of the workshop, 12 projections were identified as relevant for the study. For each of these projections three possible variations are described, giving a total of 36 cases.

- A.A Labour shortage (e.g., due to aging, increased cost, pandemics etc). Labour shortages in aquaculture manifest as a lack of available and qualified workers to meet the industry's demands.
    - A.A1. Attractive salaries lead to a rejuvenation of the workforce and improved productivity in the sector.
    - A.A2. Some salary increments are offered with limited effects on attractiveness on job attractiveness.
    - A.A3. Companies are not able to offer attractive salaries leading to a loss of labour force.
- A.B Market price volatility. Market price volatility in aquaculture manifests through frequent and sometimes unpredictable changes in the prices of aquaculture products. Volatility manifests when prices rise or fall sharply, creating uncertainty for producers and consumers alike.
    - A.B1. Utility costs are stable, and competitiveness is low. Market price is not affected and remain stable.
    - A.B2. Prices fluctuate periodically due to costs of utilities fluctuations and market competitiveness. These fluctuations are managed through adaptive business strategies.
    - A.B3. Significant price volatility, driven by high market competitiveness and utility costs, disrupts business planning and causes uncertainty in production costs and revenues.
- A.C Climate Change impacting the environment. Climate change consists of the long-term shifts and alterations in temperature, precipitation, and other atmospheric conditions on Earth that are expected to happen in coming years and decades. Climate change has global effects, but it is expected to locally affect the geographic areas in

which aquaculture activities are located, mostly due to more frequent alternations of weather events that lead to water scarcity or the opposite flooding. Other important impacts include warmer water temperatures that can reduce the availability of oxygen in water and rising sea levels can lead to the intrusion of saltwater into freshwater aquaculture systems, affecting the water quality and suitability for certain species. Finally extreme events can ultimately damage the water supply infrastructure serving aquaculture activities.

  - A.C1. Climate change has little effects on external temperature excursions and access to water
  - A.C2. Climate change has moderate effects on temperature changes and access to water.
  - A.C3. Climate change impacts significantly external temperature with effects on energy consumption for cooling purposes. Access to water is also affected.

- A.D Research and Innovation in the sector. There are several key areas of development that are investigated in the aquaculture sector. Some of these include 1) recirculation systems that are used for water treatment allowing for a more efficient use of water, enabling farming in areas where water is scarce and 2) advances in fish therapeutics are helping to detect and treat diseases early, improving overall fish welfare.
  - A.D1 R&D reaches significant achievements and development of technologies for water treatment. This improves/reduces fish mortality. Likewise, farmers reach agreements in form of techniques and approaches to improve fish welfare.
  - A.D2 Some developments are done in terms of water treatment technologies, but these are not easily implementable and still expensive. Fish welfare agreements have moderate diffusion across farmers.
  - A.D3 Water treatment technologies are not advancing and remain expensive. Initiatives for fish welfare are not supported by the majority of farmers.
- A.E Appropriate food education and awareness. Food educational programs can be designed to inform individuals and communities about the role of sustainable and ecological practices in the sector. These programs support communities in enhanced understanding about the products they purchase at the grocery stores, favouring companies following sustainable practices and at the same time promoting and ensuring well-being and health.
  - A.E1 Significant improvements in public educational initiatives result in widespread consumer awareness about aquaculture practices effects on human health (less contaminants), driving positive changes in consumer behaviour (willingness to pay higher prices).
  - A.E2 Moderate improvements in awareness campaigns cause intermittent changes in consumer choices, but knowledge gaps remain.
  - A.E3 Education and awareness programs are lacking or ineffective, leading to minimal understanding among consumers about the benefits of sustainable aquaculture and health impacts. Consumers buys cheapest options available on the market.
- A.F Geopolitical Conflicts. Geopolitical conflicts can significantly impact energy prices by disrupting supply chains, creating market uncertainty, imposing sanctions, and threatening key transportation routes. These factors collectively lead to fluctuations in energy prices, making them highly sensitive to geopolitical events. Aquaculture activities are energy intensive and therefore could be impacted

significantly by these fluctuations. For instance, new systems being used to recirculate water or for the automation of feeding and other smart techniques require significant energy inputs. Additionally, the production and transportation of feed can also contribute to the overall energy consumption of aquaculture operations.
    - A.F1 International geopolitical conflicts in, near or even far from Europe (e.g. Ukraine, Middle East, Africa or Asia) will reduce and stability will be back. Energy prices are not affected
    - A.F2 International geopolitical conflicts in, near or even far from Europe (e.g. Ukraine, Middle East and Ukraine, Africa or Asia) will continue but not reduce nor escalate. Prices are expected to rise and fall in occasional times.
    - A.F3 Energy prices are significantly affected, increasing volatility of utilities in terms of sudden raises of prices.
- A.G Pollution and contamination. The level of pollution in the geographic areas in which aquacultural activities are located, ultimately determine the contamination of soil and the ground water circulating in it. As a matter of the fact, high quality water may become scarce and purification systems, that are expensive and energy intensive may need to be implemented. In extreme situations some drastic decisions may include to relocate the facilities to other places with lower levels of pollution and soil contamination.
    - A.G1 Pollution is under control, reducing drastically the contamination of soil and ground water.
    - A.G2 Pollution is limited, contaminating ground water partially. Water treatment solutions are needed. Increased pollution leads to the contamination of soil and ground water.
    - A.G3 This decreases water access or put more pressure on technologies to purify water.
- A.H Pests and diseases. Infectious diseases caused by bacteria, viruses, fungi, and parasites can lead to high mortality rates and economic losses. This is a problem, that often, manifest when a supplied species has not been controlled adequately, either by the supplier or the plant receiving it.
    - A.H1 Supply quality control concern and internal management, and water treatment lead to the introduction of infected diseases. Treatment of water and cleaning (high costs) happens often.
    - A.H2 Supply quality control may happen but are rare. Cleaning is high-cost but rare (e.g., once every 20 years).
    - A.H3 There is strong and effective control of suppliers and related materials/farming introduced in the plant. No treatment of water and cleaning are necessary.
- A.I Lack or inadequacy of policy frameworks. Local, or national governments can support the aquacultural sectors in multiple ways, e.g., proving fundings or incentives, ensuring fair trading agreements or stimulating research.
    - A.I1 Policies are developed to support the sector, e.g., market incentives.
    - A.I2 some limited policies are created but these are limited and too complex to apply.
    - A.I3 No policies are available to support the sector.
- A.J Lack of financial liquidity. Financial liquidity refers to the ease with which a company operating in this sector can convert cash into value by performing investments, stock products increasing capital tied up and increase employment.

    - A.J1 Financial instruments are available to support investments in new technologies and sustainable practices. Especially SMEs are able to access convenient instruments.
    - A.J2 Some instruments are available but with limited size and impacts on companies, especially SMEs.
    - A.J3 No financial instruments are available.
- A.K Decreased water availability and quality. Decreased water availability and quality pose significant challenges for aquaculture. Limited water resources can lead to insufficient water supply for aquaculture operations, affecting the growth and health of aquatic species. Poor water quality, caused by pollution, can result in disease outbreaks and increased mortality rates. These issues can disrupt production cycles, reduce yields, and impact the overall sustainability and profitability of aquaculture operation.
    - A.K1 Access to water is ensured and not at risk in the near future.
    - A.K2 Some water scarcity is experienced leading to some concerns in terms of production capacity and appearance of pests and diseases. Dependence to water treatment technologies increase.
    - A.K3 Significant concern are experienced forcing the plant to relocate.
- A.L Disruption or unavailability of up-stream supplies. Aquaculture plants need supplies to ensure continuity of day-to-day operations, sustainability and most of all the quality and well-being of the fish being farmed. Typical supplies include feed, water quality testing kits, medications, and cleaning for maintaining hygiene in tanks and ponds. In addition, some spare parts like filters, pumps and aeration systems need to purchased and kept in inventory, despite used less often.
    - A.L1 the plant is served by a comprehensive portfolio of suppliers that can ensure the continuity of operations.
    - A.L2 The plant is able to use multiple sources for a limited number of critical materials that are needed to run the operations.
    - A.L3 A large majority of the materials supplied remain single-sourced with loyalty-based partnerships stipulated locally.

Given the high number of projections and variants selected for this case study, a total of 1756 scenarios are generated (max inconsistency accepted = 2). The first 100 scenarios sorted on the total impact scores are provided in Table 24, 43<TIS <60. As for the previous case study we describe two selected scenarios with a high total impact score:

- A1 Balancing Innovation and Environmental Challenges.
- A2 Facing Workforce and Environmental Challenges.

4.2.1 A1 Balancing Innovation and Environmental Challenges

In the coming years, the aquaculture sector is a dynamic and evolving industry. Attractive job conditions have drawn a skilled workforce, making it a desirable field for employment. However, the sector faces significant price volatility, which poses challenges for maintaining stable profit margins. Environmental challenges are prominent, with significant temperature changes affecting aquatic ecosystems and pollution leading to soil contamination and water quality issues. Despite these hurdles, advancements in water treatment technologies have helped mitigate some of the negative impacts.

Food education remains a weak point, with the population not fully aware of the benefits and challenges of aquaculture. On the positive side, supportive policies have been developed, providing subsidies, research grants, and regulatory frameworks that encourage sustainable practices. Geopolitical conflicts have escalated, impacting energy prices and increasing operational costs for aquaculture businesses. However, financial instruments are available to help companies manage these risks and invest in sustainable practices.

The industry also faces significant concerns forcing relocation due to environmental and geopolitical factors. The reliance on single-sourced suppliers has made the supply chain vulnerable to disruptions. Fortunately, there are no major concerns about pests and diseases, allowing for more stable production.

Table 7. "A1 Balancing Innovation and Environmental Challenges", descriptor consistency matrix with projections and selected variants (Total Impact Score = 60).

Projections	Variants
A.A. Labour Shortage	A.A1 - Attractive job
A.B. Market Price Volatility	A.B3 - Significant fluctuations
A.C. Climate Change	A.C3 - Significant temperature changes
A.D. Research and Innovation	A.D1 - R&D significant development water treatment
A.E. Appropriate food and education	A.E3 - Education is lacking or ineffective
A.F. Geopolitical conflicts	A.F3 - Conflicts escalate impacting energy prices
A.G. Pollution and contamination	A.G3 - pollution increases with impacts on water
A.H Policy frameworks	A.H1 - Policies are developed to support the sector
A.I Lack of financial liquidity	A.I1 - Financial instruments available
A.J Decreased water availability and quality	A.J3 - Significant concerns forcing relocation
A.K Suppliers availability	A.K3 - Large majority are single sourced
A.L Pests and diseases	A.L3 - No concerns

4.2.2 A2 Facing Workforce and Environmental Challenges

In this scenario, the industry is grappling with a significant loss of labour force, leading to operational challenges and increased reliance on automation. This, coupled with significant price fluctuations, makes it difficult for businesses to maintain economic stability. Environmental challenges are prominent, with significant temperature changes affecting aquatic ecosystems and pollution leading to water quality issues. However, advancements in water treatment technologies have provided some relief, helping to mitigate the adverse effects of pollution and temperature changes.

Despite these advancements, food education remains lacking or ineffective, leaving the general population unaware of the benefits and challenges of aquaculture. On the positive side, supportive policies have been developed, providing subsidies, research grants, and regulatory frameworks that encourage sustainable practices. Geopolitical conflicts have escalated, impacting energy prices and increasing operational costs for aquaculture businesses. Unfortunately, there are no financial instruments available to help companies

manage these risks, making it harder for them to invest in sustainable practices and innovations.

The industry also faces significant concerns forcing relocation due to environmental and geopolitical factors. The reliance on single-sourced suppliers has made the supply chain vulnerable to disruptions. Fortunately, there are no major concerns about pests and diseases, allowing for more stable production.

Table 8. "A2 Facing Workforce and Environmental Challenges", descriptor consistency matrix with projections and selected variants (Total Impact Score, TIS= 58).

Projections	Variants
A.A. Labour Shortage	A.A3 - Loss of labour force
A.B. Market Price Volatility	A.B3 - Significant fluctuations
A.C. Climate Change	A.C3 - Significant temperature changes
A.D. Research and Innovation	A.D1 - R&D significant development water treatment
A.E. Appropriate food and education	A.E3 - Education is lacking or ineffective
A.F. Geopolitical conflicts	A.F3 - Conflicts escalate impacting energy prices
A.G. Pollution and contamination	A.G3 - pollution increases with impacts on water
A.H Policy frameworks	A.H1 - Policies are developed to support the sector
A.I Lack of financial liquidity	A.I3 - No financial instruments available
A.J Decreased water availability and quality	A.J3 - Significant concerns forcing relocation
A.K Suppliers availability	A.K3 - Large majority are single sourced
A.L Pests and diseases	A.L3 - No concerns

4.2.3 Supply chain impacts

Supply chain impacts have been assessed for the two scenarios selected for the aquaculture use case. Results of the impacts analysis are reported in Figure 6 and Figure 7Figure 4.

A1 impacts on supply chains

The supply chain impacts that scored the highest (5 points, on Likert scale), are only three (Figure 6):

- SRSI-1. Stock-outs and sales losses, triggers recovery strategies.
- SRSI-9. Temporary production stop or slow-down, labour injuries / deaths, legal investigations.
- DRSI-1. Pessimistic forecasts result in stock-outs, hence loss of sales. Optimistic forecasts generate excesses and waste. Peaks in demand uncertainty could be cause by extreme events, e.g., pandemics, wars, natural hazards etc.

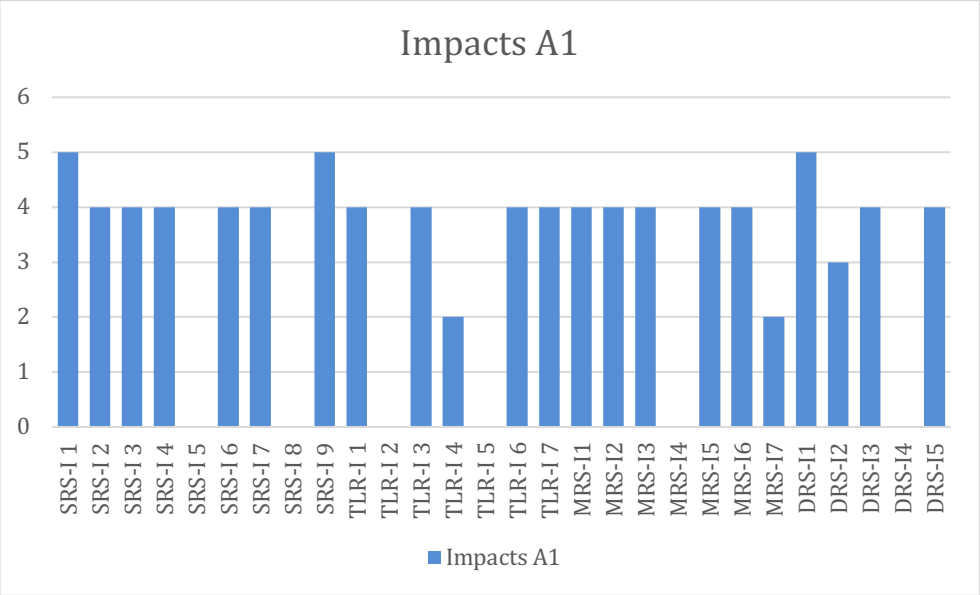

Figure 6. Supply chain impacts scenario A1.

A2 Impacts on supply chains

The supply chain impacts that scored the highest (5 points, on Likert scale), are only three (Figure 7):

- SRSI-1. Stock-outs and sales losses, triggers recovery strategies.
- SRS-I 7. Long-term supply halt, push on traceability on market delivered contaminated batches, activates reverse logistics and disposal processes, health injuries and deaths
- SRSI-9. Temporary production stop or slow-down, labour injuries / deaths, legal investigations.
- DRSI-1. Pessimistic forecasts result in stock-outs, hence loss of sales. Optimistic forecasts generate excesses and waste. Peaks in demand uncertainty could be cause by extreme events, e.g., pandemics, wars, natural hazards etc.

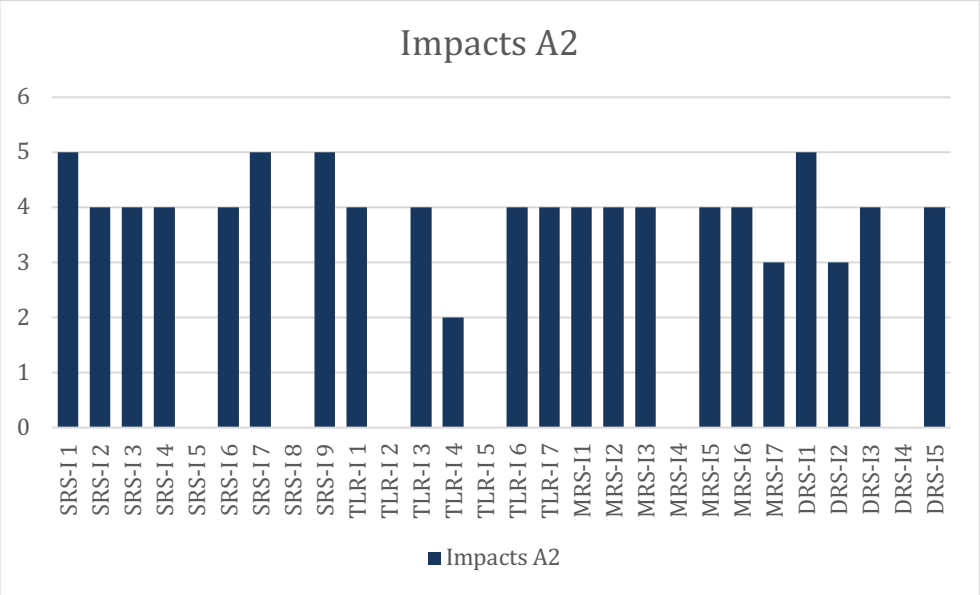

Figure 7. Supply chain impacts scenario A2.

4.3 Grain

From the workshop driven with the case study's representative a set of 7 projections is identified. In correspondence of these projections 3 variants are identified, giving a total of 21 possible variations.

- G.A Energy market volatility. Energy market volatility can significantly impact the grain sector due to the interconnected nature of these markets. For instance, fluctuations in crude oil prices can lead to changes in the cost of agricultural production and transportation.
    - G.A1 Heavy destructions discontinue as a result of reduced geopolitical tensions. The country starts the reconstruction and renovation of the energy system. Energy market volatility reduces ensuring more stable energy prices, safeguarding food production.
    - G.A2 Shift to Renewable Energy and development/investment in local small electrical stations. To mitigate the risks associated with energy price volatility, there may be a significant shift towards renewable energy sources and local electrical stations to power the agricultural sector. This transition could reduce dependency on nuclear power or fossil fuels whose access is compromised by the war. This could partially stabilize production costs presenting some intermittent volatility.
    - G.A3 Heavy extensive destructions because of Russian attacks on the infrastructure leads to higher market volatility. Energy market volatility could lead to greater price volatility in grain production. This may result in unpredictable costs for farmers, impacting their ability to plan and invest.
- G.B (Geo)political instability and war. Geopolitical instability, conflicts, and wars can have profound impacts on global economies and societies. Conflicts such as the Russia-Ukraine war and tensions in the Middle East can escalate regional instability, affecting global energy and food security. This projection includes possible developments of the on-going conflict between Russia and Ukraine.

  - G.B1 The ongoing geopolitical crisis determined by the Russian-Ukrainian War will reduce, and stability will be back to normality.
  - G.B2 The Russian-Ukrainian war is stable and will not escalate.
  - G.B3 The ongoing Russian-Ukrainian war will continue and it escalates to a wider level.
- G.C Prolonged drought. Prolonged droughts lead to reduced water availability, affecting agriculture, ecosystems, and communities. They cause crop failures, higher food prices, and increased wildfire risks, making sustainable water management crucial.
  - G.C1 Adoption of Drought-Resistant Crops designed to withstand lower water availability and higher temperatures, helping to maintain yields despite adverse conditions and/or Advanced Irrigation Techniques ensuring that crops receive the necessary moisture with minimal waste. Governments might include support policies such as subsidies for water-saving technologies, insurance schemes to cover crop losses due to drought, and investments in research for sustainable agricultural practices. Additionally, farmers can easily access fertilizers/chemicals to increase yield.
  - G.C2 Slow implementation of advanced irrigation techniques/resistant crops or limited access to fertilizers/chemicals leads to mixed results. While some regions benefit from improved water efficiency and stable yields, others struggle with the high costs and technical challenges of adopting these new systems.
  - G.C3 Prolonged droughts lead to significant reductions in grain yields, e.g., through limited access to arable land. Water scarcity and extreme temperatures overwhelm existing agricultural practices, resulting in food shortages and increased prices, severely impacting both farmers and consumers.
- G.D Failure of transport infrastructure and logistics. A robust and resilient infrastructure is essential to ensure the continuous transport of grain and related logistics activities. In Ukraine, efforts are underway to restore seaports and railways, thereby generating the necessary transport capacity to trade and export the grain produced. These restoration projects are crucial for maintaining the flow of agricultural goods and supporting the country's economy.
  - G.D1 Ukraine manages to keep control of the main seaports to export grain through the Black Sea. Damages are restored or counteracted with redundancy of the infrastructure as well as coordination with additional routes, inland or other seaports.
  - G.D2 Mixed Improvements: seaports experience severe blockages and intermittent operations due to continued attacks on the infrastructure. Additional channels via railway are created, e.g., via Romania or Hungary, but these offer limited capacity as well as diverse inefficiencies. In particular, due to different standards of the railway trucks the grain needs to be reloaded increasing delays/delivery times. All seaports are occupied by Russian troops.
  - G.D3 The new projects opening railway connections with Romania and Hungary are not completed. This leads to severe disruptions in grain supply chains, causing food shortages and increased prices, negatively impacting both producers and consumers.
- G.E Generational renewal (e.g., lack of attractiveness in the food sector for younger generations). Generational renewal in the grain sector is vital for sustainability. It involves supporting young farmers with financial aid, land access, and credit to replace the aging farming population and ensure the sector's future.

