



# Final Conference Event 21/09/2021

Food Systems Dynamics

VALUMICS H2020 PROJECT - Understanding food value chain and network dynamics

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## VALUMICS project work and research outcomes

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UNIVERSITY OF ICELAND

# Contents

- The VALUMICS Project work
  - ✓ Case Studies
- **Project Focus:** Understanding dynamics of Food Value Chains (FVC) and impacts on the sustainability, fairness, integrity and resilience through the analysis of:
  - ✓ governance, actors', decision making and behaviours,
  - ✓ material flows,
  - ✓ environmental impacts (LCA)
  - ✓ consumer
  - ✓ economic analysis (price transmission, market power, profitability, efficiency)
  - ✓ modelling and risk and resilience
  - ✓ future scenarios

**20 participating organisations**

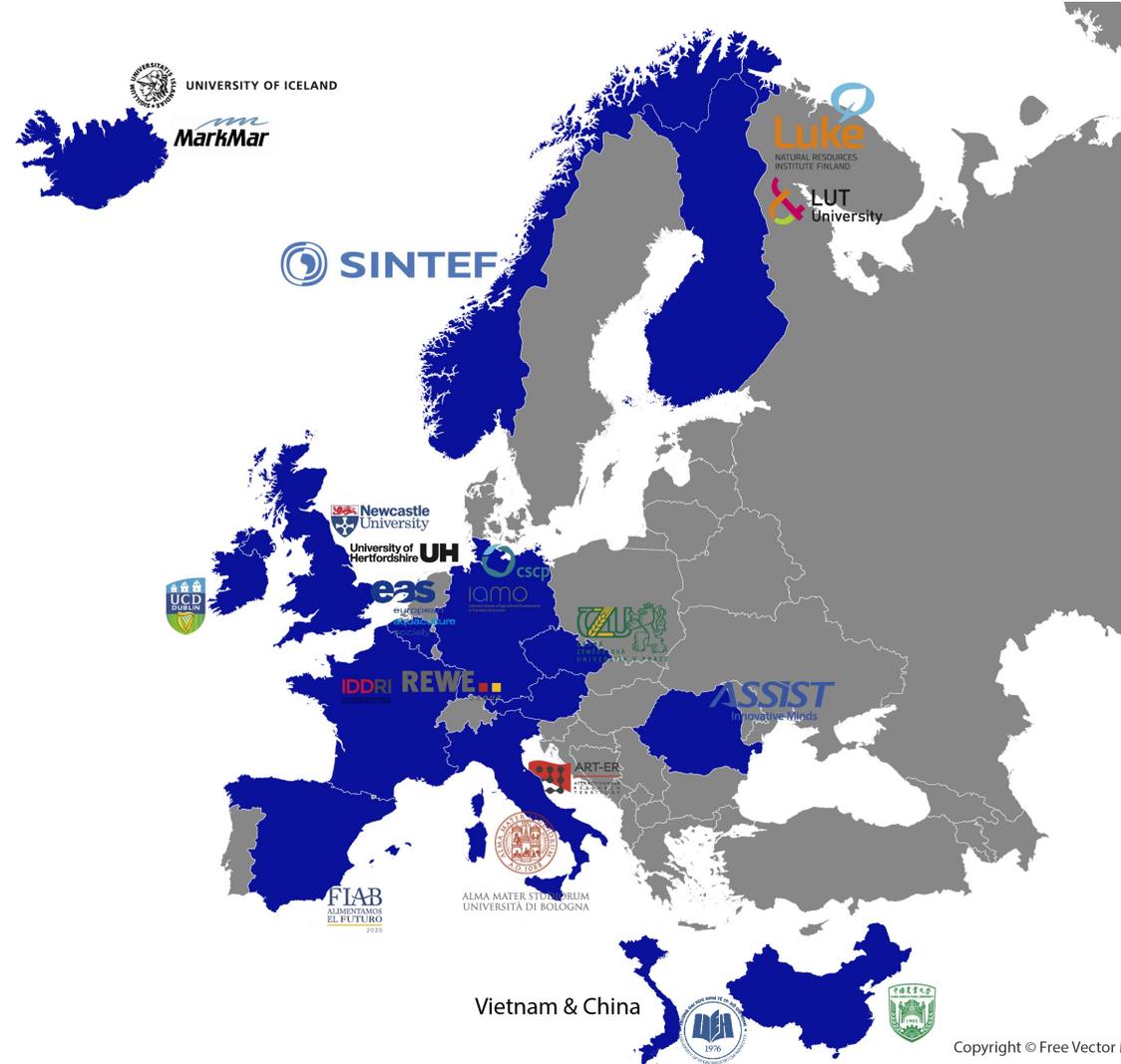
18 partners from 13 European countries,

and 2 Asian partners,

EU Grant of 6 million EURO

1 June 2017 to 30 September 2021

*[52 months]*



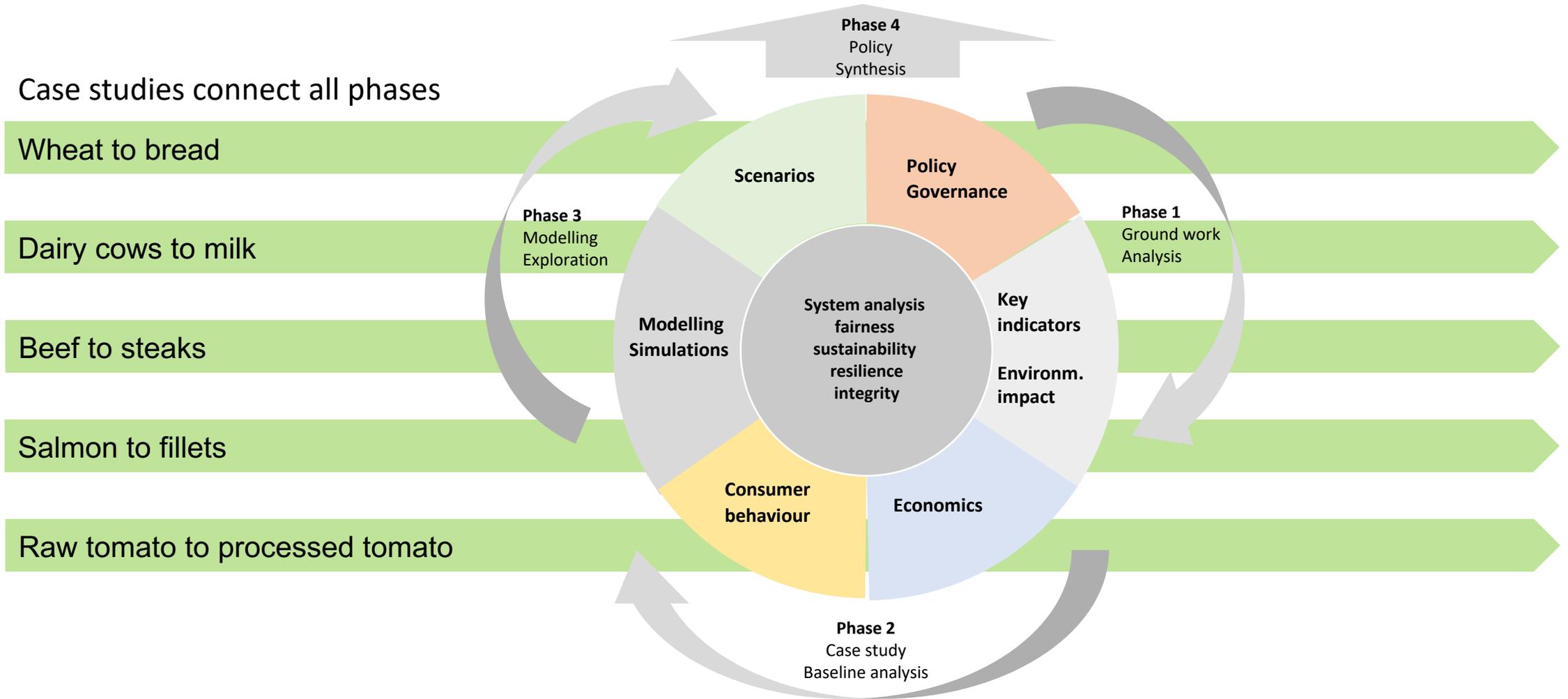


# Objectives of the VALUMICS project

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- To provide **tools and approaches** to enable **decision makers** in food value chains to evaluate the impact of **strategic and operational policies** aimed at enhancing **fairness**, integrity, resilience in future scenarios of sustainable food value chains

# VALUMICS project structure and operational phases





# VALUMICS outcomes

Suite of tools and approaches

# OUTCOMES → Suite of tools and approaches

## Food system analysis and Policy

Fairness Sustainability Resilience Integrity

### Co-creation

- Workshops
- Conceptual model
- Case study prioritization

### Characterization of EU and national policy

## Case study analysis

### Information & material flow analysis

### Life Cycle Analysis (LCA)

### Governance analysis

### Economic analysis

- Price transmission
- Market Power
- Persistency of trade
- Technical efficiency
- Profitability

## Consumer behaviours

### Food consumption behaviours

### Behavioural insights of sustainable food consumption



## Modelling

### Logistics optimization

### Modelling agents' decisions

- Fairness
- Employment
- Risk & resilience

## Foresight scenarios Transition pathways

### Scenario analysis:

i) 2030; ii) 2050

### Transition pathways

- Lock-ins

### Recommendations



Food system analysis Policy

Fairness

Sustainability

Resilience

Integrity



**Work on policy and governance provides bases for evaluating issues related:**

- to unfair trading practices e.g. power imbalances in food chains
- stakeholders' perception on fairness.

**Economic analysis using historical data provides evidence of the functioning of the value chains.**

- **Stakeholder insights**
- **and consumer behaviour studies provide evidence base for**
  - policy makers and food industry actors
  - recommendations to drive more sustainable food production, purchasing and consumption behaviours.

Food system analysis

Policy

Fairness

Sustainability

Resilience

Integrity



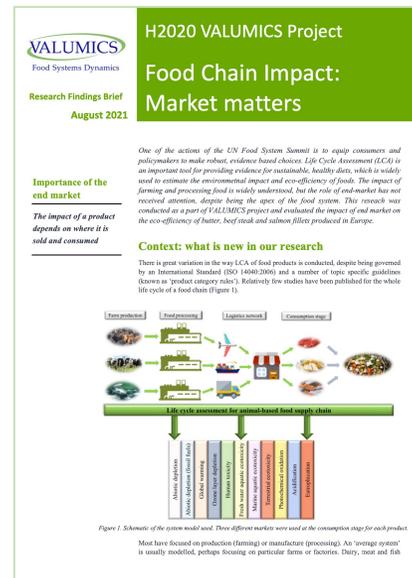
**Framework for risk and resilience in food value chains and applies the global salmon value chain as a case study to develop a hybrid simulation model**

**Labels and authenticity of food is directly linked to transparency of data which VALUMICS depends on for empirical analysis.**

- **The transparency of market data for FVC in the EU is still not ensured for consumers**
