# SCENARIO ANALYSIS REPORT WITH POLICY RECOMMENDATIONS

## AN ASSESSMENT OF SUSTAINABILITY, RESILIENCE, EFFICIENCY AND FAIRNESS AND EFFECTIVE CHAIN RELATIONSHIPS IN VALUMICS CASE STUDIES

PROJECT REPORT D8.4

VALUMICS - UNDERSTANDING FOOD VALUE CHAINS AND NETWORK DYNAMICS

OCTOBER 2021

VALUMICS

Food Systems Dynamics

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## ABOUT

VALUMICS stands for value chain dynamics and is a research project funded by the EU H2020 programme. VALUMICS will enable decision makers to evaluate policy impact on food value chains

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# 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:

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VALUMICS
Food Systems Dynamics

H2020 VALUMICS Project

# Synthesis of VALUMICS outcomes and policy recommendations

**September 2021**

## VALUMICS analyses through FVC case studies

***The VALUMICS analysis of food value chains, stakeholder insights and consumer behaviour studies provide policy makers and food industry actors with a range of evidence-based approaches and recommendations to drive more sustainable food production and consumption behaviours***

## Future scenarios and food system transition

***Future scenarios and simulation of relevant policy implementation aimed at fairer, more resilient, and sustainable food system. Furthermore, transition pathways are explored which account for social and political pressures***


## Summary

The functioning of food value chains entails a complex organisation from farm to fork which is characterised by various governance forms and externalities which have shaped the overall food system. VALUMICS food value chain case studies: wheat to bread, dairy cows to milk, beef cattle to steak, farmed salmon to fillets and tomato to processed tomato were selected to enable explorative and empirical analysis to better understand the functioning of the food system and, to identify the main challenges that need to be addressed to improve sustainability, integrity, resilience, and fairness of European food chains.

The VALUMICS system analysis was executed through four operational phases starting with Groundwork & analysis including mapping specific attributes and impacts of food value chains and their externalities. This was followed by Case study baseline analysis, which provided input to the third phase on Modelling and exploration of future scenarios and finally Policy and synthesis of the overall work (Figure 1)


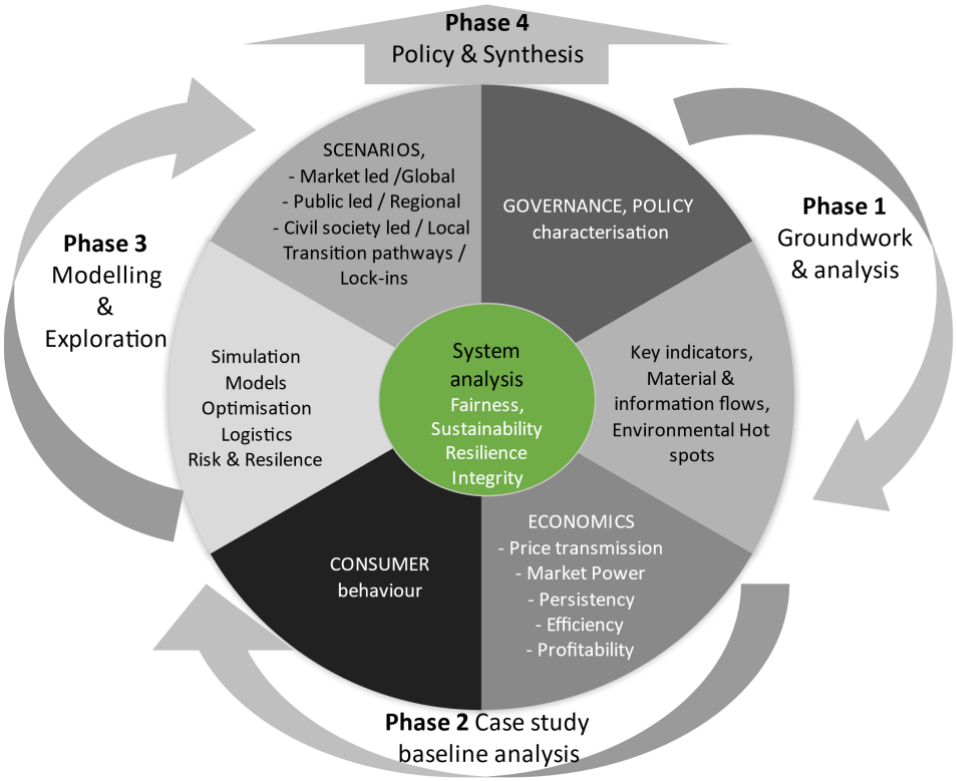


*Figure 1 VALUMICS operational phases and the specific research areas focusing on better understanding the dynamics of food systems with the objective to enhance fairness, sustainability, resilience and integrity through baseline analysis of FVC case studies, modelling and future scenario exploration.*

## VALUMICS Objective

***To provide decision makers throughout food value chains with a comprehensive suite of approaches and tools that will enable them to evaluate the impact of strategic and operational policies to enhance the resilience, integrity and sustainability of food value chains for European countries.***

## VALUMICS Outcome

***The results are an evidence base to facilitate decision makers in their efforts to support EU strategies towards more sustainable food systems***

This report delivers the outcome of **Phase 4: Policy and Synthesis**. The goal is to provide an overall synthesis of the VALUMICS results as follows:

- Key findings from the VALUMICS project on the functioning of European food value chains and their impacts on more sustainable, resilient, fairer, and transparent food system are summarised through a compilation of 25 Research Findings and Policy Briefs.
- By highlighting the major contributions from the research activities throughout the four phases of the VALUMICS project, this report delivers an assessment of various factors influencing sustainability, resilience, efficiency and fairness and effective chain relationships of different food value chains, and their determinants.
- The synthesis of the outcome allows the identification of opportunities and challenges characterising the functioning of food supply chains, and thus, the prospects and potentials for strengthening the EU food sector.

The VALUMICS interdisciplinary research activities focused on policy and governance analysis, material and information flows, life cycle assessments, economic analysis, modelling approaches to optimize logistics, and process optimisation to mitigate risk and enhance resilience. Furthermore, simulation modelling of FVC agents´ decisions was developed with the aim to enable evaluation of the impact of future policy interventions on fairness in terms of fair value distribution and employment in the food value chains. Consumer behaviour studies provided recommendations to enhance sustainable consumption behaviour. Finally, foresight scenarios and transition pathways to a more sustainable food system were explored, and policy implications addressed. Particular attention is devoted to the analysis of the contribution of food systems in promoting fairness and fair value distribution in food value chains, employment opportunities and fostering economic growth within the EU, while exploring pathways towards transforming food systems and ensure more sustainable production and consumption which supports the emphasis in the current scientific and high-level policy literature and the EU Green Deal and Farm-to-Fork strategies.

The EU strategic policy and legislative framework and in particular the Farm-to-Fork strategy, the new Common Agricultural Policy (CAP) and the new strategic guidelines for aquaculture (all of which were launched during the later stages of the VALUMICS project) have the potential to successfully support a transformation of European food value chains towards fairness, resilience, transparency, and sustainability targets. However, such a transformation must be supported by food system actions involving all food value chain actors, from farmers to processors, retailers, and consumers and including also a wider perspective of integrated food system and policy.

Policy measures must ensure a holistic and coherent approach by co-ordination of both supply and demand sides. Importantly, ambitious aims to tackle the sustainability challenges of the European food system should consider unintended consequences for the competitiveness and economic profitability of the agri- and livestock sectors, while at the same time realising that action is needed to ensure a food system that is beneficial to the climate, biodiversity, and health. The ongoing Covid-19 pandemic, whose onset was at the final stage of the VALUMICS project, exposed weaknesses in food systems' functioning and further underscored the importance of ensuring fair, resilient, transparent, and sustainable European food systems.

This report is a compilation of briefs presenting the overall VALUMICS research findings and synthesis of policy recommendations.

The outcomes are directed at two main tiers of users

(i) stakeholders /industry policy managers, and

(ii) governmental policy makers

# Overview of VALUMICS Research Findings and Policy briefs – Short summaries

## Case studies

***The food system and value chain analyses in VALUMICS are enabled by the selected case studies***

## Policy gaps

***The findings presented on EU policies were identified prior to publication of the Farm to Fork Strategy (F2F), and some key policy gaps identified are now on the agenda of the Strategy***

## Information sharing

***Information sharing through strategic collaborations and vertical coordination is crucial for optimal decision making in the salmon value chain***

## Climate reduction potential

- ✓ ***Use of novel technologies key to reducing climate impacts of animal-based foods.***
- ✓ ***Inclusion of end-markets important for accurate climate impact assessment.***

**Phase 1: Groundwork and food system analysis.**

### 1. Food system analysis - VALUMICS case studies

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 generic food value chains and systems. Food value chain case studies served as enablers of the overall knowledge building and development work in VALUMICS and provided the scope of scenarios to explore the functioning of food value chains and systems using various analysis tools and modelling.

- ✓ Wheat to bread (Czech, Germany, France, UK)
- ✓ Beef cattle to steak (UK, Germany)
- ✓ Dairy cows to milk (Ireland, UK, France, Germany, and Vietnam)
- ✓ Salmon to fillets (Norway and export to EU)
- ✓ Tomatoes to processed tomatoes (Italy)

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

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. A characterisation framework was developed 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.

### 3. Norwegian Salmon Value Chain: Flow of products and decision mechanisms

Salmon case study in the VALUMICS project represents the Norwegian farmed salmon chain with production and primary processing in Norway, export and secondary processing in Europe (mainly in Poland and France) and final distribution in Europe. Mapping of product flows, decision making mechanisms and factors influencing these decisions in the salmon value chain provided input to VALUMICS model developments.

### 4. Food Chain Impact: Market matters

### 5. Novel Solutions for Food Chain Climate Impact Reduction

Life cycle assessment was performed to identify environmental hotspots and improvement opportunities in selected case studies. Potential climate reduction of animal-based foods using novel technologies were identified.

- ✓ Farm production stage: novel feed ingredients
- ✓ Airfreight in the logistics stage: sustainable fuel
- ✓ Food waste: waste prevention and reduction programs
- ✓ End market matters

Studies that have focused on production of foods, processing of food and even full system assessment of foods can lead to poor policy if the impact of the end market is not recognized. The end market causes two important drivers of difference in eco-efficiency: rate of wasted food and type of transport. The farm remains the greatest impact hotspot, however, airfreighting can become the dominant hotspot

## Moves towards fairer value chains

***Subjectivity in the views of stakeholders over issues such as price negotiations means that interpreting fairness as an absolute state for a food value chain may not be achievable. Rather, moves towards greater fairness and transparency***

## Market Concentration

***Large supermarkets key gatekeepers to most consumers in European markets***
***Ongoing concentration of producers provides them with advantage towards processors***

## Bargaining power

***Producers tend to have better bargaining power in the food value chains characterised with strong cooperation /coordination on the upstream level (e.g. salmon and tomato)***

## Market imperfection

***Strong integration of the value chains on the downstream level (e.g. wheat and dairy), inevitably lead towards some sort of market imperfections that usually result in an unfavourable position for producers***

**Phase 2: Case study baseline analysis**

### 6. The governance of European Food Value chains

Governance issues in European food value chains, and their implications for various stages and actors along the chains were explored through eight case studies in different countries. Governance and relationships, value distribution, power asymmetries including perceptions of fairness and information exchange along food chains were explored and assessment of collaborative governance forms. 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 actor 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 Directive 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

**Economic analyses** with a focus on analysis of price transmission, market power, persistency of trade, technical efficiency and profitability provide an evidence base to better understand the functioning of the selected food value chains.

### 7. Norwegian salmon value chain: how does it influence the EU markets?

- ✓ Producer driven global value chain
- ✓ Hybrid governance
- ✓ Trading partners easily switched
- ✓ Efficiency comes from scale
- ✓ Productivity driven by technical efficiency
- ✓ Export price in Norway influences price along the value chain

### 8. Market orientation: Dairy value chain in Germany, France, and UK

- ✓ Milk producers don't have a strong bargaining power towards processors (there is a long-term negative price/cost ratio).
- ✓ Dual pricing system between raw milk producers and processors.
- ✓ Raw milk price changes are completely transmitted to consumer-ready dairy products in the long run.
- ✓ Adjustments in the scale of operations provide considerable space for productivity improvements in milk production even though the size adjustments in the direction of optimal size were the main source of productivity growth in milk production after milk quota deregulation/abolishment.
- ✓ Most milk producers and processors operate near the production frontier.
- ✓ Technological change was the source of productivity improvements in milk processing.
- ✓ Stable long-term trade with EU partners compared to non-EU (no intra-EU trade barriers and perishability of the end product play a crucial role).

### 9. Market orientation: Wheat-to-bread supply chain in France and UK

- ✓ France pays an important role in setting the global wheat reference price.
- ✓ UK has higher concentration of actors along the wheat-to-bread value chain compared to France.
- ✓ Market imperfections are mainly present in milling industries (on input markets);
- ✓ Small millers and bakers operate in niche markets to obtain higher markup.
- ✓ Adjustments in the scale of operations provide considerable space for productivity improvements in cereal production.

## Balancing market power

***Price formation under the Interbranch Organisation (IBO) ensures higher competitiveness and sustainability of inter-value chain relations for both tomato producers and processors***
***The findings in Italy identify reverse auctions as an unfair trading practice which warrants policy attention in countries where it is in use***

- ✓ Milling and baking industries indicate optimal size of operations and high overall technical efficiency.
- ✓ France has more persistent trade relations with EU partners compared to non-EU (lack of intra-EU trade barriers plays the crucial role).

### 10. Italian processed tomato value chain: market competitiveness, efficiency, and pricing mechanism

- ✓ Dual-level governance
- ✓ Interbranch Organisation (IBO) plays a crucial role in price setup and balancing of power between producers and processors
- ✓ Market power switched towards producers
- ✓ Efficiency of small producers comes from the increasing scale of operations
- ✓ Unfair trading practices remain downstream in the value chain

### 11. Role of regional policies in multi-level governance of agri-food value chains: Emilia Romagna

Results of the analysis of Italian policies, regulations and initiatives that impact agri-food value chains with specific focus on the Emilia-Romagna region along with stakeholder interviews demonstrated how regional policies may effectively support the national (and European) regulations. Regional policies identified in this brief refer to Emilia-Romagna region, located in north-east Italy.

## Policies for Sustainable food consumption

***Behavioural insights should be applied when designing, implementing and monitoring policies for a more effective outcome and impact.***

### 12. Profitability in the European food industries

- ✓ The European food industries are characterized generally by low margins
- ✓ Both firm and industry effects explain variations in firm-level profitability
- ✓ Larger firms in the food industry are generally more profitable
- ✓ Lower returns are witnessed where there are many, smaller firms competing
- ✓ Short term debt is associated with lower returns
- ✓ While margins are generally low, growth niches exist which offer opportunities for higher profitability

**Consumer behaviour studies** underpin the understanding of the functioning of the food system. To achieve food consumption change, it is crucial to better understand the motivations and contexts behind consumer behaviour and how this relates to the rest of the food value chain

### 13. Food Consumption Behaviours in Europe

Understanding food value chains and network dynamics is highly relevant to identify pathways for a sustainable, healthy, and nutritious food future in Europe. 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. On basis of interviews with experts from the key food stakeholder groups, potential "pathways" or opportunities towards enabling more sustainable food consumption practices in the EU were identified

## Food Consumption Behaviour

***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?***

### 14. Behavioural insights for sustainable food consumption

Which interventions work? Which ones fail? The VALUMICS report *"Putting solutions on the table"* analyses and showcases 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

## Evidence based actions

***'Recommendations' based on the VALUMICS research findings are put forward broadly to describe evidence-based actions whose deployment has the ability to support promoting and reaching more sustainable food consumption in Europe.***

### 15. Making sustainable food consumption a reality

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 food purchasing and consumption patterns that are based on plant and fruit-rich diets with fewer animal-based products, locally sourced and organically produced food, and with less food waste and/or food packaging.