    - G.E1 Increased Attractiveness and Support: Enhanced policies and incentives, such as subsidies, training programs, and access to technology, make farming more attractive to younger generations. In particular, specific legislation could favour the introduction of foreign workforce in the sector. This leads to a steady influx of young, innovative farmers, ensuring the sustainability and modernization of grain production.
    - G.E2 Gradual Improvement with Regional Variations: Some regions successfully implement measures to attract young farmers, e.g., using immigration policies, while others struggle due to economic and social barriers. However, the continuing war is still mobilizing youth, pushing them away from the sector (emigrating to other countries, or moving to the front line). This leads to uneven generational renewal across Europe, with certain areas thriving and others facing ongoing challenges
    - G.E3 Decline in Young Farmers: Despite efforts, the agricultural sector fails to attract younger generations due to escalation of the war, and absence of policies targeting the introduction of foreign labour in the sector. This results in an aging farmer population, reduced innovation, and potential declines in productivity and food security
- G.F Market contraction. Market contraction refers to a decrease in the total number of businesses operating within a particular industry or market. This can occur due to various factors such as economic downturns, increased competition, or changes in consumer demand. As a result, some firms may go out of business, merge with others, or exit the market altogether. This reduction in the number of firms can lead to decreased market competition and potentially higher prices for consumers.
    - G.F1 The market does not contract, and the agricultural sector maintains its traditional configuration where several small businesses, family driven, dominate the market.
    - G.F2 The market shows some signs of small businesses moving abroad or closing.
    - G.F3 Several small businesses are forced to terminate operations, and larger players enter the market. While efficiency may improve, competition is affected hindering entrance and work opportunities of local families.
- G.G Labour Shortage. Wars often lead to the loss of a substantial portion of the working-age population due to casualties and displacement. This reduction in the labour force can result in decreased productivity and economic output of the grain sector.
    - G.G1 War terminates and in combination with effective policies and initiatives, such as subsidies for training and automation, lead to an increase of the workforce and improved productivity in the sector.
    - G.G2 Workers are somewhat declining but there are some small improvements through seasonal workers or automation that ease the problem.
    - G.G3 Decline of workers due to war. Emigration and mobilization affect access to workforce, while aging increases in importance.

A total of 104 scenarios are generated using a maximum consistency of two. Table 25 reports the first 100 scenarios with total impact scores from 0 to 19. The following text describe two of the scenarios with highest total impact scores:

- G1 Path to Stability and Growth

- G2 War challenges amidst progress

4.3.1 G1 Path to Stability and Growth

In this scenario, heavy destructions cease, and the ongoing Russian-Ukrainian War diminishes. Control of the main seaports is effectively managed, leading to increased attractiveness and support for the region. This stability allows for the restoration and enhancement of infrastructure, facilitating the smooth transport of goods and boosting trade activities. The absence of market contraction indicates a resilient economy, with businesses continuing to operate and grow. Additionally, subsidies for training and automation lead to an increase in the workforce, as more individuals gain the skills needed for modern agricultural practices. This combination of factors creates a stable and supportive environment for economic growth and development, ensuring the continuous flow of agricultural goods and bolstering the region's overall economic health.

Table 9. "G1 Path to Stability and Growth", descriptor consistency with projections and selected variants (Total Impact Score = 19).

G.A. Energy market volatility	G.A1 - Heavy destructions discontinues
G.B. (Geo)political instability and war	G.B1 - The ongoing geopolitical crisis determined by the Russian-Ukrainian War will reduce, and stability will be back to normality.
G.C. Failure of transport infrastructure and logistics.	G.C1 - Control of the main seaports is managed
G.D. Generational renewal	G.D1 - Increased Attractiveness and Support
G.E. Market contraction	G.E1 - No market contraction
G.F. Labour shortage	G.F1 - Subsidies for training and automation lead to an increase of the workforce

4.3.2 G2 War challenges amidst progress

In this scenario, the Russian-Ukraine war escalates, leading to intermittent operations due to continued attacks on infrastructure. Despite efforts to promote renewable energy and local small electrical stations, the agricultural sector faces a decline in young farmers. Small businesses are either moving abroad or closing, further straining the economy. Additionally, there is a strong decline in the workforce due to the ongoing war, exacerbating the challenges faced by the country.

Table 10. "G2 war challenges amidst progress", descriptor consistency matrix with projections and selected variants (Total Impact Score, TIS = 18).

Projections	Variants
G.A. Energy market volatility	G.A2 - Renewable Energy and local small electrical stations
G.B. (Geo)political instability and war	G.B3 – Russian-Ukrainian War escalates
G.C. Failure of transport infrastructure and logistics.	G.C2 - Intermittent operations due to continue attacks on the infrastructure
G.D. Generational renewal	G.D3 - Decline in Young Farmers
G.E. Market contraction	G.E2 - Small businesses moving abroad or closing
G.F. Labour shortage	G.F3 - Strong decline of workers due to war

4.3.3 Supply chain impacts

Supply chain impacts have been assessed for the two grain use case scenarios. Results of the impacts analysis are reported in Figure 8 and Figure 9Figure 4.

G1 impacts on supply chains

The supply chain impacts that scored the highest (4 points, on Likert scale), are only three (Figure 8):

- SRS-I3. It affects supplies for longer term with significant effects on the business. Supply halt, stock-outs and sales stop.
- SRS-I5. Productivity temporary slow-down. Short term delays that can be recovered with emergency shipments
- SRS-I6. Stock-outs and sales losses, triggers recovery strategies.
- TLR-I1. Operational problems related to collection, transport and consignment of cargo.
- MRS-I1. Inventory costs, late deliveries to customers, sales loss.
- DRS-I3. Quality problems that cannot be traced backwards in upstream supply. Monetary losses (lost sales, reverse logistics and disposal), penalties, brand image. Health injuries and deaths.

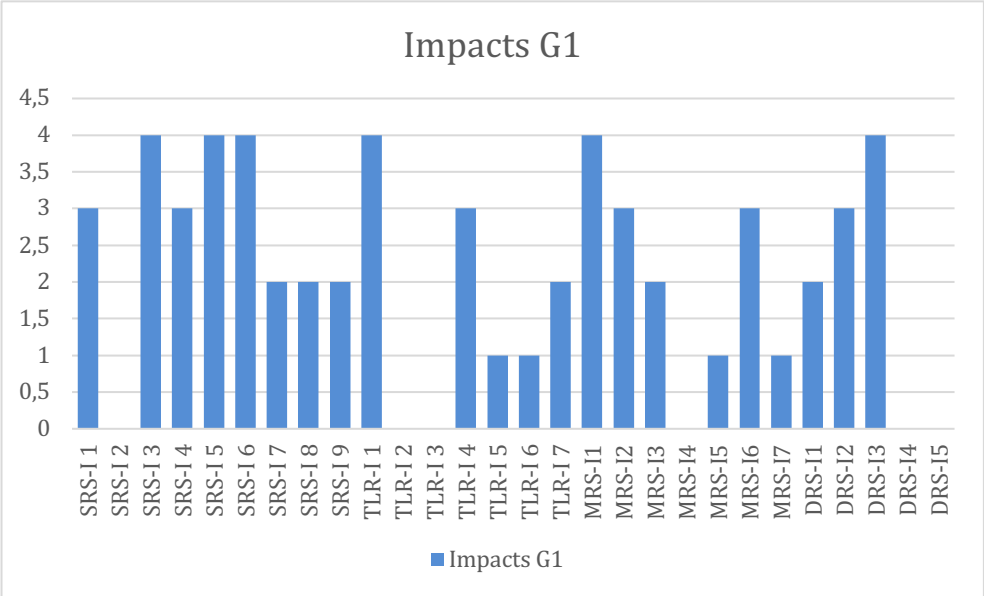

Figure 8. Supply chain impacts of scenario G1.

G2 impacts on supply chains

Figure 9 expounds the resulting impacts of scenario G2 on food supply chains. Based on the figure, the impacts scored highest are the same as those for G1 (4 points, Likert scale 1-5):

- SRS-I3. It affects supplies for longer term with significant effects on the business. Supply halt, stock-outs and sales stop.

- SRS-I5. Productivity temporary slow-down. Short term delays that can be recovered with emergency shipments
- SRS-I6. Stock-outs and sales losses, triggers recovery strategies.
- TLR-I1. Operational problems related to collection, transport and consignment of cargo.
- MRS-I1. Inventory costs, late deliveries to customers, sales loss.
- DRS-I3. Quality problems that cannot be traced backwards in upstream supply. Monetary losses (lost sales, reverse logistics and disposal), penalties, brand image. Health injuries and deaths.

Examining the differences with G1, we found that impact SRSI2 increases to +2 (0 for the G1 scenario): SRS-I 2 Supply stop, stock-outs and sales stop but for shorter period.

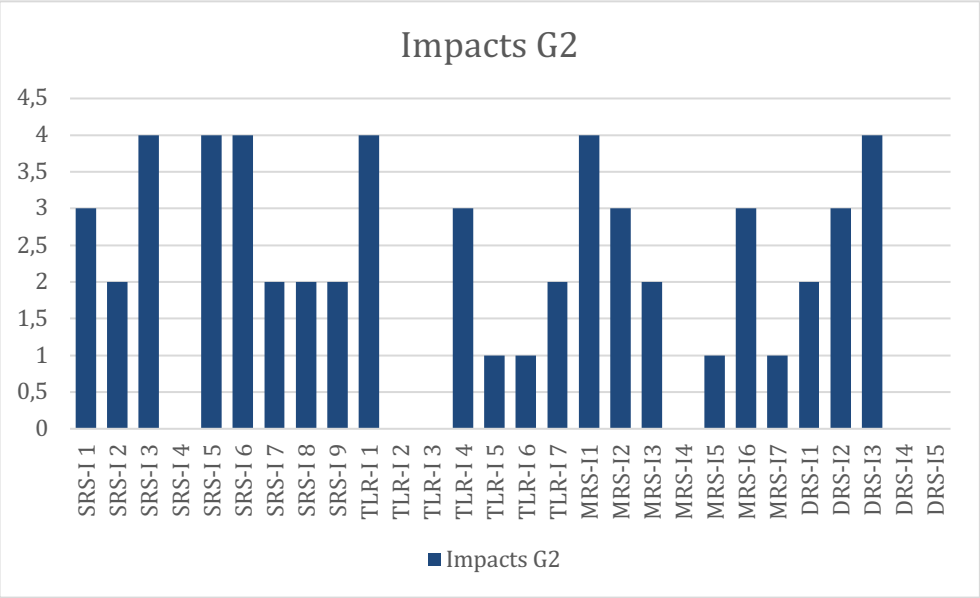

Figure 9. Supply chain impacts of scenario G2.

4.4 Milk and dairy products Greece

A total of 6 projections and three variants per projection were identified as an outcome of the workshop held with the Greek case study. This gives a total of 18 possible projections/variations.

- MDG.A Market price volatility. This projection refers to the volatility of milk and dairy prices as an effect of fluctuations of costs and diverse inefficiencies.
    - MDG.A1 Stabilized Prices through Innovation: Advances in technology and improved supply chain management lead to more stable milk and dairy prices. Innovations in production and distribution reduce costs and inefficiencies, helping to buffer against market fluctuations. Strict controls based on digital tools and traceability systems eliminate possibilities for illegal imports of sheep milk and assist higher levels of market control for fraud regarding cow milk use for feta. Higher levels of market information contribute to reduce uncertainties regarding feed availability that are the most important cost driver.
    - MDG.A2 Mixed Impact of Policy Interventions: Government policies and market interventions have mixed success in stabilizing prices. While some measures -

such as the coupled payments to sheep farmers in Greece - help mitigate volatility, others fail to address underlying issues (mainly with regards to market regulation and feedstuff availability), resulting in only partial stabilization. These include decoupled payments (they stand for a very small part of incomes of dairy cow farms), while structural problems remain regarding the use of rangelands and controls in illegal imports of raw sheep milk to be used for feta production.

    - MDG.A3 Increased Volatility due to Climate Change: Climate change exacerbates weather extremes, affecting feedstock, and thereby milk yields and price volatility. High irregularities in feedstuff availability (including quality issues) have an effect on milk productivity and also burden the production costs of farms. Frequent droughts and floods disrupt production, causing significant price swings and economic instability for producers and consumers.

- MDG.B Prolonged drought and heatwaves. Climate change may have different impacts depending on the geographic location of the area being investigated. In the context of this case study, the type of climatic conditions that represent a threat to the dairy industry include prolonged drought and heatwaves. These weather phenomena can affect the cattle as well as the feed production.
    - MDG.B1 Technological and Genetic Advancements: The dairy industry adopts advanced technologies and breeds heat-resistant cattle. Innovations in cooling systems, water management, and feed efficiency help maintain milk production quantity and quality at necessary levels despite challenging climatic conditions. With these measures, feed production is ensured and smoothened. For extensive sheep systems, rangeland management effective practices contribute to maintain accessible and productive pastures.
    - MDG.B2 Adaptation with Mixed Success: some farmers adopt improved irrigation and heat management systems, while others struggle due to financial or logistical barriers. Occasional shortages in key feedstuff (especially forage) are experienced and this increases uncertainty and production costs. This results in uneven impacts on milk quantity and quality, with some farmers maintaining stable output and others experiencing periodic declines. You could also consider the following: Access to rangelands and productivity are exacerbated and extensive farmers are becoming even less effective and diminished.
    - MDDG.B3 Severe Production Declines: Prolonged droughts and heatwaves lead to significant reductions in milk quantity and quality because of reduced livestock productivity, high irregularities in feedstuff availability and decrease of rangelands. Heat stress on livestock and water scarcity result in lower productivity and higher mortality rates, causing economic strain on dairy farmers and potential milk shortages.
- MDG.C Generational renewal (e.g., lack of attractiveness in the food sector for younger generations). The milk and dairy sector is affected by the issue of low attractiveness among youth and consequently a struggle to find new workforce, while the existing one is aging and loosing efficiency/productivity. Support and tailored initiatives are necessary to make the sector more appealing to younger generations.
    - MDG.C1 Enhanced Attractiveness and Support: Comprehensive policies and incentives, such as grants, training programs, and access to modern technology, make dairy farming more appealing to younger generations. This

results in a steady influx of young, innovative farmers, ensuring the sustainability and modernization of the dairy sector.
    - MDG.C2 Some farmers successfully implement measures to attract young farmers, while others struggle due to economic and social barriers. This results in uneven generational renewal across Europe, with certain areas thriving and others facing ongoing challenges. In addition, availability of foreign workers partially offsets the problem but still uncertainties about farm continuation remain and also foreign workers are not as skilled as family members.
    - MDG.C3 Decline in Young Farmers: Despite efforts, the dairy sector fails to attract younger generations due to perceived low profitability and high labour demands. This leads to an aging farmer population, reduced innovation. Lack of foreign workers leads to shrinkage of the sector, less farms and potential declines in productivity and food security.
- MDG.D (Geo)political instability, conflicts, war. The war in Europe as well as other crises in the world are increasing uncertainty and thereby threatening the security of food training and supply. Geopolitical stability is necessary to ensure that the sector can operate in a transparent and productive environment.
    - MDG.D1 Strengthened Resilience and Cooperation: European countries enhance their cooperation and develop robust contingency plans to ensure food security. Investments in resilient infrastructure and diversified supply chains help mitigate the impacts of geopolitical instability, maintaining stable milk and dairy production as well as regulated feedstuff markets.
    - MDG.D2 The effects of geopolitical instability vary across Europe. Some regions manage to maintain stable production through localized solutions and adaptive measures, while others face periodic disruptions and challenges, leading to an uneven impact on milk and dairy production as well as occasional uncertainties in feedstuff markets.
    - MDG.D3 Severe Disruptions and Shortages: Ongoing conflicts and political instability lead to significant disruptions in milk and dairy supply chains. Transportation blockages, resource scarcity, and damaged infrastructure result in severe production declines and widespread shortages, affecting both producers and consumers.
- MDG.E Inappropriate food processing and packaging leading to food loss. Inappropriate food processing and packaging used for milk and dairy products can lead to significant food loss due to outdated techniques, poor handling, substandard materials, and temperature control issues. This not only results in economic losses and environmental damage but also wastes valuable resources like water, labour, and energy. Modernizing processing methods, improving training, and using better materials can significantly reduce this waste.
    - MDG.E1 Technological Innovations: Significant advancements in food processing and packaging technologies as well as in logistics (smooth transportation under good conditions especially in periods of extreme heat) drastically reduce food loss. Innovations such as smart packaging that monitors freshness and improved preservation techniques ensure that milk and dairy products remain safe and consumable for longer periods.
    - MDG.E2 Gradual Improvements with Mixed Results: Some farmers adopt new technologies and improve their processing while also some dairies have the capacity to adopt better processing, logistics and packaging methods, leading

to reduced food loss. However, others lag behind due to financial constraints or lack of access to innovations.
    - MDG.E3 Persistent Inefficiencies: Despite efforts, outdated processing and packaging methods continue to cause substantial food loss. Inadequate infrastructure and lack of investment in modern technologies result in high levels of spoilage and waste, negatively impacting both producers and consumers.
- MDG.F Failure of transport infrastructure. Failures in transport infrastructure, such as aging roads, bridges, and railways, natural disasters, and poor planning, can cause severe disruptions. These failures lead to economic losses, safety hazards, increased emissions, and reduced access to essential services. Investing in resilient infrastructure, proactive maintenance, and adaptive planning is crucial to ensure reliable transport networks.
    - MDG.F1 Road infrastructure significantly improves rural roads connecting farmers to factory. Transportation improves significantly during summertime ensuring reliability and lower perishability.
    - MDG.F2 Road infrastructure improves but not equally in the region of interest. This implies that some farmers may benefit of better road connections, others not.
    - MDG.F3 Road infrastructure does not improve and maintenance is not performed, increasing the wear and tear of the pavement. Transportation becomes less reliable, during summertime, increasing the risk for perishability.

The scenario analysis generates 122 scenarios (max consistency = 2) with total impacts scores between -10 and 56. Annex B reports the first 100 scenarios for the selected case. Two selected scenarios based on their Total Impact Score (max values) have been selected for further description:

- MDG1 Sustainable and Resilient Agricultural Future.
- MDG2 Progress Gradually Towards a Sustainable Agricultural Future.

4.4.1 MDG1 Sustainable and Resilient Future

In a future where sustainability and innovation are fundamental, the agricultural sector has undergone significant transformations. A higher level of traceability and information (MDG.A1) allows farmers and consumers to track the origin and quality of produce, ensuring transparency and trust in the food supply chain. Technological and genetic advancements (MDG.B1) have led to the development of resilient crops that can withstand extreme weather conditions and pests, boosting productivity and food security. The agricultural sector has become more attractive and supportive (MDG.C1), encouraging younger generations to pursue careers in farming. Enhanced educational programs and financial incentives have led to a generational renewal, bringing fresh ideas and energy to the industry. Strengthened resilience and cooperation (MDG.D1) among countries and regions have fostered a collaborative approach to addressing global challenges such as climate change and food security.

Significant advancements in packaging processes and logistics (MDG.E1) have reduced food loss and waste, ensuring that more produce reaches consumers in optimal condition. Road infrastructure has significantly improved (MDG.F1), facilitating efficient transportation of goods and reducing delays and costs associated with poor infrastructure.

Table 11. "MDG1 Sustainable and Resilient Future", descriptor consistency matrix with projections and selected variants (Total Impact Score, TIS = 56).

Projections	Variants
MDG.A. Market Price Volatility	MDG.A1 - Higher level of traceability and information
MDG.B. Prolonged Droughts and Heatwaves	MDG.B1 - Technological and Genetic Advancements
MDG.C. Generational Renewal	MDG.C1 - Enhanced Attractiveness and support
MDG.D. Geopolitical instability	MDG.D1 - Strengthened resilience and cooperation
MDG.E. Inappropriate food processing and packaging	MDG.E1 - Significant advancements in packaging processes and logistics
MDG.F. Failure of transport infrastructure	MDG.F1 - Road infrastructure significantly improved

4.4.2 MDG2 Progress Gradually Towards a Sustainable Future

In this scenario, the agricultural sector sees significant strides toward sustainability and efficiency. A higher level of traceability and information (MDG.A1) ensures transparency in the food supply chain, allowing consumers to make informed choices and enhancing trust in the system. Technological and genetic advancements (MDG.B1) lead to the development of resilient crops and innovative farming practices, increasing productivity and food security. The sector becomes more attractive and supportive (MDG.C1), encouraging younger generations to pursue careers in agriculture and bringing fresh perspectives and energy into the industry. Strengthened resilience and cooperation (MDG.D1) foster a collaborative approach to addressing global challenges such as climate change, food security, and market fluctuations. While there are significant advancements in packaging processes and logistics, the improvements are gradual (MDG.E2). This slow but steady progress helps to reduce food loss and waste over time, ensuring that more produce reaches consumers in optimal condition. Additionally, road infrastructure is significantly improved (MDG.F1), facilitating efficient transportation of goods and reducing delays and costs associated with poor infrastructure.

Table 12. "MDG1 Sustainable and Resilient Future", descriptor consistency matrix with projections and selected variants (Total Impact Score, TIS = 52).

Projections	Variants
MDG.A. Market Price Volatility	MDG.A1 - Higher level of traceability and information
MDG.B. Prolonged Droughts and Heatwaves	MDG.B1 - Technological and Genetic Advancements
MDG.C. Generational Renewal	MDG.C1 - Enhanced Attractiveness and support
MDG.D. Geopolitical instability	MDG.D1 - Strengthened resilience and cooperation
MDG.E. Inappropriate food processing and packaging	MDG.E2 - Gradual improvements
MDG.F. Failure of transport infrastructure	MDG.F1 - Road infrastructure significantly improved

4.4.3 Supply chain impacts

The two scenarios for the milk and dairy sector in Greece have been assessed in terms of supply chain impacts as shown in Figure 10 and Figure 11Figure 4.

MDG1 impacts on supply chains

The supply chain impacts that scored the highest (5 points, on Likert scale), are only three (Figure 10):

- **SRS-I7.** Long-term supply halt, push on traceability on market delivered contaminated batches, activates reverse logistics and disposal processes, health injuries and deaths
- **SRS-I8.** It propagates downstream: Customs control and penalties, health injuries and deaths, business disruption
- **SRS-I9.** Temporary production stop or slow-down, labour injuries / deaths, legal investigations.
- **TLR-I2.** The cargo loses quality and perish. It cannot be used and therefore must be disposed.
- **TLR-I5.** Due to accidents, the cargo is lost during transport
- **TLR-I6.** Cargo is stolen during transport. Loss value.
- **TLR-I7.** Cargo is contaminated during transport/temporary storage and therefore loss/disposed.
- **MRS-I5.** Food deterioration/perishability, spoilage or contamination leading, mislabelling leading to health injuries or deaths.
- **DRS-I3.** Quality problems that cannot be traced backwards in upstream supply. Monetary losses (lost sales, reverse logistics and disposal), penalties, brand image. Health injuries and deaths.
- **DRS-I4.** Tax revenues traded off with public health risks. Impacts on health and deaths.

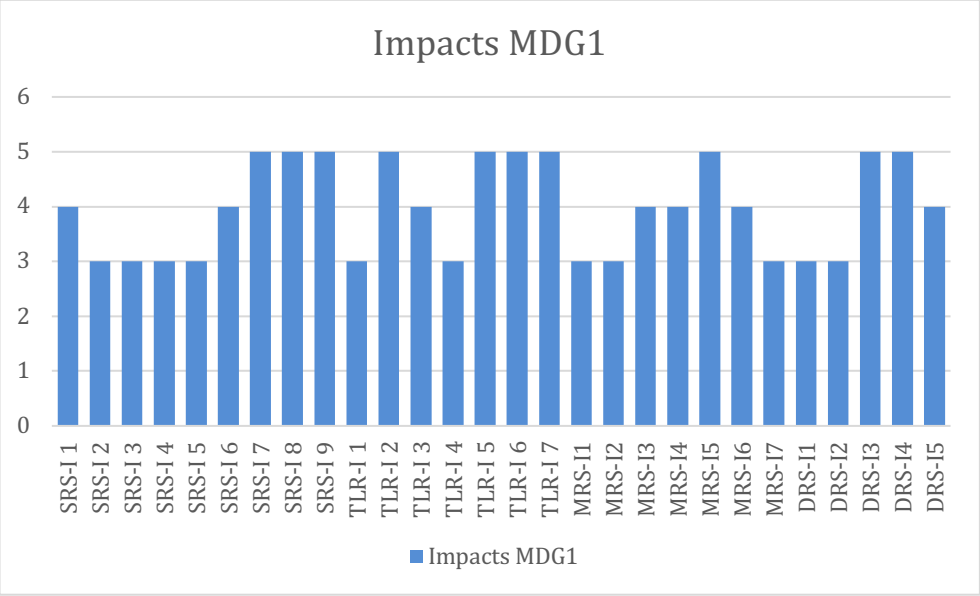

Figure 10. MDG1 impacts on food supply chains.