- **and further work is needed to align different sectors' data management policies, to facilitate research and informed choices of safe and sustainable foods.**

# The synthesis of results into series of BRIEFS

- The exploitation of results and communication is being facilitated through disseminating key results in Briefs,
  - ✓ These target stakeholders and actors along the FVC,
  - ✓ Policymakers, FVC stakeholders and general public,
  - ✓ Briefs and reports promoted with short videos, highlighting key findings,



Video examples:



The YouTube Channel for VALUMICS:  
[https://www.youtube.com/results?search\\_query=valumics](https://www.youtube.com/results?search_query=valumics)



SOME KEY  
POLICY GAPS  
IDENTIFIED  
ARE BEING  
ADDRESSED IN  
THE EU'S FARM  
TO FORK (F2F)  
STRATEGY

# Phase 1 Food system analysis, policy and governance

Research Findings Brief  
August 2021

**Food system analysis**

A food system thinking approach was applied in co-creation workshops during the first phase of the VALUMICS project in 2017-2018, with the objective to build a conceptual modelling framework for future food value chains and systems. The VALUMICS project's main objective is to gain an understanding of the dynamics of food supply- and value chain systems using structural analysis and system dynamics and various analysis tools.

**Wheat to bread**

**Dairy cows to milk**

**Beef to steaks**

**Salmon to fillets**

**Raw tomato to processed tomato**

**Food system analysis**

**H2020 VALUMICS Project**

**Food System Analysis VALUMICS Case Studies**

**Food system analysis**

A food system thinking approach was applied in co-creation workshops during the first phase of the VALUMICS project in 2017-2018, with the objective to build a conceptual modelling framework for future food value chains and systems. The VALUMICS project's main objective is to gain an understanding of the dynamics of food supply- and value chain systems using structural analysis and system dynamics and various analysis tools.

**Food value chains** is comprised of the stages of the path of the food products starting with inputs, primary production, manufacturing processing, distribution including logistics and retail sectors and consumers. The viewpoint of food value chains/networks and in addition, waste management and all the supporting and intersecting activities such as administration and policies (governance), education and research, financing activities etc.

**Sustainable Food Value Chain** has been defined as: "the full range of firms and firms and their successive coordinated value-adding activities that produce particular raw agricultural materials and transform them into particular products that are sold to final consumers, in a manner that is profitable throughout, has broad-based benefits for society and does not permanently deplete natural resources". (FAO 2016)

**System analysis and VALUMICS project framework**

The work is executed through four operational phases (Figure 1). A conceptual framework for a broad sustainability assessment (including environmental, economic, social and governance aspects) to provide insights to the functioning of the selected food value chains.