The VALUMICS specific recommendations for increasing sustainable food consumption are based on behavioural insights and are targeted to three main actor groups: policymakers, food industry actors and civil society. The recommendations are largely aligned with and can provide evidence-based support for the implementation of the Farm to Fork Strategy

## Phase 3: Modelling and Future Scenario Exploration

**The modelling objective** was to develop an integrated approach and use for the analysis of external and internal drivers influencing the performance of food value chains and demonstrate options for improved business strategies.

## Modelling tools

***Simulation modelling is one of the tools developed in the VALUMICS project with the aim to facilitate decision makers to evaluate the impact of different interventions in future scenarios towards fairer and sustainable food supply chains.***

### 16. Environmentally Conscious Transportation and Logistics Modelling for Agri-Food Supply Chains: An Application to Norwegian Salmon

A logistics mathematical model is proposed, drawing on evidence from the VALUMICS case study of a globally integrated food supply chain, i.e., a Norwegian salmon. The modelling aims to optimise the cost and effectiveness of logistics operations. It also allows for the integration and consideration of environmental aspects within transportation, processing, and distribution operations. A move away from road transport to moving goods by sea wherever possible could significantly reduce both total costs and overall carbon emissions. However, judgements must be made about the relative benefits on a case-by-case basis

### 17. Framework for risk and resilience in food value chains

Agent Based Modelling is a powerful way to model the preferences and actions of heterogeneous members of a supply chain via autonomous agents, combined with the ability of DES (Discrete Event Simulation) to model the queueing behaviour of internal production processes. The resilience of a supply chain to a series of disruptions can be assessed and the impact of a range of approaches to increase resilience can be evaluated. With specific focus on the Norwegian salmon supply chain, the interaction between various actors such as feed suppliers and producers is modelled using an agent-based framework (ABM).

## Price influences fairness perception

***The price negotiated in each transaction is the central mechanism by which the different echelons of the supply chain are interlinked. When examining quantitative metrics for distributive fairness, the importance of price for agents in the FVC is acknowledged as part of their effort to maximize profit***

### 18. Conceptual system model and operationalisation of fairness in food value chains

A system thinking approach was applied for the conceptualisation of a simulation model developed in the VALUMICS project. The undesirable behaviour of the system which was prioritised for the modelling was fairness in food value chains. The system conceptualization phase analysed the underlying feedback structure and the causalities of how behaviour is generated in the system, and this was presented as a mental model in the form of a Causal Loop Diagram (CLD). The subjectivity and intangibleness of fairness perceptions make them difficult to operationalize in a quantitative model. Therefore, to identify a quantifiable measure of fairness as an output of a simulation model the factors related to interorganisational fairness (IOF) which contribute to procedural and distribute fairness were explored.

### 19. Implementation of system dynamics and agent-based modelling simulation of fairness in food value chains

The steps carried out in the development and implementation phase of the hybrid system dynamics and agent-based model following the initial conceptualisation phase of the

## Future scenarios

***The VALUMICS scenario exercise includes characterisation of transition pathways which account for social and political processes at play in the transition***

## Level playing field

***Harmonisation of market rules a necessity for EU actors to raise their level of sustainability and fairness without being at risk of losing market shares or profitability***

***Specific policy proposals for costing the negative externalities into the pricing of the food and drink products needed***

## Changes in agricultural policies

***Aligning the CAP with the Green Deal and Farm to Fork objectives will prove critical to enhance the environmental sustainability of food production.***

## Future scenarios

***Local policy-led: Reducing the rate of farm loss while maintaining employment***
***Global market-led: Price competitiveness is strengthened but with significant reduction in the number of jobs***

simulation model are further explained. The system analysis work was an iterative development in the conceptualisation phase and through technical analysis the model was implemented as a policy scenario simulator for a generic four-echelon FVC, then specialised to the VALUMICS case study FVCs: French wheat to bread; North Italian region raw tomato to processed tomato; and Norwegian farmed salmon to fillets.

**Future scenarios:** The objective was to build foresight scenarios to reflect on the possible evolution of selected food chains and on the kind of public, private, and civil society instruments that would enable enhancing their desirable outcomes or counteract their negative impacts

### 20. Anticipatory scenarios for sustainable, resilient efficient and fair food value chains on the basis of contrasted paradigms

Anticipatory long-term (2050) target scenarios were created that all fulfil the objectives of being sustainable, efficient, fair, and resilient, but relying on contrasting worldviews or paradigms with their underlying assumptions and consequent governance systems and actor behavioural patterns. The aim was to enlighten a broad range of options to reach the objectives (not to compare, which scenario is 'best' and not to predict which is most probable), available to be implemented in potentially distinctive spatiotemporal contexts, and to be combined in varied mixtures.

### 21. Towards a Sustainable and Fair EU Food System in the EU: Challenges and Conditions of a Protein Transition

The publication of the Farm2Fork Strategy paves the road for an ambitious transformation of the EU food system 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 pulses - 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.).

The long-term direction of travel of the protein transition gathered a consensus among the VALUMICS Workshop Series Participants, while three key questions were addressed: **(i)** What are the specific challenges associated to the reorganisation of key food value chains? **(ii)** What are the key policy changes required to trigger those transformations? **(iii)** What sort of collective action is needed to kickstart this process? The discussions focused on three value chains of key importance for the protein transition: plant proteins, wheat, and dairy.

The results highlighted that the protein transition will depend on the collective action of actors within food value chains: policy makers and economic actors can no longer pass the buck to each other or wait for consumers to drive the change. All actors of the system need to move in the same direction to create cumulative effects and ultimately overcome the macro socio-political lock-in of our food system.

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

The modelling results demonstrate that a climate-focused transition pathway based essentially on a change in supply-side policies but with minor interventions on demand and market organization, would have significant socio-economic impacts. In contrast, the results of the local policy-led scenario for the two sectors studied make credible the hypothesis of a just transition of the food system. The economic viability of such a scenario depends, however, on a simultaneous transformation of supply, demand, and market organization - and therefore on major policy changes in these three areas.

## Food system perspective

***The salmon value chain and its role in the wider food system must be considered when assessing sustainability outcomes***

***Integration of fish in food policy especially in relation to the protein transition is crucial***

### 23. Transition pathways towards more sustainable salmon aquaculture

Industry stakeholders´ views were analysed through integration of Multi Level Perspective framework and an extended Global Value Chain governance framework for the salmon value chain. Although landscape pressure, specifically related to global environmental change and changing consumer preferences, seems to be reasonably high and on the rise, it continues to be offset by the resistance to change by powerful actors in the regime and their ability to adapt and align their production network enough to alleviate some of the pressure. Furthermore, competitive niche-innovations, such as land based, and offshore farming systems, do not seem to be sufficiently developed to compete with the highly efficient traditional sea-based farming systems. Therefore, a gradual transformation towards more sustainability within the current regime with, mainly, regime driven innovations and refinements is the most likely in the near future.

## Potential improvement measures in VN

- ***Enhancing linkage by contract farming and dairy cooperatives***
- ***Increasing milk cow farm scales***
- ***Diversifying dairy products with the higher value added***
- ***Improving and certifying milk quality***
- ***Upgrading science and technology in milk cow raising and dairy processing***

## Research findings and Policy Briefs from Vietnam

### 24. Exploring the governance and fairness in Vietnam's milk value chain

Under the high pressures of globalisation, climate change, and changes in consumer behaviour, Vietnam's milk value chain has been notably upgraded in a more sustainable and modern way. The government's regulatory interventions have also had considerable influences on the fairness, welfare, sustainability, and governance in the milk supply chain. However, not all dairy farmers have benefited from these supporting policies and schemes. Thus, the regulatory interventions on enhancing of the fairness and welfare to dairy farmers should be diverse, gradual, and inclusive. The main and potential measures can be recommended as follows:

### 25. Milk Consumption Behaviour Analysis in Vietnam

An international perspective from Vietnam contributing to the research on food consumption behaviours within the VALUMICS project. The study identifies the key drivers and barriers to sustainable and fair milk consumption and proposes an intervention design to improve food consumption patterns through focus groups and a food consumption behaviour model. The key findings show that health aspects and taste are the most important drivers of milk consumption while milk price and the place of purchase are the strongest restrictions

## VALUMICS briefs - Further reading

Deliverable **D8.4 Scenario Analysis report with policy recommendations** compiles the VALUMICS Research Findings and Policy Briefs. The briefs were created by VALUMICS partners who contributed to the research reported in earlier VALUMICS deliverables. The reference to the deliverables, special reports, and scientific publications is detailed in the briefs and key contacts for more information. The individual briefs are also available on the VALUMICS website. www.valumics.eu

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*Disclaimer: This report reflects only the authors' view and the EU Funding Agency is not responsible for any use that may be made of the information it contains*.

# Content






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VALUMICS
Food Systems Dynamics

H2020 VALUMICS Project

# Food System Analysis: VALUMICS Case Studies and Common Challenges

**Research Findings Brief**
**August 2021**

## VALUMICS co-creation workshops

***This brief summarises findings from the VALUMICS food system thinking workshops. The objective was to; (1) create a conceptual model for a generic food system; (2) explore common challenges of food systems; and (3) select case studies for the further analysis to provide understanding of the factors influencing, sustainability, fairness, integrity and resilience of the food system***

## Selected case studies

***Wheat to bread***
***Beef cattle to steak***
***Dairy cows to milk***
***Salmon to fillets***
***Tomatoes to processed tomatoes***

## 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 generic food value chains and systems. The VALUMICS project´s aim is to gain an understanding of the dynamics of food supply- and value chain systems using structural analysis, including system analysis and system dynamics and various analysis tools.
The following definitions for food value chains, food systems and sustainable food value chains have been adopted in VALUMICS:

- Food value chain is comprised of the stages of the path of the food products starting with inputs, primary production, manufacturing /processing, distribution including logistics and transportation, wholesale, and retail sectors until consumers. The viewpoint of economic value addition is emphasised.
- Food system encompasses the food value chains/networks and in addition, waste management and all the supporting and interacting 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 farms 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 and disposed of after use, in a manner that is profitable throughout, has broad-based benefits for society and does not permanently deplete natural resources".* (FAO 2014)[1]

## Prioritisation of VALUMICS case studies

The prioritised food system case studies encompass different food value chains at different levels; i) national, ii) European and iii) global and including animal production systems (beef and dairy, farmed salmon), plant crops targeting both food and feed inputs for the animal production systems (wheat), and wider selection of food product chains e.g. tomatoes as a vegetable source. The final selection of case studies considered existing data availability and partners' expertise based on e.g. participation in different European projects and considering the possibility of involving stakeholders and the potential to support the goals of the VALUMICS project to explore fairness, resilience, sustainability and integrity of food supply chains and systems was considered.
The VALUMICS value chain case studies and the countries where analysis and assessments are performed are the following:

1. *Wheat to bread* (Czech, Germany, France, UK)
2. *Beef cattle to steak* (UK, Germany)
3. *Dairy cows to milk* (Ireland, UK, France, Germany and Vietnam)
4. *Salmon to fillets (*Norway and export to EU*)*
5. *Tomatoes to processed tomatoes (*Italy*)*

[1] FAO (2014). Developing sustainable food value chains – Guiding principles. Rome, http://www.fao.org/3/a-i3953e.pdf

## The food system structure and material flow

***The integration of flow charts of the selected case studies revealed similarities in supply chain structures, with the input and output stocks of food raw material and products flowing through the similar stages of production, harvesting, processing, distribution, consumption and the food system waste.***

## Sustainability

***The VALUMICS analysis of food value chains, stakeholder insights and consumer behaviour studies provide policy makers and food industry actors with a range of evidence-based approaches and recommendations to drive more sustainable food production, purchasing and consumption behaviours***

## Fairness

***VALUMICS qualitative work on policy and governance provides bases for evaluating issues related to unfair trading practices e.g. power imbalances in food chains and stakeholders´ perception on fairness.***

The selected food value chain case studies serve as enablers of the overall knowledge building and development work and provide the scope of scenarios to explore the functioning of food value chains and systems using various analysis tools and modelling. The system analysis is presented in VALUMICS via sets of flow diagrams for the case studies, and when integrated the similarities in their structure becomes evident as shown in Figure 1.

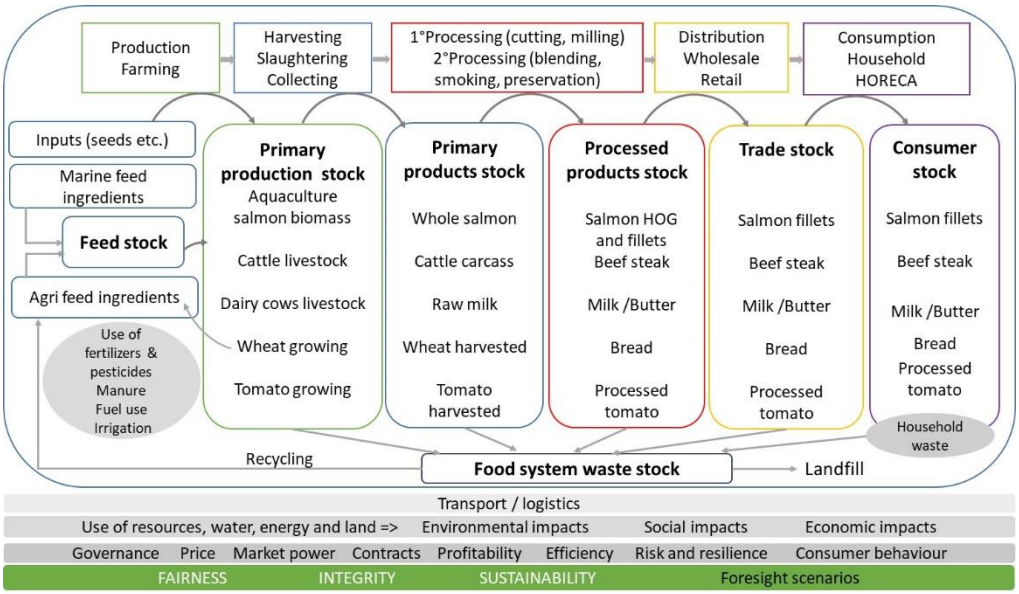


*Figure 1 An overview flowchart of the food supply chains selected as case studies in the VALUMICS project and the topics of analyses performed are highlighted in the horisontal lines at the bottom*

# Sustainability, Fairness, Integrity and Resilience and the VALUMICS case studies

The selected case studies are relevant 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 analyses include assessment of environmental and social dimension 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. Structural 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 position of upstream actors. Therefore, VALUMICS research focus is on analysis of governance and food chain organisations, market power, price formation and price transmission, persistence of supply chain relations, assessment of economies of scale and technical innovations, and finally statistical analysis of agribusiness profitability. Moreover, the insights on stakeholder perceptions and consumer behaviour provides understanding of the dynamics of the functioning of food supply chains and systems.

***Fairness***: Food value chains are characterised by industrial food manufacturing segments dominated by large corporations, often international ones, that are deemed to put a pressure on farmers. For example, milk producers, have been hit by a continuous decrease in milk prices at farm gate and an increase price volatility. The issue of unfair trading practices and trade contracts is thus a key topic in milk / dairy chains as well as other food chains.

The market power of the retailers has been increasing and in many countries the specification for e.g., meat cutting and packing are managed and driven by the retailers. This affects selection of breeds, animal welfare and other rearing parameters stipulated within increasingly integrated supply chains involving specialised large processors and packers. In Germany, France and UK the top five beef/veal companies in these countries have more than 50% market share. This impacts on competitiveness of different actors along the value chain and issues of unfair trading

practices may arise. The work in VALUMICS pays special attention to fairness in the case study work, while acknowledging the proposal of the Council of the EU for fairer relations in the agro-food sector between small farmers and processors, and their larger trading partners[2], which has now been adopted as EU Directive on Unfair Trading Practices[3]. Furthermore, the focus of the VALUMICS modelling work is on simulations to assess fairness in terms of fair value distribution among actors in the food value chains.