MDG2 impacts on supply chains

The supply chain impacts that scored the highest (5 points, on Likert scale), are only three (Figure 11):

- SRS-I7. Long-term supply halt, push on traceability on market delivered contaminated batches, activates reverse logistics and disposal processes, health injuries and deaths
- SRS-I8. It propagates downstream: Customs control and penalties, health injuries and deaths, business disruption
- SRS-I9. Temporary production stops or slow-down, labour injuries / deaths, legal investigations.
- TLR-I2. The cargo lose quality and perish. It cannot be used and therefore must be disposed.
- TLR-I5. Due to accidents, the cargo is loss during transport
- TLR-I6. Cargo is stolen during transport. Loss value
- TLR-I7. Cargo is contaminated during transport/temporary storage and therefore loss/disposed.
- MRS-I6. Operational disruptions, late market deliveries, contract penalties. Equipment stop may lead to perishability as food cannot be processed amplifying market deliveries and stockouts.
- DRS-I3. Quality problems that cannot be traced backwards in upstream supply. Monetary losses (lost sales, reverse logistics and disposal), penalties, brand image. Health injuries and deaths.
- DRS-I4. Tax revenues traded off with public health risks. Impacts on health and deaths.

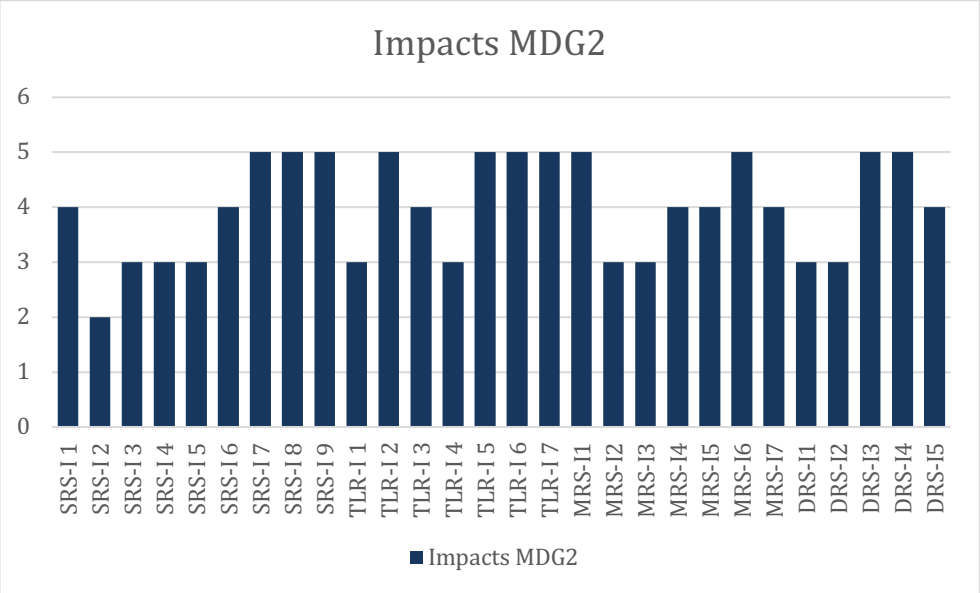

Figure 11. MDG1 impacts on food supply chains.

4.5 Milk and dairy products Finland

6 projections and 3 variants were identified for this case, resulting into 18 projections/variations used for the generation of possible future scenarios.

- MDF.A Market price volatility. It refers to the volatility of milk and dairy prices, sudden and unexpected rises and falls, as an effect of fluctuations of costs and diverse inefficiencies.
    - MDF.A1 Fixed prices or price protection mechanisms can nullify price fluctuations. For instance, this can be achieved with contracts between producers and processors or diversification: farms can reduce dependence on milk by producing other products and providing services.
    - MDF.A2 Adaptation is only partial, because the system is affected by market dynamics, regulation and external factors. Fluctuations in feed, energy and labour costs can reduce the ability to fully buffer against changes in market prices. The increase in these costs weakens profitability, regardless of the market prices of milk products. EU agricultural subsidies may help smooth price fluctuations, but their effect may be limited in sudden market crises or strong fluctuations in the world market.
    - MDF.A3 Pandemics can determine logistical challenges weakening the profitability of farmers. Changes in consumption habits, such as switching to plant-based alternatives, can affect milk demand and prices in the long term.
- MDF.B Prolonged drought and heatwaves. Prolonged droughts and heatwaves are extended periods of unusually low precipitation and extremely high temperatures. These extreme weather events can last for weeks, months, or even years, and they can have severe impacts on both the environment and human activities.
    - MDF.B1 Transition to forage plant varieties that are more resistant to weather conditions is successfully adopted. Likewise, development of weather-tolerant crops and fodder varieties and diversified crop rotations reduce the risks of drought or heavy rains. Other measures adopted include 1) agreements with external feed suppliers in case of crisis situations; 2) air conditioning and cooling systems of the barns; 3) use of artificial irrigation systems and improvement of irrigation efficiency. 4) Utilization of weather forecasts and satellite data in agricultural planning. 5) Automated systems that optimize the use of resources in real time. 6) Training farmers on the impacts of climate change and means of adaptation.
    - MDF.B2 Adaptation with Mixed Success: some farmers adopt improved irrigation and heat management systems, while others struggle due to financial or logistical barriers. This results in uneven impacts on milk quantity and quality, with some farmers maintaining stable output and others experiencing periodic declines.
    - MDF.B3 Severe Production Declines: Prolonged droughts and heatwaves, alternating with heavy precipitations, lead to significant reductions in milk quantity and quality. Drought can reduce feed availability and increase feed prices, while heavy rains can make it difficult to harvest and maintain feed quality. Heat stress on livestock and water scarcity result in lower productivity and higher mortality rates, causing economic strain on dairy farmers and potential milk shortages.
- MDF.C Generational renewal (e.g., lack of attractiveness in the food sector for younger generations). Generational renewal refers to the process of rejuvenating an industry, organization, or community by integrating new, younger members who bring fresh ideas, perspectives, and energy. This concept is essential for maintaining the vitality and sustainability of various sectors, as it ensures a continuous influx of talent and innovation.

  - MDF.C1 Digitization and automation: technology such as robots, drones, sensors and artificial intelligence can make work modern, efficient and interesting. Smart agriculture is also used, emphasizing the environmental friendliness and sustainability of smart farming and production. Virtual reality and simulations are used to teach dairy farm operations and agricultural processes in an innovative way. Social media campaigns: Use social media to tell the everyday life of agriculture and inspiring projects to young people in a close way. Introduce young people who have succeeded in agriculture or dairy farming and share their experiences.
  - MDF.C2 Some farmers successfully implement measures to attract young farmers, while others struggle due to economic and social barriers. This results in uneven generational renewal across Europe, with certain areas thriving and others facing ongoing challenges.
  - MDF.C3 Dairy farms have to stop their operations when the owners get old and new generations will not continue. This can lead to a decrease in the number of farms and production capacity. Food security risk: Dairy products are a key part of many food chains, and their reduction cause disruptions in the wider food chain. When rural dairies close, regional services such as schools, shops and public transport can also suffer, further accelerating rural depopulation. Decrease in exports: A decrease in domestic milk production can weaken the opportunities to export milk products, which has a negative impact on the national economy.
- MDF.D (Geo)political instability, conflicts, war. It encompasses a range of tensions and conflicts arising from political, economic, and social factors within and between nations. When these instabilities lead to conflicts and wars, the ramifications are widespread and severe. Adding a layer of complexity, cybersecurity has become a critical factor in modern geopolitical tensions, as cyber-attacks can both exacerbate and result from these instabilities.
  - MDF.D1 The geopolitical instability supports increased cybersecurity investments to protect automated production systems (tackling cyber-attacks).
  - MDF.D2 National investments partly ensure domestic production through investments on energy self-sufficiency, other inputs self -sufficiency (fertilisers, purchased feed).
  - MDF.D3 Ineffective or no investments facilitate attacks on production systems (cyber and physical), supply chain, and logistics on imported inputs (refined oil and gas products are still a major input in primary production).
- MDF.E Inappropriate food processing and packaging leading to food loss. As for the Greek case, the Finland cases highlight the importance of using appropriate food processing and packaging for milk and dairy products. To reduce food losses due to inappropriate packaging it is necessary to modernize processing methods, improve training, and using better materials.
  - MDF.E1 Technological Innovations: Significant advancements in food processing and packaging technologies drastically reduce food loss. Innovations such as smart packaging that monitors freshness and improved preservation techniques ensure that milk and dairy products remain safe and consumable for longer periods.
  - MDF.E2 Gradual Improvements with Mixed Results: Some farmers adopt new technologies and improve their processing and packaging methods, leading to

reduced food loss. However, others lag behind due to financial constraints or lack of access to innovations.
    - MDF.E3 Persistent Inefficiencies: Despite efforts, outdated processing and packaging methods continue to cause substantial food loss. Inadequate infrastructure and lack of investment in modern technologies result in high levels of spoilage and waste, negatively impacting both producers and consumers Profitability in farms lags and hampers investments, problems with e.g., listeria in raw milk (unpasteurized milk).
- MDF.F Failure of transport infrastructure. Milk and dairy farms are often situated in remote areas, necessitating transport over poorly maintained rural roads and long distances to emergency services in case of issues. Like the Greek case, the Finnish situation underscores the critical role of transport infrastructure. However, it highlights unique challenges experienced during winter, such as icy roads and snow blockages, which significantly impede transportation and emergency access.
    - MDF.F1 Road infrastructure significantly improves rural roads connecting farmers to factories. Transportation improves significantly during wintertime ensuring reliability and lower perishability
    - MDF.F2 Road infrastructure improves but not equally in the region of interest. This implies that some farmers may benefit from better road connections, others not.
    - MDF.F3 Road infrastructure does not improve, and maintenance is not performed, increasing the wear and tear of the pavement. Transportation becomes less reliable, during wintertime, increasing the risk for perishability.

97 scenarios are ultimately generated using a maximum consistency of two. The full list of 97 scenarios is made available in Table 27. Using the total impact scores, the two highest impacts scenarios were selected and further described in this report:

- MDF1 Experiencing challenges with resilience, cooperation and technology.
- MDF2 Innovation driven growth.

4.5.1 MDF1 Experiencing challenges with resilience, cooperation and technology

In this scenario, the dairy sector faces significant challenges but manages to navigate them through a combination of resilience, cooperation, and technological advancements. A higher level of traceability and information (MDF.A1) ensures transparency in the supply chain, allowing consumers and producers to track and verify the quality and origin of dairy products. Despite severe production declines (MDF.B3) due to factors such as climate change, disease, or economic downturns, the sector leverages foreign workers to partially offset the labour shortage (MDF.C2). These workers play a crucial role in maintaining dairy production and supporting the industry's operations. Strengthened resilience and cooperation (MDF.D1) among countries, regions, and industry stakeholders help to address the challenges posed by production declines. Collaborative efforts focus on sharing resources, knowledge, and best practices to ensure the sector's stability and sustainability. Significant advancements in packaging processes and logistics (MDF.E1) further enhance the efficiency and effectiveness

of the dairy supply chain. Improved packaging techniques reduce waste and extend the shelf life of dairy products, while advanced logistics ensure timely and reliable delivery to consumers.

Table 13. "MDF1 Experiencing challenges with resilience, cooperation and technology", descriptor consistency matrix with projections and selected variants (Total Impact Score, TIS = 29).

Projection	Variants
MDF.A. Market Price Volatility	MDF.A1 - Higher level of traceability and information
MDF.B. Prolonged Droughts and Heatwaves	MDF.B3 - Severe production decline
MDF.C. Generational Renewal	MDF.C2 - Foreign workers partially offset problem
MDF.D. Geopolitical instability	MDF.D1 - Strengthened resilience and cooperation
MDF.E. Inappropriate food processing and packaging	MDF.E1 - Significant advancements in packaging processes and logistics
MDF.F. Failure of transport infrastructure	MDF.F1 - Road infrastructure significantly improved

4.5.2 MDF2 Innovation driven growth

In this future scenario, the milk and dairy sector experiences a remarkable transformation driven by innovation, cooperation, and sustainability. Enhanced traceability and information systems (MDF.A1) ensure transparency in the entire supply chain, allowing consumers to trace the origin and quality of products, thereby fostering trust and accountability. Technological and genetic advancements (MDF.B1) revolutionize farming practices, leading to the development of high-yield, resilient crops that can withstand various environmental challenges. These innovations boost productivity and contribute to food security. The sector becomes highly attractive and supportive (MDF.C1), drawing in a new generation of farmers and professionals. Enhanced educational programs, financial incentives, and career development opportunities rejuvenate the industry, bringing fresh perspectives and energy. Strengthened resilience and cooperation (MDF.D1) are at the core of this transformation. Countries, regions, and industry stakeholders collaborate to tackle global challenges such as climate change, food security, and market volatility. This cooperation fosters a resilient and adaptable agricultural system. Significant advancements in packaging processes and logistics (MDF.E1) ensure that food reaches consumers in optimal condition, reducing waste and extending the shelf life of products. Improved packaging technologies and efficient logistics enhance the overall efficiency of the supply chain. Finally, the road infrastructure is significantly improved (MDF.F1), facilitating the smooth transportation of goods from farms to markets. These enhancements reduce transportation costs, minimize delays, and ensure timely delivery of agricultural products.

Table 14. "MDF2 Innovation driven growth", descriptor consistency matrix with projections and selected variants (Total Impact Score, TIS = 27).

Projections	Variants
MDF.A. Market Price Volatility	MDF.A1 - Higher level of traceability and information
MDF.B. Prolonged Droughts and Heatwaves	MDF.B1 - Technological and Genetic Advancements
MDF.C. Generational Renewal	MDF.C1 - Enhanced Attractiveness and support
MDF.D. Geopolitical instability	MDF.D1 - Strengthened resilience and cooperation
MDF.E. Inappropriate food processing and packaging	MDF.E1 - Significant advancements in packaging processes and logistics
MDF.F. Failure of transport infrastructure	MDF.F1 - Road infrastructure significantly improved

4.5.3 Supply Chain Impacts

The two scenarios for the milk and dairy sector in Finland have been assessed in terms of supply chain impacts as shown in Figure 12 and Figure 13Figure 4.

MDF1 impacts on supply chains

The supply chain impacts that scored the highest (5 points, on Likert scale 1-5), is only one (Figure 12):

- MRS-I3 Quality problems in batches leading to late deliveries to selected customers. It may cause reverse logistics to collect batches from market.

While the following scored 4 points on the Likert scale:

- **SRS-I2.** Supply stop, stock-outs and sales stop but for shorter period.
- **SRS-I3.** Supplies are affected for longer term with significant effects on the business. Supply halt, stock-outs and sales stop.
- **SRS-I4.** Selected batches supply stop, leading to selected and temporary stock-outs
- **SRS-I7.** Long-term supply halt, push on traceability on market delivered contaminated batches, activates reverse logistics and disposal processes, health injuries and deaths
- **SRS-I8.** It propagates downstream: Customs control and penalties, health injuries and deaths, business disruption
- **SRS-I9.** Temporary production stop or slow-down, labour injuries / deaths, legal investigations.
- **MRS-I2**. Normally short term. Slowing down productivity causing late, backlogs and the risk of perishability.
- **DRS-I3.** Quality problems that cannot be traced backwards in upstream supply. Monetary losses (lost sales, reverse logistics and disposal), penalties, brand image. Health injuries and deaths.

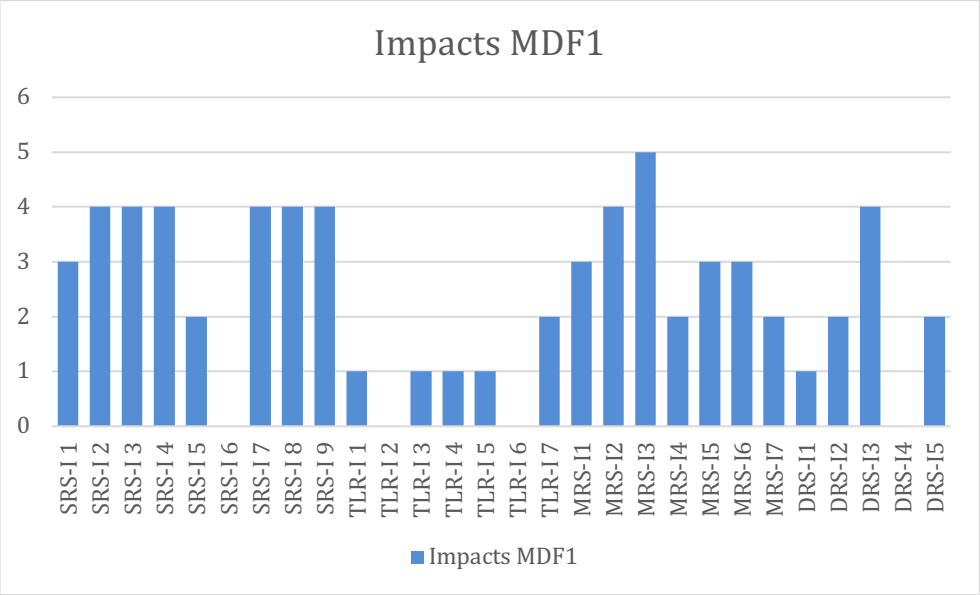

Figure 12. MDF1 impacts on food supply chains.

MDF2 Impacts on supply chains

The second scenario seems to have very limited impacts on the supply chains, where the highest scores measured only 2 points of the Likert scale 1-5 (Figure 13). These were the following:

- **SRS-I1.** Stock-outs and sales losses, triggers recovery strategies
- **SRS-I2.** Supply stop, stock-outs and sales stop but for a shorter period.
- **SRS-I3.** Affecting supplies for longer term with significant effects on the business. Supply halt, stock-outs and sales stop.
- **SRS-I8.** It propagates downstream: Customs control and penalties, health injuries and deaths, business disruption
- **MRS-I1.** Inventory costs, late deliveries to customers, sales loss
- **MRS-I3.** Quality problems in batches leading to late deliveries to selected customers. It may cause reverse logistics to collect batches from market.
- **DRS-I3.** Quality problems that cannot be traced backwards in upstream supply. Monetary losses (lost sales, reverse logistics and disposal), penalties, brand image. Health injuries and deaths.

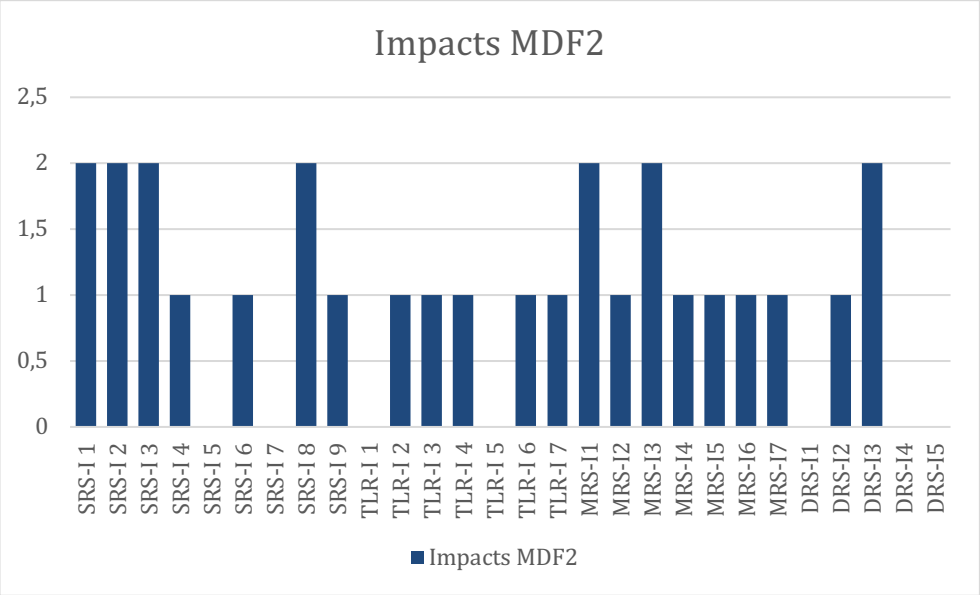

Figure 13. MDF2 impacts on food supply chains.

4.6 Fruits and vegetables

A total of 9 projections and 3 variants were identified in the workshop:

- FV.A Labour shortage (e.g., due to aging, increased cost, pandemics etc.).
  - FV.A1 Effective policies and initiatives, such as subsidies for training and automation, lead to a rejuvenation of the workforce and improved productivity in the sector.
  - FV.A2 Temporary improvements in labour availability through some policies that been recently passed, but these have limited effects or a slowly adopted. Hence, some fundamental issues such as an aging workforce and high labour costs remain unresolved.
  - FV.A3 Aging workforce and lack of labour due to high costs and inadequate policies and training programs worsen production capacity. Despite the initial policy changes done, adoption is slow and not leading to the expected results.
- FV.B Water availability
  - FV.B1 Weather alternating heavy precipitations and droughts do not manifest as expected or significantly as in the available IPCC predictions. Therefore, no impact on water access or orange cultivations manifest.
  - FV.B2 Climate change present some sporadic alternate of high temperature and drought versus heavy precipitations. So, access to water and impact on orange cultivation is limited to a few weeks over a year.
  - FV.B3 Consistent climate changes switching from heavy precipitation and prolonged drought, create significant problems in accessing water. In particular orange cultivations, representing an important business sector for the Algarve region, will see their yield significantly affected.
- FV.C Research and innovation, and technological advances
  - FV.C1 Technologies and strategies to adopt best global practices that can help with water management/needs - e.g.: regenerative agriculture, agro-ecology,

etc., to adapt production and try to make it more resilient are widely used by farmers.
    - FV.C2 Technologies and strategies to adopt best global practices that can help with water management/needs - suffer slow adoption and high investments costs. Farmers implementation is limited and scattered across the country.
    - FV.C3 Technologies and strategies to adopt best global practices that can help with water management/needs - suffer slow distrust and high investments costs. Farmers implementation is non-existent.
- FV.D Infrastructural failure
    - FV.D1 A new political program result into an improved management of dams addressing the problem of water scarcity in the region.
    - FV.D2 Some new political agendas are developed, but the local instability of the governing parties do not guarantee proper development and application of a new program to manage dams.
    - FV.D3 There is no political efforts to solve the problem of managing dams in the region.
- FV.E Plant pests and diseases
    - FV.E1 There is a wide scale positive implementation of biological control and monitoring strategies to manage and mitigate the fruit fly pest issue in the region. This leads to a yield improvement in terms of size and quality.
    - FV.E2 Biological control and monitoring strategies are slowly adopted and require some financial investments. Hindering their wide scale implementation and limiting impacts.
    - FV.E3 There is no prompt implementation of biological and monitoring strategies. Pests attacking orange cultivations increase leading to devastating effects on the orange industry.
- FV.F Lack of appropriate education and awareness
    - FV.F1 Comprehensive Education Programs: Governments and organizations implement extensive education and awareness programs, integrating modern agricultural practices into school curriculums and community initiatives. This leads to a well-informed new generation of farmers who adopt sustainable practices, boosting productivity and environmental stewardship
    - FV.F2 Incremental Improvements: There are gradual improvements in education and awareness, with some regions implementing successful programs while others lag behind. This results in a mixed landscape where certain areas see advancements in farming practices and productivity, while others continue to struggle with knowledge gaps
    - FV.F3 Persistent Knowledge Gaps: Despite some efforts, inadequate education and awareness persist, leading to continued use of outdated and inefficient farming practices. This results in lower yields, higher food loss, and increased environmental degradation, negatively impacting the overall sustainability of the sector
- FV.G (Geo)political instability, conflicts, war.
    - FV.G1 Stable Imports of critical materials: European countries enhance their cooperation and develop robust contingency plans to ensure food security. Investments in resilient infrastructure and diversified supply chains help mitigate the impacts of geopolitical instability, maintaining stable imports of pesticides and animal feed that are important for the sector.