**In Phase 1: Development phase – Fundamental groundwork**, the analysis of the food system and the selected food value chains. This includes mapping product and information flow and the drivers of change are identified in terms of mitigating problematic system behaviour. Boundaries of the system and problems to be addressed based on historical behaviour and potential future behaviour are defined. Relevant key indicators determinants and metrics are prioritised based on their capacity to explain influences on resilience and sustainability, including economic, environmental and social assessments.

**H2020 VALUMICS Project**

**Policy Brief**

**EU policies promoting Fairer Trading Practices, Food Integrity, and Sustainability Collaboration along European Food Value Chains**

**Introduction**

This brief presents the updated findings of a mapping exercise, carried out in 2017-8, of the different European Union (EU) policies and governance actions impacting upon food value chains, with a focus on fairer trading practices, food integrity (food safety and authenticity), and sustainability collaboration.

The findings detail the processes and drivers of the EU's policy, and how its policy activity is impacting on food value chain dynamics, and is seeking to improve their effectiveness. The researchers developed a characterisation framework (see Box 1) to clarify the forms that EU policies take across multi-levels of governance. This framework was used to organise and understand the range of types and levels of policy action identified in the mapping.

**Box 1: Characterisation framework for EU policies and their impacts on Food Value Chains:**

EU Policies are characterised by the following framework which illustrates how the European Commission and authorised national (and subnational) public authorities deploy different types of policy action:

- EU Treaty-led policy competencies provide the legal authority for broader strategic policies or programmes that set overall objectives
- More specific laws in the forms of regulations, directives and agreements
- Non-legislative policy instruments: so-called 'soft law' that allows the Commission to seek policy influence beyond the direct scope of its competencies. This latter area of public policy activity embraces modes of governance such as:
  - Voluntary agreements with key stakeholders
  - Pilot activities designed to influence stakeholders in a policy area to change their actions as a result of shared learning based upon the dissemination of evidence and 'good practice' generated
- Supplemented by multilevel governance through national level laws and/or state led

**H2020 VALUMICS Project**

**Role of the regional policies in multi-level governance of agri-food value chains: Emilia-Romagna**

**Key Outcomes**

- Research into the governance of five food value chains identified a range of features and characteristics specific to each sector, and common themes across all chains, including that actors at key stages of each value chain may be in a better structural position than others, which can give them an advantage in the negotiations and bargaining over contracts; and that governance is changing due to increasing levels of corporate concentration at different stages of the chain.
- Along with these inter-firm relations, governance also involves private governance initiatives – such as technical standards – and public policy intervention, including the "EU Directives on unfair trading practices in business-to-business relationships in the agricultural and food supply chain", support for producer organisations; and voluntary codes of practice.

**Box 1. Conceptualising Food Value Chain Governance**

Private governance of value chains covers the inter-relationships between businesses at different stages of the food chain – where different degrees of power and information are distributed between the buyers and the sellers. This can result in an unequal distribution of a value of the final product to the different actors along the chain. The differing types of relationships have been conceptualised by studies of Global Value Chains. These studies tend to focus on commodities grown in less-developed countries being turned into ed and drink products sold primarily in more affluent developed country markets.

While the global value chain framework was taken as a starting point for analysis, the current research project focused on the relationships within the more developed countries of the European market. Here, the societal, political and policy contexts and interventions at occur in, and impact upon, the European food value chains were brought into the analysis. The public-private policy interventions and governance dynamics, well as the relationships between actors and businesses along the value chains, were investigated. This lead back to earlier work on the project, where policy and governance was explained as iterative process of negotiation and compromise enabling power relationships between firms, and across governments and public agencies, the private sector and civil society.

**Multi-level governance: a definition**

Multi-level governance is at the basis of the territory's governance; it is necessary for the instrument of coordinated instruments, agreements, and contracts that local developers will act. Multilevel Governance should be understood as multidimensional, with multiple actors who can have overlapping capacities within the same policy area. Within this work, multilevel governance is to be understood as the exercise of authority and various relationships transcending across levels of government. Multilevel governance leads to new forms of governance, reflected in vertical and horizontal dimensions. The "vertical" dimension refers to the linkages between higher and lower levels of government (including their

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**The Governance of European Food Value Chains**

**Key findings**

Since the economic reforms in 1986 and 1991, Vietnam's milk production and dairy market have developed considerably. The milk value chain is structured alongside three governance models, i.e. relational, captive, and hierarchy models. Vietnam's dairy sector has progressed through three phases of building: expanding in breadth, and developing in-depth and the governance models have adjusted positively since these reforms. However, Vietnamese dairy farmers, particularly those of small-scale, have been exposed to a low level of fairness and welfare across the supply chain. In the short term, dairy farmers in the relational model may benefit from more power and fairness, whereas farmers in the captive model may gain benefits if powerful farmers in the long term. Vietnam has various regulatory interventions and these have positive and significant influences on the fairness, welfare, sustainability, and governance of the milk supply chain. However, not all farmers have benefited from these policies and measures regarding fairness and welfare should be diverse, gradual, and inclusive.

**Analysing the milk value chain in Vietnam**

**Overview of the milk sector in Vietnam**

Since the Renovation in 1986, Vietnam's economy and dairy sector, in particular, constructed from a planned system to a socialist-oriented market system with a free market. Since then, the dairy sector has developed dynamically and become one of the important agri-food sectors with providing diverse dairy products for the domestic market and creating jobs and incomes for farmers, and gradually replacing imported dairy products.

# Phase 1 Case study analysis: Material flows and LCA

**Seafood as an alternative for meat**

*Diet change has been recommended to reduce the environmental impact of meat production and consumption*

**Seafood supply to EU**

*Atlantic salmon is an important source of seafood in the EU market*

## H2020 VALUMICS Project

### Norwegian salmon value chain: Flow of products and decision mechanisms

**Aquaculture as a solution to increasing demand for food?**

Norway's salmon aquaculture is a rapidly growing sector with an important role to play in the transition to more sustainable food systems. There is limited land available for production of food, so aquaculture plays an important role in meeting the increasing demand for food. The Norwegian salmon supply chain represents a global food system with a complex logistics network taking feed inputs from one part of the world and distributing products to different parts of the world after processing them in various locations. Only a few countries such as Norway, Chile, Canada and the United Kingdom account for 94% of the global salmon production (2.69 million MT in 2020), with Norway accounting for about 55%. Shift in dietary patterns to more plant-based foods and seafood is recommended to reduce the environmental impact of meat production and consumption. Consumption in Europe will continue to increase as salmon is increasingly being a popular seafood as part of the centre plate.

VALUMICS project is applying a suite of tools to understand the drivers and outcomes of behaviours within food value networks focusing on improving resilience, integrity and sustainability of food value chains. Salmon case study in the VALUMICS project represents the Norwegian farmed salmon chain with production and primary processing in Norway, export to and secondary processing in Europe (mainly in Poland and France) and final distribution to Europe. Research teams from SINTEF Ocean, Norway and University of Iceland have mapped the product flows, decision making mechanisms and factors influencing these decisions in the salmon value chain. Their key findings that formed the input to the development of functional specifications for the VALUMICS simulation model are presented in this brief.