## Integrity

***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.***

***Integrity***: An important part of the integrity of food value chains is food authenticity which has become a key issue in relation to food fraud and responsibility, and consequently the enforcement of EU food standards and labelling regulations. Until recent years, drinking milk for example, was mainly considered as an undifferentiated product and the issue of authenticity was not so important. The increased level of competition has led to various attempts to segment the final markets through labels (free GMO milk in Germany, grass-fed milk in France and the Netherlands). However, there is complexity in labelling as evidenced for example in the commercial connections in the tomato value chain e.g., start global, go local and become global again. Companies can use foreign tomatoes and tomato by-products, process them in Italy, and then resell in other intra-European and extra-European countries. Tomato products must be labelled to communicate the origin of production site, or if different, of the packaging site. This is aimed at giving to the agro-food companies a competitive advantage and providing a more efficient protection of consumer health.

Another aspect of food integrity is the availability of data for empirical analysis. In this respect transparency of food market data and information availability continues to be seen as competition issue by the FVC actors. The reluctance to make data accessible has impacted the research in VALUMICS. Example is the higher level of transparency in the Norwegian salmon case study compared to agricultural case studies which has resulted in a number of studies in VALUMICS being focused on salmon food value chain. The EU Transparency and sustainability of the EU risk assessment in the food chain regulation[4] that came into force in March 2021 covers the reliability, objectivity and independence of studies used by European food Safety Authority (EFSA). However, the transparency of market data for FVC is not ensured for the consumers and further work is needed to align different sectors data management policies to facilitate research and informed choices of safe, sustainable foods taking all aspects into consideration for understanding the dynamics of the food system.

## Resilience

***VALUMICS work includes the development of a 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***

***Resilience:*** The increase in the globalization of food value chains and interconnectedness among supply chain partners have led to higher dependency and increased complexity of relations between the firms in the supply chain. Firms have in recent years been focused on generating high levels of efficiency through lean operations during stable business conditions, but at the same time they have become highly vulnerable to disruption risks. VALUMICS has adapted the definition of resilience considering food supply chain system: "*Capacity over time of a food system and its units at multiple levels to provide sufficient, appropriate and accessible food to all, in the face of various and even unforeseen disturbances*"[5].
Disruptions often derive from upstream suppliers due to production problems, that may be caused by natural disasters, quality defects, or financial reasons which influence downstream partners and trade. While not foreseen at the outset of the VALUMICS project, the COVID-19 pandemic has significantly disrupted food supply chains, for example the raw material shortage due to plant closures or shortage of workers; transportation disruption impacted firms who are dependent on airfreight capacity in passenger aircraft, with a knock-on impact on the price and availability of commercial cargo plane capacity. Shift in consumer demand due to lockdown of HoReCa has resulted in more demand at the retailers, for food being consumed at home. In addition, the reduction in consumer disposable income may lead to purchasing of cheaper items, such as cheaper cuts of meat as well as more demand of frozen or canned products with longer shelf life etc. VALUMICS work on risk and resilience aims at enabling value chain actors to develop appropriate resilience strategies by utilising a simulation model for process optimisation.

[2] Press Release 538/18, 01/10/2018. Better protection for farmers against unfair trading practices: Council agrees its negotiating position. Visited on Internet 16/10/2018; https://www.consilium.europa.eu/en/press/press-releases/2018/10/01/better-protection-for-farmers-against-unfair-trading-practices-council-agrees-its-negotiating-position/
[3] 17 April 2019, Directive (EU) 2019/633 on unfair trading practices in business-to-business relationships in the agricultural and food supply chain
[4] Transparency and sustainability of the EU risk assessment in the food chain, European Commission
[5] Tendall, D.M., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q.B., Krütli, P., Grant, M. and Six, J., 2015. Food system resilience: defining the concept. Global Food Security, 6, pp.17-23. https://doi.org/10.1016/j.gfs.2015.08.001

# VALUMICS Case studies: Characteristics and scope

## Wheat production in Europe

***Wheat accounts for about 50 % of total cereal production in Europe. The main wheat producers are France, Germany, UK and Poland***

## Competition

***The value chain is highly industrialised and characterised by high competition***

## Challenges

***The volume and quality of production is significantly influenced by weather conditions/climate changes***

## Wheat to bread

***The countries targeted for analysis are the Czech Republic, Germany, France and UK.***

## WHEAT TO BREAD

**Characteristic of the value/supply chain:**

- ✓ Wheat dominates the cereal production in EU. Moreover, world wheat production creates over one third of world cereal production.
- ✓ Primary production: has a form of intensive farming.
- ✓ Milling industry: The production process is characterised by transformation of large volumes to reach economies of scale (i.e. saving in costs gained by higher quantity of production) and profitability (typically, small margin business). Moreover, the flour millers sell most of their flours B2B to downstream manufactures[6]. The production has typically high efficiency and productivity.
- ✓ Bakery and delivery system: is highly industrialized. The market is characterized by high competition and product innovations.
- ✓ Supply chain: is demand driven. That is, the demands of the bakers shape the varieties of wheat grown for the chain by the farmers to meet the end product specifications i.e. higher protein content in the harvested wheat grain (Smith and Barling, 2014) [7]. Moreover, there are strong links between the industrial baking sector and the agriculture and milling industries with many of the large bakers being owned by key agricultural or milling concerns.[8]

**Challenges**

- ✓ Cereals represent major part of the crop production with the largest share on arable land and consequently associated with various environmental challenges
- ✓ The production is characterized by high production and market risks coming from unpredictable weather conditions/climate changes and considerable market volatility.
- ✓ CAP plays important role in securing stable supply of wheat and in preventing crisis situations.
- ✓ Stagnating yields on one side and increasing population on other side ask for efficiency and productivity improvements.
- ✓ First-generation agri-ethanol generates new competition for land between energy and food suppliers.

**Case Study Specification**

The case study will focus on wheat to bread value/supply chain, from wheat production to bread consumption. The research work is on material flows and governance analysis, economic studies on food chain organisations, market power, price formation and price transmission, persistency of supply chain relations, assessment of economies of scale and, technical innovations and furthermore statistical analysis of agribusiness profitability. A special focus in France is on future scenarios and transition pathways.

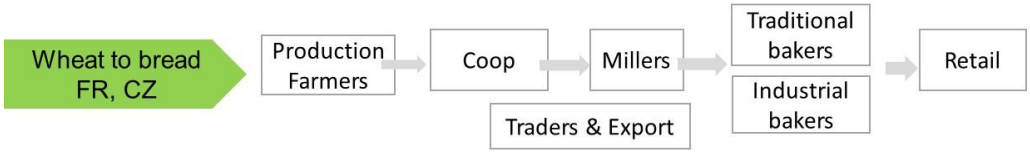


*Figure 2 Key actors in the wheat to bread chain*

[6] European flour millers (2018)

[7] Smith J and Barling D (2014) Glamur project UK wheat to bread supply chain case study. City University London http://glamur.eu/wp-content/uploads/2015/04/glamur-wp3-uk-bread-3-cases.pdf (Accessed 28 October 2018)

[8] https://www.fob.uk.com/about-the-bread-industry/industry-facts/european-bread-market/ (Accessed 23 October 2018)

## Production

***Dairy sector in Europe produces approximately 150 million tons of raw milk, out of which nearly 15 % is exported under different forms (depending on the year considered)***

## Challenges

***Policy interventions /end of quota system 2015***

***Volatile prices - influenced by world market (milk powder and butter)***

***Competition across Europe – lower production cost – environmental challenges***

## Dairy cows to milk

***The dairy cow to fresh milk and butter chains are relevant to reflect on the main issues that need to be addressed to improve the integrity, sustainability and fairness of European food chains***

***The countries to be studied for the fresh milk product value chain are France, Germany, UK, Ireland and complementary analysis in Vietnam***

# DAIRY COWS TO MILK (AND BUTTER)

### Characteristic of the value chain

The dairy chain illustrates the complexity of European food chains and allows to address connections and interdependences between scales and chains. The dairy value chain is part of a structuring sub-sector of the European agri-food sector, with a total production of raw milk amounting to 150 million tons, out of which nearly 15 % is exported under different forms (depending on the year considered).

The sector has a variety of systems and chains at different levels, e.g. (1) at local / national scale, grazing vs confinement systems (Germany vs. Ireland/UK or Intensive *vs* extensive systems in French Britany); (2) short vs. long supply chains (e.g. local production and consumption *vs* local production and international consumption or raw milk to processed dairy ingredient to processed consumer food).

From the raw milk 97% of all milk produced in the EU is produced by cattle, and 92% of the milk produced is delivered to dairies. Foreign trade in raw milk is of negligible magnitude. About 20% of the raw milk is processed into fresh drinking milk and an additional 10% into other fresh milk products. The remaining 70% are processed into manufactured dairy commodities (cheese, milk powder, butter, and whey as by product) which are traded globally.

### Challenges

- ✓ The dairy sector has been highly regulated over years through a quota system, whose termination at the end of the year 2015 has had important impacts on the organization of the whole chain. More generally, the milk chain has been a matter of policy interventions from upstream to downstream for more than six decades. For example, during the 1940s', the modernization of dairy systems upstream has been accompanied by a system of public promotion / incentives for milk consumption downstream to ensure an uptake of the increase of the production.
- ✓ The fresh milk market, while being mainly a local or a national one, is highly influenced by the world market, especially since the end of the quota system in the EU: price for raw milk at farm gate has become more and more volatile and is based on world market for milk powder and butter and does not depend anymore upon the level of local / national demand. Milk producers across Europe (especially in Denmark, Ireland, France and the Netherlands) are engaged in a fierce competition between each other's that force them to lower production costs, often at the expense of their level of environmental sustainability.

### Case Study Specification

The dairy case study will focus on the fresh milk as a consumer product and for the LCA work the butter product is defined as a sub case study in Ireland. The analysis is on material flows, life cycle assessment, governance and economics, modelling to optimise logistics and simulation of decisions linked to supply flows and assessment of fairness in terms of market power and price. Furthermore, studies to consumer behaviour, future scenarios and transition pathways are included.

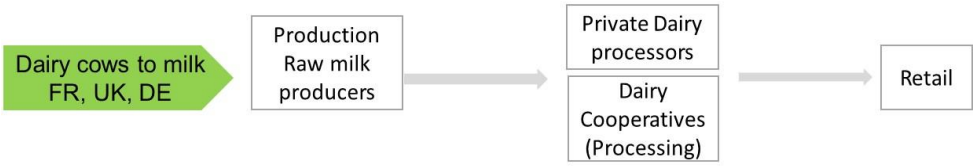


*Figure 3 Key actors/ activities in the Dairy cows to milk chain*

## BEEF CATTLE TO STEAK

### Characteristic of the value chain

## Production

***Main beef producing countries in EU are Germany, France, UK and Italy***

The majority of the bovine meat production is concentrated in few countries, and the annual output is about 800 thousand tons of bovine meat. The standing animal stock above 2 years old is about 44 million animals and about 8.5 million animals are slaughtered annually.

In EU 3.6 million farms are in the cattle sector and this accounts for 17% of all farms in EU and rear half of the livestock units and contribute 33% of the agricultural gross production value using one third of EU agricultural land – employing 25%of the agricultural labour force. The biggest producing countries are respectively Germany, France, UK and Italy.

The farm types involved in the meat sector are:

- ✓ Specialist cattle — rearing and fattening ("specialist fattening"),
- ✓ Cattle — dairying, rearing and fattening combined ("dairying and meat"),
- ✓ Mixed livestock, mainly grazing livestock ("mixed livestock") and
- ✓ Field crops — grazing livestock combined ("crops and cattle")

### Challenges

## Challenges

- ***Pressure from environmental groups***
- ***Changed consumption patterns***
- ***CAP subsidies influence the drivers in the beef market sector***

The EU cattle sector has been undergoing reshaping in recent years and concentration of market power has become increasingly vested in the retail sector. The consumption of beef and dairy products has reduced in Europe as consumers' lifestyles are changing and also the CAP direct payments to farmers have changed the drivers in the beef market sector. Overall cattle farm incomes in EU are dependent on the CAP support, 49% in dairy and 100% in the bovine meat sector [15].

Pressure from environmental concern groups[9] are likely to further impact policies and motivate consumption patterns that in short- and longer term will lead to reduced meat production from conventional systems.

The consumption of meat products has been driven by the increase in white meat (poultry and pig meat) and declining or stagnant red meat consumption. The importance of bovine farming in EU, especially in more rural areas is a core factor in pursuing this case study, and with consideration of continued use of grass/range lands that would not be appropriate for another crop production. The cattle can during their life cycle eat grass and feeds that cannot be directly consumed by humans, i.e. cattle can utilise farmlands that otherwise would not be used to produce foods directly.

In EU the bovine meat consumption has not changed much in recent years and average bovine meat consumption is about 11 kg per capita, or 17% of total average meat consumption. The EU is a net importer of bovine meat for its consumption.

### Case Study Specification

## Beef to steak

***The countries targeted for analysis are Germany and UK***

The case study will focus on bovine meat production, from farm to beef steak as a product. The research work is on governance, economic analysis and consumer insights.


*Figure 4 Key actors/ activities in the Beef to steak chain*

[9] Buckwell, A., and Nadeu, E. (2018). What is the Safe Operating Space for EU Livestock? RISE Foundation, Brussels.

## Production

***About 70% of the world's salmon production is farmed. Main producing countries are Norway, Chile, Scotland and Canada and the top four largest salmon producers are Norwegian enterprises.***

## Technical innovation to mitigate challenges

***Development of closed farming systems and novel feed using alternative feed sources (e.g. microalgae, seaweed, microbial cultures or insects)***

## Export to EU

***Majority of salmon produced in Norway is exported as commodity to avoid tariffs of value-added products within EU***

## Salmon to fillets

***The countries targeted for analysis are Norway and export to France and Poland. Included are stakeholder interviews in Norway, Scotland and in Iceland***

# ATLANTIC SALMON TO FILLETS

### Characteristic of the value chain

The salmon aquaculture industry has been one of the fastest growing food producing sector in recent years. The Norwegian salmon supply chain represents a global food system which sources feed ingredients from crops and marine systems worldwide and supplies products to various markets including Europe, Asia and America. Thus, salmon feed and subsequently the salmon product are associated with a wide range of environmental impacts on many ecosystems and with other social and environmental conflicts.

- ✓ The farming of salmon is based on smolt production in freshwater in a land-based hatchery and grow out in sea cages with a total life cycle length of 24-40 months[10]
- ✓ The chain is driven by the producers and characterised by strategic horizontal collaboration and vertical integration. The large aquaculture producers have driven the technical innovations, which has ensured their market competitiveness
- ✓ The primary processing includes slaughtering, gutting, filleting, chilling and packaging and by-products such as guts, heads, tailbones and other fractions from slaughtering are further processed into fish oil and fish meal. Secondary processing is mainly outside of Norway (e.g. France and Poland).

### Challenges

- ✓ Salmon aquaculture is heavily influenced by political decisions in terms of regulation of where farm sites and slaughter plants are located and legislation regarding feeds and medication (antibiotic use)[11].
- ✓ The aquaculture sector has invested in research to mitigate environmental impacts. The focus is on biological uncertainties, farming technologies and feed (e.g. feed utilization, optimizing the feed conversion ratio and novel). ingredients The share of vegetable ingredients has increased and a corresponding reduction in the share of marine ingredients has reduced the impact on marine ecosystems, per unit of salmon produced, but shifted environmental burdens to terrestrial ecosystems
- ✓ Governmental monitoring and legal requirements ensure that aquaculture farms report on biological challenges (e.g. occurrences of lice, escapees, the use of medication and water quality and sediment monitoring).
- ✓ There is an increasing awareness of transparency and consensus that monitoring data should be accessible in the public domain to enhance the integrity and help building an image of responsibility for the sector.