    - FV.G2 Intermittent supplies of critical materials: The effects of geopolitical instability vary with some regions managing to maintain stable imports through localized solutions and adaptive measures, while others face periodic disruptions and challenges.
    - FV.G3 Severe Disruptions and Shortages: Ongoing conflicts and political instability lead to significant disruptions in the supply chains for pesticides and animal feed. Transportation blockages, resource scarcity, and damaged infrastructure result in severe halt of production and widespread shortages, affecting both producers and consumers.
- FV.H Lack of financial liquidity.
    - FVV.H1 Local governments and financial institutions can provide the necessary support to ensure access to training programs and/or investing in new technologies or strategies to counteract existing problems in the sector.
    - FV.H2 Local governments and financial institutions can provide with some support to ensure access to training programs and/or investing in new technologies or strategies to counteract existing problems in the sector. However, adoption is slow and problematic, with hidden costs discouraging adoption.
    - FV.H3 No support is provided by local governments and financial institutions.
- FV.I Biodiversity
    - FV.I1 Technological advancements and policy interventions play a crucial role in protecting biodiversity. Innovations in biotechnology, such as the development of climate-resilient crop varieties, help maintain agricultural productivity despite changing environmental conditions. Policies that promote conservation and sustainable land use practices are implemented, encouraging farmers to adopt biodiversity-friendly practices.
    - FV.I2 Adaptation and resilience. Proactive measures are taken to mitigate the impacts of climate change on biodiversity. Sustainable farming practices, such as crop rotation, cover cropping, and organic farming, are widely adopted to improve soil health and water management. Efforts to restore and protect natural habitats help maintain biodiversity and enhance ecosystem resilience. As a result, agricultural systems become more resilient to climate change, and biodiversity is preserved, ensuring the continued provision of essential ecosystem services.
    - FV.I3 Decline. Climate change continues to negatively impact soil health, water availability, and habitats. As a result, many species struggle to survive, leading to a significant decline in biodiversity. The loss of plant and animal species disrupts ecosystems, reducing their resilience and ability to provide essential services such as pollination, pest control, and nutrient cycling. Agricultural production suffers due to the lack of these ecosystem services, leading to lower crop yields and increased production costs.

89 scenarios are generated using a maximum inconsistency of -3 and total impacts scores between 22 and 86. The full list of scenarios is available in Table 28. Using the total impact scores, the two highest impacts scenarios were selected and further described in this report:

- FV1 Resilient Agriculture: Adapting to Change and Ensuring Sustainability.
- FV2 Sustainable Resilience: Addressing Climate Challenges with Innovation and Education.

4.6.1 FV1 Resilient Agriculture: Adapting to Change and Ensuring Sustainability

In this scenario, effective policies (FV.A1) are the driving force behind societal progress, fostering rejuvenation of workforce. However, sporadic changes in climate (FV.B2) present intermittent challenges, with periods of high temperatures and droughts alternating with heavy precipitation. Despite these fluctuations, technology plays a crucial role in improving production and resilience (FV.C1), helping farmers adapt to the changing conditions.

A new political program (FV.D1) focuses on improving infrastructure, particularly in managing water resources, which is vital for agriculture. The wide-scale implementation of biological control strategies (FV.E1) effectively manages pests, leading to improved crop yields and quality.

Comprehensive education programs (FV.F1) are implemented, ensuring that the new generation of farmers is well-informed and adopts sustainable practices. This boosts productivity and environmental stewardship. Stable imports of critical raw materials (FV.G1) are maintained through enhanced cooperation and robust contingency plans, ensuring the agricultural sector remains well-supplied.

Necessary financial packages (FV.H1) are available, providing support for training programs and investments in new technologies. This financial backing helps farmers counteract existing problems and adopt innovative solutions. Adaptation and resilience (FV.I2) are key themes, with proactive measures taken to mitigate the impacts of climate change on biodiversity. Sustainable farming practices are widely adopted, improving soil health and water management, and efforts to restore and protect natural habitats help maintain biodiversity and enhance ecosystem resilience.

Table 15. "FV1 Resilient Agriculture: Adapting to Change and Ensuring Sustainability", descriptor consistency matrix with projections and selected variants (Total Impact Score, TIS = 86).

Projections	Variants
FV.A Labour Shortage	FV.A1 - Effective policies
FV.B Water Availability	FV.B2 - Sporadic changes
FV.C Research and innovation	FV.C1 - Tech improving production and resilience
FV.D Infrastructure Failure	FV.D1 - New political program improving
FV.E Plant pests and diseases	FV.E1 - Wide scale implementation of biological control
FV.F Lack of appropriate education	FV.F1 - Comprehensive Education Programs
FV.G Geopolitical Instability	FV.G1 - Stable Imports of critical raw materials
FV.H Lack of financial liquidity	FV.H1 - Necessary financial packages available
FV.I Biodiversity	FV.I2 - Adaptation and resilience

4.6.2 FV2 Sustainable Resilience: Addressing Climate Challenges with Innovation and Education

In this scenario, effective policies (FV.A1) are the cornerstone of societal progress, driving innovation and growth. However, the world faces consistent climate changes (FV.B3), with alternating periods of heavy precipitation and prolonged droughts creating significant challenges for water access and agriculture.

To combat these challenges, technology plays a crucial role in improving production and resilience (FV.C1). Farmers widely adopt best global practices, such as regenerative agriculture and agroecology, to adapt their production methods and make them more resilient to climate fluctuations.

A new political program (FV.D1) focuses on improving infrastructure, particularly in managing water resources, which is vital for agriculture. This program addresses the problem of water scarcity in the region, ensuring a more stable and reliable water supply.

The wide-scale implementation of biological control strategies (FV.E1) effectively manages pests, leading to improved crop yields and quality. Comprehensive education programs (FV.F1) are implemented, ensuring that the new generation of farmers is well-informed and adopts sustainable practices. This boosts productivity and environmental stewardship.

Stable imports of critical raw materials (FV.G1) are maintained through enhanced cooperation and robust contingency plans, ensuring the agricultural sector remains well-supplied. Necessary financial packages (FV.H1) are available, providing support for training programs and investments in new technologies. This financial backing helps farmers counteract existing problems and adopt innovative solutions.

Adaptation and resilience (FV.I2) are key themes, with proactive measures taken to mitigate the impacts of climate change on biodiversity. Sustainable farming practices, such as crop rotation, cover cropping, and organic farming, are widely adopted to improve soil health and water management. Efforts to restore and protect natural habitats help maintain biodiversity and enhance ecosystem resilience.

Table 16. "FV2 Sustainable Resilience: Addressing Climate Challenges with Innovation and Education", descriptor consistency matrix with projections and selected variants (Total Impact Score, TIS = 86).

Projections	Variants
FV.A Labour Shortage	FV.A1 - Effective policies
FV.B Water Availability	FV.B3 - Consistent climate changes
FV.C Research and innovation	FV.C1 - Tech improving production and resilience
FV.D Infrastructure Failure	FV.D1 - New political program improving
FV.E Plant pests and diseases	FV.E1 - Wide scale implementation of biological control
FV.F Lack of appropriate education	FV.F1 - Comprehensive Education Programs
FV.G Geopolitical Instability	FV.G1 - Stable Imports of critical raw materials
FV.H Lack of financial liquidity	FV.H1 - Necessary financial packages available
FV.I Biodiversity	FV.I2 - Adaptation and resilience

4.6.3 Supply Chain Impacts

The impacts on fruit and vegetables supply chains are assessed and expounded in Figure 14 and Figure 15.

FV1 impacts on food supply chains

The following impacts are assessed with an impact corresponding to 5, following the Likert scale 1-5 used in the study:

- **SRS-I3.** May affect supplies for longer term with significant effects on the business. Supply halt, stock-outs and sales stop.
- **SRS-I6.** Stock-outs and sales losses, triggers recovery strategies.
- **TLR-I2.** The cargo lose quality and perish. It cannot be used and therefore must be disposed.
- **TLR-I3.** Due to delays or accidents, the cargo lose quality, but it can still be used
- **TLR-I5.** Due to accidents, the cargo is loss during transport
- **TLR-I6.** Cargo is stolen during transport. Loss value
- **TLR-I7.** Cargo is contaminated during transport/temporary storage and therefore loss/disposed.
- **MRS-I2.** Normally short term. Slowing down productivity causing late, backlogs and the risk of perishability.
- **DRS-I3.** Quality problems that cannot be traced backwards in upstream supply. Monetary losses (lost sales, reverse logistics and disposal), penalties, brand image. Health injuries and death
- **DRS-I4.** Tax revenues traded off with public health risks. Impacts on health and deaths.
- **DRS-I5.** Cargo perish/is lost and needs to be wasted /disposed.

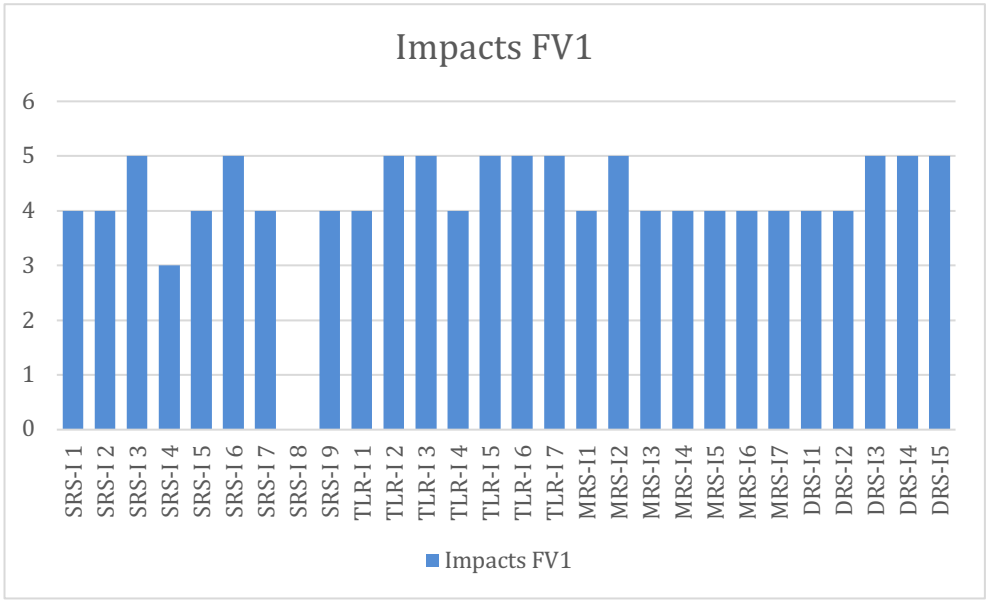

Figure 14. Impacts of FV1 scenario on fruit and vegetables supply chain.

Given the list of impacts it may be noticed that, compared to other use cases, the transport/logistics related impacts are more critical for this use case.

FV2 impacts on food supply chains

Finally, the following list of impacts are most relevant for the FV2 scenario identified in the study (5 points, Likert scale 1-5):

- **SRS-I3.** It affects supplies for longer term with significant effects on the business. Supply halt, stock-outs and sales stop.
- **SRS-I6.** Stock-outs and sales losses, triggers recovery strategies.
- **TLR-I1.** Operational problems related to collection, transport and consignment of cargo.
- **TLR-I3.** Due to delays or accidents, the cargo lose quality, but it can still be used
- **TLR-I5.** Due to accidents, the cargo is loss during transport
- **TLR-I6.** Cargo is stolen during transport. Loss value
- **TLR-I7.** Cargo is contaminated during transport/temporary storage and therefore loss/disposed.
- **MRS-I2.** Normally short term. Slowing down productivity causing late, backlogs and the risk of perishability.
- **DRS-I3.** Quality problems that cannot be traced backwards in upstream supply. Monetary losses (lost sales, reverse logistics and disposal), penalties, brand image. Health injuries and death
- **DRS-I4.** Tax revenues traded off with public health risks. Impacts on health and deaths.
- **DRS-I5.** Cargo perishes/is lost and needs to be wasted /disposed.

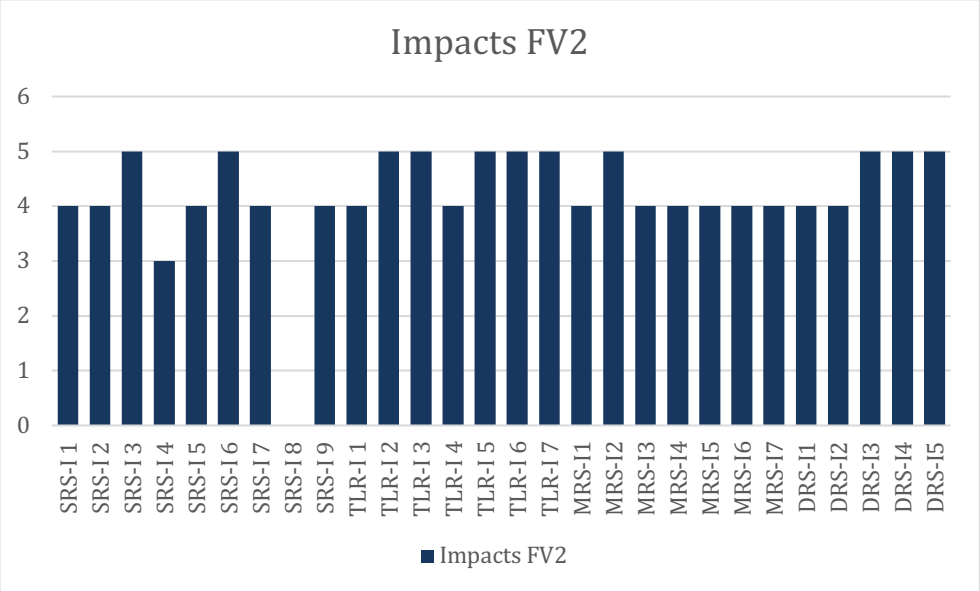

Figure 15. Impacts of FV1 scenario on fruit and vegetables supply chain.

5 Conclusions

The study developed in this report "D3.1 – Cross-impact based scenarios", as part of the SecureFood project, presents a comprehensive foresight analysis and scenario development for various food sectors:

- Fish (Greece)
- Aquaculture (Belgium)
- Grain (Ukraine)
- Milk and Dairy products (Greece)
- Milk and Dairy products (Finland)
- Fruits and Vegetables (Portugal)

A cross-impact analysis is performed, generating a total of 594 scenarios. Among those scenarios, 2 for each of the case studies are selected (those with the highest total impact scores, and therefore greater plausibility) and further analysed descriptively and thereby in terms of impacts on the selected food supply chain.

Fish (Greece)

The two scenarios, "Resilient Horizons" (F1) and "Steady Waters" (F2), emphasize effective policies and initiatives to drive progress and innovation amidst economic volatility and environmental challenges. "Resilient Horizons" faces significant price volatility and invasive species growth, managed through public education and digital traceability, while "Steady Waters" benefits from a stable geopolitical situation despite similar challenges. Both scenarios stress public health initiatives to contain pandemics and preserve marine biodiversity, highlighting the need for education and sustainability. Supply chain impacts in both scenarios include risks of supplier accidents, operational problems, cargo contamination, inventory costs, late deliveries, and food spoilage, with additional concerns over quality problems leading to monetary losses and health risks.

Aquaculture (Belgium)

In the "A1 Balancing Innovation and Environmental Challenges" scenario, the aquaculture sector attracts a skilled workforce but faces price volatility and environmental challenges like temperature changes and pollution, though advancements in water treatment technologies help mitigate negative impacts. Food education remains weak, but supportive policies and financial instruments aid the sector. Geopolitical conflicts escalate, affecting energy prices and causing relocation concerns. The supply chain's reliance on single-sourced suppliers makes it vulnerable to disruptions, though there are no major concerns about pests and diseases. In the "A2 Facing Workforce and Environmental Challenges" scenario, the industry struggles with significant labour loss, relying on automation, and faces price fluctuations and environmental challenges. Water treatment advancements provide some relief, but food education remains ineffective. Supportive policies exist, but no financial instruments are available to manage risks. Geopolitical conflicts escalate, impacting energy prices and operational costs. The sector faces relocation concerns and supply chain vulnerabilities due to single-sourced suppliers but remains stable in terms of pest and disease control. Both scenarios emphasize the need for effective recovery strategies to address supply chain vulnerabilities, with impacts including stock-outs, sales losses, temporary production stoppages, and health risks.

Grain (Ukraine)

The two scenarios selected are "G1 Path to Stability and Growth" and "G2 War Challenges Amidst Progress." In the former, the diminishing Russian-Ukrainian War and effective control of seaports lead to increased regional support, enhancing infrastructure, trade, and workforce commitment, fostering a resilient economy with continuous agricultural growth. Conversely, in the "G2 War Challenges Amidst Progress" scenario, considers an escalation of the conflict, causing intermittent operations, a decline in young farmers, and struggles for small businesses and the workforce due to ongoing war. Both scenarios highlight supply chain impacts, including long-term supply halts, temporary productivity slow-downs, stock-outs, sales losses, operational problems during transport, inventory costs, and quality issues. However, "G2" also includes shorter-term supply stops due to escalating conflicts, emphasizing the need for effective recovery strategies to mitigate supply chain vulnerabilities.

Milk and Dairy (Greece)

In the "MDG1 Sustainable and Resilient Future" scenario, the agricultural sector experiences significant transformations with enhanced traceability, technological advancements, and support for younger generations, resulting in resilient crops, improved productivity, and food security. Global challenges are addressed through strengthened resilience and cooperation, while advancements in packaging, logistics, and infrastructure reduce food loss and waste. The "MDG2 Progress Gradually Towards a Sustainable Future" scenario similarly emphasizes sustainability and efficiency, with gradual improvements in packaging and logistics, and enhanced infrastructure facilitating efficient transportation. Both scenarios highlight the need for effective measures to mitigate supply chain vulnerabilities, with impacts including long-term supply halts, temporary production stops, cargo quality loss, and health risks, underscoring the importance of protecting public health and ensuring food security.

Milk and dairy products (Finland)

In the "MDF1 Experiencing Challenges with Resilience, Cooperation, and Technology" scenario, the dairy sector faces severe production declines due to climate change, disease, or economic downturns, but navigates these challenges through resilience, cooperation, and technological advancements. Enhanced traceability ensures supply chain transparency, while foreign workers help offset labour shortages. Collaboration among countries strengthens stability and sustainability, and advancements in packaging and logistics improve efficiency, reduce waste, and extend shelf life. In the "MDF2 Innovation Driven Growth" scenario, the dairy sector transforms through innovation, cooperation, and sustainability. Enhanced traceability and technological advancements lead to resilient crops, boosting productivity and food security. Educational programs and financial incentives attract a new generation of farmers, while advancements in packaging, logistics, and road infrastructure ensure optimal food quality and reduced waste. The highest supply chain impact in MDF1 is quality problems leading to late deliveries and reverse logistics, while MDF2 experiences limited supply chain impacts, including stock-outs, short-term supply stops, and quality issues causing monetary losses and health risks.

Fruits and Vegetables (Portugal)

In the "FV1 Resilient Agriculture" scenario, effective policies drive societal progress, helping farmers adapt to climate fluctuations through technology, infrastructure improvements,

biological control strategies, and comprehensive education programs. Financial packages and stable imports ensure resilience, enhancing biodiversity and ecosystem resilience. The "FV2 Sustainable Resilience" scenario focuses on innovation and growth, with technology and best practices improving agricultural resilience to consistent climate changes. A new political program improves water management, and biological control strategies enhance crop yields. Both scenarios highlight the importance of financial support, comprehensive education, and sustainable farming practices in ensuring agricultural sustainability and ecosystem resilience.

The various scenarios outlined highlight the complex interplay of factors influencing European supply chains in the face of economic volatility, environmental challenges, and geopolitical instability. Effective policies, technological advancements, and cooperation are critical in driving progress and resilience across different sectors. Scenarios like "Resilient Horizons" and "Steady Waters" underscore the importance of public health initiatives, education, and sustainability to navigate these challenges. Similarly, the aquaculture and dairy sectors illustrate how innovation, supportive policies, and adaptation strategies can help mitigate supply chain vulnerabilities and ensure stability. Overall, the scenarios emphasize the need for proactive measures, robust contingency plans, and collaborative efforts to build resilient, sustainable, and efficient European supply chains that can withstand future disruptions and maintain food security.