**Global flows of Norwegian salmon**

The flow of products in Norwegian salmon value chain was analysed using the data from Statistical Bureau of Norway (SSB), The Fisheries Directorate, Norwegian Seafood Council, and data from open company reports and scientific literature.

**Feed production for salmon aquaculture**

Feed is the most important input for the

*Production cycle of farmed salmon*

**Feed production for salmon aquaculture**

Feed is the most important input for the

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### Food Chain Impact: Market matters

One of the actions of the UN Food System Summit is to equip consumers and policymakers to make robust, evidence based choices. Life Cycle Assessment (LCA) is an important tool for providing evidence for sustainable, healthy diets, which is widely used to estimate the environmental impact and eco-efficiency of foods. The impact of farming and processing food is widely understood, but the role of end-market has not received attention, despite being the apex of the food system. This research was conducted as a part of VALUMICS project and evaluated the impact of end market on the eco-efficiency of butter, beef steak and salmon fillets produced in Europe.

**Context: what is new in our research**

There is great variation in the way LCA of food products is conducted, despite being governed by an International Standard (ISO 14040:2006) and a number of topic specific guidelines (known as 'product category rules'). Relatively few studies have been published for the whole life cycle of a food chain (Figure 1).

**Life cycle assessment for animal-based food supply chain**

## H2020 VALUMICS Project

### Novel Solutions for Food Chain Climate Impact Reduction

Life Cycle Assessment was used to estimate the change in environmental impact and eco-efficiency of novel technologies targeting hotspots in animal-based food chains. This research evaluated the role of (1) novel feed ingredients (production stage), (2) sustainable aviation fuel (international logistics stage), and (3) wasted food reduction (consumption and end of life stage) on the impact of butter, beef steak and salmon fillets produced in Europe.

**Context: what did we set out to achieve?**

It is well recognized that the production stage of animal-based foods makes a major contribution to impact. A new finding from our research showed, depending on where the food was sold (the end market), that transport could become a dominant hotspot, and that wasted food can be an important hotspot (Figure 1 illustrates this for Norwegian salmon fillets sold domestically and to Denmark and China).

A number of solutions have been suggested to reduce the climate impact of these hotspots. Our research identified three important solutions, one for each hotspot:

- Farm production stage – novel feed ingredients (black soldier fly, which can be used with both cattle and salmon). Common to

Material flows / Life Cycle Analysis - Environmental hotspots –Transport – Novel solution

# Phase 2 Case study baseline assessments - Economics

**H2020 VALUMICS Project**  
Italian processed tomato value chain: market competitiveness, efficiency, and pricing mechanism

**H2020 VALUMICS Project**  
Norwegian salmon value chain: how does it influence the EU markets?

**H2020 VALUMICS Project**  
Market orientation: Wheat-to-bread supply chain in France and UK

**H2020 VALUMICS Project**  
Market orientation: Dairy value chain in Germany, France and UK

**H2020 VALUMICS Project**  
Profitability in the European food industries

**Economic and governance analyses**

This brief summarises key findings from economic and governance analyses using a suite of tools to provide in-depth understanding of the functioning of the Italian processed tomato value chain. The scope of the analysis includes tomato producers and processors in the leading Italian tomato producing region of Emilia-Romagna.

**Processed tomato market in Italy**

Italy is the largest producer of processed tomato in the EU and among the largest producers in the world, representing 49% and 13.6% of the EU and global production, respectively. Italy is also the largest EU country in exports of finished processed tomato products deriving 35% of total sales revenues from exports<sup>1</sup>. More specifically, for the season 2017/2016, Italy accounted for 22% of total tomato paste exports and 80% of canned tomato exports in the world.



Production of tomatoes for processing is spatially concentrated in a northern (mainly Emilia-Romagna region) and southern (mainly Campania and Puglia region) production areas in Italy. Out of 5.16 million tons of processed tomatoes, 53% is produced in the north production area and 47% is produced in the center and south production areas. The tomatoes are mainly processed into four different types of processed tomato products: tomato puree (pazzata), pulp (chopped tomato), tomato paste (concentrato), and whole tomato (pelati). Regarding the production method, 90% of tomato cultivation is conventional, 10% is organic (2020)<sup>2</sup>.

**Raw tomato to processed tomato**

The VALUMICS analysis of "Governance of north Italian tomato to processed tomato value chain" suggested in agreement with other studies that "dual-level relationship governance"

**Aquaculture salmon producers are key players in the EU seafood market**

With the rapid growth in demand for farmed salmon, global production of Atlantic salmon increased threefold from 0.89 to 2.69 million metric tons (mt) between 2000 and 2020. Only a few countries such as Norway, Chile, Canada and the United Kingdom account for 94% of the total salmon production, with Norway accounting for about 55% (1.2 million mt in 2019)<sup>1</sup>.

Atlantic salmon is the most consumed farmed fish species in the EU<sup>2</sup>. Norway exported about 85% (1.06 million mt in 2019) of farmed salmon worldwide. Europe is the largest importing market, taking approximately 70% of total Norwegian export volumes in recent years. Poland, France and Denmark are the main importers. Secondary processors in those countries further process the salmon and sell products such as, e.g. fillets, smoked salmon and other value-added products mainly to EU countries without a customs duty, which otherwise has to be paid if the processed salmon is exported directly from Norway to the EU.

Structural changes through mergers and acquisition have influenced the development of the global aquaculture industry. These changes have facilitated knowledge transfer of technologies, uptake of standards, and access to the market. Salmon producers have been industry leaders in

**Salmon to fillets**

The VALUMICS analysis of "Governance in the farmed salmon value chain from Norway" suggested that "Hybrid governance" best describes the current governance form of the global salmon value chain (Oftedal et al., 2019a; Dahlyverbeke & L. Ch.). Horizontal collaborations and vertical integration, including relations through networks, third-party assessment and certification schemes on top of the traditional model of state-only regulations characterises the hybrid governance<sup>3</sup>. This form of governance further entails that the global salmon value chain is influenced by international organizations and trade agreements, international civil society and industry initiatives, which on the other hand is motivated by societal pressures from non-governmental organizations e.g. through sustainability standard settings and auditing. In terms

**Global wheat market dynamics**

The global wheat export has grown significantly in the last two decades, reaching 203 million t (T) in 2020 compared to 98 MT in 2000. This significant growth was greatly enabled by the emergence of the large wheat exporters from the Black Sea region (mainly Russia, Ukraine and Kazakhstan). These countries made a tremendous switch from being large wheat importers to becoming the largest wheat exporters globally. This is especially true for Russia that contributed

**Wheat to bread**

the most important actors in the EU grain sector as well. Concerning the domestic wheat-to-bread value chain, its main characteristic is the strong integration of the upstream sector. This is especially the case for integrating large millers and industrial bakeries (Loveluck & Aubert, 2019)<sup>1</sup>.