### Case Study Specification

The scope of the case study is salmon aquaculture supply chain in Norway from farming and processing into HOG (head on gutted) products and export to EU for further processing into fillets and distribution to markets. The analysis is on material flows, decision making, life cycle assessment, governance and economics. Modelling work is on optimised logistics and simulation of decisions linked to supply flows and assessment of fairness in terms of market power and price. Furthermore, consumer behaviour insights and development of future scenarios include a study on transition pathways.

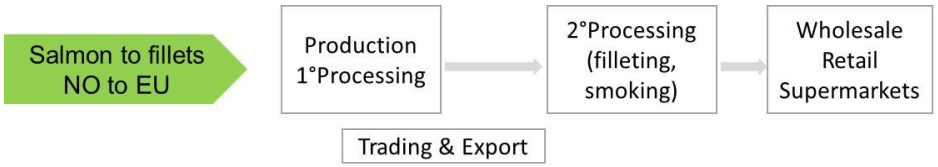


*Figure 5 Key actors/ activities in the salmon to fillets chain*

[10] Salmon Farming Industry Handbook 2017. http://hugin.info/209/R/2103281/797821.pdf
[11] Ziegler et al., (2012). The Carbon Footprint of Norwegian Seafood Products on the Global Seafood Market. Journal of Industrial Ecology, 17 (1): 103 - 116.

## TOMATO TO PROCESSED TOMATOES

### Characteristic of the value chain

## Production

***Italy is the largest tomato producing country in Europe and in Northern Italy there is a localized production district, including companies of production, processing, cooperatives and private processing***

The tomato chain is an example of a fruit and vegetables produce from South European/Mediterranean agricultural goods, that completes the set of food products analysed by VALUMICS.

- ✓ The value chain organization includes a tomato Interbranch Organization (IBO) with a role to establish actions in favour of tomato food chain functioning, such as the creation of an emergency fund for farms. Tomato value chain has specific chain governance relationships including the Producer Organizations[12] and the IBO, an umbrella organization, which includes tomato producers and processors in Northern Italy.
- ✓ It is a localized production district, including several types of companies.

The tomatoes are mainly transformed into the following types of products: i) Canned tomatoes (Whole tomatoes, sliced, smashed, purée); ii) Tomato sauce, such as ketchup and similar; iii) Ingredient product for other food products (e.g., pizza, soup, ready-to-eat products, etc.)

## Price negotiations and setting of reference price

***The price can vary according to quality parameters specified in the Framework Contract agreed by all the companies of the district. One of the parameters is the level of "BRIX" of the tomato. Another parameter is the "percentage of major and minor defects".***

**Challenges: Price negotiation in the supply chain**

- *Between processing industry and retailers:* The processors negotiate only a small part of their products (15%) with the retailers through reverse auctions. Interviewees sustain that the auction system influences the price setting strategy also beyond the auction system itself, and leads to low prices, especially in consideration of the quality characteristics of the tomato product produced.

- *Between production and processing industry:* Processed tomato is produced on a contractual basis. Tomato production and commercial relationships within the IBO are regulated by general rules. These are set within a Framework Contract and specific contract-by-contract conditions set in detailed Supply/Delivery contracts between producers and processors, and between producers and self-processing cooperatives (e.g. no pesticide residues or chemical ingredients, Brix level, consistency, flaws, etc.).

**Recycling of the waste in the processing stage:** Water: 70% of the water utilized in the depuration process of the tomato is recycled and utilized again in the first phase to transport the fresh to-be-processed tomatoes in the processing line. The parts of the tomatoes not utilized in the final product are recycled in agriculture, biogas or fodder.

**The processing stage includes several steps:** Thanks to the geographical proximity of the chain actors, the tomato is harvested and sent directly to the processing plant, without intermediate storage. The transport of the harvested tomato from producer to processor is carried out mainly on trucks organized/provided mostly by specialized logistics and transportation companies. The harvested tomato is delivered to the processing industry within few hours after harvest, and undergo a quality check within four hours of the agreed delivery time.

## Tomato to processed tomato

***The scope of the analysis on Northern Italy Emilia Romagna region and specifically focuses on the role of PO and IBO to mitigate power imbalance and fairer outcomes for farmers***

**Case Study Specification**

The tomato case study focuses on the Italian production and processing of tomatoes into canned products and distribution to consumer market. Analysis includes governance and studies on food chain organisations, market power, price formation, persistency of supply chain relations, assessment of economies of scale and technical innovations. Furthermore, studies on consumer behaviour are included.

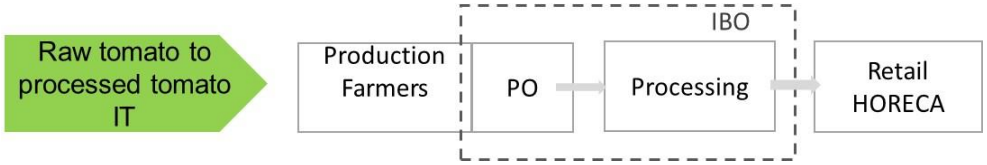


*Figure 6 Key actors/ activities in the raw tomato to processed tomato chain*

[12] PO recognized and regulated by the EU as part of the European Common Agricultural Policy (CAP) Reg. EU 1234/2007, Reg 1308/2013

## Interconnections through use of feed

***The dairy chain is linked to the beef chain through the production systems, while the wheat chain is linked as feed component for the livestock. Moreover, the imports of soy and use of wheat for feed for farmed salmon links those systems that are dependent on feed***

## Governance and externalities

***To improve the fairness, resilience and longer-term sustainability, the governance of the food system, actors' behaviours and various externalities shaping the different food sectors as part of the food system must be considered holistically***

## Environmental challenges

***The environmental challenges of the food system include the use of water for agricultural irrigation, degradation of land and contribution to global greenhouse gas emissions through e.g. use of fuel, pesticides and fertilisers, and livestock manure. Agriculture through intensive farming is a primary cause of biodiversity loss***

# Interconnections of VALUMICS case studies

There are important common challenges and interconnections between the VALUMICS case studies. For example, the production of milk, and more generally the functioning of the whole dairy chain, relates to the functioning of at least three other major food or commodity chains. The first two are protein crops and cereals, that play an important role for feeding dairy cows and other livestock under the form of compound feed, depending on whether it is an intensive or extensive system. The beef case study is linked to the dairy case study in terms of the dynamic linkages between these two production systems, also, the case study on wheat is inherently linked due to the feed components used for the livestock. Amongst the different environmental issues of livestock, are those related to manure management and enteric fermentation in farmed animals (livestock) and eutrophication in aquaculture as well as water pollution, feeding strategies, and deforestation embodied in e.g. soy imports for feed. These are all common upstream challenges of beef and dairy value chains as well as farmed salmon. The efficiency of the feeding and farming systems is of key importance to minimize environmental impacts. Furthermore, food loss and waste through processing, storage and transportation contribute to downstream environmental challenges which are common for all food value chains, in particular for distant markets.

# Challenges of food systems

Agro-food systems have been successful in feeding a growing number of people but are pushing planetary boundaries in terms of greenhouse gas emissions, biodiversity loss, freshwater use, and both nitrogen and phosphorous cycles, risking expensive, potentially irreversible environmental change[13]. The global food system, which includes all actors and sectors involved in producing, distributing, retailing, and consuming food, is thus at the centre to mitigate the challenges facing the planet. Numerous studies using Life Cycle Assessment (LCA) have shown that the primary production and intensive farming is causing the main environmental burden in the whole life cycle of animal and aquaculture products. This is contributed by e.g., the use of fertilisers and pesticides in the production of feed components through growing of crops and by fuel use in fisheries while sourcing marine feed ingredients. The use of fuel during transport can also contribute considerable climate change impacts of exported products in distant markets.

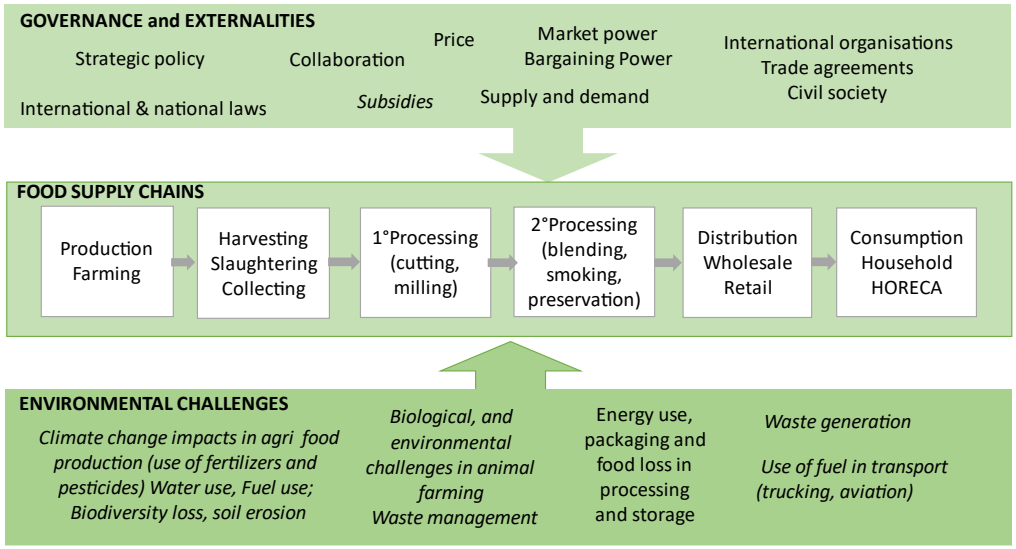


Figure 7 *Environmental challenges, governance and externalities influencing the functioning of the food system*

[13] Rockström et al., (2009) "Planetary Boundaries: Exploring the Safe Operating Space for Humanity." https://www.ecologyandsociety.org/vol14/iss2/art32/)

It has also been emphasised that open, efficient, and *fair-trading systems* should be encouraged, and countries should reduce trade distortions by reducing high *import tariffs* and eliminating *export bans* and restrictions in order to expand secure an equal access to markets for food and agriculture. The challenges of the global food system are also reflected by rising *anti-globalism, especially trade protectionism*, which is influencing the free flow of goods needed to ensure food security and nutritional products, particularly for nutritious and sustainably sourced foods[14].

## CAP and subsidies

***The farm support policies in developed countries often insulate producers from market price and can lead to overproduction and depressed global prices. Countries have been reluctant to give up farm subsidies and multi-country agreements on reforming domestic support have not been reached***

The Common Agricultural Policy (CAP) support of the EU through direct payments and market measures under the first pillar and rural development measures under the second pillar have been debated. However, challenges in the meat and dairy sector are of such nature that specific support measures, especially for the dairy sector, have been introduced. These include the 2012 milk package to improve bargaining of dairy farmers in the milk supply chain and the 2015 aid package targeting the beef meat and dairy sectors through, among others, aid for private storage and promotion[15]. In a global context, in terms of farm support policies, low-income farmers lose when they compete against subsidized production and the developing countries may face increased malnutrition, food insecurity, and adverse consequences for rural development[14]. Further, while the discussion on reducing meat production and consumption in response to the severe environmental challenges, the analysis of the EU cattle sector in recent years, has highlighted its economic importance, productivity, and prospects for further increases in bovine meat and milk. The analysis emphasise that further consideration of impacts are needed in terms of*: public policies, - both at national and EU level – such as environmental restrictions and the abolition of the milk quota system in April 2015; price developments at world, EU and national levels; problems of profitability in the sector; changing demand both in terms of quantity and quality; increased competition in the EU due to the progressive opening of the market through international trade agreements; a changing geopolitical context; the international economic situation; and the consequences of climate change.* " [15]

## Policy support needed for radical changes

- ***Sustainable production***
- ***Reduce food loss & waste***
- ***Diet changes***
- ***Exploit knowledge and emerging technologies***
- ***Fair trading systems***
- ***Level playing field***

The need for a radical change in the global food system is widely acknowledged, where changes in production and emerging technologies are seen as an opportunity for food systems. Major food system can thus contribute to the UN´s Sustainable Development Goals (SDGs)[16] by increasing sustainable production efficiencies (more food with less impact), reducing food waste and loss, and shifting diets in particular shifting towards plant-based diets[14]. Furthermore, to support radical changes in the food system it has been highlighted that "polices must encourage structural change in farming to bring about a better balance, structure, location and de-concentration of livestock and better integration of crop and animal production, as well as resource efficiency improvements and reduction of leakage and waste"[17].

It should be noted that during the later phases of the VALUMICS project the Green Deal[18] and the Farm2Fork strategy [19,20] have been launched with ambitious aims to tackle the challenges of the European food system and motivate transition to sustainable food system. The work in VALUMICS provides evidence on the functioning of selected food value chains through stakeholder insights, policy oversight, governance analysis, mapping of information and material flows, economic analysis, life cycle assessment, consumer behaviour studies and modelling work aimed at optimising logistic and simulation modelling of processes and actors' decision, as tools to explore the impact of interventions aimed at enhancing fairness, resilience and sustainability in future scenarios.

[14] Glauber, Joseph W. 2018. Developed country policies: Domestic farm policy reform and global food security. In 2018 Global food policy report. Chapter 7. Pp. 54-61. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/9780896292970_07
[15] Ihle, R., Dries, L., Jongeneel, R., Venus, T., Wesseler, J. (2017). Research for Agri Committee – The EU Cattle Sector: Challenges and Opportunities – Milk and Meat. Diectorate-General for Internal Policies, Policy Department B: Structural and Cohesion Policies, Agriculture and Rural Development. doi:10.2861/85585 http://www.europarl.europa.eu/supporting-analyses
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## Key sources for further information

This brief presents an overview of the VALUMICS project phases and findings from co-creation workshops in the first year of the project where all VALUMICS partners contributed. Common challenges of food systems and the selected case study specifications are highlighted.

To discuss the research presented in this brief, please contact Gudrun Olafsdotttir, University of Iceland, email: go@hi.is

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*Participating partners*: CSCP (DE), UNIBO (IT), UNEW (UK), IDDRI (FR), UoI (IS), MM (IS), CZU (CZ), UEH (VN), CAU (CN), REWE (AT)

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## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

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VALUMICS
Food Systems Dynamics

# H2020 VALUMICS Project Policy Brief

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

June 2021

## Key Outcomes

***The need for improved fairness and transparency are two key themes that arose out of the mapping of polices impacting upon food value chains in terms of fairer trading practices, food integrity, and sustainability collaborations.***

***Some key policy gaps identified in the original mapping carried out in 2017-8 are being addressed in the EU's Farm to Fork (F2F) Strategy – however, there are important steps that need to be taken if EU ambitions are to be realised.***

## 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 polices 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 governance actions, as explained above, down to regional-local levels.

Governance modes which incorporate stakeholders from the private sector of business and industry, as well as the voluntary sector and other civil society organisations, are also used by national governments, to extend policy reach and achieve public policy goals. This outsourcing of policy making and delivery means governance involves an iterative process of negotiation and compromise entailing power relationships between actors, and across governments and public agencies, the private sector and civil society.

# Mapping EU Policies and Governance

Unfair trading practices are defined as: 'Practices that grossly deviate from good commercial conduct, are contrary to good faith and fair dealing and are unilaterally imposed by one trading partner on its counterparty'[1].

The following sections summarise briefly the mapping findings across the three defined areas of interest.