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Annex A Use Case-specific cross-impact tables

A.1 Fish Case study cross-impact table (Greece)

Table 17. Fish Case study cross-impact table (Greece)

	D			**G**			**J**			**O**				**R**			**T**			**V**			**W**		
	D 1	D 2	D 3	G 1	G 2	G 3	J 1	J 2	J 3	O 1	O 2	O 3	O 4	R 1	R 2	R 3	T 1	T 2	T 3	V 1	V 2	V 3	W 1	W 2	W 3
D. Labour Shortage																									
-D1 Effective policies and initiatives				0	0	0	-2	0	0	3	2	3	-3	0	0	0	0	0	0	0	0	0	0	0	-3
-D2 Temporary/Short term improvements				0	0	0	-2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
-D3 Aging workforce and lack of labour				0	0	0	2	1	0	-1	-1	-2	0	0	0	0	0	0	0	0	0	0	0	0	3
G. Market Price Volatility																									
-G1 Prices remain stable as oil prices are stable	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-G2 Prices fluctuate moderately due to oil prices fluctuations	0	0	0				1	1	0	1	-1	-1	1	0	0	0	0	0	0	0	0	0	0	0	0
-G3 Significant price volatility due to fluctuation of oil prices and other indirect supplies	0	0	0				2	1	0	3	-3	-3	3	0	0	0	0	0	0	0	0	0	0	0	3
J. Climate change impacting the environment																									
-J1 Growth of invasive species affecting fisheries	2	-2	-2	0	0	0				3	0	3	-3	3	2	-3	0	0	0	0	0	0	0	0	0
-J2 Moderate growth of invasive species and moderate impact on fisheries	0	0	0	0	0	0				2	0	2	-2	2	-2	-2	0	0	0	0	0	0	0	0	0
-J3 Limited change with no impacts on fishery	0	0	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O. Lack of research and Innovation																									
-O1 Research will develop and offer digital traceability and certificates but no electrification	3	0	-1	0	0	-3	-3	-2	0					3	2	-2	0	0	0	0	0	0	0	0	-3
-O2 Research will electrify fishing vessels but not digital traceability and certificates	2	0	-2	0	0	0	0	0	0					1	0	-1	0	0	0	0	0	0	0	0	0
-O3 Research will develop both digital traceability certificates and electrification	3	0	-3	0	0	0	-3	-2	0					3	2	-2	0	0	0	0	0	0	0	0	-3
-O4 No advances in research and innovation	0	0	0	0	-1	-3	0	0	0					-1	-1	-1	0	0	0	0	0	0	0	0	3
R. Lack of appropriate FOOD education																									
-R1 Significant improvements in public educational initiatives	0	0	0	0	0	0	-3	-2	0	3	1	3	-1				0	0	0	0	0	0	0	0	-3

	D			G			J			O				R			T			V			W		
	D1	D2	D3	G1	G2	G3	J1	J2	J3	O1	O2	O3	O4	R1	R2	R3	T1	T2	T3	V1	V2	V3	W1	W2	W3
-R2 Moderate improvements in awareness campaigns	0	0	0	0	0	0	2	-2	0	2	0	2	-1				0	0	0	0	0	0	0	0	-2
-R3 Education and awareness programs are lacking or ineffective	0	0	0	0	0	0	3	2	0	-2	-1	-3	-1				0	0	0	0	0	0	0	0	3
T. Geopolitical Conflicts																									
-T1 conflicts and wars are contained and reduced	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0
-T2 the current geopolitical situation remains stable	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0
-T3 the current geopolitical situation escalates into a global conflict	0	0	3	-3	-2	3	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0
V. Pandemic and human health																									
-V1 Stable conditions with pandemics and health under control	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	-1	0	0	0				0	0	0
-V2 There are occasional pandemics occurring but in limited scale and with moderate disruptions	0	0	0	0	1	2	1	1	0	0	0	0	0	1	1	-1	0	0	0				0	0	0
-V3 Significant pandemics with disruption in healthcare and other economic activities globally	0	0	0	0	1	2	3	1	0	0	0	0	0	2	2	-2	0	0	0				0	0	0
W. Illegal Fishing																									
-W1 Negligible over-/illegal fishing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
-W2 Occasional over-/illegal fishing with moderate impacts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
-W3 Significant over-/illegal fishing	0	0	0	0	0	0	3	2	0	1	0	1	2	0	0	0	0	0	0	0	0	0			

A.2 Aquaculture Case study cross-impact table (Belgium)

Table 18. Aquaculture Case study cross-impact table (Belgium)

	A			B			C			D			E			F			G			H			I			J			K			L		
	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2	E3	F1	F2	F3	G1	G2	G3	H1	H2	H3	I1	I2	I3	J1	J2	J3	K1	K2	K3	L1	L2	L3
A. Labour Shortage																																				
A1 - Attractive job				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A2 - Limited attractiveness				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 - Loss of labour force				0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
B. Market Price Volatility																																				
B1 - Market price is not affected	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2- Prices fluctuate	0	0	0				0	0	0	-2	-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B3 - Significant fluctuations	-1	1	3				0	0	0	-2	-1	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Climate Change																																				
C1 - little effect on external temp	0	0	0	1	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	-1	-2	0	0	0	0	0	0
C2- Moderate effects	0	0	0	0	1	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C3 - Significant temp changes	0	0	0	0	0	1				2	0	0	1	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	2	3	-1	0	0	0	0	3
D. Research and Innovation																																				
D1 - R&D significant development water treatment	1	0	0	0	0	0	0	0	-2				0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
D2 - Moderate R&D development	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D3 - Water treatment tech not advancing	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	A			B			C			D			E			F			G			H			I			J			K			L		
	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2	E3	F1	F2	F3	G1	G2	G3	H1	H2	H3	I1	I2	I3	J1	J2	J3	K1	K2	K3	L1	L2	L3
E. Appropriate food and education																																				
E1 - Significant improvements in public education	1	0	0	1	-1	-1	0	0	-2	2	0	0				0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
E2 - Moderate improvements	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E3 - Education is lacking or ineffective	0	0	1	0	0	0	0	0	2	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Geopolitical conflicts																																				
F1 - Conflicts reduce, and energy prices not affected	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0				0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F2 - Conflicts continue with limited impacts on energy prices	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F3 - Conflicts escalate impacting energy prices	0	0	0	-1	2	3	0	0	3	-1	0	1	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
G. Pollution and contamination																																				
G1 - Pollution is under control	0	0	0	-2	-1	2	0	0	0	0	0	0	0	0	0	0	0	0				2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G2- Limited pollution contaminating water	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G3 - pollution increases with impacts on water	0	0	0	0	1	2	0	0	0	2	0	0	0	0	1	0	0	0				0	0	0	0	0	0	0	0	3	-1	0	0	0	0	3
H. Policy frameworks																																				
H1 - Policies are developed to support the sector	2	0	-2	2	0	-2	0	0	-2	3	0	0	1	0	0	1	0	0	2	0	0				3	0	0	3	0	0	0	0	0	3	0	0
H2 - Some policies available but too complex	-1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0

	A			B			C			D			E			F			G			H			I			J			K			L		
	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2	E3	F1	F2	F3	G1	G2	G3	H1	H2	H3	I1	I2	I3	J1	J2	J3	K1	K2	K3	L1	L2	L3
H3 - No policies are available	-1	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0
I. Lack of financial liquidity																																				
I1 - Financial instruments available	2	0	-2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0				1	0	0	1	0	0	0	0	0
I2 - limited access to financial instruments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0	0	0	0
I3 - No financial instruments available	-2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0				0	0	0	0	0	0	0	0	0
J. Decreased water availability and quality																																				
J1 - Access to water not at risk	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0				0	0	0	0	0	0
J2 - Some water scarcity	0	0	0	0	1	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0
J3 - Significant concerns forcing relocation	0	0	1	0	2	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0				0	0	0	0	0	3
K. Suppliers availability																																				
K1 - Plant served by portfolio of suppliers	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0
K2 - Plant can use multiple sources but for limited materials	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0
K3 - Large majority are single sourced	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0				0	0	2
L. Pests and Diseases																																				
L1	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
L2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0			

	A			B			C			D			E			F			G			H			I			J			K			L		
	A 1	A 2	A 3	B 1	B 2	B 3	C 1	C 2	C 3	D 1	D 2	D 3	E 1	E 2	E 3	F 1	F 2	F 3	G 1	G 2	G 3	H 1	H 2	H 3	I 1	I 2	I 3	J 1	J 2	J 3	K 1	K 2	K 3	L 1	L 2	L 3
L3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	1			

A.3 Grain Case study cross-impact table (Ukraine)

Table 19. Grain Case study cross-impact table (Ukraine)

	G_A			G_B			G_C			G_D			G_E			G_F		
	G_ A1	G_ A2	G_ A3	G_ B1	G_ B2	G_ B3	G_ C1	G_ C2	G_ C3	G_ D1	G_ D2	G_ D3	G_ E1	G_ E2	G_ E3	G_ F1	G_ F2	G_ F3
G_A. Energy market volatility																		
G_A1 - Heavy destructions discontinues				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G_A2 - Renewable Energy and local small electrical stations				0	0	0	0	0	0	0	0	0	0	-2	-1	0	0	0
G_A3 - Heavy extensive destructions				0	0	0	0	0	0	0	0	-1	0	-3	-2	0	0	-1
G_B. (Geo)political instability conflicts war																		
G_B1 - The ongoing geopolitical crisis will reduce	3	1	-3				3	0	-3	0	0	0	0	0	0	0	0	0
G_B2 - The Russian-Ukrainian war is stable	0	0	0				1	0	-1	0	0	0	0	0	0	0	0	0
G_B3 - War escalates	0	2	3				-2	2	2	0	0	0	0	0	0	0	0	0
G_C. Failure of transport infrastructure and logistics.																		
G_C1 - Control of the main seaports is managed	0	0	0	0	0	0				1	0	0	3	-2	0	0	0	-1
G_C2 - Intermittent operations due to continue attacks on the infrastructure	0	0	0	0	0	0				0	0	0	-1	1	0	0	0	1
G_C3 - All seaports are occupied by Russian troops.	0	0	0	0	0	0				0	0	0	-3	2	0	0	0	2
G_D. Generational renewal																		
G_D1 - Increased Attractiveness and Support	0	0	0	0	0	0	0	0	0				1	-1	0	2	1	-2
G_D2 - Gradual Improvement with Regional Variations	0	0	0	0	0	0	0	0	0				1	-1	0	1	1	-1
G_D3 - Decline in Young Farmers	0	0	0	0	0	0	0	0	0				-1	1	0	-1	-1	3

	G_A			G_B			G_C			G_D			G_E			G_F		
	G_A1	G_A2	G_A3	G_B1	G_B2	G_B3	G_C1	G_C2	G_C3	G_D1	G_D2	G_D3	G_E1	G_E2	G_E3	G_F1	G_F2	G_F3
G_E. Market contraction																		
G_E1 - No market contraction	0	0	0	0	0	0	0	0	0	2	1	-2				1	0	0
G_E2 - Small businesses moving abroad or closing	0	0	0	0	0	0	0	0	0	-1	-1	1				-2	-1	2
G_E3 - Large players enter the market	0	0	0	0	0	0	0	0	0	1	1	0				1	1	0
G_F. Labour shortage																		
G_F1 - Subsidies for training and automation lead to an increase of the workforce	0	0	0	0	0	0	0	0	0	2	2	-2	1	-1	0			
G_F2 - Seasonal workers or automation that easy the problem	0	0	0	0	0	0	0	0	0	1	1	-1	1	-1	0			
G_F3 - Strong decline of workers due to war	0	0	0	0	0	0	0	0	0	-1	-1	3	-2	3	1			

A.4 Milk and dairy Case study cross-impact table (Greece)

Table 20. Milk and dairy Case study cross-impact table (Greece)

	A			B			C			D			E			F		
	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2	E3	F1	F2	F3
A. Market Price Volatility																		
A1 - Higher level of traceability and information				1	1	1	1	1	1	2	2	3	1	2	3	2	2	2
A2 - Coupled Payments				0	0	0	1	1	1	-1	-1	-2	0	0	0	0	0	0
A3- Climate change driven volatility				-2	-3	-3	-1	-1	-1	-1	-1	-1	-1	-1	-2	0	0	0
B. Prolonged Droughts and Heatwaves																		
B1 - Technological and Genetic Advancements	1	0	2				3	1	3	2	2	2	3	2	3	1	1	1
B2 - Adaptation with Mixed Success	1	0	1				2	1	2	1	1	1	1	1	1	1	1	-1
B3 - Severe production decline	-1	0	-3				-3	-1	-3	-3	-3	-3	0	-1	-1	-2	-2	-2
C. Generational Renewal																		

	A			B			C			D			E			F		
	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2	E3	F1	F2	F3
C1 - Enhanced Attractiveness and support	2	1	1	3	2	1				2	2	2	2	2	2	1	1	-1
C2 - Foreign workers partially offset problem	1	0	0	0	0	-1				0	1	-1	0	0	0	0	0	0
C3 - Decline of young workers	-1	0	0	-1	-1	-1				-1	-1	-1	0	0	0	0	0	0
D. Geopolitical instability																		
D1 - Strengthened resilience and cooperation	3	0	1	3	3	1	2	1	2				1	0	0	1	0	0
D2 - Instability varies across Europe	1	0	1	1	1	0	1	1	1				0	0	0	0	0	0
D3 - Severe disruptions and shortages	-2	0	-2	-3	-3	-3	-3	-2	-3				-1	-1	-1	-1	-1	-2
E. Inappropriate food processing and packaging																		
E1 - Significant advancements in packaging processes and logistics	3	1	1	3	3	1	1	0	1	1	2	2				2	2	2
E2 - Gradual improvements	2	1	1	2	1	1	1	0	1	1	1	1				1	1	1
E3 - Persistent inefficiencies	-3	0	-3	-1	-1	-3	-1	0	-1	-1	-1	-3				0	-1	-2
F. Failure of transport infrastructure																		
F1 - Road infrastructure significantly improved	1	0	1	2	1	1	1	0	0	2	2	1	3	3	1			
F2 - Limited improvements	0	0	0	1	0	0	0	0	0	1	1	1	3	0	0			
F3 - increased wear and tear	0	0	0	0	0	-2	-1	0	0	-1	-2	-3	-2	-1	-2			

A.5 Milk and dairy Case study cross-impact table (Finland)

Table 21. Milk and dairy Case study cross-impact table (Finland)

	A			B			C			D			E			F		
	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2	E3	F1	F2	F3
A. Market Price Volatility																		
A1 - Price protection mechanisms				3	2	3	1	1	0	2	1	0	2	1	0	1	0	0
A2 - Partial adaptation				0	0	0	1	0	-2	1	-1	-2	1	0	-1	0	0	0
A3- Pandemics and consumer habits changes				-3	-2	-3	0	-1	-3	-1	-2	-3	0	-1	-3	0	0	-1
B. Prolonged Droughts and Heatwaves																		
B1 - Transition to forage plant varieties	0	1	0				2	-1	-2	0	0	0	0	0	0	0	0	0
B2 - Adaptation with Mixed Success	0	2	2				1	2	1	0	0	0	0	0	0	0	0	0
B3 - Droughts alternating with heavy precipitation	0	2	3				-2	2	3	0	0	0	0	0	0	0	0	0
C. Generational Renewal																		
C1 - Digitization automation and social media	-1	0	1	-1	0	1				-1	0	1	-2	2	3	0	2	3
C2 - Foreign workers partially offset problem	0	1	2	0	1	2				0	1	2	1	2	3	0	2	3
C3 - Decline of young workers	1	2	3	1	2	3				0	2	3	-1	2	3	0	2	3
D. Geopolitical instability																		
D1 - Strengthened resilience through cybersecurity investments	3	2	3	1	0	0	2	1	0				3	1	0	1	0	0
D2 - Partial investments	1	1	-1	0	0	-2	1	0	-1				2	0	-2	0	0	-2
D3 - No investments with increasing attacks on production systems	-1	-2	-3	0	-2	-3	0	-1	-2				0	-2	-3	0	-1	-2
E. Inappropriate food processing and packaging																		
E1 - Significant advancements in packaging processes and logistics	2	-1	-1	1	1	1	2	0	0	1	0	0				0	0	0
E2 - Gradual improvements	-1	2	2	0	2	2	-1	1	2	0	0	0				0	0	0
E3 - Persistent inefficiencies	-1	2	3	-2	2	3	-3	2	3	0	0	0				0	0	0
F. Failure of transport infrastructure																		
F1 - Road infrastructure significantly improved	1	1	0	0	0	0	1	-1	-3	1	0	0	2	1	0			

F2 - Limited improvements	0	0	-1		0	0	-2		1	0	-3		0	0	-1		1	0	-1						
F3 - increased wear and tear	0	0	-1		0	-2	-3		0	0	-3		0	-1	-2		0	-1	-3						

A.6 Fruits and vegetables Case study cross-impact table (Portugal)

Table 22. Fruits and vegetables Case study cross-impact table (Portugal)

	A 1	A 2	A 3	B 1	B 2	B 3	C 1	C 2	C 3	D 1	D 2	D 3	E 1	E 2	E 3	F 1	F 2	F 3	G 1	G 2	G 3	H 1	H 2	H 3	I 1	I 2	I 3
A. Labour Shortage																											
A1 - Effective policies				0	0	0	3	-2	-2	2	-1	0	2	-2	-2	3	2	-2	1	0	0	3	-1	-1	2	2	-1
A2 - Temporary Investments				0	0	0	1	-1	-1	0	0	3	1	-1	-1	2	1	-1	1	0	0	2	-1	0	1	1	0
A3 - Aging Workforce				0	0	0	-1	1	2	-1	1	-1	-1	1	1	2	2	3	-1	1	1	2	-1	-1	0	-1	2
B. Water Availability																											
B1 - Frequent changes of weather conditions	1	1	0				1	1	2	-1	1	2	-1	1	2	1	1	2	1	0	0	-1	1	2	2	1	1
B2 - Sporadic changes	-1	1	1				2	-1	-1	2	-1	-1	-1	0	-1	2	2	-1	-1	1	2	2	-2	-1	2	2	1
B3 - Consistent climate changes	-2	2	2				3	-2	-1	1	1	-1	-1	0	-1	1	1	-1	-1	2	3	2	2	-1	1	3	3
C. Research and innovation																											
C1 - Tech improving production and resilience	1	1	0	0	-1	-1				0	0	2	2	-1	-2	0	0	-1	1	-1	-1	-2	-1	2	-2	1	-1
C2 - Tech slow adoption	1	1	0	0	0	-1				-1	-1	-1	0	2	2	0	0	-1	0	1	1	1	-1	0	0	0	1
C3 - Tech distrust and high costs	1	1	0	0	0	0				-1	-1	-1	0	2	2	1	1	0	1	2	2	3	2	-1	2	2	3
D. Infrastructure Failure																											
D1 - New political program improving	1	1	0	0	-2	-1	1	0	0				2	-1	0	1	1	1	2	-1	0	1	0	1	3	3	-1
D2 - Limited political program with local instability	0	0	0	0	-1	-1	1	1	2				0	0	0	1	1	0	1	-1	0	0	-1	0	1	1	0
D3 - No political actions	0	0	1	0	1	-1	-2	2	2				-1	1	0	1	2	0	**-1**	1	2	2	-1	-1	-2	-2	3
E. Plant pests and diseases																											

E1 - Wide scale implementation of biological control	1	1	0	0	0	0	3	-2	-2	1	0	0				0	0	-2	1	1	1	1	-1	0	1	1	0
E2 - Slow adoption of biological control strategies	1	1	0	0	0	0	-1	2	2	0	0	0				1	1	-1	-1	2	2	1	-1	0	1	1	0
E3 - No prompt implementation of strategies	1	1	0	0	0	0	-1	3	2	-1	1	-1				2	2	0	-2	3	3	1	-1	-1	-2	-2	0
F. Lack of appropriate education																											
F1 - Comprehensive Education Programs	3	2	-2	0	0	0	3	-2	-3	2	-1	0	3	-2	-2				1	-1	-1	1	-1	0	3	3	-1
F2 - Incremental improvements	2	2	-1	0	0	0	2	-1	-2	1	-1	0	2	-2	-2				1	-1	-1	1	-1	-1	2	2	-1
F3 - Persistent knowledge gaps	1	1	1	0	0	0	-2	2	3	-1	1	-1	-3	3	1				-1	1	2	2	-2	-1	-2	-2	2
G. Geopolitical Instability																											
G1 - Stable Imports of critical raw materials	1	1	0	0	0	0	2	-1	0	1	-1	0	3	0	0	1	1	0				0	0	0	2	2	0
G2 - Intermittent supplies	-1	0	0	0	0	0	-2	2	2	-1	1	-1	-2	2	0	1	1	0				1	-1	-1	-1	-1	0
G3 - Severe disruptions shortages	-1	0	0	0	0	0	-2	2	2	-2	2	-1	-3	3	0	1	1	0				2	-2	-2	-2	-2	1
H- Lack of financial liquidity																											
H1 - Necessary financial packages available	1	1	-2	0	0	0	3	-2	-2	2	-1	0	3	-3	-3	1	1	-2	2	-1	0				2	2	-1
H2 - financial solutions available but limited adoptions	0	0	-1	0	0	0	2	-1	2	1	0	0	2	-2	-2	1	1	-1	1	-1	0				2	2	0
H3 - No financial support	-1	-1	1	0	0	0	0	3	-3	-2	1	-1	-2	2	2	2	2	2	-2	2	2				-2	-2	2
I - Biodiversity																											
I1 - Biodiversity protected with technologies and policies	1	1	-1	0	0	0	2	-2	-2	1	-1	1	1	-1	-1	1	1	-1	2	-1	0	1	-1	0			
I2 - Adaptation and resilience	1	1	0	0	0	0	2	-2	-2	1	-1	1	1	-1	-1	1	1	-1	2	-1	0	1	-1	0			
I3 - Decline	1	1	0	-2	2	3	1	1	-1	-2	2	-1	-2	2	2	2	2	0	-2	1	2	1	-1	-1			

Annex B (Case study scenarios)

B.1 Fish Case study Scenarios (Greece)

Table 23. List of scenarios and impact score, fish case (TIS = Total Impact Score).