**Value chain governance**

Value chain governance analysis is a tool to identify lead actors, trading practices, inter-firm relations, and structural elements along the value chain to better understand if fairness, in terms of perceived market power and fair value distribution, is or could be an issue in the French and UK wheat-to-bread value chains.

The UK and France have relatively different wheat-to-bread supply chains by focusing on milling and baking industries. The size of the wheat harvest in France was 29.5 MT in 2020,

**The EU dairy sector**

**Dairy cows to milk**

100% milk production, 29.4% butter, 11.9% cream, 11% drinking milk, and other products (10%)<sup>2</sup>.

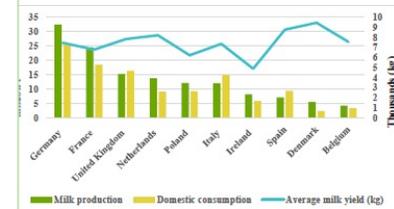


Figure 1 Top 10 milk producers in EU-28 (2019) Source: CLAL.it (2020)<sup>3</sup>.

The upstream level of the EU dairy chains is mainly organized through cooperatives that vary in size and market share. Usually, these cooperatives represent a form of Producers' organisations, whose activities are supported by the EU Common Agricultural Policy and the Common Market Organisation<sup>4</sup>. It should be noted that large cooperatives

**Profitability: an introduction**

Classical economic models of perfect competition assume that profits above or below "normal" levels will not persist, as other firms will enter and exit the market, bidding up or down economic returns until they reach an equilibrium. In practice, however, variations in firm profitability persist within and across industries, including the agri-food sector, and explaining the patterns is an important theoretical and empirical research topic. There are broadly two sets of factors which may explain why some firms achieve higher profitability than others: "industry effects" and "firm level effects".

Industry effects are associated with the "structure-conduct-performance" framework of industrial economics theory and the pioneering work of Joe Bain<sup>1</sup>, which in turn influenced the work of Michael Porter<sup>2</sup>, particularly his "five forces" model. According to this approach, variations in enterprise performance stem from the characteristics of the industry to which they belong. Specifically, average rates of return will be higher in industries characterised by a high level of concentration and high barriers to entry<sup>3</sup>.

**Beef to steaks**

While both are significant, empirical evidence to date across different sectors suggests that "firm effects" are more important than "industry effects" for explaining variations in enterprise profitability<sup>4</sup>. However, given the size and importance of the food industries in Europe, there is need to consider the latest evidence for this sector to understand what accounts for variations in performance.

This brief focuses on understanding the determinants of EU agri-food industry profitability, using data from Bureau van Dijk's AMADEUS database, with records relating to firms in the manufacturing/processing sector selected. It seeks to understand the relative impact of firm and industry level effects in explaining variations in food industry profitability, complemented with data from Eurostat's Structural Business Statistics (SBS) to cross

**Case study analysis Governance & Economic analysis**

# Phase 2 Consumer behaviour studies

Food Systems Dynamics

**H2020 VALUMICS Project**

**Food Consumption Behaviours in Europe**

Research Findings Brief  
September 2021

Food Systems Dynamics

**H2020 VALUMICS Project**

**Behavioural insights for sustainable food consumption**

Research Findings Brief  
September 2021

Food Systems Dynamics

**H2020 VALUMICS Project**

**Making sustainable food consumption a reality**

Research Findings Brief  
September 2021

	About this Research
<b>Wheat to bread</b>	Understanding food value chains and network dynamics is highly relevant to identify pathways for a sustainable, healthy and nutritious food future in Europe. Eating and food purchase patterns have been known for years to account for at least 25% of the already oversized average carbon footprint of European citizens! In addition, there is also growing concern that current mainstream consumption patterns contribute to unfair trading practices in food value chains across the EU. In this context, the "Food consumption behaviours in Europe" report, through research, consumer focus groups and expert interviews, brings together evidence and deeper understanding of EU food consumption behaviours, particularly in relation to the consumption of food products such as beef, salmon, dairy products, tomatoes and bread. The results provide further knowledge about consumption patterns, drivers, barriers as well as current trends. This understanding helps to kickstart the discussion in regards to potential interventions that can be implemented by different stakeholder groups, to support a behavioural shift towards environmentally friendly food consumption and more fair and sustainable food value chains.
<b>Dairy cows to milk</b>	
<b>Beef to steaks</b>	
<b>Salmon to fillets</b>	<b>General Key Insights</b> Why European consumers buy food the way they do and which are the most influential drivers of their consumption behaviours? Food consumption behaviours are complex and influenced by a combination of drivers, not being possible to identify one single reason behind food purchases. However, an overview of the main drivers that seem to influence consumers the most have been identified in the aforementioned report and summarised below.
<b>Raw tomato to processed tomato</b>	Food consumption behaviours are complex and influenced by a combination of drivers, not being possible to identify one single reason behind food purchases. However, an overview of the main drivers that seem to influence consumers the most have been identified in the aforementioned report and summarised below. The social context and habits have a considerable influence in food consumption behaviours. The eating habits of the family or other social members around an individual are important in shaping food purchasing and consumption behaviours. Health was identified as playing an increasingly important role in shaping food purchasing patterns. Behaviours do not seem to be primarily driven by price, but price considerations count among the main determinants of purchasing decisions.

	About this Research
<b>Pathways towards more sustainable eating behaviours</b>	The necessary transition towards more sustainable food systems in Europe has put a key question on the table: how can we halve the consumption of high impact foods in Europe in the next decades, thereby also cutting by half their negative sustainability impacts? Which interventions work? Which ones fail? The Valumics report "Putting solutions on the table" aims at contributing to this discussion, by analysing and showcasing the latest and most compelling pieces of evidence about behaviourally-informed interventions that support a shift towards more sustainable and healthier diets in real-life contexts. The report is particularly targeted at policy makers, retailers and restaurants to guide them putting this shift forward, but also to the general citizens, to learn about their own possible behaviour change towards this path.
<b>Behavioural insights</b>	<b>Background</b> Socioeconomic, political and ecological systems are both defined by and condition human behaviour. A prime example is the food market, where individuals act as representatives and shapers of market demand. Various scientific fields, including the social sciences, economics and psychology, as well as the cognitive and neurosciences have generated a growing body of thematically diverse empirical evidence grounding insights into human behaviour and its socioeconomic manifestations. Such insights have been initially used to understand and protect consumer decision making in all areas of life and work, including food consumption! However, over the years, with increasing awareness of our societies' unsustainable development patterns, behavioural insights have been recognized and utilized as an important aspect of mitigation and prevention strategies in all areas (including food) and on various levels (top-down/ bottom-up).
	<b>What do behavioural insights tell us?</b> Challenging the longstanding premise of humans as purely rational decision makers and information optimisers, behavioural insights suggest people possess limited rationality and incapable of perfectly understanding all the elements and implications of a given situation. To ensure non-interrupted functioning, people rely on simple cognitive heuristics, mental shortcuts and satisfying strategies, which in turn cause them to make predictable errors. It has been estimated that a large share of our daily behaviours is based on unreflected routines! Bookmark not defined.