## Fairer Trading Practices

***Adverse impacts of asymmetries of power within food value chain relationships, in particular on farmer-growers, have motivated policy approaches for Fairer Trading Practices.***

### 1. Policy Approaches to Fairer Trading Practices

Fairer trading practices along food value chains were identified as an issue for policy attention in the European Commission's work on the Competitiveness of the Agro-Food Industry in the late 2000s. The findings highlighted the adverse impacts of asymmetries of power within food value chain relationships leading to the Commission's multi-stakeholder High Level Forum (HLF) for a Better Functioning Food Supply. The Commission created a voluntary Supply Chain Initiative, aiming to eliminate unfair business-to-business trading practices in the food supply chain through collaboration, to promote a 'genuine culture change'. However, it failed to get buy-in from the peak European farming organisation COPA-COCEGA, and had limited take up in member states. The farmer-grower's voice was taken up by DG Agriculture which set up the *Agricultural Markets Taskforce*, as it was concerned that increased market orientation of farming and less management (by governments) of agricultural markets meant that farmers were becoming 'the main shock absorber in the supply chain', yet lacked the resilience to withstand price volatility or long periods of low prices[2]. Invoking Article 39 of the Consolidated version of the Treaty on the Functioning of the European Union (TFEU): '*contributing to a fair standard of living for the agricultural community*', the task force recommended regulation that was finally legislated as the *Directive on unfair trading practices in business-to-business relationships in the agricultural and food supply chain (EU) 2019/633*, adopted in April 2019. The Directive applies a "step approach" based on turnover figures as a proxy for the different bargaining powers of suppliers and buyers, and prohibits 16 specific unfair trading practices (UTPs) imposed unilaterally by one trading partner on another. Another key initiative from the Commission was the introduction of a *European Food Price Monitoring Tool* online in 2009, to increase transparency of 'price dispersion', making it easier for enterprises and policy actors to see and compare statistical data on indexed food prices at successive stages in the chain) and between Member States[3].

## Food Integrity

***The safety and quality aspects of food integrity have been well-addressed by policy, but concerns remain around food fraud, and in particular the need to better resource national inspection and prevention.***

### 2. Policy Approaches to Food Integrity

Regulation of food integrity - defined as safety and aspects of authenticity - has been a key focus for two decades, to ensure a functioning single market while protecting consumer health and wellbeing. A food chain perspective has been attempted, through regulations such as the General Food Law, with its traceability requirements, and the rationalisation of the Official Controls on food and feed safety. The importance of food safety led to the creation of the European Food Safety Authority (EFSA) and the revamping of the Rapid Alert System for Food and Feed, which shares information on food safety risks across the Member States. A 'Regulatory Fitness and Performance Programme' review of the General Food Law and EFSA concluded that the law has achieved its core objectives, namely high protection of human health and consumers' interests and the smooth functioning of the internal market; but, it is less adequate to address new challenges like food sustainability in general, and more specifically, food waste. In the case of transparency for the consumer, both the General Food Law and the Official Controls Regulation play important roles along with the Food Information to Consumers Regulation. The latter Regulation also has a key role in ensuring authenticity, and dovetails with the Regulation on quality schemes for agricultural products and foodstuff (Geographical Indications) The mapping also identified gaps in the effective monitoring and transparency of food safety and of food integrity along value chains, as exemplified by misleading claims and criminal fraud.

[1] COM (2016) 32 Final Report from the commission to the European parliament and the council on unfair business-to-business trading practices in the food supply chain.
[2] Agricultural Markets Task Force (2016) *Enhancing the position of farmers in the supply chain: Report of the Agricultural Markets Task Force.*
[3] Website for European Food Price Monitoring Tool, https://ec.europa.eu/growth/sectors/food/competitiveness/prices-monitoring_en, (Accessed May 2021)

Renewed policy actions over food fraud included the creation of an EU Food Fraud Network, the effectiveness of which remains to be proven. Commitment of sufficient national level budgetary resources is a necessity to ensure successful fraud inspection and prevention, as evidenced by concerns raised in some member states (UK & Czech Republic).

## Sustainability Collaboration

***The European Commission has initiatives to measure the sustainability impacts of food products; yet EU competition law inhibits sustainability collaboration between supply chain actors***

## 3. Policy Approaches to Sustainability Collaboration

Environmental sustainability, and to a lesser or more peripheral extent, social sustainability, have attracted extensive regulation and policy activity. Within this activity, collaborative sustainability initiatives along food value chains have come mainly in the form of establishing more common methodologies and metrics around food waste, and Life Cycle Analysis (LCA) of food and drink products, or through encouraging and mobilising Corporate Social Responsibility (CSR) actions. Food value chain sustainability collaborations fall within broader EU policy strategies, for example the Roadmap to a Resource Efficient Europe and its Sustainable Consumption-Production initiatives, the Circular Economy Action Plan, and the more recent Green Deal. These strategies are focused on collaborative processes, such as the EU Food Sustainable Consumption and Production Round Table. A key part of this initial work was to coordinate the methodologies for assessing the life cycle impact of food products in the form of the Envifood protocol. EU Competition Law, with its emphasis upon preventing market collusion to ensure a fair price to the consumer, was identified as inhibiting sustainability collaboration by actors within stages of, and along, the food value chain as a whole. One area for consideration is the revision of EU market competition rules in order to incorporate public interest outcomes, such as sustainability.

### Box 2: What policy and governance gaps do food value chain stakeholders want to see filled?

A survey of policy-facing food value chain stakeholders across selected European countries found support for the policy approaches being taken to fairer trading practices, food integrity (food safety and authenticity), and sustainability collaboration. But the stakeholders also highlighted areas they wanted policy to go further.

On **fairness**, for example, stakeholders identified nationally set Minimum Wage levels and special laws to protect seasonal or other precarious food chain workers as important aspects of supply chain fairness. These are not captured in the Directive on Unfair Trading Practices.

On **food integrity**, addressing food fraud regulation was found to be a bigger concern than food safety, where legislation was broadly seen to be effective.

On **sustainability**, collaboration was seen to be vital if the issues were to be tackled effectively. EU Competition policy was seen as a barrier to progress as it could inhibit sustainably initiatives and collaborations along and within sectors of food value chains identifying them as collusion and so anti-competitive. Voluntary measures (including Corporate Social Responsibility or sustainability practices) were not seen to be very effective, but there was strong support for a combination of ‘hard’ and ‘soft’ approaches (i.e., regulations coupled with voluntary measures such as Codes of Conduct). Linked to this, most respondents agreed that actors were not taking sufficient action to measure environmental performance in their chains, and there was uncertainty over the adequacy of methodologies to measure environmental impacts; retailers, in particular, were unconvinced of this. At the consumer level, there was agreement that ‘Use By’ and ‘Best Before’ dates need to be more understandable to help prevent food waste.

# Cross-cutting Themes: Fairness and Transparency

## Cross-cutting Themes

***Power relationships and their management remain key to achieving better functioning food value chains.***

***While the policy to tackle fairness has focused on eliminating market distorting unfair trading practices in business-to-business relationships, fairness could be enhanced with more explicit recognition of the health and working conditions of the labour force.***

***Increased transparency of the environmental impacts will require a move towards true costing of FVC products.***

**Fairness** is a general principle of EU administrative law, 'connoting the equal treatment of all people or parties, irrespective of differences in status, power or other social, physical or cultural differences'[4]. In terms of fairness, the policy focus regarding food value chains has been to try to eliminate market distorting unfair trading practices in business-to-business (B2B) relationships. However, there are associated regulatory interventions, which are important to the maintenance of fair and effective food value chains, that go beyond B2B relationships, in particular in their embrace of the work conditions and health of the labour force upon which such chains depend. Fairness would be enhanced with a more explicit recognition of how policy ensures fairness along food value chains to include the role of the workforce. The European Pillar of Social Rights spells out key principles, and there are numerous pieces of EU legislation in place. In particular, these laws address those in precarious work, although there are a large number of national derogations. Precarious work is a feature of food value chains, as is work often reliant upon temporary workers from outside of the European Union particularly in terms of seasonal harvesting and packing of crops and fresh produce, and animal slaughter and rendering.

**Transparency** and the monitoring of working conditions and pay levels are becoming increasingly necessary, as abusive working practices and modern slavery practices come under the public and regulatory spotlight, notably in food supply chains. Consequently, national governments are introducing laws to ban and police such practices, including addressing the rights of the temporary work force[5]. At the regional level, there are innovative policies such as a scheme in Emilia-Romagna for quality certification of produce based on sustainability criteria that include health impacts upon agricultural workers through reduced use of pesticides. The scheme makes the health of the agricultural work force more transparent along the value chain to the final consumer[6].

EU policy on food value chain transparency in more recent years has focused upon market transparency, both in terms of making B2B contacts more visible, and monitoring price setting along chains. Earlier, the application of traceability offered a food safety and authenticity related form of transparency, albeit with flaws, as the continued fraudulent activity in food value chains attests.

A developing form of food value chain transparency relates to identifying and measuring the environmental and natural resource impacts of these chains as measured, primarily, through the final product's overall environmental impact through its life cycle, as with the Product Environmental Footprint (PEF) initiative. This form of transparency has not transferred into any market-based system of costing and pricing, yet. However, it has important implications for the sustainability of the EU agri-food sector and ultimately for its resilience in an era of environmental change. The move towards a true costing of food products based upon their impacts will allow for a more sustainable future for European food chains, where the true costs are reflected in the value and pricing of food products.

# Addressing the Policy Gaps: Recommendations

The findings presented above were identified prior to publication of the **Farm to Fork Strategy (F2F**), and some **key policy gaps** identified are now on the agenda of the Strategy. The Strategy aims to build a "*Food chain that works for Consumers, Producers, Climate and the Environment*", supported with legislation for a framework for a sustainable food system [7].

***Fairer trading practices and the labour force***

- The importance of critical staff, such as agri-food workers, to food value chains has been highlighted by the COVID-19 pandemic, leading to a declaration in the F2F Strategy "*to ensure that the key principles enshrined in the European Pillar of Social Rights are respected, especially when it comes to precarious, seasonal and undeclared workers*".

[4] Directorate-General for Internal Policies, Policy Department C: Citizens' Rights and Constitutional Affairs (2015) *The General Principles of EU Administrative Procedural Law* (PE 519.224). http://www.europarl.europa.eu/RegData/etudes/IDAN/2015/519224/IPOL_IDA(2015)519224_EN.pdf
[5] See deliverable 3.2, section 4.3. http://valumics.eu/publications/
[6] See deliverable 3.2, p228. http://valumics.eu/publications/
[7] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system COM/2020/381 final (European Commission, 2020) (p4) (Accessed May 2021)

## Addressing Policy Gaps through the F2F Strategy

***The Covid-19 pandemic has highlighted the importance of critical staff, such as agri-food workers, to food value chains, as recognized in the worker protection aims of the Farm to Fork Strategy, but delivering on the aims will require detailed attention from law-makers.***

***Plans to scale up and strengthen control and enforcement of food fraud will need adequate investment and budgets for national enforcement.***

***Alongside clarifying competition rules, the Strategy proposes a sustainable labelling framework, however sustainability impacts will need to be reflected in the costs of food.***

Workers' social protection, working and housing conditions as well as protection of health and safety are seen as key elements in "*a fair, strong and sustainable food systems*".

- However, the means by which these aims will be delivered, and the numerous national derogations in existing EU "soft law" initiatives, will demand detailed attention from European law-makers. For example, proposed amendments to the CAP, which would make subsidies conditional upon farmers' upholding working and employment standards, termed "social conditionality", are proving to be controversial with farming stakeholders[8].

***Food Integrity***

- On food fraud, the Strategy's aims include scaling up and strengthening "*the powers of control and enforcement authorities"* with stricter *"dissuasive measures",* and better import controls, and to *"examine the possibility to strengthen coordination and investigative capacities of the European Anti-Fraud Office (OLAF*)"[9].
- These measures will still need adequate investment and budgets for national enforcement authorities from member states, as well as careful monitoring from the Commission in order to be successful.

***Sustainability Collaboration***.

- The Commission envisages a clarification of competition rules for collective initiatives that promote sustainability in supply chains[10]. The EU's competition regulatory framework has been argued to constrain private sector capacity to attend to broader societal interests such as sustainability. DG Comp's October 2020 call for contributions on the role of competition policy in supporting the Green New Deal[11], led to over 180 responses from stakeholders, with many cited examples of where competition policy has undermined sustainability in business practices[12].
- Another recent development has been the use of 'comfort letters' to allow for coordination in the pharmaceutical sector during the Covid pandemic, and suggestions it may extend this tool 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[13].
- The F2F Strategy proposes a sustainable labelling framework covering nutritional, climate, environmental and social aspects of food products. In addition, responsibility is put upon the corporate sector to integrate sustainability objectives and to be part of an EU Code of Conduct for Responsible Business and Marketing Practice, accompanied by a monitoring framework.
- The presentation of these sustainability aspects will require a coordinated and transparent approach to their measurement and monitoring; and, still awaits more specific policy proposals for the costing the negative externalities into the pricing of the food and drink products.

[8] https://www.euractiv.com/section/agriculture-food/news/social-conditionality-set-to-be-sticking-point-in-cap-negotiations/?utm_source=EURACTIV&utm_campaign=dfdedbd60d-AgriFood_Brief_COPY_01&utm_medium=email&utm_term=0_c59e2fd7a9-dfdedbd60d-
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[10] Ibid (p12)
[11] https://ec.europa.eu/competition/information/green_deal/call_for_contributions_en.pdf
[12] https://www.lw.com/thoughtLeadership/sustainability-eu-competition-law
[13] Ibid

## Key sources for further information

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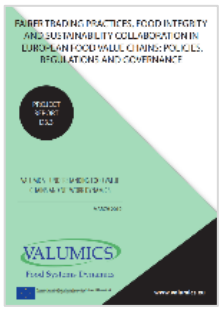
*Reference*:

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Available at: https://valumics.eu/wp-content/uploads/2019/10/D3.3_Project-Report.pdf

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## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

University of Iceland, Dunhagi 5, Reykjavik, Iceland – https://www.valumics.eu

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

VALUMICS
Food Systems Dynamics

Research Findings Brief

July 2021

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 focussing 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.

### 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***

## 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.

***Production cycle of farmed salmon***


### *Feed production for salmon aquaculture*

Feed is the most important input for the salmon industry and dominates the overall environmental impact of salmon aquaculture. Norwegian salmon industry sources feed ingredients from crops and marine systems worldwide. Aquaculture feed currently consists of about 30% marine and 70% terrestrial ingredients. The main components of feed are plant and marine fats, marine and plant protein, starch and some

micronutrients. Our analysis found that Norway imports about 64% of the fish meal and 78% of the fish oil of its total requirement. Domestic production of fish oil and fish meal is from by-products from fisheries and aquaculture slaughterhouses, where the trimmings and by-catch are used. The terrestrial ingredients comprise of about 70% of the total feed of which soy protein is about 37% of the feed. Approximately 19% plant oils like rapeseed and palm oil are used while starch from wheat and peas used as binders for the feed and account to approximately 11%. Micro additives are also added at 3.7% that include pigments, amino acids and palatability ingredients to compensate for insufficiencies or used as enrichment in the feed. These can be terrestrial, aquatic (krill) or synthetic ingredients. Norway produces 97% of its own feed domestically and 94% of the feed is used for salmon aquaculture.