No.	F.A	F.B	F.C	F.D	F.E	F.F	F.G	F.H	TIS
1	F.A1	F.B3	F.C1	F.D3	F.E1	F.F1	F.G2	F.H1	53
2	F.A1	F.B3	F.C1	F.D3	F.E1	F.F2	F.G2	F.H1	53
3	F.A1	F.B3	F.C1	F.D3	F.E1	F.F1	F.G3	F.H1	52
4	F.A1	F.B3	F.C1	F.D3	F.E1	F.F2	F.G3	F.H1	50
5	F.A1	F.B3	F.C1	F.D3	F.E1	F.F1	F.G1	F.H1	49
6	F.A1	F.B3	F.C1	F.D3	F.E1	F.F2	F.G1	F.H1	49
7	F.A1	F.B2	F.C1	F.D3	F.E1	F.F1	F.G3	F.H1	48
8	F.A1	F.B2	F.C1	F.D3	F.E1	F.F3	F.G2	F.H1	46
9	F.A1	F.B2	F.C2	F.D3	F.E1	F.F1	F.G3	F.H1	46
10	F.A1	F.B2	F.C1	F.D3	F.E1	F.F2	F.G3	F.H1	46
11	F.A1	F.B2	F.C1	F.D1	F.E1	F.F1	F.G3	F.H1	44
12	F.A1	F.B2	F.C2	F.D3	F.E1	F.F2	F.G3	F.H1	44
13	F.A1	F.B2	F.C1	F.D3	F.E1	F.F3	F.G1	F.H1	42
14	F.A1	F.B2	F.C2	F.D3	F.E1	F.F1	F.G2	F.H1	42
15	F.A1	F.B2	F.C2	F.D3	F.E1	F.F2	F.G2	F.H1	42
16	F.A1	F.B1	F.C1	F.D1	F.E1	F.F1	F.G3	F.H1	42
17	F.A1	F.B2	F.C2	F.D1	F.E1	F.F1	F.G3	F.H1	42
18	F.A1	F.B2	F.C1	F.D1	F.E1	F.F2	F.G3	F.H1	42
19	F.A1	F.B2	F.C2	F.D3	F.E1	F.F3	F.G2	F.H1	41
20	F.A2	F.B2	F.C2	F.D3	F.E1	F.F1	F.G3	F.H1	41
21	F.A2	F.B3	F.C2	F.D3	F.E1	F.F1	F.G3	F.H1	41
22	F.A1	F.B1	F.C2	F.D1	F.E1	F.F1	F.G3	F.H1	40
23	F.A1	F.B1	F.C1	F.D1	F.E1	F.F2	F.G3	F.H1	40
24	F.A1	F.B2	F.C2	F.D1	F.E1	F.F2	F.G3	F.H1	40
25	F.A2	F.B2	F.C2	F.D3	F.E1	F.F2	F.G3	F.H1	39
26	F.A2	F.B3	F.C2	F.D3	F.E1	F.F2	F.G3	F.H1	39
27	F.A2	F.B3	F.C2	F.D3	F.E1	F.F1	F.G3	F.H2	39
28	F.A1	F.B2	F.C1	F.D1	F.E1	F.F3	F.G1	F.H1	38
29	F.A1	F.B1	F.C3	F.D1	F.E1	F.F1	F.G3	F.H1	38
30	F.A1	F.B1	F.C2	F.D1	F.E1	F.F2	F.G3	F.H1	38
31	F.A1	F.B2	F.C1	F.D1	F.E1	F.F1	F.G1	F.H1	37
32	F.A1	F.B2	F.C1	F.D1	F.E1	F.F2	F.G1	F.H1	37
33	F.A1	F.B2	F.C2	F.D3	F.E1	F.F3	F.G1	F.H1	37
34	F.A2	F.B2	F.C3	F.D3	F.E1	F.F1	F.G3	F.H1	37
35	F.A2	F.B3	F.C3	F.D3	F.E1	F.F1	F.G3	F.H1	37
36	F.A2	F.B3	F.C2	F.D3	F.E1	F.F2	F.G3	F.H2	37

No.	F.A	F.B	F.C	F.D	F.E	F.F	F.G	F.H	TIS
37	F.A1	F.B1	F.C1	F.D1	F.E1	F.F3	F.G1	F.H1	36
38	F.A1	F.B1	F.C3	F.D1	F.E1	F.F2	F.G3	F.H1	36
39	F.A1	F.B1	F.C1	F.D1	F.E1	F.F1	F.G1	F.H1	35
40	F.A1	F.B1	F.C1	F.D1	F.E1	F.F2	F.G1	F.H1	35
41	F.A1	F.B1	F.C3	F.D3	F.E1	F.F3	F.G2	F.H1	35
42	F.A2	F.B1	F.C3	F.D3	F.E1	F.F1	F.G3	F.H1	35
43	F.A2	F.B2	F.C3	F.D3	F.E1	F.F2	F.G3	F.H1	35
44	F.A2	F.B3	F.C3	F.D3	F.E1	F.F2	F.G3	F.H1	35
45	F.A1	F.B2	F.C2	F.D1	F.E1	F.F3	F.G1	F.H1	33
46	F.A2	F.B1	F.C3	F.D3	F.E1	F.F2	F.G3	F.H1	33
47	F.A1	F.B1	F.C2	F.D1	F.E1	F.F3	F.G1	F.H1	31
48	F.A1	F.B1	F.C3	F.D3	F.E1	F.F3	F.G1	F.H1	31
49	F.A3	F.B2	F.C2	F.D1	F.E1	F.F3	F.G1	F.H1	30
50	F.A1	F.B1	F.C3	F.D1	F.E1	F.F3	F.G1	F.H1	29
51	F.A3	F.B2	F.C2	F.D1	F.E1	F.F3	F.G1	F.H2	29
52	F.A3	F.B2	F.C2	F.D2	F.E1	F.F3	F.G1	F.H2	29
53	F.A3	F.B1	F.C2	F.D1	F.E1	F.F3	F.G1	F.H1	28
54	F.A3	F.B2	F.C2	F.D1	F.E1	F.F3	F.G2	F.H1	28
55	F.A3	F.B2	F.C2	F.D1	F.E1	F.F3	F.G2	F.H2	27
56	F.A3	F.B1	F.C3	F.D1	F.E1	F.F3	F.G1	F.H1	26
57	F.A3	F.B2	F.C3	F.D1	F.E1	F.F3	F.G1	F.H1	26
58	F.A3	F.B1	F.C2	F.D1	F.E1	F.F3	F.G2	F.H1	26
59	F.A3	F.B2	F.C3	F.D2	F.E1	F.F3	F.G1	F.H2	25
60	F.A3	F.B1	F.C3	F.D1	F.E1	F.F3	F.G2	F.H1	24
61	F.A3	F.B2	F.C3	F.D1	F.E1	F.F3	F.G2	F.H1	24
62	F.A3	F.B2	F.C3	F.D2	F.E1	F.F3	F.G2	F.H2	23
63	F.A3	F.B3	F.C2	F.D2	F.E1	F.F1	F.G1	F.H2	22
64	F.A3	F.B3	F.C2	F.D2	F.E1	F.F2	F.G1	F.H2	22
65	F.A3	F.B1	F.C3	F.D2	F.E1	F.F3	F.G1	F.H2	21
66	F.A3	F.B1	F.C3	F.D2	F.E1	F.F3	F.G1	F.H1	20
67	F.A3	F.B1	F.C3	F.D2	F.E1	F.F3	F.G2	F.H2	19
68	F.A3	F.B1	F.C3	F.D2	F.E1	F.F3	F.G2	F.H1	18
69	F.A3	F.B3	F.C3	F.D2	F.E1	F.F1	F.G1	F.H2	18
70	F.A3	F.B3	F.C3	F.D2	F.E1	F.F2	F.G1	F.H2	18
71	F.A3	F.B3	F.C3	F.D2	F.E1	F.F1	F.G1	F.H1	16
72	F.A3	F.B3	F.C3	F.D2	F.E1	F.F2	F.G1	F.H1	16
73	F.A3	F.B1	F.C3	F.D4	F.E2	F.F3	F.G1	F.H2	11
74	F.A3	F.B1	F.C3	F.D4	F.E2	F.F3	F.G1	F.H1	10
75	F.A3	F.B1	F.C3	F.D4	F.E2	F.F3	F.G2	F.H2	9
76	F.A3	F.B1	F.C3	F.D4	F.E2	F.F3	F.G2	F.H1	8
77	F.A1	F.B1	F.C3	F.D4	F.E2	F.F1	F.G1	F.H1	6
78	F.A1	F.B1	F.C3	F.D4	F.E2	F.F2	F.G1	F.H1	6
79	F.A2	F.B1	F.C3	F.D4	F.E2	F.F1	F.G1	F.H1	1
80	F.A2	F.B1	F.C3	F.D4	F.E2	F.F2	F.G1	F.H1	1
81	F.A2	F.B1	F.C3	F.D4	F.E2	F.F1	F.G2	F.H1	1

No.	F.A	F.B	F.C	F.D	F.E	F.F	F.G	F.H	TIS
82	F.A2	F.B1	F.C3	F.D4	F.E2	F.F2	F.G2	F.H1	1
83	F.A2	F.B1	F.C3	F.D4	F.E2	F.F1	F.G1	F.H2	0
84	F.A2	F.B1	F.C3	F.D4	F.E2	F.F2	F.G1	F.H2	0
85	F.A2	F.B1	F.C3	F.D4	F.E2	F.F1	F.G2	F.H2	0
86	F.A2	F.B1	F.C3	F.D4	F.E2	F.F2	F.G2	F.H2	0

B.2 Aquaculture Case study Scenarios (Belgium)

Table 24. List of scenarios and impact score, Aquaculture case (TIS = Total Impact Score).

No.	A.A	A.B	A.C	A.D	A.E	A.F	A.G	A.H	A.I	A.J	A.K	A.L	TIS
1	A.A1	A.B3	A.C3	A.D1	A.E3	A.F3	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	60
2	A.A3	A.B3	A.C3	A.D1	A.E3	A.F3	A.G3	A.H1	A.I3	A.J3	A.K3	A.L3	58
3	A.A1	A.B3	A.C3	A.D1	A.E2	A.F3	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	57
4	A.A1	A.B3	A.C3	A.D1	A.E3	A.F3	A.G1	A.H1	A.I1	A.J3	A.K3	A.L1	55
5	A.A3	A.B3	A.C3	A.D1	A.E3	A.F3	A.G1	A.H1	A.I3	A.J3	A.K3	A.L1	55
6	A.A1	A.B3	A.C3	A.D1	A.E3	A.F3	A.G1	A.H1	A.I1	A.J3	A.K3	A.L3	55
7	A.A1	A.B1	A.C1	A.D1	A.E1	A.F1	A.G1	A.H1	A.I1	A.J1	A.K1	A.L1	54
8	A.A3	A.B3	A.C3	A.D1	A.E2	A.F3	A.G3	A.H1	A.I3	A.J3	A.K3	A.L3	54
9	A.A1	A.B3	A.C3	A.D1	A.E2	A.F3	A.G1	A.H1	A.I1	A.J3	A.K3	A.L1	53
10	A.A1	A.B3	A.C3	A.D1	A.E2	A.F3	A.G1	A.H1	A.I1	A.J3	A.K3	A.L3	53
11	A.A3	A.B3	A.C3	A.D1	A.E3	A.F3	A.G1	A.H1	A.I3	A.J3	A.K3	A.L3	53
12	A.A1	A.B3	A.C1	A.D1	A.E1	A.F3	A.G1	A.H1	A.I1	A.J1	A.K3	A.L1	52
13	A.A3	A.B3	A.C3	A.D1	A.E2	A.F3	A.G1	A.H1	A.I3	A.J3	A.K3	A.L1	52
14	A.A1	A.B3	A.C3	A.D1	A.E3	A.F1	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	52
15	A.A1	A.B3	A.C3	A.D1	A.E3	A.F2	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	52
16	A.A1	A.B1	A.C1	A.D1	A.E1	A.F1	A.G1	A.H1	A.I1	A.J1	A.K2	A.L1	51
17	A.A1	A.B1	A.C1	A.D1	A.E1	A.F1	A.G1	A.H1	A.I1	A.J1	A.K3	A.L1	51
18	A.A1	A.B1	A.C2	A.D1	A.E1	A.F1	A.G1	A.H1	A.I1	A.J1	A.K1	A.L1	51
19	A.A1	A.B3	A.C3	A.D1	A.E3	A.F3	A.G1	A.H1	A.I1	A.J2	A.K3	A.L1	51
20	A.A1	A.B1	A.C3	A.D1	A.E3	A.F1	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	51
21	A.A1	A.B1	A.C1	A.D1	A.E1	A.F2	A.G1	A.H1	A.I1	A.J1	A.K1	A.L1	50
22	A.A1	A.B3	A.C2	A.D1	A.E1	A.F3	A.G1	A.H1	A.I1	A.J1	A.K3	A.L1	50
23	A.A3	A.B3	A.C3	A.D1	A.E3	A.F3	A.G1	A.H1	A.I3	A.J2	A.K3	A.L1	50
24	A.A3	A.B3	A.C3	A.D1	A.E2	A.F3	A.G1	A.H1	A.I3	A.J3	A.K3	A.L3	50

No.	A.A	A.B	A.C	A.D	A.E	A.F	A.G	A.H	A.I	A.J	A.K	A.L	TIS
25	A.A3	A.B3	A.C3	A.D3	A.E3	A.F3	A.G1	A.H1	A.I3	A.J3	A.K3	A.L3	50
26	A.A3	A.B3	A.C3	A.D1	A.E3	A.F1	A.G3	A.H1	A.I3	A.J3	A.K3	A.L3	50
27	A.A3	A.B3	A.C3	A.D1	A.E3	A.F2	A.G3	A.H1	A.I3	A.J3	A.K3	A.L3	50
28	A.A1	A.B3	A.C1	A.D1	A.E1	A.F1	A.G1	A.H1	A.I1	A.J1	A.K3	A.L1	49
29	A.A1	A.B3	A.C1	A.D1	A.E1	A.F2	A.G1	A.H1	A.I1	A.J1	A.K3	A.L1	49
30	A.A1	A.B3	A.C3	A.D1	A.E2	A.F3	A.G1	A.H1	A.I1	A.J2	A.K3	A.L1	49
31	A.A1	A.B3	A.C3	A.D1	A.E3	A.F3	A.G3	A.H1	A.I1	A.J1	A.K3	A.L3	49
32	A.A1	A.B1	A.C3	A.D1	A.E3	A.F1	A.G3	A.H1	A.I1	A.J3	A.K1	A.L3	49
33	A.A1	A.B3	A.C1	A.D1	A.E1	A.F2	A.G1	A.H1	A.I1	A.J1	A.K1	A.L1	48
34	A.A1	A.B1	A.C1	A.D1	A.E1	A.F3	A.G1	A.H1	A.I1	A.J1	A.K1	A.L1	48
35	A.A1	A.B3	A.C1	A.D1	A.E1	A.F3	A.G1	A.H1	A.I1	A.J1	A.K1	A.L1	48
36	A.A1	A.B1	A.C2	A.D1	A.E1	A.F1	A.G1	A.H1	A.I1	A.J1	A.K2	A.L1	48
37	A.A1	A.B1	A.C2	A.D1	A.E1	A.F1	A.G1	A.H1	A.I1	A.J1	A.K3	A.L1	48
38	A.A1	A.B3	A.C3	A.D1	A.E3	A.F3	A.G1	A.H1	A.I1	A.J2	A.K3	A.L3	48
39	A.A1	A.B1	A.C3	A.D1	A.E3	A.F1	A.G3	A.H1	A.I1	A.J3	A.K2	A.L3	48
40	A.A1	A.B1	A.C1	A.D1	A.E1	A.F2	A.G1	A.H1	A.I1	A.J1	A.K2	A.L1	47
41	A.A1	A.B3	A.C1	A.D1	A.E1	A.F2	A.G1	A.H1	A.I1	A.J1	A.K2	A.L1	47
42	A.A3	A.B3	A.C1	A.D1	A.E1	A.F3	A.G1	A.H1	A.I3	A.J1	A.K3	A.L1	47
43	A.A1	A.B3	A.C2	A.D1	A.E1	A.F1	A.G1	A.H1	A.I1	A.J1	A.K3	A.L1	47
44	A.A1	A.B1	A.C2	A.D1	A.E1	A.F2	A.G1	A.H1	A.I1	A.J1	A.K1	A.L1	47
45	A.A1	A.B3	A.C2	A.D1	A.E1	A.F2	A.G1	A.H1	A.I1	A.J1	A.K3	A.L1	47
46	A.A1	A.B3	A.C2	A.D1	A.E3	A.F3	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	47
47	A.A3	A.B3	A.C3	A.D1	A.E2	A.F3	A.G1	A.H1	A.I3	A.J2	A.K3	A.L1	47
48	A.A1	A.B3	A.C3	A.D1	A.E3	A.F1	A.G1	A.H1	A.I1	A.J3	A.K3	A.L1	47
49	A.A3	A.B3	A.C3	A.D1	A.E3	A.F1	A.G1	A.H1	A.I3	A.J3	A.K3	A.L1	47
50	A.A1	A.B3	A.C3	A.D1	A.E3	A.F2	A.G1	A.H1	A.I1	A.J3	A.K3	A.L1	47
51	A.A3	A.B3	A.C3	A.D1	A.E3	A.F2	A.G1	A.H1	A.I3	A.J3	A.K3	A.L1	47
52	A.A1	A.B3	A.C3	A.D1	A.E3	A.F1	A.G1	A.H1	A.I1	A.J3	A.K3	A.L3	47

No.	A.A	A.B	A.C	A.D	A.E	A.F	A.G	A.H	A.I	A.J	A.K	A.L	TIS
53	A.A1	A.B3	A.C3	A.D1	A.E3	A.F2	A.G1	A.H1	A.I1	A.J3	A.K3	A.L3	47
54	A.A3	A.B3	A.C3	A.D3	A.E2	A.F3	A.G1	A.H1	A.I3	A.J3	A.K3	A.L3	47
55	A.A1	A.B3	A.C3	A.D1	A.E3	A.F1	A.G3	A.H1	A.I1	A.J3	A.K2	A.L3	47
56	A.A1	A.B3	A.C3	A.D1	A.E3	A.F2	A.G3	A.H1	A.I1	A.J3	A.K2	A.L3	47
57	A.A1	A.B3	A.C2	A.D1	A.E1	A.F2	A.G1	A.H1	A.I1	A.J1	A.K1	A.L1	46
58	A.A1	A.B3	A.C2	A.D1	A.E1	A.F3	A.G1	A.H1	A.I1	A.J1	A.K1	A.L1	46
59	A.A1	A.B3	A.C2	A.D1	A.E2	A.F3	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	46
60	A.A1	A.B3	A.C3	A.D1	A.E2	A.F3	A.G1	A.H1	A.I1	A.J2	A.K3	A.L3	46
61	A.A1	A.B3	A.C3	A.D1	A.E3	A.F1	A.G3	A.H1	A.I1	A.J3	A.K1	A.L3	46
62	A.A1	A.B3	A.C3	A.D1	A.E3	A.F2	A.G3	A.H1	A.I1	A.J3	A.K1	A.L3	46
63	A.A1	A.B1	A.C1	A.D1	A.E2	A.F1	A.G1	A.H1	A.I1	A.J1	A.K1	A.L1	45
64	A.A1	A.B1	A.C1	A.D1	A.E3	A.F1	A.G1	A.H1	A.I1	A.J1	A.K1	A.L1	45
65	A.A1	A.B3	A.C1	A.D1	A.E2	A.F3	A.G1	A.H1	A.I1	A.J1	A.K3	A.L1	45
66	A.A1	A.B3	A.C1	A.D1	A.E3	A.F3	A.G1	A.H1	A.I1	A.J1	A.K3	A.L1	45
67	A.A1	A.B3	A.C2	A.D1	A.E1	A.F1	A.G1	A.H1	A.I1	A.J1	A.K2	A.L1	45
68	A.A1	A.B3	A.C2	A.D1	A.E1	A.F2	A.G1	A.H1	A.I1	A.J1	A.K2	A.L1	45
69	A.A1	A.B1	A.C2	A.D1	A.E1	A.F3	A.G1	A.H1	A.I1	A.J1	A.K1	A.L1	45
70	A.A3	A.B3	A.C2	A.D1	A.E1	A.F3	A.G1	A.H1	A.I3	A.J1	A.K3	A.L1	45
71	A.A3	A.B3	A.C2	A.D1	A.E3	A.F3	A.G3	A.H1	A.I3	A.J3	A.K3	A.L3	45
72	A.A1	A.B3	A.C3	A.D1	A.E3	A.F1	A.G1	A.H1	A.I1	A.J3	A.K1	A.L1	45
73	A.A1	A.B3	A.C3	A.D1	A.E3	A.F1	A.G1	A.H1	A.I1	A.J3	A.K2	A.L1	45
74	A.A1	A.B3	A.C3	A.D1	A.E3	A.F2	A.G1	A.H1	A.I1	A.J3	A.K1	A.L1	45
75	A.A1	A.B3	A.C3	A.D1	A.E3	A.F2	A.G1	A.H1	A.I1	A.J3	A.K2	A.L1	45
76	A.A3	A.B3	A.C3	A.D1	A.E3	A.F1	A.G1	A.H1	A.I3	A.J3	A.K3	A.L3	45
77	A.A3	A.B3	A.C3	A.D1	A.E3	A.F2	A.G1	A.H1	A.I3	A.J3	A.K3	A.L3	45
78	A.A1	A.B2	A.C3	A.D1	A.E3	A.F1	A.G3	A.H1	A.I1	A.J3	A.K2	A.L3	45
79	A.A1	A.B1	A.C3	A.D1	A.E3	A.F1	A.G3	A.H1	A.I3	A.J3	A.K3	A.L3	45
80	A.A3	A.B1	A.C3	A.D1	A.E3	A.F1	A.G3	A.H1	A.I3	A.J3	A.K3	A.L3	45

No.	A.A	A.B	A.C	A.D	A.E	A.F	A.G	A.H	A.I	A.J	A.K	A.L	TIS
81	A.A1	A.B1	A.C3	A.D1	A.E3	A.F2	A.G3	A.H1	A.I1	A.J3	A.K1	A.L3	45
82	A.A3	A.B3	A.C1	A.D1	A.E1	A.F1	A.G1	A.H1	A.I3	A.J1	A.K3	A.L1	44
83	A.A3	A.B3	A.C1	A.D1	A.E1	A.F2	A.G1	A.H1	A.I3	A.J1	A.K3	A.L1	44
84	A.A1	A.B3	A.C1	A.D1	A.E1	A.F3	A.G1	A.H1	A.I3	A.J1	A.K3	A.L1	44
85	A.A2	A.B3	A.C1	A.D1	A.E1	A.F3	A.G1	A.H1	A.I3	A.J1	A.K3	A.L1	44
86	A.A1	A.B1	A.C2	A.D1	A.E1	A.F2	A.G1	A.H1	A.I1	A.J1	A.K2	A.L1	44
87	A.A1	A.B1	A.C2	A.D1	A.E3	A.F1	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	44
88	A.A1	A.B3	A.C2	A.D1	A.E3	A.F1	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	44
89	A.A1	A.B3	A.C2	A.D1	A.E3	A.F2	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	44
90	A.A1	A.B2	A.C2	A.D1	A.E3	A.F3	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	44
91	A.A2	A.B3	A.C3	A.D1	A.E2	A.F3	A.G1	A.H1	A.I3	A.J2	A.K3	A.L1	44
92	A.A1	A.B1	A.C3	A.D1	A.E3	A.F1	A.G1	A.H1	A.I1	A.J3	A.K1	A.L1	44
93	A.A2	A.B1	A.C3	A.D1	A.E3	A.F1	A.G3	A.H1	A.I3	A.J3	A.K3	A.L3	44
94	A.A1	A.B2	A.C3	A.D1	A.E3	A.F2	A.G3	A.H1	A.I1	A.J3	A.K2	A.L3	44
95	A.A1	A.B1	A.C1	A.D1	A.E1	A.F1	A.G1	A.H1	A.I3	A.J1	A.K3	A.L1	43
96	A.A1	A.B3	A.C2	A.D1	A.E2	A.F3	A.G1	A.H1	A.I1	A.J1	A.K3	A.L1	43
97	A.A1	A.B3	A.C2	A.D1	A.E3	A.F3	A.G1	A.H1	A.I1	A.J1	A.K3	A.L1	43
98	A.A1	A.B1	A.C2	A.D1	A.E2	A.F1	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	43
99	A.A1	A.B3	A.C2	A.D1	A.E2	A.F1	A.G3	A.H1	A.I1	A.J3	A.K3	A.L3	43
100	A.A1	A.B1	A.C2	A.D1	A.E3	A.F1	A.G3	A.H1	A.I1	A.J3	A.K1	A.L3	43

B.3 Grain Case study Scenarios (Ukraine)

Table 25. List of scenarios and impact score, Grain case (TIS = Total Impact Score).