	About this research
<b>Evidence based actions</b>	How can we move from attitudes and intentions to action and generate behavioural change towards more sustainable food consumption in Europe? The findings and insights of the VALUMICS report 'From intention to action' help answer this question by making recommendations to various stakeholder groups on how to support sustainable consumption of food. Sustainable food consumption is understood as fewer animal-based products, locally sourced and organically produced food, and with less food waste and/or food packaging.
<b>Intention-action gap</b>	According to the EU Farm to Fork Strategy, citizens "pay increasing attention to environmental, health, social and ethical issues and they seek value in food more than ever before". A recent European consumer survey across 11 European countries, with over 11,000 consumers, points to a similar trend: it shows that most consumers are aware of the environmental impact of food habits in general and two-thirds of consumers are open to changing their eating habits for the benefit of the environment". While majority of people state their good intentions towards eating healthier and more sustainably, the share of sustainable food consumption is still stagnating low. There is a large gap between pro-environmental and more sustainable attitudes and actual consumption of more sustainable food products". The central question is: how can we move from attitude to action and generate actual behaviour change towards more sustainable food consumption? That's a very complex question as "food preferences, choices, and eating habits are notoriously hard to change". The complexity emerges from the interplay between individual, social and contextual factors that influence and shape food consumption choices and patterns. Moreover, food purchasing and consumption are perceived as highly personal activities, often associated with one's culture and identity" and largely habitual and not subject to self-reflection". The transdisciplinary character of food consumption behaviours requires a similarly transdisciplinary approach when looking at influencing behaviours towards more sustainable ones.
<b>Intention-action gap</b>	Despite people stating their intentions to eat healthier and more sustainably, the share of sustainable food consumption is still low. There is a large gap between sustainable attitudes and actual consumption.

Consumer behavior towards sustainable food consumption

# Phase 3 Modelling and Scenario Exploration

**H2020 VALUMICS Project**

## Functional specifications for a generic model to assess fairness in food value chains

Research Findings Brief  
September 2021

**Content**

This brief summarises the VALUMICS developments of functional specifications for a simulation model with the objective to assess the impact of interventions influencing fairness in FVCs.

The focus was on exploring behaviours and actors' decisions which have an impact on the distribution of value added along food value chains

**System behaviour**

System conceptualization entails analysing the underlying feedback structure of the system in an effort to formulate a dynamic hypothesis concerning the system's behaviour.

**Wheat to bread**

**Dairy cows to milk**

**Salmon to fillets**

**Raw tomato to processed tomato**

<sup>1</sup> Guéhenneucq L.Y., Oudshoorn A.H., Sverdrup H.U., Oudshoorn G., Bergson S.G., Selimsson G. (2018) Modelling of integrated supply, value and decision chains within food systems. Proceedings in System Dynamics and Innovation in Food Networks 2018, p. 341-348, DOI: <https://doi.org/10.15261/psdin.2018.1802>

<sup>2</sup> Sterman, J. (2000). Business dynamics: Systems thinking and modeling for a complex world. Irwin/McGraw-Hill.

**H2020 VALUMICS Project**

## Framework for risk and resilience in food value chains

**Introduction**

The focus of VALUMICS project task 4.6 was to develop a framework for risk and resilience in food value chains, thereby enabling value chain actors to analyse these risks and to develop appropriate strategies to increase resilience.

In recent years, the scope of agribusiness research has been extended from focusing solely on farming activities to include more stages and links, therefore taking an end-to-end supply chain perspective. The industrialisation of the agri-food sector has changed perspectives of farming from an idyllic rural life-style to a highly competitive agribusiness sector with a supply chain **subject to change in demand, climate, and other external factors**. In an agri-food supply chain, the decision making environment is highly uncertain. On the upstream side, an agri-food supply chain is faced with uncertainty caused by weather, varying input costs, and material availability etc. On the other hand, the downstream side of an agri-food supply chain is confronted with demand volatility and is highly sensitive to price fluctuations. Therefore, incorporating these and other uncertainties is critical for managerial decision-making in agri-business supply chain planning at operational, tactical, and strategic levels.

The globalisation of operations and growing interconnectedness among nodes in agri-food supply chains have led to high levels of interdependency and increased complexity. Supply chains that have generated high levels of efficiency through lean operations during stable business conditions become vulnerable to disruption risks. Evolving customer preferences in relation to food consumption and sustainability present additional risks and opportunities for food value chain actors, as well as an area of focus for policy makers interested in the resilience of food systems.

**Concept of resilience**

Conventional risk management tools, which depend heavily on historical data, become ineffective when disruptions are unanticipated. Systems that face predictable risks can adapt and increase resilience through mitigation. Since resilience is a multi-disciplinary concept, a range of this phenomenon are available in diverse fields of scientific literature. The purpose of the VALUMICS project, was the definition of resilience developed considering food supply chain systems. <sup>1</sup> "Resilience is the ability of a system to absorb disturbance and reorganise while retaining the same or a similar function, structure, and identity." <sup>2</sup> "Resilience is the capacity of a system to absorb perturbations and still provide sufficient, appropriate and accessible food to all, in the face of various and even unforeseen disturbances".

Where:

- "Sufficient" means quantity and nutritional quality.
- "Appropriate" incorporates cultural, technical and nutritional aspects.

**H2020 VALUMICS Project**

## Policy Brief

**Towards a Sustainable and Fair EU Food System: Challenges and Conditions of a Protein Transition**

June 2021

**Key Outcomes**

*Over 20 diverse actors from the European food system agree that the protein transition is both necessary and feasible. Although discussions remain on the precise scale of change needed in the next 10 years, the broad direction of travel must include a decrease in animal and food production while*

The publication of the Farm2Fork Strategy paves the road for an ambitious transformation of the EU food system in order to address environmental, health and social issues and deliver on sustainable and healthy diets for all. The "protein transition" – i.e. the decrease in the consumption and production of animal products while increasing that of plants – represents a key component of this transformation and is especially crucial to reduce the environmental pressures currently exerted by the food system (GHG emissions, biodiversity loss, water and soil pollution, etc.).

Yet, such a transition entails a considerable reorganization of food value chains, which often constitute a roadblock in discussions. In this context, the Protein Transition Series, held from November 2020 to January 2021, aimed to address the challenges and conditions of a protein transition.

➤ Over 20 actors, all with a stake in the European food system (agricultural businesses and civil society – agreed on the need pointing out key political and socio-economic challenges operationalization within FVCs. To this end, the collective three main questions: (i) how can this transition be economic and what are the relevant policy levers to be implemented (ii) how can value chain actors drive and enhance the speed of change through collective action?