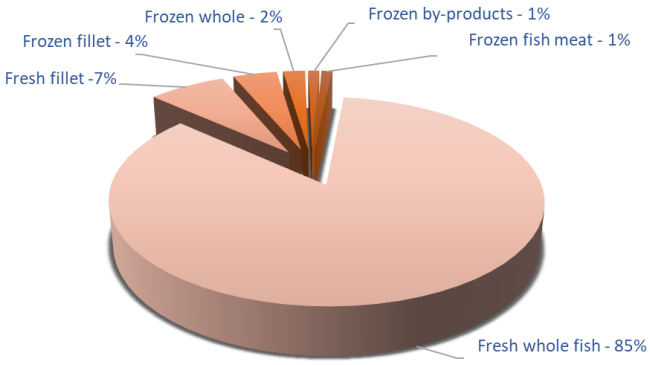
## *Post-harvest flows of salmon*

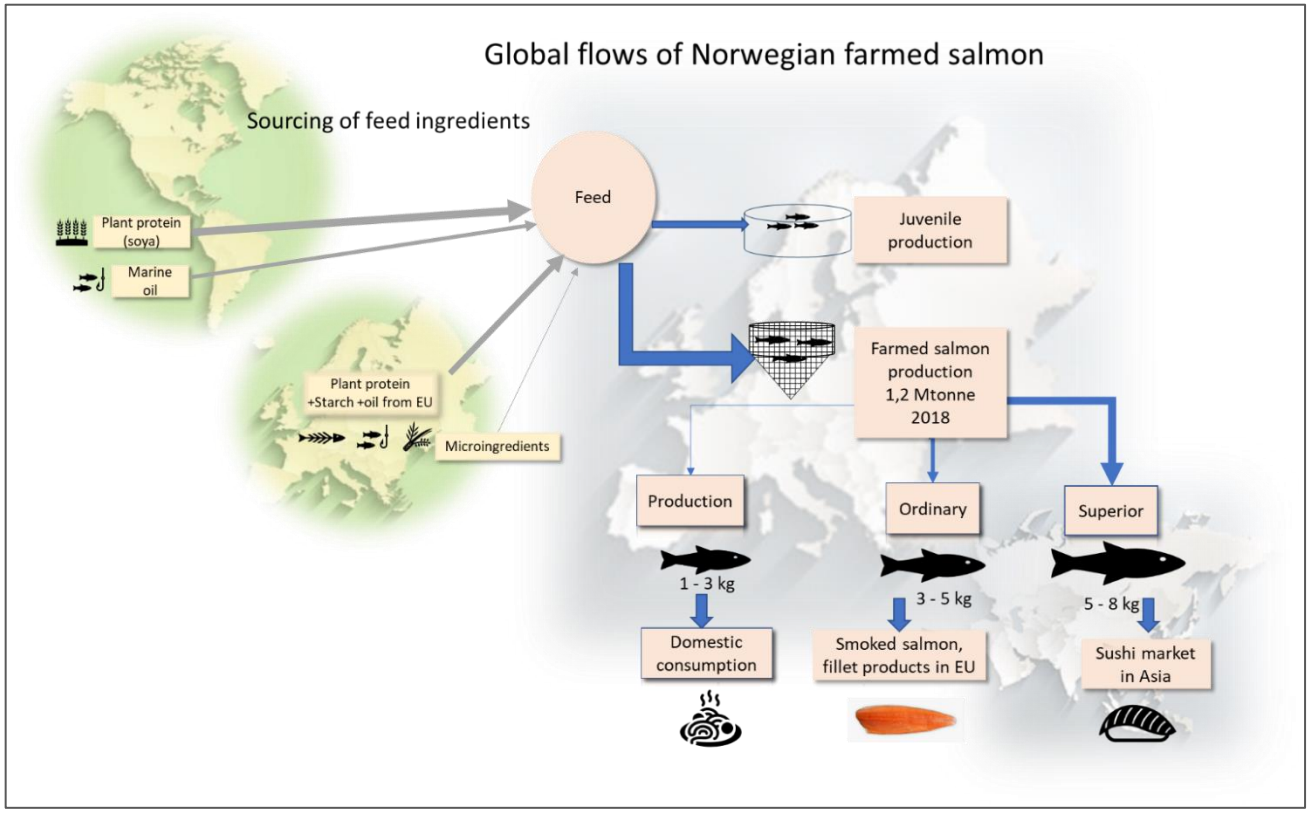
### Norwegian fresh salmon exports

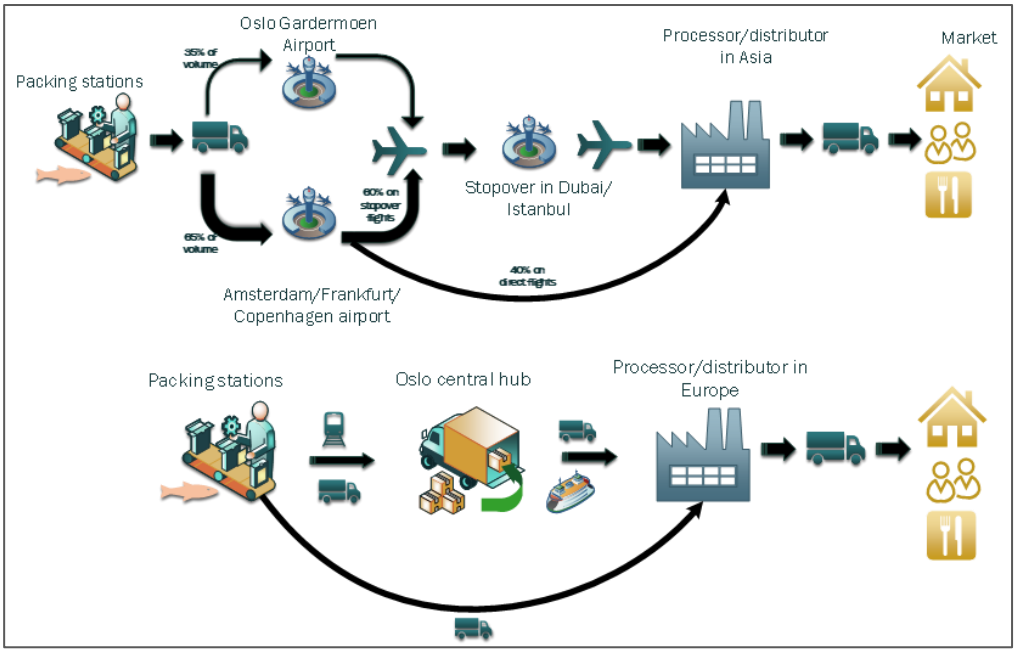
***Majority (85%) of the Norwegian salmon is exported as fresh whole gutted fish.***

***Poland, France and Denmark are the main importers as well as hub-markets that re-export salmon after further processing***

After harvesting, salmon undergoes primary processing consisting of slaughtering, gutting and grading by size and quality into three categories: Superior, Ordinary and Production. A major proportion of fish produced in Norway is of Superior and Ordinary quality which is exported. Most of the superior quality is exported as whole head-on-gutted (HOG) fish while production quality fish is only for domestic consumption due to regulatory reasons. Our analysis shows that of all exports, 85% of the salmon exported was in the form of fresh/chilled HOG fish. The three biggest importers of fresh/chilled whole salmon in 2018 were Poland (16%), France (11%) and Denmark (10%) which are also the major hub markets that re-export salmon after further processing. It is at the hub markets that the secondary processing such as filleting and smoking outside Norway takes place. A small fraction of salmon is also exported frozen whole. The following figures show the global flows of Norwegian salmon and the representative logistics chains with transportation modes for export of salmon from Norway to Continental Europe and from Norway to Asia.



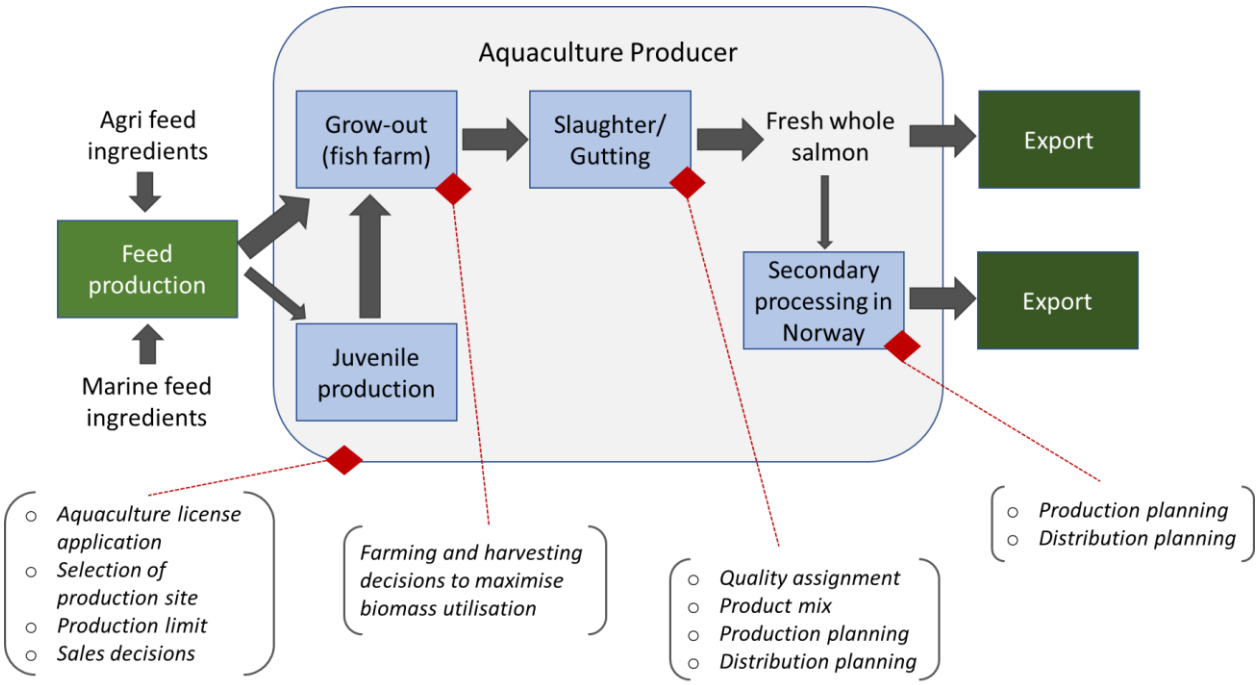



# Decision mechanisms in the salmon value chain

## Production planning

***Production and harvest planning focusses on maximising biomass utilisation while fulfilling sales contracts***

Effective decision mechanisms at various points in the salmon value chain are crucial for optimal production efficiency including harvest planning, production and inventory levels, spot market exposure and sales allocation strategies. Salmon aquaculture is also heavily influenced by political decisions in terms of regulation for location of farm sites and processing plants as well as legislation regarding feed use. Therefore, information sharing and timely availability of high-quality data through vertical coordination in the value chain is essential for reducing uncertainties and improving decision processes. The following figure shows the overview of the salmon value chain including material flows and key decisions taken at different stages of the value chain. Understanding of decision mechanisms in the salmon value chain draws from the work performed in the project including expert interviews, current literature and industry reports and formed an input to the development of functional specifications for the simulation model (see D5.2 for details).



## Information sharing

***Information sharing through strategic collaborations and vertical coordination is crucial for optimal decision making in the salmon value chain***

### *Production plans maximise biomass utilisation*

Once a year the aquaculture producers make decisions about increasing their production because they always want to utilise the maximum allowable biomass (MAB) which is the maximum volume of fish a company can hold at sea at all times. In general, one license is currently set a MAB of 780 tonnes in Norway (945 tonnes in the counties of Troms and Finnmark). In addition, each production site has a MAB between 2340 and 4680 tonnes. The producer will, therefore, check if their current biomass is less than the MAB so there is room to add to production. At the same time, they will change their harvesting schedule including the biomass they just added to the harvesting schedule two years (104 weeks) from the current date.

The optimal harvest weight is between 4 – 5 Kg. However, fish are commonly marketed in the range between 3.5 and 7 kg. Volatile salmon prices make the timing of harvest an important factor for profitability. The aquaculture producer has to decide whether to harvest the fish at a known price or to continue to feed until a later harvest and market a larger fish at an unknown future price. However, delaying harvest comes at a price. The farmer has to pay to keep the fish in the pen, a cost consisting both of extra feed expenses. Slaughter (primary processing) capacity plays a big role in the harvesting plan. The processing plant is always running so it's not a question of whether to harvest or not. It's always the time to harvest - the question is: where is the biomass available to be harvested? In other words, which cage (at which site) should be harvested on a given day?

## Trading and Export

***Salmon production in Norway is export oriented and the value chain is driven by high demand of salmon products***

***Various factors influence the decision making of actors in the trade of salmon products***

### *Factors influencing decision making in trading*

In VALUMICS, factors influencing decision making were mapped to identify suitable indicators to be applicable for simulation modelling with the aim to assess the impact of strategic and operational policies towards fairer food value chains. Following are the key factors, influencing decision making in the context of procedural fairness and the outcome in terms of distributive fairness as it relates to the salmon value chain.

- *Strategic coordination* characterises the governance of the Norwegian salmon value chain. The coordination includes controls of biomass production, collaboration, information sharing and relationship quality which is facilitated by both horisontal and vertical intergration.
- *External factors* influencing decision making are caused by uncertainties in supply and demand because of long production cycles, biological challenges, short shelf life of fresh commodity, price, logistics etc.
- *Power relations* between firms influence decision making capacity and leverage. The salmon producers, in particular large companies have a strong bargaining power against the supermarkets.
- *External constraints* in decision making include regulations on production (licences) and trade barriers, market dynamics, market price and access to market. While demand has been high for a long period, the trade has been favourable for producers. However, the producers are probably price takers in the short term and volatile prices influence profits. Market price is established through supply and demand and salmon is typically traded through free market exchanges. The spot market price is based on information from several links in the value chain, including farmers, exporters and importers. Risk due to volatile prices has been mitigated through flexible contracts between e.g. large integrated companies of producers and supermarket chains or the large value-added processors in Europe.
- *Internal constraints* like financial position, technology, know-how and efficiency are all factors which have impact on decisions of actors in the salmon value chain.

The above factors are all related to procedural fairness. Outcomes are the results of the operational efforts and are realised as distributive fairness e.g. in financial terms (profit) or efficiency, as well as operational outcome reflected in quality, safety, and sustainability[1].

[1] Gudbrandsdottir et al.(2021)

# Concluding remarks

Understanding of product flows, trade structures and decision mechanisms is required for modelling of food value chains and to evaluate the impact of operational and strategic decisions policies on value chain sustainability, resilience and fairness. In the years to come, salmon is expected to be more commonly produced on land and in open sea. Production planning and decision mechanisms in the salmon value chain with these new production technologies are expected to have many similarities with today's practice. However, new mechanisms may come into play, e.g., localisation decisions in relation to consumer markets for land-based production, and more complex logistics planning in offshore aquaculture. Besides this, producers are focusing more on value added products, branding, and differentiating themselves in the market to remain competitive.