No.	G.A	G.B	G.C	G.D	G.E	G.F	TIS
1	G.A1	G.B1	G.C1	G.D1	G.E1	G.F1	19
2	G.A2	G.B3	G.C2	G.D3	G.E2	G.F3	18
3	G.A2	G.B3	G.C3	G.D3	G.E2	G.F3	18
4	G.A2	G.B1	G.C1	G.D1	G.E1	G.F1	17
5	G.A1	G.B1	G.C1	G.D3	G.E2	G.F3	17
6	G.A3	G.B3	G.C2	G.D3	G.E2	G.F3	17
7	G.A3	G.B3	G.C3	G.D3	G.E2	G.F3	17
8	G.A1	G.B1	G.C1	G.D2	G.E1	G.F1	16
9	G.A1	G.B1	G.C1	G.D1	G.E1	G.F2	16
10	G.A1	G.B2	G.C2	G.D3	G.E2	G.F3	16
11	G.A1	G.B2	G.C3	G.D3	G.E2	G.F3	15
12	G.A1	G.B2	G.C1	G.D1	G.E1	G.F1	14
13	G.A2	G.B2	G.C1	G.D1	G.E1	G.F1	14
14	G.A3	G.B2	G.C1	G.D1	G.E1	G.F1	14
15	G.A3	G.B3	G.C3	G.D1	G.E1	G.F1	14
16	G.A2	G.B1	G.C1	G.D2	G.E1	G.F1	14
17	G.A2	G.B1	G.C1	G.D1	G.E1	G.F2	14
18	G.A1	G.B1	G.C1	G.D2	G.E1	G.F2	14
19	G.A2	G.B2	G.C2	G.D3	G.E2	G.F3	14
20	G.A3	G.B3	G.C2	G.D1	G.E1	G.F1	13
21	G.A2	G.B3	G.C3	G.D1	G.E1	G.F1	13
22	G.A2	G.B1	G.C1	G.D3	G.E2	G.F3	13
23	G.A2	G.B2	G.C3	G.D3	G.E2	G.F3	13
24	G.A2	G.B3	G.C2	G.D1	G.E1	G.F1	12
25	G.A3	G.B3	G.C3	G.D2	G.E1	G.F1	12
26	G.A2	G.B1	G.C1	G.D2	G.E1	G.F2	12
27	G.A1	G.B2	G.C1	G.D3	G.E2	G.F3	12
28	G.A3	G.B2	G.C2	G.D3	G.E2	G.F3	12
29	G.A1	G.B1	G.C1	G.D3	G.E3	G.F3	12
30	G.A1	G.B2	G.C1	G.D2	G.E1	G.F1	11
31	G.A2	G.B2	G.C1	G.D2	G.E1	G.F1	11
32	G.A3	G.B2	G.C1	G.D2	G.E1	G.F1	11
33	G.A3	G.B3	G.C2	G.D2	G.E1	G.F1	11
34	G.A2	G.B3	G.C3	G.D2	G.E1	G.F1	11
35	G.A1	G.B2	G.C1	G.D1	G.E1	G.F2	11
36	G.A2	G.B2	G.C1	G.D1	G.E1	G.F2	11
37	G.A3	G.B2	G.C1	G.D1	G.E1	G.F2	11
38	G.A3	G.B3	G.C3	G.D1	G.E1	G.F2	11
39	G.A3	G.B2	G.C3	G.D3	G.E2	G.F3	11
40	G.A2	G.B3	G.C2	G.D2	G.E1	G.F1	10
41	G.A3	G.B3	G.C2	G.D1	G.E1	G.F2	10

No.	G.A	G.B	G.C	G.D	G.E	G.F	TIS
42	G.A2	G.B3	G.C3	G.D1	G.E1	G.F2	10
43	G.A3	G.B3	G.C3	G.D2	G.E1	G.F2	10
44	G.A2	G.B2	G.C1	G.D3	G.E2	G.F3	10
45	G.A2	G.B3	G.C2	G.D1	G.E3	G.F1	9
46	G.A2	G.B3	G.C2	G.D1	G.E1	G.F2	9
47	G.A1	G.B2	G.C1	G.D2	G.E1	G.F2	9
48	G.A2	G.B2	G.C1	G.D2	G.E1	G.F2	9
49	G.A3	G.B2	G.C1	G.D2	G.E1	G.F2	9
50	G.A3	G.B3	G.C2	G.D2	G.E1	G.F2	9
51	G.A2	G.B3	G.C3	G.D2	G.E1	G.F2	9
52	G.A2	G.B1	G.C1	G.D3	G.E3	G.F3	9
53	G.A1	G.B2	G.C2	G.D1	G.E1	G.F1	8
54	G.A2	G.B2	G.C2	G.D1	G.E1	G.F1	8
55	G.A3	G.B2	G.C2	G.D1	G.E1	G.F1	8
56	G.A1	G.B2	G.C3	G.D1	G.E1	G.F1	8
57	G.A2	G.B2	G.C3	G.D1	G.E1	G.F1	8
58	G.A3	G.B2	G.C3	G.D1	G.E1	G.F1	8
59	G.A2	G.B3	G.C2	G.D2	G.E3	G.F1	8
60	G.A2	G.B3	G.C2	G.D2	G.E1	G.F2	8
61	G.A3	G.B2	G.C1	G.D3	G.E2	G.F3	8
62	G.A2	G.B3	G.C2	G.D1	G.E3	G.F2	7
63	G.A2	G.B3	G.C2	G.D2	G.E3	G.F2	7
64	G.A1	G.B2	G.C1	G.D3	G.E3	G.F3	7
65	G.A1	G.B2	G.C2	G.D2	G.E1	G.F1	6
66	G.A2	G.B2	G.C2	G.D2	G.E1	G.F1	6
67	G.A3	G.B2	G.C2	G.D2	G.E1	G.F1	6
68	G.A1	G.B2	G.C3	G.D2	G.E1	G.F1	6
69	G.A2	G.B2	G.C3	G.D2	G.E1	G.F1	6
70	G.A3	G.B2	G.C3	G.D2	G.E1	G.F1	6
71	G.A1	G.B2	G.C2	G.D1	G.E3	G.F1	6
72	G.A2	G.B2	G.C1	G.D3	G.E3	G.F3	6
73	G.A2	G.B2	G.C2	G.D1	G.E3	G.F1	5
74	G.A1	G.B2	G.C3	G.D1	G.E3	G.F1	5
75	G.A1	G.B2	G.C2	G.D2	G.E3	G.F1	5
76	G.A1	G.B2	G.C2	G.D1	G.E1	G.F2	5
77	G.A2	G.B2	G.C2	G.D1	G.E1	G.F2	5
78	G.A3	G.B2	G.C2	G.D1	G.E1	G.F2	5
79	G.A1	G.B2	G.C3	G.D1	G.E1	G.F2	5
80	G.A2	G.B2	G.C3	G.D1	G.E1	G.F2	5
81	G.A3	G.B2	G.C3	G.D1	G.E1	G.F2	5
82	G.A2	G.B2	G.C2	G.D2	G.E3	G.F1	4
83	G.A1	G.B2	G.C3	G.D2	G.E3	G.F1	4
84	G.A1	G.B2	G.C2	G.D2	G.E1	G.F2	4
85	G.A2	G.B2	G.C2	G.D2	G.E1	G.F2	4

No.	G.A	G.B	G.C	G.D	G.E	G.F	TIS
86	G.A3	G.B2	G.C2	G.D2	G.E1	G.F2	4
87	G.A1	G.B2	G.C3	G.D2	G.E1	G.F2	4
88	G.A2	G.B2	G.C3	G.D2	G.E1	G.F2	4
89	G.A3	G.B2	G.C3	G.D2	G.E1	G.F2	4
90	G.A1	G.B2	G.C2	G.D1	G.E3	G.F2	4
91	G.A1	G.B2	G.C2	G.D2	G.E3	G.F2	4
92	G.A2	G.B3	G.C3	G.D2	G.E1	G.F3	4
93	G.A3	G.B3	G.C3	G.D2	G.E1	G.F3	4
94	G.A3	G.B2	G.C1	G.D3	G.E3	G.F3	4
95	G.A2	G.B2	G.C2	G.D1	G.E3	G.F2	3
96	G.A1	G.B2	G.C3	G.D1	G.E3	G.F2	3
97	G.A2	G.B2	G.C2	G.D2	G.E3	G.F2	3
98	G.A1	G.B2	G.C3	G.D2	G.E3	G.F2	3
99	G.A3	G.B2	G.C1	G.D3	G.E1	G.F3	1
100	G.A1	G.B2	G.C2	G.D1	G.E2	G.F1	0

B.4 Milk and Dairy Case study Scenarios (Greece)

Table 26. List of scenarios and impact score, Mik and Dairy products Greece case (TIS = Total Impact Score).

No.	MDG.A	MDG.B	MDG.C	MDG.D	MDG.E	MDG.F	TIS
1	MDG.A1	MDG.B1	MDG.C1	MDG.D1	MDG.E1	MDG.F1	56
2	MDG.A1	MDG.B1	MDG.C1	MDG.D1	MDG.E2	MDG.F1	52
3	MDG.A1	MDG.B1	MDG.C1	MDG.D1	MDG.E1	MDG.F2	51
4	MDG.A1	MDG.B2	MDG.C1	MDG.D1	MDG.E1	MDG.F1	50
5	MDG.A1	MDG.B1	MDG.C1	MDG.D2	MDG.E1	MDG.F1	50
6	MDG.A1	MDG.B1	MDG.C1	MDG.D2	MDG.E2	MDG.F1	46
7	MDG.A1	MDG.B1	MDG.C1	MDG.D2	MDG.E1	MDG.F2	46
8	MDG.A1	MDG.B2	MDG.C1	MDG.D1	MDG.E1	MDG.F2	45
9	MDG.A1	MDG.B2	MDG.C1	MDG.D2	MDG.E1	MDG.F1	44
10	MDG.A1	MDG.B1	MDG.C3	MDG.D1	MDG.E1	MDG.F1	42
11	MDG.A1	MDG.B2	MDG.C1	MDG.D2	MDG.E1	MDG.F2	40
12	MDG.A1	MDG.B1	MDG.C3	MDG.D1	MDG.E2	MDG.F1	38
13	MDG.A1	MDG.B1	MDG.C3	MDG.D1	MDG.E1	MDG.F2	38
14	MDG.A1	MDG.B2	MDG.C3	MDG.D1	MDG.E1	MDG.F1	37
15	MDG.A1	MDG.B1	MDG.C1	MDG.D3	MDG.E1	MDG.F1	37
16	MDG.A3	MDG.B1	MDG.C1	MDG.D2	MDG.E1	MDG.F1	36
17	MDG.A1	MDG.B1	MDG.C3	MDG.D2	MDG.E1	MDG.F1	36
18	MDG.A1	MDG.B1	MDG.C1	MDG.D3	MDG.E1	MDG.F2	34
19	MDG.A1	MDG.B1	MDG.C1	MDG.D2	MDG.E1	MDG.F3	34
20	MDG.A1	MDG.B2	MDG.C3	MDG.D1	MDG.E2	MDG.F1	33
21	MDG.A1	MDG.B1	MDG.C1	MDG.D3	MDG.E2	MDG.F1	33
22	MDG.A1	MDG.B2	MDG.C3	MDG.D1	MDG.E1	MDG.F2	33
23	MDG.A1	MDG.B1	MDG.C3	MDG.D2	MDG.E1	MDG.F2	33
24	MDG.A3	MDG.B1	MDG.C1	MDG.D2	MDG.E2	MDG.F1	32
25	MDG.A1	MDG.B1	MDG.C3	MDG.D2	MDG.E2	MDG.F1	32
26	MDG.A3	MDG.B1	MDG.C1	MDG.D2	MDG.E1	MDG.F2	32
27	MDG.A1	MDG.B2	MDG.C3	MDG.D2	MDG.E1	MDG.F1	31
28	MDG.A1	MDG.B2	MDG.C1	MDG.D3	MDG.E1	MDG.F1	31
29	MDG.A1	MDG.B2	MDG.C2	MDG.D2	MDG.E1	MDG.F2	31
30	MDG.A1	MDG.B1	MDG.C1	MDG.D2	MDG.E2	MDG.F3	31
31	MDG.A1	MDG.B1	MDG.C3	MDG.D1	MDG.E1	MDG.F3	30
32	MDG.A3	MDG.B1	MDG.C3	MDG.D1	MDG.E1	MDG.F1	28
33	MDG.A1	MDG.B2	MDG.C3	MDG.D2	MDG.E1	MDG.F2	28
34	MDG.A1	MDG.B2	MDG.C1	MDG.D3	MDG.E1	MDG.F2	28
35	MDG.A1	MDG.B2	MDG.C3	MDG.D2	MDG.E2	MDG.F1	27
36	MDG.A1	MDG.B1	MDG.C3	MDG.D1	MDG.E2	MDG.F3	27

No.	MDG.A	MDG.B	MDG.C	MDG.D	MDG.E	MDG.F	TIS
37	MDG.A3	MDG.B1	MDG.C3	MDG.D2	MDG.E1	MDG.F1	24
38	MDG.A3	MDG.B1	MDG.C3	MDG.D1	MDG.E2	MDG.F1	24
39	MDG.A1	MDG.B1	MDG.C1	MDG.D3	MDG.E3	MDG.F1	24
40	MDG.A3	MDG.B1	MDG.C3	MDG.D1	MDG.E1	MDG.F2	24
41	MDG.A1	MDG.B2	MDG.C2	MDG.D2	MDG.E2	MDG.F2	24
42	MDG.A1	MDG.B1	MDG.C3	MDG.D2	MDG.E1	MDG.F3	24
43	MDG.A1	MDG.B1	MDG.C3	MDG.D3	MDG.E1	MDG.F1	23
44	MDG.A2	MDG.B1	MDG.C1	MDG.D2	MDG.E3	MDG.F1	23
45	MDG.A1	MDG.B1	MDG.C2	MDG.D2	MDG.E3	MDG.F1	23
46	MDG.A2	MDG.B1	MDG.C1	MDG.D3	MDG.E1	MDG.F2	23
47	MDG.A3	MDG.B1	MDG.C1	MDG.D3	MDG.E1	MDG.F1	22
48	MDG.A1	MDG.B1	MDG.C2	MDG.D3	MDG.E1	MDG.F2	22
49	MDG.A2	MDG.B1	MDG.C1	MDG.D3	MDG.E2	MDG.F1	21
50	MDG.A3	MDG.B1	MDG.C3	MDG.D2	MDG.E1	MDG.F2	21
51	MDG.A1	MDG.B1	MDG.C3	MDG.D3	MDG.E1	MDG.F2	21
52	MDG.A1	MDG.B2	MDG.C3	MDG.D2	MDG.E2	MDG.F2	21
53	MDG.A1	MDG.B2	MDG.C2	MDG.D2	MDG.E1	MDG.F3	21
54	MDG.A1	MDG.B1	MDG.C3	MDG.D2	MDG.E2	MDG.F3	21
55	MDG.A1	MDG.B2	MDG.C2	MDG.D3	MDG.E1	MDG.F1	20
56	MDG.A3	MDG.B1	MDG.C3	MDG.D2	MDG.E2	MDG.F1	20
57	MDG.A3	MDG.B1	MDG.C1	MDG.D2	MDG.E1	MDG.F3	20
58	MDG.A1	MDG.B1	MDG.C3	MDG.D3	MDG.E2	MDG.F1	19
59	MDG.A1	MDG.B2	MDG.C2	MDG.D2	MDG.E3	MDG.F1	19
60	MDG.A3	MDG.B1	MDG.C1	MDG.D3	MDG.E1	MDG.F2	19
61	MDG.A1	MDG.B2	MDG.C3	MDG.D3	MDG.E1	MDG.F1	18
62	MDG.A3	MDG.B1	MDG.C1	MDG.D3	MDG.E2	MDG.F1	18
63	MDG.A1	MDG.B2	MDG.C1	MDG.D3	MDG.E3	MDG.F1	18
64	MDG.A1	MDG.B2	MDG.C2	MDG.D3	MDG.E1	MDG.F2	18
65	MDG.A1	MDG.B2	MDG.C3	MDG.D2	MDG.E1	MDG.F3	18
66	MDG.A1	MDG.B2	MDG.C2	MDG.D2	MDG.E2	MDG.F3	18
67	MDG.A3	MDG.B2	MDG.C3	MDG.D2	MDG.E1	MDG.F1	17
68	MDG.A2	MDG.B2	MDG.C1	MDG.D2	MDG.E3	MDG.F1	17
69	MDG.A2	MDG.B2	MDG.C1	MDG.D3	MDG.E1	MDG.F2	17
70	MDG.A3	MDG.B1	MDG.C1	MDG.D2	MDG.E2	MDG.F3	17
71	MDG.A1	MDG.B2	MDG.C2	MDG.D3	MDG.E2	MDG.F1	16
72	MDG.A1	MDG.B2	MDG.C3	MDG.D3	MDG.E1	MDG.F2	16
73	MDG.A3	MDG.B1	MDG.C3	MDG.D1	MDG.E1	MDG.F3	16
74	MDG.A2	MDG.B1	MDG.C1	MDG.D3	MDG.E3	MDG.F1	15
75	MDG.A1	MDG.B2	MDG.C3	MDG.D2	MDG.E2	MDG.F3	15
76	MDG.A1	MDG.B2	MDG.C3	MDG.D3	MDG.E2	MDG.F1	14

No.	MDG.A	MDG.B	MDG.C	MDG.D	MDG.E	MDG.F	TIS
77	MDG.A3	MDG.B2	MDG.C3	MDG.D2	MDG.E1	MDG.F2	14
78	MDG.A2	MDG.B1	MDG.C3	MDG.D3	MDG.E1	MDG.F1	13
79	MDG.A2	MDG.B1	MDG.C2	MDG.D2	MDG.E3	MDG.F1	13
80	MDG.A1	MDG.B1	MDG.C2	MDG.D3	MDG.E3	MDG.F1	13
81	MDG.A3	MDG.B1	MDG.C3	MDG.D1	MDG.E2	MDG.F3	13
82	MDG.A2	MDG.B1	MDG.C3	MDG.D3	MDG.E1	MDG.F2	12
83	MDG.A3	MDG.B1	MDG.C3	MDG.D2	MDG.E1	MDG.F3	12
84	MDG.A2	MDG.B1	MDG.C3	MDG.D2	MDG.E3	MDG.F1	11
85	MDG.A1	MDG.B2	MDG.C2	MDG.D3	MDG.E2	MDG.F2	11
86	MDG.A1	MDG.B1	MDG.C2	MDG.D3	MDG.E1	MDG.F3	11
87	MDG.A1	MDG.B1	MDG.C2	MDG.D2	MDG.E3	MDG.F3	11
88	MDG.A3	MDG.B1	MDG.C3	MDG.D3	MDG.E1	MDG.F1	10
89	MDG.A1	MDG.B1	MDG.C3	MDG.D3	MDG.E1	MDG.F3	10
90	MDG.A2	MDG.B1	MDG.C3	MDG.D3	MDG.E2	MDG.F1	9
91	MDG.A2	MDG.B2	MDG.C2	MDG.D2	MDG.E3	MDG.F1	9
92	MDG.A2	MDG.B2	MDG.C1	MDG.D3	MDG.E3	MDG.F1	9
93	MDG.A1	MDG.B2	MDG.C2	MDG.D3	MDG.E3	MDG.F1	9
94	MDG.A1	MDG.B2	MDG.C3	MDG.D3	MDG.E2	MDG.F2	9
95	MDG.A3	MDG.B1	MDG.C3	MDG.D2	MDG.E2	MDG.F3	9
96	MDG.A2	MDG.B2	MDG.C3	MDG.D3	MDG.E1	MDG.F1	8
97	MDG.A3	MDG.B1	MDG.C3	MDG.D3	MDG.E1	MDG.F2	8
98	MDG.A1	MDG.B1	MDG.C2	MDG.D3	MDG.E2	MDG.F3	8
99	MDG.A3	MDG.B1	MDG.C2	MDG.D3	MDG.E1	MDG.F2	7
100	MDG.A2	MDG.B2	MDG.C3	MDG.D3	MDG.E1	MDG.F2	7
101	MDG.A1	MDG.B1	MDG.C3	MDG.D3	MDG.E2	MDG.F3	7
102	MDG.A3	MDG.B1	MDG.C3	MDG.D3	MDG.E2	MDG.F1	6
103	MDG.A2	MDG.B2	MDG.C3	MDG.D2	MDG.E3	MDG.F1	6
104	MDG.A2	MDG.B2	MDG.C3	MDG.D2	MDG.E2	MDG.F3	5
105	MDG.A2	MDG.B2	MDG.C3	MDG.D3	MDG.E2	MDG.F1	4
106	MDG.A2	MDG.B1	MDG.C2	MDG.D3	MDG.E3	MDG.F1	4
107	MDG.A3	MDG.B2	MDG.C3	MDG.D2	MDG.E1	MDG.F3	4
108	MDG.A3	MDG.B2	MDG.C3	MDG.D3	MDG.E1	MDG.F1	3
109	MDG.A2	MDG.B1	MDG.C3	MDG.D3	MDG.E3	MDG.F1	3
110	MDG.A3	MDG.B2	MDG.C2	MDG.D2	MDG.E2	MDG.F3	2
111	MDG.A2	MDG.B1	MDG.C2	MDG.D2	MDG.E3	MDG.F3	2
112	MDG.A3	MDG.B2	MDG.C3	MDG.D3	MDG.E1	MDG.F2	1
113	MDG.A2	MDG.B1	MDG.C3	MDG.D3	MDG.E1	MDG.F3	1
114	MDG.A3	MDG.B2	MDG.C3	MDG.D2	MDG.E2	MDG.F3	1
115	MDG.A2	MDG.B2	MDG.C2	MDG.D3	MDG.E3	MDG.F1	0
116	MDG.A2	MDG.B1	MDG.C3	MDG.D2	MDG.E3	MDG.F3	0

No.	MDG.A	MDG.B	MDG.C	MDG.D	MDG.E	MDG.F	TIS
117	MDG.A1	MDG.B3	MDG.C3	MDG.D3	MDG.E2	MDG.F1	-2
118	MDG.A2	MDG.B2	MDG.C3	MDG.D3	MDG.E3	MDG.F1	-2
119	MDG.A3	MDG.B1	MDG.C3	MDG.D3	MDG.E1	MDG.F3	-3
120	MDG.A3	MDG.B1	MDG.C2	MDG.D2	MDG.E3	MDG.F3	-4
121	MDG.A3	MDG.B1	MDG.C3	MDG.D3	MDG.E2	MDG.F3	-6
122	MDG.A2	MDG.B3	MDG.C3	MDG.D3	MDG.E2	MDG.F1	-10

B.5 Milk and Dairy products (Finland)

Table 27. List of scenarios and impact score, Milk and Dairy Finland case (TIS = Total Impact Score).