➤ Food value chain transformations will require policy shifts at three complementary levels: (i) supporting changes in food habits through public procurement and broader interventions on consumers' food environments; (ii) levelling the playing field for agricultural markets both within the EU and between third countries, while addressing the specific challenges of small-scale and family-run agricultural practices

**Protein transition**

the same direction to create cumulative effects and ultimately overcome the macro socio-political lock-in of our food system.

**H2020 VALUMICS Project**

## Policy conditions for a just transition of the French dairy and wheat sectors

**Introduction**

Even in the current ecological crisis, European food value chains must undergo profound transformations. The "protein transition" – i.e. the decrease in the consumption and production of animal products while increasing that of plants – represents a key component of this transformation and is especially crucial to reduce the environmental pressures currently exerted by the food system (GHG emissions, biodiversity loss, water and soil pollution, etc.).

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**Dairy cows to milk**

**Wheat to bread**

**An innovative methodological framework**

An effective inclusion of socio-economic issues in the dialogue on the sustainable transformation of the European food system is currently obstructed due to considerable

**H2020 VALUMICS Project**

## Transition pathways towards more sustainable salmon aquaculture

**Salmon aquaculture**

Sea-based salmon aquaculture is one of the most advanced and most efficient animal-based food supply chains [1]. As an oily fish, salmon is a rich source of healthy fats and micronutrients necessary in the promotion of healthy diets [2]. However, there are several negative environmental impacts associated with sea-based salmon aquaculture such as sea lice [3], escapements, disease [4], eutrophication and algal blooms [5]. Salmon aquaculture also contributes to, and is impacted by, global environmental change and especially climate change through the provision of feed ingredients, production methods, distribution, and waste. Feed in particular is an important issue for the industry as it links fisheries, aquaculture and terrestrial ecosystems [6]. Feed production is by far the largest contributor to the industry's environmental impact [7,8]. Transport is also responsible for a significant share of the carbon emissions of seafood supply chains, in particular transport of feed ingredients and air transport of products to distant markets [9,10].

Transition theory frameworks have been developed and applied, but the Multi-Level Perspective (MLP) is one of the more prominent ones [13] and has been applied to various integral socio-technical systems including food [16].

The Norwegian aquaculture industry is the global leader in salmon farming as most cost-efficient producers [28]. Other salmon producing countries are e.g. Chile, USA, Faroe Islands, and Iceland. The EU is the largest importer of salmon globally and also the largest salmon producer in Europe. The EU's largest salmon aquaculture producers are Norwegian enterprises and Iceland's salmon aquaculture is largely owned by Norwegian companies [30]. In this study, industry and ex

**Salmon to fillets**

## Modelling - Foresight scenarios Transition pathways

# Phase 4 Policy and Synthesis

- Compilation of VALUMICS Briefs
- Synthesis of outcomes, policy implications
- Policy recommendations
- Final VALUMICS Deliverable

Grant Agreement number: 727243  
**VALUMICS**  
 Understanding food value chains and network dynamics

Start date of project: 01/06/2017      Duration: 52 Months

**Deliverable D8.4**  
**Scenario analysis report with policy recommendations**  
 An assessment of sustainability, resilience, efficiency and fairness and effective chain relationships in VALUMICS case studies.



Food Systems Dynamics

Project co-funded by European Commission within the H2020 Programme	
Dissemination level of this deliverable	
PU	Public
CO	Confidential, only for members of the consortium (including the Commission Services)
RE	Restricted to a group specified by the consortium (including the Commission Services)
CI	Classified, information as referred to in Commission Decision 2001/664/EC

 \*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727243\*



H2020 VALUMICS Project

**Synthesis of VALUMICS outcomes and policy recommendations**

September 2021

**Sustainability, Integrity, Fairness, and Resilience explored through VALUMICS case studies**

**VALUMICS analysis through FVC case studies**

The VALUMICS case studies were selected to enable explorative and empirical analysis to better understand the functioning of the food system and the main challenges that need to be addressed to improve sustainability, integrity, resilience and fairness of European food chains.

**Sustainability**

The food system is responsible for environmental impacts including climate change, biodiversity loss, use of water and waste generation. The VALUMICS analysis include assessment of environmental and social dimensions of food chains by life cycle assessment and the influence of transportation and logistics of selected food chains. Considering the socio-economic impacts, the profitability and competitiveness of the enterprises constituting food value chains are also key elements to ensure employment and livelihoods. Important changes through mergers and acquisitions are common trends in food value chains at all stages, although most prominent in food processing and retail, and these influence bargaining positions of upstream actors. The VALUMICS research focus was on analysis of governance and food chain organizations through empirical economic analysis of market power, price formation and price transmission, persistence of supply chain relations, assessment of economic, social and technical innovations, and finally statistical analysis of agricultural profitability. Moreover, the insights on stakeholder perceptions and consumer behaviour provides understanding of the dynamics of the functioning of food supply chains and systems XXXXX.

**Food Value Chain Findings: Competition Law/Environmental Sustainability Policy Recommendations**

**Competition Law.** The EU's competition regulatory framework was identified as a potential constraint on private sector capacity to coordinate and advance sustainability. DG Comp's October 2020 call for contributions on the role of competition policy in supporting the Green New Deal, led to over 100 responses from stakeholders, with many cited examples of where competition policy has undermined sustainability in business practices. The Commission envisages a clarification of competition rules for collective initiatives that promote sustainability in supply chains. The use of "comfort letters" to allow for coordination in the pharmaceutical sector during the Covid pandemic may be extended to green cooperation. Several national competition authorities are also addressing the coherence of their competition rules with sustainability goals. At the same time, the framing of the call for contributions from the European Commission suggest a cautious approach will be taken. (FPF) EU Policy, RPA Practitioners Forum: Sustainable and Fair).

## Synthesis of outcomes and policy recommendations

# Scientific publications

- Published in peer reviewed journals and conference proceedings, > 20 papers
- ✓ A special issue in Agriculture, MDPI Journal in progress
- ✓ Trade magazines have also published articles of sector interest

**sustainability** **MDPI**

Article  
**Stakeholder Perceptions of Policy Tools in Support of Sustainable Food Consumption in Europe: Policy Implications**

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**Abstract:** Transitioning agri-food systems towards increased sustainability and resilience requires that attention be paid to sustainable food consumption policies. Policy-making processes often require the engagement and acceptance of key stakeholders. This study analyses stakeholders' solutions for creating sustainable agri-food systems, through interviews with a broad range of stakeholders including food value chain actors, non-governmental organizations, governmental institutions, research institutions and academic experts. The study draws on 36 in-depth, semi-structured interviews conducted in four European countries: France, Iceland, Italy and the UK, as well as three interviews with high-level EU experts. The interviewees' solutions were analysed according to a five-category typology of policy tools, encompassing direct activity regulations, and market-based, knowledge-based, governance and strategic policy tools. Most of the identified solutions were located in the strategic tools category, reflecting shared recognition of the need to integrate food policy to achieve long-term goals. Emerging solutions—those which were most commonly identified among the different national contexts—were then used to derive empirically-grounded and more universally applicable recommendations for the advancement of sustainable food consumption policies.