## Key sources for further information

To discuss the research presented in this brief, please email maitri.thakur@sintef.no

**Deliverable report citations:**


Thakur, M., Johansen, U., Jafarzadeh, S., Čechura, L., Rumankova, L., Kroupova, Z. Z., Jaghdani, T.J., Loveluck, W., Mehta, S., Aditjandra, P., Gresham, J., Esposito, G., Samoggia, A., Ólafsdóttir, G., Gudbrandsdottir, I., Schan, C. S., Sjøberg, I., Richardsen, R., Haug, K. (2020). **Report on Information and Material Flow Analysis for the selected case studies.** The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. Deliverable: D4.3, SINTEF Ocean, Trondheim, 70 pages. DOI 10.5281/zenodo.5105848 *Contact: maitri.thakur@sintef.no*

Thakur, M., Mehta, S., Sjøberg, I., Ólafsdóttir, G., Erikson, U., Duric, I., Cechura, L., Jaghdani, T.J., Samoggia, A., Riedel, B., Chen, W., Gorton, M., Pang, G., Hubbard, C., Aditjandra, P. (2018). **Report on the integrated event-driven framework for data collection.** The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. Deliverable: D4.1, SINTEF Ocean, Trondheim, 36 pages. DOI 10.5281/zenado.5105767 *Contact: maitri.thakur@sintef.no*

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**Published scientific paper and articles:**


Gudbrandsdottir I.Y., Olafsdottir G., Oddsson G.V, Stefansson H., Bogason S.G. **Operationalization of Interorganizational. Fairness in Food Systems: From a Social Construct to Quantitative Indicators.** Agriculture. 2021; 11(1):36. https://doi.org/10.3390/agriculture11010036

Olafsdottir, G., Mehta, S., Richardsen, R., Cook, D., Gudbrandsdottir, I.Y., Thakur, M., Lane, A. and Bogason S.G. (2019b). **Governance of the farmed salmon Value Chain from Norway to the EU.** Aquaculture Europe 44 (2) 5-19. https://valumics.eu/wp-content/uploads/2019/10/Valumics-AES-vol44-2-sept2019.pdf



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## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

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VALUMICS
Food Systems Dynamics

Research Findings Brief

August 2021

H2020 VALUMICS Project

# 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 environmetnal 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 reseach 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.*

## Importance of the end market

***The impact of a product depends on where it is sold and consumed***

## 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).

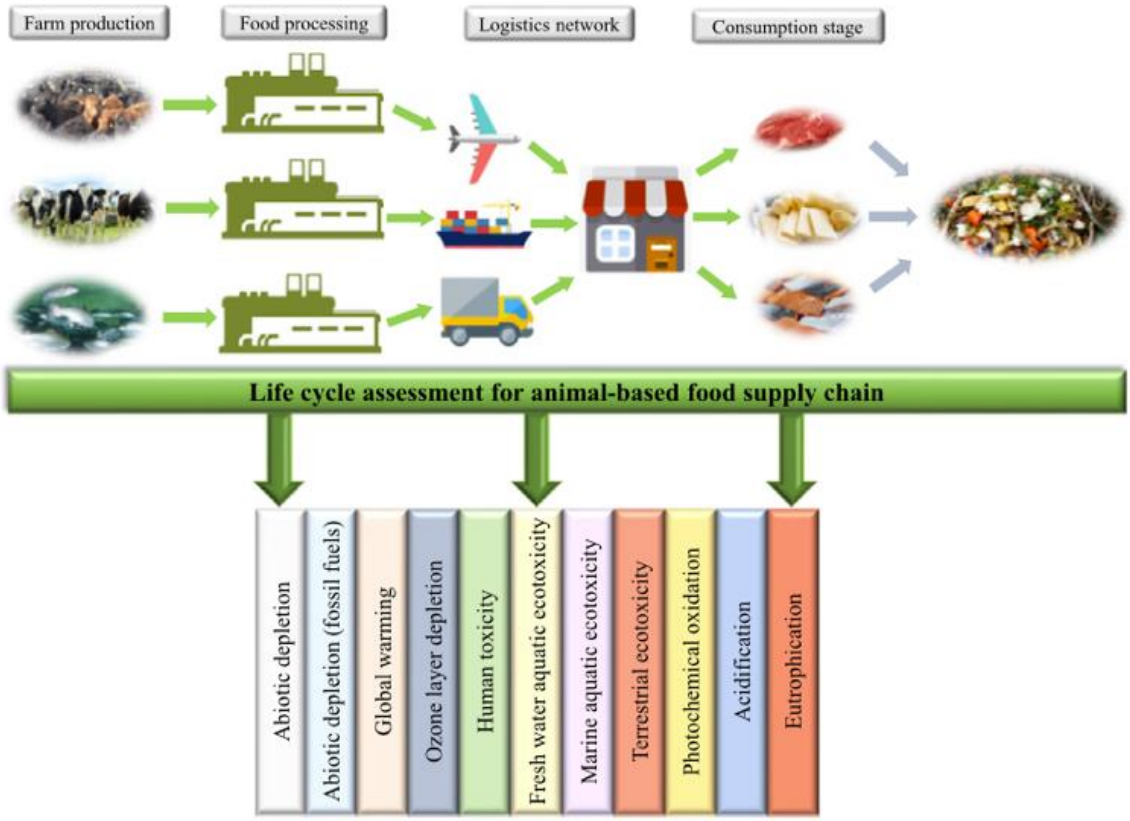


*Figure 1. Schematic of the system model used. Three different markets were used at the consumption stage for each product.*

Most have focused on production (farming) or manufacture (processing). An 'average system' is usually modelled, perhaps focusing on particular farms or factories. Dairy, meat and fish

products produced in Ireland and Norway are typically destined for export, so this research asked the question, does market matter when calculating the eco-efficiency of a food product? Irish butter was chosen because it is a processed consumer product (not an ingredient) with large domestic, European and international markets. Irish beef steak was chosen because it is a premium consumer product with little secondary processing, popular in export markets. Norwegian salmon fillets were chosen because Norway dominates the international market with this lightly processed salmon product. Each product was modelled from production to consumption and waste disposal, assuming three markets: domestic, European and International.

## Markets: where does the food go?

### Market impacts the supply chain

***Market determines how the product is transported and used, including need for airfreight and the amount that is likely to be wasted.***

Based on international trade data and market reports, the most important markets for each product were identified, along with transport requirements for supplying fresh product and likely wastage based on consumer surveys from each country:

**National Markets**

| Irish Butter | Irish Beef Steak | Norwegian Salmon Fillet |
|---|---|---|
| *Ireland* | *Ireland* | *Norway* |
| Truck | Truck | Truck |
| 10% consumption waste | 6% consumption waste | 7% consumption waste |

**European Markets**

| Irish Butter | Irish Beef Steak | Norwegian Salmon Fillet |
|---|---|---|
| *Germany* | *United Kingdom* | *Denmark* |
| Near shore shipping | Near shore shipping | Near shore shipping |
| 8% consumption waste | 6% consumption waste | 7% consumption waste |

**International Markets**

| Irish Butter | Irish Beef Steak | Norwegian Salmon Fillet |
|---|---|---|
| *Japan* | *United States of America* | *China* |
| Airfreighted | Airfreighted | Airfreighted |
| 1% consumption waste | 13% consumption waste | 7% consumption waste |

## Findings

### Impact of food waste reduction

***Reducing the percentage wasted food will drive an important reduction in all impacts.***

Similar patterns were seen for all three food chains. Butter is used here to illustrate some of the key findings (Figure 2).

A. Food waste in the end-market can have a discernable impact. Compare 10% waste in Ireland vs. 1% in Japan. Consumer behavior in the end market matters.

B. Domestic and European markets can effectively be treated as similar. The influence of near short shipping and truck transport is similar.

C. Airfreighting significantly changes the relative contribution of impact. The farm represents around 80% of impact for butter supplied to the domestic market, similar for the European market, but as low as 10% for some impacts for the global market.

## Impact of airfreighting

***Airfreighting fresh product globally drives impact.***

Time critical supply of fresh product by airfreighting has a significant influence on the impact hotspots.

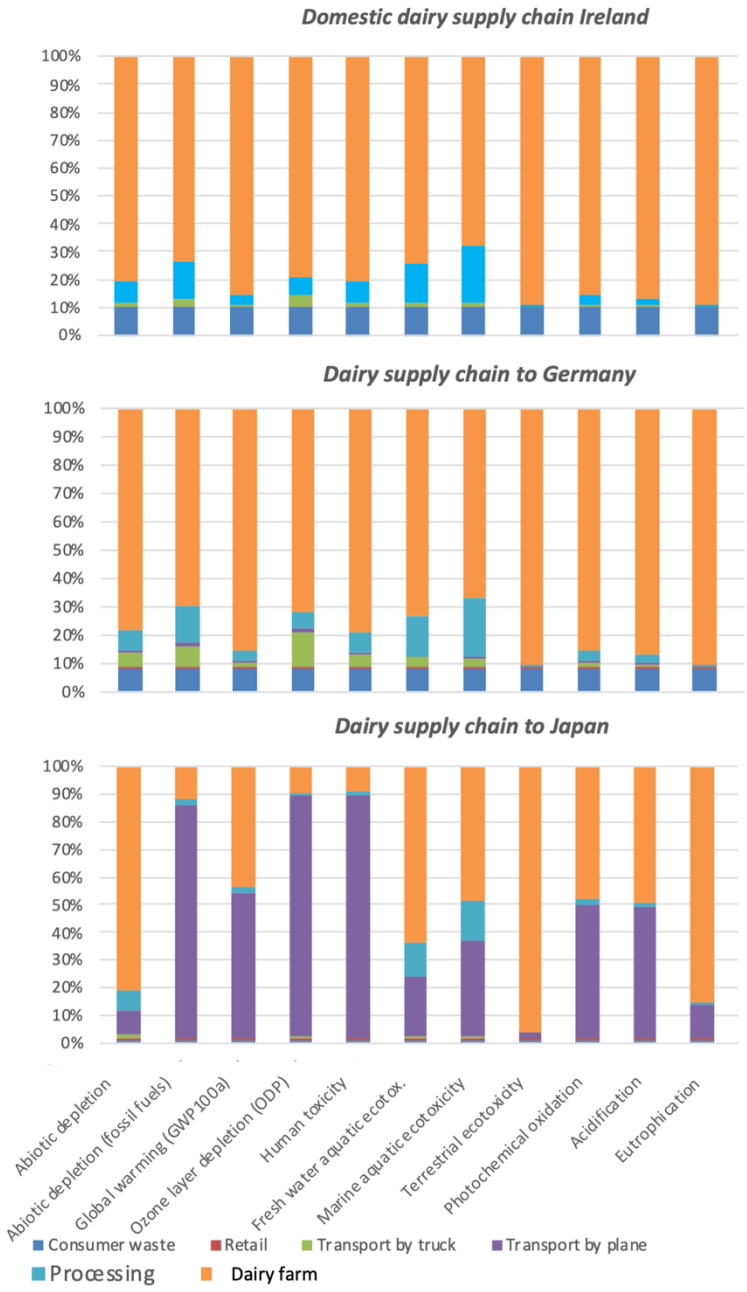


*Figure 2 Change in impact distribution for 11 impact categories for different markets for Irish Butter.*

## Policy needs

***The luxury of serving global markets by airfreighting fresh food needs policy attention.***

***Policy is needed to reduce wasted food.***

# Concluding remarks

The idea of encouraging consumers to buy sustainable, healthy food as part of a sustainable, healthy diet underpins the thinking behind the UN Food Systems Summit and recent research encouraging changes in diets.

Our research makes an important contribution to this discussion that policymakers need to be aware of. Assuming butter, beef steak and salmon fillets have the same impact, regardless of where they are consumed is untenable.

Studies that have focused on production of foods, processing of food and even full system assessment of foods can lead to poor policy if the impact of end market is not recognized. End market causes two important drivers of difference in eco-efficiency: rate of wasted food and type of transport.

The farm remains the greatest impact hotspot, but for some impact categories (e.g., abiotic depletion, ozone layer depletion and human toxicity), airfreighting can become the dominant hotspot.

The type of transport and distance matters for fresh food products. The luxury of being able to serve global markets comes with a high impact cost across almost all impact categories (terrestrial ecotoxicity is the least influenced).

All markets should be introducing policy and incentives to reduce wasted food to the minimum possible. The Japanese market shows that 1% waste is possible. All markets should be aiming for this level of waste in order to reduce the impact of the food system. Valorizing food waste cannot offset the impact of creating it in the first place (Oldfield et al., 2016).

## Key sources for further information

This brief presents results from analysis reported in VALUMICS Deliverable D4.4 and published papers from the VALUMICS partners at University College Dublin, SINTEF Ocean and University of Iceland.

To discuss the research presented in this brief, please email *Nick.Holden@ucd.ie*

**Deliverable report citations:**

Chen, W., Holden N.M., Mehta, S., Thakur, M., Ólafsdóttir, G., Gudbrandsdottir (2020). **Report on LCA and Social-LCA of the selected food products.** The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. **Deliverable: D4.4**, University College Dublin, Ireland, 66 pages. doi.org/10.5281/zenodo.5151582

**Published scientific papers and articles:**

Chen, W., Jafarzadeh, S., Thakur, M., Olafsdottir, G., Mehta, S., Bogason, S., Holden, N.M. (2021). **Environmental impacts of animal-based food supply chains with market characteristics.** *Science of the Total Environment*, 782, 147077. https://doi.org/10.1016/j.scitotenv.2021.147077

Oldfield, T., White. E., Holden, N.M. (2016). **An environmental analysis of options for utilizing wasted food and food residue.** *Journal of Environmental Management*, 183, 826-835. DOI:10.1016/j.jenvman.2016.09.035

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VALUMICS
Food Systems Dynamics

H2020 VALUMICS Project

# Novel Solutions for Food Chain Climate Impact Reduction

**Research Findings Brief**

**August 2021**

*Life Cycle Assessment was used to estimate the change in environmetnal 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?

### Impact hotspots

***The farm, airfreighting fresh products and wasted food are the most important impact hotspots for fresh animal-based food products.***

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 all markets.
- Airfreight in the logistics stage – sustainable aviation fuel. Only relevant to international markets.
- Wasted food at the consumer stage – waste prevention programmes. Common to all markets. This research focused on climate impact only.

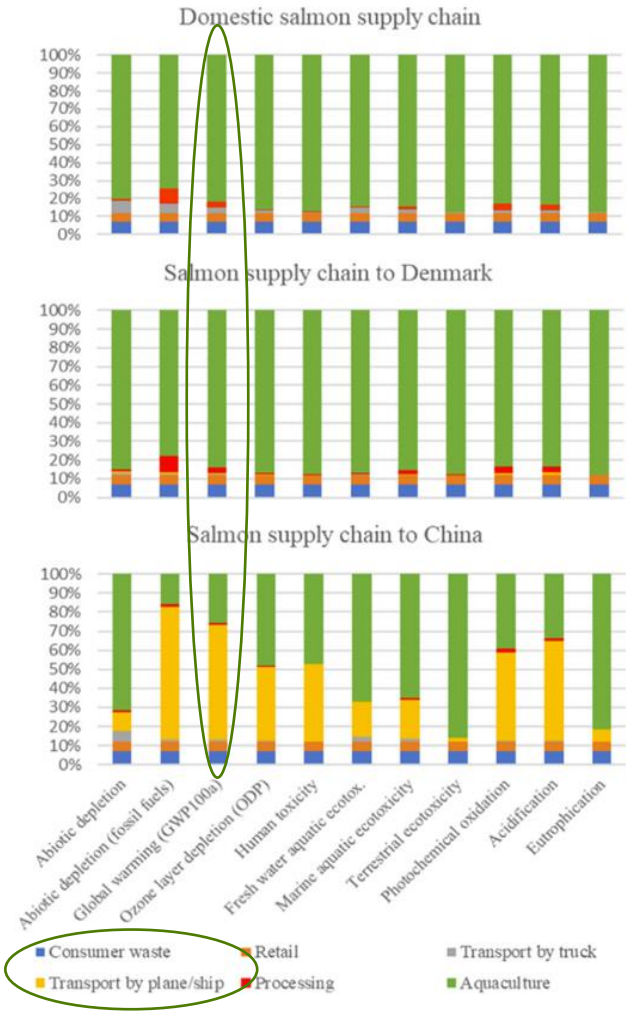


*Figure 1. Relative contribution of hotspots for 11 different environmental impacts by market for Norwegian Salmon*

# What impact reduction was possible?

## Novel feed for cattle and salmon

### Impact of novel feed

***In a whole system context, novel feed could offer a small but consistent climate impact reduction.***

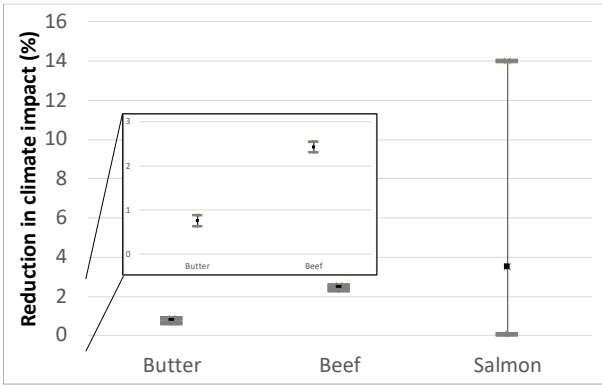


*Figure 2. Climate impact reduction due to novel feed*

*See Figure 2.*

- A greater range on impact reduction was possible for salmon than cattle because feed is a larger hotspot for salmon.
- For cattle the effect is small but certain. For salmon the effect is large but uncertain.
- In most cases, a climate impact reduction of 1% to 2% might be expected.