No.	MDF.A	MDF.B	MDF.C	MDF.D	MDF.E	MDF.F	TIS
1	MDF.A1	MDF.B3	MDF.C2	MDF.D1	MDF.E1	MDF.F1	29
2	MDF.A1	MDF.B1	MDF.C1	MDF.D1	MDF.E1	MDF.F1	27
3	MDF.A1	MDF.B2	MDF.C1	MDF.D1	MDF.E1	MDF.F1	25
4	MDF.A1	MDF.B3	MDF.C2	MDF.D1	MDF.E1	MDF.F2	25
5	MDF.A1	MDF.B3	MDF.C1	MDF.D1	MDF.E1	MDF.F1	24
6	MDF.A1	MDF.B1	MDF.C1	MDF.D1	MDF.E1	MDF.F2	24
7	MDF.A1	MDF.B3	MDF.C2	MDF.D1	MDF.E1	MDF.F3	24
8	MDF.A1	MDF.B1	MDF.C1	MDF.D1	MDF.E1	MDF.F3	23
9	MDF.A1	MDF.B2	MDF.C1	MDF.D1	MDF.E1	MDF.F2	22
10	MDF.A2	MDF.B3	MDF.C2	MDF.D1	MDF.E1	MDF.F1	21
11	MDF.A1	MDF.B3	MDF.C2	MDF.D2	MDF.E1	MDF.F1	20
12	MDF.A2	MDF.B1	MDF.C1	MDF.D1	MDF.E1	MDF.F1	19
13	MDF.A2	MDF.B2	MDF.C1	MDF.D1	MDF.E1	MDF.F1	19
14	MDF.A1	MDF.B1	MDF.C1	MDF.D2	MDF.E1	MDF.F1	19
15	MDF.A2	MDF.B2	MDF.C1	MDF.D1	MDF.E2	MDF.F1	19
16	MDF.A1	MDF.B3	MDF.C1	MDF.D1	MDF.E1	MDF.F2	19
17	MDF.A1	MDF.B2	MDF.C1	MDF.D2	MDF.E1	MDF.F1	18
18	MDF.A2	MDF.B3	MDF.C2	MDF.D1	MDF.E1	MDF.F2	18
19	MDF.A1	MDF.B1	MDF.C1	MDF.D2	MDF.E1	MDF.F2	18
20	MDF.A1	MDF.B3	MDF.C2	MDF.D2	MDF.E1	MDF.F2	18
21	MDF.A2	MDF.B3	MDF.C1	MDF.D1	MDF.E1	MDF.F1	17
22	MDF.A2	MDF.B3	MDF.C1	MDF.D1	MDF.E2	MDF.F1	17
23	MDF.A2	MDF.B1	MDF.C1	MDF.D1	MDF.E1	MDF.F2	17
24	MDF.A2	MDF.B2	MDF.C1	MDF.D1	MDF.E1	MDF.F2	17
25	MDF.A1	MDF.B2	MDF.C1	MDF.D2	MDF.E1	MDF.F2	17
26	MDF.A2	MDF.B2	MDF.C1	MDF.D1	MDF.E2	MDF.F2	17
27	MDF.A1	MDF.B3	MDF.C1	MDF.D1	MDF.E1	MDF.F3	17
28	MDF.A2	MDF.B3	MDF.C2	MDF.D1	MDF.E1	MDF.F3	17
29	MDF.A3	MDF.B3	MDF.C2	MDF.D1	MDF.E1	MDF.F1	16
30	MDF.A2	MDF.B1	MDF.C1	MDF.D1	MDF.E1	MDF.F3	16
31	MDF.A1	MDF.B3	MDF.C1	MDF.D2	MDF.E1	MDF.F1	15
32	MDF.A2	MDF.B2	MDF.C1	MDF.D1	MDF.E3	MDF.F1	15
33	MDF.A2	MDF.B1	MDF.C1	MDF.D1	MDF.E2	MDF.F2	15
34	MDF.A1	MDF.B2	MDF.C2	MDF.D2	MDF.E1	MDF.F3	15
35	MDF.A3	MDF.B2	MDF.C1	MDF.D1	MDF.E1	MDF.F1	14
36	MDF.A1	MDF.B1	MDF.C1	MDF.D3	MDF.E1	MDF.F1	14

No.	MDF.A	MDF.B	MDF.C	MDF.D	MDF.E	MDF.F	TIS
37	MDF.A1	MDF.B3	MDF.C2	MDF.D3	MDF.E1	MDF.F1	14
38	MDF.A3	MDF.B2	MDF.C1	MDF.D1	MDF.E2	MDF.F1	14
39	MDF.A2	MDF.B2	MDF.C1	MDF.D1	MDF.E1	MDF.F3	14
40	MDF.A1	MDF.B1	MDF.C1	MDF.D2	MDF.E1	MDF.F3	14
41	MDF.A2	MDF.B1	MDF.C1	MDF.D1	MDF.E2	MDF.F3	14
42	MDF.A2	MDF.B2	MDF.C1	MDF.D1	MDF.E2	MDF.F3	14
43	MDF.A2	MDF.B2	MDF.C1	MDF.D2	MDF.E2	MDF.F1	13
44	MDF.A2	MDF.B3	MDF.C1	MDF.D1	MDF.E1	MDF.F2	13
45	MDF.A3	MDF.B3	MDF.C2	MDF.D1	MDF.E1	MDF.F2	13
46	MDF.A2	MDF.B2	MDF.C1	MDF.D2	MDF.E2	MDF.F2	13
47	MDF.A3	MDF.B1	MDF.C1	MDF.D1	MDF.E1	MDF.F1	12
48	MDF.A3	MDF.B3	MDF.C1	MDF.D1	MDF.E1	MDF.F1	12
49	MDF.A3	MDF.B3	MDF.C1	MDF.D1	MDF.E2	MDF.F1	12
50	MDF.A3	MDF.B2	MDF.C1	MDF.D1	MDF.E1	MDF.F2	12
51	MDF.A2	MDF.B2	MDF.C1	MDF.D2	MDF.E1	MDF.F2	12
52	MDF.A1	MDF.B3	MDF.C1	MDF.D2	MDF.E1	MDF.F2	12
53	MDF.A3	MDF.B2	MDF.C1	MDF.D1	MDF.E2	MDF.F2	12
54	MDF.A1	MDF.B2	MDF.C1	MDF.D3	MDF.E1	MDF.F1	11
55	MDF.A2	MDF.B1	MDF.C1	MDF.D2	MDF.E1	MDF.F2	11
56	MDF.A1	MDF.B1	MDF.C1	MDF.D3	MDF.E1	MDF.F2	11
57	MDF.A2	MDF.B3	MDF.C1	MDF.D1	MDF.E1	MDF.F3	11
58	MDF.A3	MDF.B3	MDF.C2	MDF.D1	MDF.E1	MDF.F3	11
59	MDF.A1	MDF.B2	MDF.C1	MDF.D2	MDF.E1	MDF.F3	11
60	MDF.A3	MDF.B1	MDF.C1	MDF.D1	MDF.E1	MDF.F2	10
61	MDF.A1	MDF.B3	MDF.C1	MDF.D3	MDF.E1	MDF.F1	9
62	MDF.A2	MDF.B3	MDF.C1	MDF.D2	MDF.E2	MDF.F1	9
63	MDF.A3	MDF.B3	MDF.C1	MDF.D1	MDF.E1	MDF.F2	8
64	MDF.A1	MDF.B2	MDF.C1	MDF.D3	MDF.E1	MDF.F2	8
65	MDF.A3	MDF.B1	MDF.C1	MDF.D1	MDF.E1	MDF.F3	8
66	MDF.A3	MDF.B2	MDF.C1	MDF.D1	MDF.E1	MDF.F3	8
67	MDF.A3	MDF.B2	MDF.C1	MDF.D1	MDF.E2	MDF.F3	8
68	MDF.A2	MDF.B2	MDF.C1	MDF.D2	MDF.E2	MDF.F3	7
69	MDF.A3	MDF.B2	MDF.C1	MDF.D2	MDF.E2	MDF.F1	6
70	MDF.A3	MDF.B2	MDF.C1	MDF.D2	MDF.E2	MDF.F2	6
71	MDF.A3	MDF.B1	MDF.C1	MDF.D1	MDF.E2	MDF.F3	6
72	MDF.A2	MDF.B1	MDF.C1	MDF.D2	MDF.E2	MDF.F3	6
73	MDF.A3	MDF.B2	MDF.C1	MDF.D2	MDF.E1	MDF.F1	5
74	MDF.A3	MDF.B3	MDF.C2	MDF.D2	MDF.E1	MDF.F1	5
75	MDF.A2	MDF.B2	MDF.C1	MDF.D3	MDF.E2	MDF.F1	5
76	MDF.A3	MDF.B2	MDF.C1	MDF.D2	MDF.E1	MDF.F2	5

No.	MDF.A	MDF.B	MDF.C	MDF.D	MDF.E	MDF.F	TIS
77	MDF.A3	MDF.B3	MDF.C1	MDF.D1	MDF.E1	MDF.F3	5
78	MDF.A2	MDF.B1	MDF.C1	MDF.D3	MDF.E2	MDF.F1	4
79	MDF.A2	MDF.B2	MDF.C1	MDF.D3	MDF.E2	MDF.F2	3
80	MDF.A3	MDF.B3	MDF.C1	MDF.D2	MDF.E2	MDF.F1	2
81	MDF.A2	MDF.B3	MDF.C1	MDF.D3	MDF.E2	MDF.F1	2
82	MDF.A2	MDF.B1	MDF.C1	MDF.D3	MDF.E2	MDF.F2	2
83	MDF.A3	MDF.B3	MDF.C1	MDF.D2	MDF.E1	MDF.F1	1
84	MDF.A2	MDF.B2	MDF.C1	MDF.D3	MDF.E3	MDF.F1	1
85	MDF.A3	MDF.B3	MDF.C2	MDF.D3	MDF.E1	MDF.F1	-1
86	MDF.A3	MDF.B2	MDF.C1	MDF.D3	MDF.E2	MDF.F1	-1
87	MDF.A3	MDF.B2	MDF.C1	MDF.D2	MDF.E2	MDF.F3	-1
88	MDF.A3	MDF.B2	MDF.C1	MDF.D3	MDF.E1	MDF.F1	-2
89	MDF.A3	MDF.B2	MDF.C1	MDF.D2	MDF.E1	MDF.F3	-2
90	MDF.A3	MDF.B2	MDF.C1	MDF.D3	MDF.E2	MDF.F2	-3
91	MDF.A3	MDF.B1	MDF.C1	MDF.D3	MDF.E2	MDF.F1	-4
92	MDF.A3	MDF.B3	MDF.C1	MDF.D3	MDF.E2	MDF.F1	-4
93	MDF.A3	MDF.B2	MDF.C1	MDF.D3	MDF.E1	MDF.F2	-4
94	MDF.A3	MDF.B3	MDF.C1	MDF.D3	MDF.E1	MDF.F1	-5
95	MDF.A3	MDF.B1	MDF.C1	MDF.D3	MDF.E2	MDF.F2	-6
96	MDF.A3	MDF.B2	MDF.C1	MDF.D3	MDF.E2	MDF.F3	-9
97	MDF.A3	MDF.B1	MDF.C1	MDF.D3	MDF.E2	MDF.F3	-10

B.6 Fruit and Vegetables (Portugal)

Table 28. List of scenarios and impact score, Fruit and Vegetables, Portugal case (TIS = Total Impact Score).

No.	FV.A	FV.B	FV.C	FV.D	FV.E	FV.F	FV.G	FV.H	FV.I	TIS
1	FV.A1	FV.B2	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H1	FV.I2	86
2	FV.A1	FV.B3	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H1	FV.I2	86
3	FV.A1	FV.B1	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H1	FV.I2	84
4	FV.A1	FV.B2	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H1	FV.I1	83
5	FV.A1	FV.B1	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H1	FV.I1	82
6	FV.A2	FV.B3	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H1	FV.I2	82
7	FV.A2	FV.B2	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H1	FV.I2	80
8	FV.A1	FV.B2	FV.C1	FV.D1	FV.E1	FV.F2	FV.G1	FV.H1	FV.I2	80
9	FV.A1	FV.B1	FV.C1	FV.D1	FV.E1	FV.F2	FV.G1	FV.H1	FV.I2	78
10	FV.A2	FV.B2	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H1	FV.I1	77
11	FV.A1	FV.B2	FV.C1	FV.D1	FV.E1	FV.F2	FV.G1	FV.H1	FV.I1	77
12	FV.A2	FV.B3	FV.C1	FV.D1	FV.E1	FV.F2	FV.G1	FV.H1	FV.I2	77
13	FV.A1	FV.B1	FV.C1	FV.D1	FV.E1	FV.F2	FV.G1	FV.H1	FV.I1	76
14	FV.A2	FV.B1	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H1	FV.I2	76
15	FV.A2	FV.B2	FV.C1	FV.D1	FV.E1	FV.F2	FV.G1	FV.H1	FV.I2	75
16	FV.A2	FV.B1	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H1	FV.I1	74
17	FV.A2	FV.B2	FV.C1	FV.D1	FV.E1	FV.F2	FV.G1	FV.H1	FV.I1	72
18	FV.A2	FV.B1	FV.C1	FV.D1	FV.E1	FV.F2	FV.G1	FV.H1	FV.I2	71
19	FV.A2	FV.B1	FV.C1	FV.D1	FV.E1	FV.F2	FV.G1	FV.H1	FV.I1	69
20	FV.A1	FV.B1	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H3	FV.I2	68

No.	FV.A	FV.B	FV.C	FV.D	FV.E	FV.F	FV.G	FV.H	FV.I	TIS
21	FV.A1	FV.B1	FV.C1	FV.D3	FV.E1	FV.F1	FV.G1	FV.H1	FV.I2	67
22	FV.A1	FV.B1	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H3	FV.I1	66
23	FV.A1	FV.B1	FV.C1	FV.D3	FV.E1	FV.F1	FV.G1	FV.H1	FV.I1	65
24	FV.A2	FV.B3	FV.C1	FV.D3	FV.E1	FV.F1	FV.G1	FV.H1	FV.I2	65
25	FV.A2	FV.B1	FV.C1	FV.D3	FV.E1	FV.F1	FV.G1	FV.H1	FV.I2	64
26	FV.A1	FV.B1	FV.C1	FV.D3	FV.E1	FV.F2	FV.G1	FV.H1	FV.I2	63
27	FV.A2	FV.B3	FV.C1	FV.D1	FV.E1	FV.F1	FV.G3	FV.H1	FV.I2	63
28	FV.A2	FV.B1	FV.C1	FV.D3	FV.E1	FV.F1	FV.G1	FV.H1	FV.I1	62
29	FV.A2	FV.B2	FV.C1	FV.D3	FV.E1	FV.F2	FV.G1	FV.H1	FV.I2	62
30	FV.A2	FV.B3	FV.C1	FV.D3	FV.E1	FV.F2	FV.G1	FV.H1	FV.I2	62
31	FV.A2	FV.B3	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H3	FV.I2	62
32	FV.A1	FV.B1	FV.C1	FV.D3	FV.E1	FV.F2	FV.G1	FV.H1	FV.I1	61
33	FV.A2	FV.B1	FV.C1	FV.D3	FV.E1	FV.F2	FV.G1	FV.H1	FV.I2	61
34	FV.A1	FV.B1	FV.C1	FV.D1	FV.E1	FV.F2	FV.G1	FV.H3	FV.I2	61
35	FV.A2	FV.B2	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H3	FV.I2	60
36	FV.A2	FV.B1	FV.C1	FV.D3	FV.E1	FV.F2	FV.G1	FV.H1	FV.I1	59
37	FV.A2	FV.B2	FV.C1	FV.D3	FV.E1	FV.F2	FV.G1	FV.H1	FV.I1	59
38	FV.A1	FV.B1	FV.C1	FV.D1	FV.E1	FV.F2	FV.G1	FV.H3	FV.I1	59
39	FV.A2	FV.B3	FV.C1	FV.D1	FV.E1	FV.F2	FV.G3	FV.H1	FV.I2	58
40	FV.A2	FV.B2	FV.C1	FV.D1	FV.E1	FV.F1	FV.G1	FV.H3	FV.I1	57
41	FV.A2	FV.B3	FV.C1	FV.D3	FV.E1	FV.F1	FV.G3	FV.H1	FV.I2	53
42	FV.A2	FV.B3	FV.C1	FV.D3	FV.E1	FV.F1	FV.G2	FV.H1	FV.I2	52
43	FV.A2	FV.B2	FV.C1	FV.D3	FV.E1	FV.F1	FV.G3	FV.H1	FV.I2	52
44	FV.A2	FV.B2	FV.C1	FV.D3	FV.E1	FV.F1	FV.G2	FV.H1	FV.I2	51
45	FV.A1	FV.B1	FV.C1	FV.D3	FV.E1	FV.F1	FV.G1	FV.H3	FV.I2	51
46	FV.A2	FV.B3	FV.C1	FV.D3	FV.E1	FV.F2	FV.G3	FV.H1	FV.I2	50

No.	FV.A	FV.B	FV.C	FV.D	FV.E	FV.F	FV.G	FV.H	FV.I	TIS
47	FV.A2	FV.B1	FV.C1	FV.D3	FV.E1	FV.F1	FV.G1	FV.H3	FV.I2	50
48	FV.A2	FV.B2	FV.C1	FV.D3	FV.E1	FV.F1	FV.G3	FV.H1	FV.I1	49
49	FV.A1	FV.B1	FV.C1	FV.D3	FV.E1	FV.F1	FV.G1	FV.H3	FV.I1	49
50	FV.A2	FV.B3	FV.C1	FV.D3	FV.E1	FV.F2	FV.G2	FV.H1	FV.I2	49
51	FV.A1	FV.B1	FV.C1	FV.D3	FV.E1	FV.F1	FV.G3	FV.H1	FV.I2	49
52	FV.A2	FV.B2	FV.C1	FV.D3	FV.E1	FV.F2	FV.G3	FV.H1	FV.I2	49
53	FV.A2	FV.B2	FV.C1	FV.D3	FV.E1	FV.F1	FV.G2	FV.H1	FV.I1	48
54	FV.A2	FV.B1	FV.C1	FV.D3	FV.E1	FV.F1	FV.G1	FV.H3	FV.I1	48
55	FV.A2	FV.B2	FV.C1	FV.D3	FV.E1	FV.F2	FV.G2	FV.H1	FV.I2	48
56	FV.A2	FV.B3	FV.C1	FV.D3	FV.E1	FV.F1	FV.G3	FV.H1	FV.I3	48
57	FV.A1	FV.B1	FV.C1	FV.D3	FV.E1	FV.F1	FV.G3	FV.H1	FV.I1	47
58	FV.A2	FV.B1	FV.C1	FV.D3	FV.E1	FV.F1	FV.G3	FV.H1	FV.I2	47
59	FV.A2	FV.B2	FV.C1	FV.D3	FV.E1	FV.F2	FV.G3	FV.H1	FV.I1	46
60	FV.A1	FV.B1	FV.C1	FV.D3	FV.E1	FV.F2	FV.G1	FV.H3	FV.I2	46
61	FV.A2	FV.B1	FV.C1	FV.D3	FV.E1	FV.F2	FV.G1	FV.H3	FV.I2	46
62	FV.A2	FV.B3	FV.C1	FV.D3	FV.E1	FV.F2	FV.G3	FV.H1	FV.I3	46
63	FV.A2	FV.B2	FV.C2	FV.D3	FV.E2	FV.F2	FV.G3	FV.H1	FV.I3	46
64	FV.A2	FV.B2	FV.C1	FV.D3	FV.E1	FV.F2	FV.G2	FV.H1	FV.I1	45
65	FV.A2	FV.B1	FV.C1	FV.D3	FV.E1	FV.F1	FV.G3	FV.H1	FV.I1	45
66	FV.A1	FV.B1	FV.C1	FV.D3	FV.E1	FV.F2	FV.G3	FV.H1	FV.I2	45
67	FV.A2	FV.B1	FV.C3	FV.D3	FV.E2	FV.F2	FV.G3	FV.H1	FV.I1	44
68	FV.A1	FV.B1	FV.C1	FV.D3	FV.E1	FV.F2	FV.G1	FV.H3	FV.I1	44
69	FV.A2	FV.B1	FV.C1	FV.D3	FV.E1	FV.F2	FV.G1	FV.H3	FV.I1	44
70	FV.A2	FV.B1	FV.C1	FV.D3	FV.E1	FV.F2	FV.G3	FV.H1	FV.I2	44
71	FV.A2	FV.B3	FV.C1	FV.D3	FV.E2	FV.F1	FV.G3	FV.H1	FV.I3	44
72	FV.A1	FV.B1	FV.C1	FV.D3	FV.E1	FV.F2	FV.G3	FV.H1	FV.I1	43

No.	FV.A	FV.B	FV.C	FV.D	FV.E	FV.F	FV.G	FV.H	FV.I	TIS
73	FV.A2	FV.B1	FV.C3	FV.D3	FV.E2	FV.F2	FV.G3	FV.H1	FV.I2	43
74	FV.A2	FV.B2	FV.C1	FV.D3	FV.E1	FV.F2	FV.G3	FV.H1	FV.I3	43
75	FV.A2	FV.B3	FV.C1	FV.D3	FV.E2	FV.F2	FV.G3	FV.H1	FV.I3	43
76	FV.A2	FV.B1	FV.C3	FV.D3	FV.E2	FV.F2	FV.G2	FV.H1	FV.I1	42
77	FV.A2	FV.B1	FV.C1	FV.D3	FV.E1	FV.F2	FV.G3	FV.H1	FV.I1	42
78	FV.A2	FV.B1	FV.C3	FV.D3	FV.E2	FV.F2	FV.G2	FV.H1	FV.I2	41
79	FV.A2	FV.B2	FV.C2	FV.D3	FV.E2	FV.F2	FV.G2	FV.H1	FV.I3	41
80	FV.A2	FV.B2	FV.C1	FV.D3	FV.E2	FV.F2	FV.G3	FV.H1	FV.I3	40
81	FV.A2	FV.B1	FV.C2	FV.D3	FV.E2	FV.F2	FV.G3	FV.H1	FV.I1	38
82	FV.A2	FV.B1	FV.C2	FV.D3	FV.E2	FV.F2	FV.G3	FV.H1	FV.I2	37
83	FV.A2	FV.B1	FV.C2	FV.D3	FV.E2	FV.F2	FV.G2	FV.H1	FV.I1	36
84	FV.A2	FV.B1	FV.C2	FV.D3	FV.E2	FV.F2	FV.G2	FV.H1	FV.I2	35
85	FV.A2	FV.B1	FV.C2	FV.D2	FV.E3	FV.F1	FV.G1	FV.H3	FV.I3	33
86	FV.A2	FV.B1	FV.C1	FV.D2	FV.E3	FV.F2	FV.G1	FV.H3	FV.I3	31
87	FV.A2	FV.B1	FV.C1	FV.D3	FV.E2	FV.F1	FV.G2	FV.H3	FV.I2	30
88	FV.A1	FV.B1	FV.C1	FV.D2	FV.E3	FV.F1	FV.G2	FV.H3	FV.I3	26
89	FV.A1	FV.B1	FV.C1	FV.D2	FV.E3	FV.F2	FV.G2	FV.H3	FV.I3	22