**Keywords:** sustainable food consumption; agri-food systems; transition; stakeholders; semi-structured interviews; policy tools

**1. Introduction**

There is growing recognition that contemporary agri-food systems are neither sustainable nor resilient, and that they are in need of profound transformation in order to meet multiple challenges [1].

**agriculture** **MDPI**

Article  
**Operationalization of Interorganizational Fairness in Food Systems: From a Social Construct to Quantitative Indicators**

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**Abstract:** Fairness issues within food systems are of increasing concern for policy makers and other stakeholders. Given the topicality and policy relevance of fairness within food systems, there is value in exploring the subject further. Simulation modelling has been successfully used to develop and test policy interventions. However, the subjectivity and intangibility of fairness perceptions make them difficult to operationalize in a quantitative model. The objective of this study is to facilitate research on fairness in food systems using simulation modelling by defining the social construct of fairness in model operational terms. The operationalization is conducted in two steps. First, the construct of fairness is conceptually defined in terms of its dimensions, antecedents, and consequences using the literature on interorganizational fairness. Then, by focusing specifically on fairness issues within food systems, the conceptual definition is used as a basis for the identification of proxy indicators of fairness. Seven groups of factors related to fairness perceptions were identified during the conceptualization phase: financial outcomes, operational outcomes, power, environmental stability, information sharing, relationship quality, and controls. From these factor groups, five indicators of fairness that are operational in a quantitative model were identified: profit margin as an indicator of distributive fairness and four indicators of procedural fairness related to market power and bargaining power.

**Keywords:** fairness; UTPs; food systems; simulation modelling; operationalization; quantification; interorganizational relationships

**1. Introduction**

Fairness issues within food supply chains are of increasing concern to European Union (EU) and member states' policy makers [1,2] as findings indicate that the negative impact of unfair trading practices (UTPs) on small and medium-sized enterprises in the EU food sector is affecting the competitiveness of the industry as a whole [3]. Although fairness issues can arise in any market or sector of an economy, they have the potential to be especially problematic in food supply chains, as agricultural producers may be placed under undue pressure and have limited bargaining power in negotiations with larger purchasers, such as retailers, given the lack of alternative buyers [1,4,5]. Attesting to the importance of fairness in the context of food systems, the EU recently issued a Directive (2019/633) on UTPs which aims at protecting weaker suppliers (primarily farmers) including their organizations (e.g., cooperatives) against their buyers, as well as suppliers of agri-food products which are further downstream [6]. The Directive is focused on interorganizational fairness (IOF), which is also the focus of this particular research. IOF concerns fairness in exchange relationships (i.e., supplier-buyer relationships). Although not the subject of this paper, fairness within food systems is also of concern at the individual level (i.e., access to nutritious food at a reasonable price), intraorganizational level (i.e., food industry working

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**INTERNATIONAL JOURNAL ON FOOD SYSTEM DYNAMICS**

Proceedings in  
**System Dynamics and Innovation in Food Networks 2018**

**Modeling of Integrated Supply-, Value- and Decision Chains within Food Systems**

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**ABSTRACT**

This paper presents a work in progress on the development of a mental model of a food system using system analysis. The aim is to be able to use this model to create a mathematical simulation model that can be used to identify policy intervention opportunities, specifically focusing on the resilience, integrity and sustainability of food supply networks. The traditional view of food systems as supply chains with a downstream physical flow of products is extended to include the associated upstream flow of money and the decision chains that link these flows. Central to this work is the idea that supply systems are driven by profit and regulated by market dynamics and that these factors generate the underlying feedback structure of the system. Studying the structure of such systems as integrated supply-, value- and decision chains has underscored their complexity and the need for further, more food system specific research.

**Keywords:** System dynamics; food system; supply chain; value chain; decision chain.

**sustainability** **MDPI**

Article  
**Sustainable Development of Food Processing Enterprises in China**

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**Abstract:** Sustainable development is an eternal topic in the development of human society. The paper seeks to contribute to the adoption of sustainable development practices in the food processing enterprises of China by fostering the capacities of the enterprises. Moreover, the paper aims to contribute to the promotion of sustainable consumption by helping and encouraging consumers in making informed choices of sustainable and eco-efficient produced foodstuffs. We combined with 1015 survey data in 28 areas of China by using AHP model analysis of the sustainable development of food processing enterprises. The results show that, the overall level of sustainable development ability of food processing enterprises in China is not high; paying attention to economic is significantly more important than paying attention to social and environmental aspects. Chinese food processing enterprises have an acceptable basis for the implementation of sustainable development. But there are still some problems. Finally, some suggestions are put forward to promote the sustainable development of Chinese food processing enterprises.

**Keywords:** Sustainability Development; Food Processing Enterprise; China

**1. Introduction**

Sustainable development is a kind of development with equal opportunities and benefits. Although different countries have different models of sustainable development, the principles of equity and sustainability are common. Human economic and social development cannot exceed the carrying capacity of resources and the environmental impacts. Sustainable development is a development theory and strategy based on the protection of natural resources and environment, on the condition of stimulating economic development, and on the goal of improving the quality of human life. It is a new concept of development, morality and civilization.

Food is one of the industries where sustainability issues are intrinsically embedded because of the amount and variety of natural resources usage, human requirements for basic nutrition, and communities that depend on food production for survival. However, improving sustainability in the food industry requires engagement of actors worldwide, in order to cope with the challenges of consumer expectations, limited resources, international policies and regulations [1].

"Food is the paramount necessity of people", namely, the food industry is the pillar of the national economy. Food industry represents nowadays a crucial motor for the development of the local economy and society, and as industrial process, it reports serious impacts that threaten its sustainability: (1) food sector entails important environmental impacts (2) the effect of globalization and the changes in consumers' preferences is contributing to the demise of the traditional production systems and small companies; (3) ethical, health and safe working conditions are not always ensured; (4) the quality of products in the food sector creates a great concern in consumers.

**AE2020 – The Blue and the Green**

**aquaculture europe**

From Norway to the EU

**VALUMICS**  
Food System Dynamics

**Overview of the farmed salmon value chain**

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- The scientific outcomes are published in open access journals,
- More results in the publication pipeline and will be accessible on the project website,
- Policy recommendations, D8.4 public report deliverable,
- The website will be maintained for 3-4 more years post project,
- The datasets and modelling tools are to be further developed through graduate student projects,
  - and dashboard access made accessible to interested policymakers,
- Consortium partners are collaborating to develop follow up joint projects to continue working together on expanding the VALUMICS knowledge base.



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