## Sustainable Aviation Fuel

### Impact of sustainable aviation fuel

***Sustainable aviation fuel offers great potential to allow fresh food to be supplied with lower impact to international markets.***

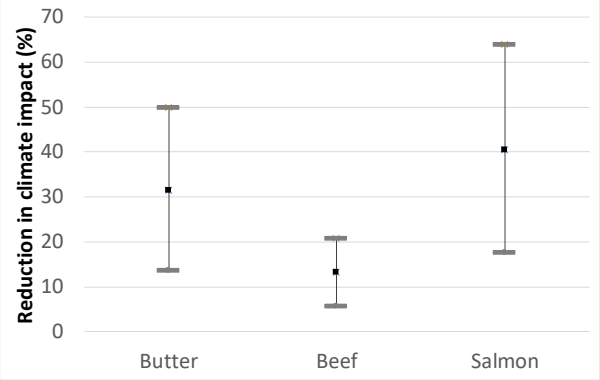


*Figure 3. Climate impact reduction due to using sustainable aviation fuel.*

*See Figure 3.*

- Only relevant for international markets
- Offered the greatest potential for impact reduction of all the interventions evaluated.
- Climate impact reduction of at least 10%, and up to 40% or more might be expected to supply animal-based products to international markets.

## Food waste reduction programme

### Importance of food waste

***Food waste reduction should be a priority in all markets for high impact foods.***


*Figure 4. Climate impact reduction due to wasted food reduction in the end market.*

*See Figure 4.*

- The impact of food waste reduction depends on the baseline wastage in each market.
- Food waste reduction should focus on high impact products (e.g., beef) and in markets with high waste rates (e.g., USA).
- Climate impact reduction of at around 2% (in low waste markets) up to around 15% (in high waste markets) is possible.

# Implications

There are technical solutions, currently available that can address hotspots in animal-based food supply chains. The simplest way of reducing the impact of these food types is to produce and eat less of them. This work looked at the eco-efficiency of animal-based food products, with a particular focus on climate impact. Given current market trends, there are options that could be factored into planning and policy to reduce the climate impact of animal-based food products, particularly those supplied as fresh food to international markets.

## Available technologies can reduce climate impact

***Novel, but currently available technologies could drive at least 15% reduction in climate impact for animal-based foods. Much greater reduction is possible.***

Our research has shown that:

- Novel feed for cattle and salmon can reduce the production (farm) stage impact. Feed is a larger hotspot for salmon, so the benefit is greater for salmon than for cattle, but there is large uncertainty that needs to be better understood.
  - 2% – 4% reduction in climate impact is likely using novel feed.
- Sustainable aviation fuel could be used for airfreighting fresh food products to reduce the climate impact when selling internationally.
  - 20% reduction in climate impact is likely using sustainable aviation fuel.
- Wasted food reduction should always be encouraged, but particularly in markets associated with high rates of waste.
  - 10% reduction in climate impact is likely through wasted food reduction in markets with moderate (ca. 7%) to high (ca. 13%) wasted food.
- Combined there is potential to drive significant reduction in climate impact of animal-based foods using novel technologies.
  - Butter: 15% – 52% reduction is possible.
  - Beef: 21% – 41% reduction is possible.
  - Salmon 32 – 82% reduction is possible.
    (The greater range reflects uncertainty around novel feeds.).

## Key sources for further information

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**Deliverable report citations:**

Chen, W., Holden N.M., Mehta, S., Thakur, M., Ólafsdóttir, G., Gudbrandsdottir (2020). **Report on LCA and Social-LCA of the selected food products.** The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. Deliverable: D4.4, University College Dublin, Ireland, 66 pages. doi.org/10.5281/zenodo.5151582

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## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

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VALUMICS
Food Systems Dynamics

H2020 VALUMICS Project

# The Governance of European Food Value Chains

**Research Findings Brief**
**July 2021**

## Overview

***This brief presents the findings of research exploring governance issues in European food value chains, and their implications for various stages and actors along the chains. The research covered eight case studies***

## Research Methods

***Used existing academic literature and documentary sources available in the public record, and generated new data through qualitative interviewing with key stakeholders in each of the value chains (see Box 2 on stakeholder views)***

## 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 Directive 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 the value of the final product to the different actors along the chain. The differing types of interrelationships have been conceptualised by studies of Global Value Chains. These studies tend to focus on commodities grown in less-developed countries being turned into food 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 Valumics research project focused on the relationships within the more developed countries of the European market. Here, the societal, political and policy contexts and interventions that 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 linked back to earlier work on the project, where policy and governance was explained as an iterative process of negotiation and compromise entailing power relationships between actors, and across governments and public agencies, the private sector and civil society.

## Five food value chains; Eight national case studies

The eight national studies into the governance of five European food value chains were:

- Dairy cows to liquid milk in France, Britain and Germany
- Beef cattle to steak in Britain and Germany
- Farmed Salmon from Norway
- Wheat into bread in France
- Tomato to processed tomatoes in Northern Italy.

## Mapping of Governance

***Each study evaluated the governance of the particular value chain through the different stages of production, processing and retail, following the transformation from farmed/grown commodity to final food product***

## Governance issues explored

- ***Value chain structure and product flow***
- ***Industry structure and concentration***
- ***Contractual arrangements***
- ***Price negotiations***
- ***Trade consumption patterns***
- ***Different EU and state-led regulatory interventions***
- ***Governance initiatives originating from corporate and societal actors.***

### Dairy cows to liquid milk: France, Germany & UK

- On-going decline in number of farms as producers exit sector, alongside increasing herd size and productivity
- Greater concentration of firms along rest of liquid milk chain at processing and retailing stages
- Support available includes Producer Organisations and provision for mandatory contracts (under EU "milk package" of reforms)
- Legal change to framework for setting contracts has been introduced in France, and UK has experimented with voluntary code of best practice on contractual relationships between producers and processors
- POs beginning to negotiate over volume management as well as price in France and Germany
- Stakeholder concerns around setting of prices between the producers as sellers and the processor and or retailer as main buyer, and volumes of milk supply agreed upon
- Small degree of product segmentation and differentiation such as organic produced milk, or pasture-fed livestock

### Beef cattle to steak: Germany & UK

- Highly customized product requiring a great degree of coordination between producer, processor and retailer
- Fragmentation in scale and location of production, compared to levels of concentration in processing and retailing
- Economic margins only positive for top third of beef producers
- Information asymmetries and limited information sharing between all sections of chain, and tensions caused by mistrust
- Time lag between retailers' customer demands for product specifications and cattle breeding cycles
- Efforts to increase transparency along the value chain through technology-applied improvements in traceability, and video identification of quality features of prime cuts and their grading

### Tomato to processed tomatoes: Italy

- Main relationships are between growers, Producer Organisations, Cooperatives, processing companies and retailers
- Localised agri-food system, characterised by geographical proximity, long and consolidated relations between agricultural production and local industry, and a distinctive governance system influencing the economic performance at local level
- Cooperative culture: tomato producers are members of local and/or interregional POs or in cooperatives that produce and process tomatoes
- Union of POs, processing companies, local institutions, and local research centres was set up which subsequently evolved into the Inter-Branch Organization (IBO) (includes POs, processing companies, cooperatives, professional organizations and entrepreneurial associations)
- IBO moderates tensions over pricing outcomes

### Wheat to bread: France

- Consumption of bread in traditional bakeries currently represents around 50% of national bread consumption in France (supported by legislation)
- Key actors are large millers, which are mostly large producer-owned cooperatives and control supply of flour mixes to traditional bakeries, putting bakeries in a relatively captive relationship
- Millers impose standards through flour mixes and so protect and add value to their flour, the process of valorisation
- Milling industry very concentrated and most milling wheat production collected by biggest cooperatives and then processed through their own mills
- Producers are captive suppliers towards cooperatives that control 70% of wheat market (vs wholesalers 30%)
- All value chain actors depend on international market due to: low trade barriers for imported wheat; changing markets with different requirements; saturated domestic market.

## FVC specific features and common themes

***Each food value chain, from beef, to bread, to processed tomato, has its own particular features and characteristics more specific to that sector: there are important structural features in each value chain that set boundaries within which the dynamics of governance take place. There are also common themes across all chains.***

### Farmed Salmon: Norway

- Producer-driven global value chain with demand for the product greater than supply
- Large vertically-integrated aquaculture companies have greater power in chain and strong bargaining position against the supermarkets that are lead buyers
- Traditionally sold as commodity, but producers focusing on developing value-added products, through branding and differentiation
- Structural changes and consolidation of aquaculture companies have reduced number of farming companies and helped companies take advantage of economies of scale and strengthened their position on global markets
- Inter-firm relations of producers and their buyers characterized by free market exchanges where products are sold on spot market, but trend towards long-term contracts between large integrated companies and retail or large secondary processors

## Inter-firm relations as part of governance

***The studies confirmed that the nature of governance in value chains covers inter-firm relations but also includes private governance initiatives and public policy interventions***

# Cross-case study findings on value chain dynamics

The **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 over contracts. In all of the value chains the nature of governance is changing due to the **increasing levels of corporate concentration** at different stages of the chain. The **concentration at the downstream stage of food retailing** means that large multiple supermarkets are key gatekeepers to the majority of consumers in the selected European markets. In the beef, dairy and wheat industries studied, the **processors are undergoing concentration though mergers and acquisitions**, reinforcing their advantages in the buyer-supplier relationship with the producers.

The Norwegian farmed salmon chain sees the **corporate concentration at the producer end** as salmon farms are integrated vertically into large corporations at all stages of the production cycle, and these corporations merge horizontally. This value chain stands out from the others as an example where **market demand for the product is greater than the supply**. However, further growth of production in Norway is compromised by the salmon farms because of biological and environmental challenges. These issues are increasingly subject to **environmental regulations which** threaten to restrict further production growth, reinforcing the social (or societal) conditionality upon production.

## Governance, initiatives and policy interventions

- *Producer Organisations*
- *Cooperatives*
- *Interbranch Organisations*
- *Voluntary code of conduct*
- *Mandatory legislation*
- *Private sustainability standards*
- *Technical standards*
- *National legislation*

### The role of policy

The EU and the national governments have sought to address some of the power imbalances that producers face. The" unfair trading practices" Directive[1], under the lead of DG Agri, is a case in point. In addition, the promotion of **producer organisations** (POs) has been extended into agricultural sectors beyond the "Mediterranean products", to sectors such as Dairy, under the EU's Milk package.

However, the impact of POs in strengthening the position of farmers in value chain bargaining and pricing decisions is not clear, as the studies from French milk and Italian processed tomato show. The findings point to the need for further research on the efficacy of producer organisations in balancing unequal power distribution in specific the value chains[2].

Cooperatives feature in the Italian tomato and the French and German milk sectors. The findings indicate examples where individual producers can feel **constrained by their membership of cooperatives** and lacking individual agency. In the German milk sector producers can find it hard and costly to move from one cooperative to another.

**Interbranch organisations** (IBOs) are another mechanism that exists to bring actors in the value chain together, usually producers and processors, to collaborate over the frameworks for contractual negotiations for the purchase of the raw product. In the processed tomato value chain, producers and processors have the opportunity to express dissatisfaction and settle conflicts within the Northern Italian IBO, thanks to the collaborative culture and setting that it provides.

The UK Government has encouraged **voluntary codes of practice** to try to improve and make more transparent the contract negotiations between processors and producers in the beef and milk sectors. There are concerns with these initiatives to date, as the beef forum lacks the participation of two of the largest processors, while the Government currently favours moving to **mandatory legislation** for the dairy code of practice.

In the case of salmon in Norway, environmental regulations are reinforced by **private standards around sustainability issues** that the industry has introduced, and which are increasingly important for market access through the retailers. The extension of **private standards** can also be seen in retailer-led development groups with their suppliers in the UK dairy-to-milk chain.

There are also **technical standards** that are common in an industry, such as the EuroGrid system for beef, or minimum protein content in harvested wheat grain, that impact upon the value of the food product such as beefsteak or milling wheat for bread flour. Producers voiced concerns regarding the **information asymmetries that exist around technical standards** and their conversion into pricing of the product, where lack of transparency is a cause for complaint, both with a homogenous commodity such as milk as well as a high-value product such as steak.

Of course, the large corporate players also have influence upon policy as with the example of the French millers in lobbying for **national legislation** to protect the traditional bakeries - their captive retail channel.

**Box 2: Stakeholder perspectives on fairness in food value chains**

Fifty stakeholders were consulted across the five value chain case studies. Stakeholders' views on fairness focused on price-setting and the means by which pricing decisions are made. It was notable that the interviewees very rarely mentioned the types of unfair trading practices, as defined and laid out in the Directive on unfair trading practices in the agricultural and food supply chain. Rather, it was the subjective experience of price-setting (and related volume agreements, for example) in their particular value chain and sector where concerns around fairness and transparency were most explicitly articulated. There is subjectivity in the views of stakeholders over issues such as price negotiations that must be considered when assessing fairness in value chains

[1] Directive on unfair trading practices in business-to-business relationships in the agricultural and food supply chain (EU) 2019/633

[2] See also: Fałkowski, J. and Ciaian, P., 2016. Factors supporting the development of producer organizations and their impacts in the light of ongoing changes in food supply chains. *Joint Research Centre Technical Reports*.

## Policy Implications and Recommendations

Industry, and more particularly policy makers, need to find the most appropriate mechanisms and interventions to achieve fairer trading and working conditions in food value chains, that are suitable to each respective agricultural and horticultural sector, as well for the agri-food industry as a whole.

- At both the sector level, and across all food value chains, the important structural features and their impacts on intra-chain bargaining must be taken into account, and interventions to enhance transparency over decision-making and price setting.

  Subjectivity in the views of stakeholders over issues such as price negotiations means that interpreting fairness as an absolute state for a food value chain may not be achievable, not least because it can cover a range of dimensions. Rather, moves towards *greater* fairness and transparency may be more practical and measurable moving forward; that is, towards *fairer* value chain

## Key sources for further information

This brief presents results from the VALUMICS Deliverable 5.1 and was compiled Kelly Parsons and David Barling from the University of Hertfordshire. For further information on the research presented in this brief, please email: d.barling@herts.ac.uk

*Reference*:
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*The chapters in Deliverable 5.1 were contributed by following authors at different VALUMICS partners organisations*:

*Chapter 1 GOVERNANCE IN EUROPEAN FOOD VALUE CHAINS by David Barling & Jennifer Gresham, University of Hertfordshire (UH)*
*Chapter 2 GOVERNANCE OF UK DAIRY COW TO LIQUID MILK VALUE CHAIN by Jennifer Gresham & David Barling, University of Hertfordshire (UH)*
*Chapter 3 GOVERNANCE OF GERMAN DAIRY TO LIQUID MILK VALUE CHAIN by Ivan Duric, The Leibniz Institute of Agricultural Development in Transition Economies (IAMO) Contact: duric@iamo.de*
*Chapter 4 GOVERNANCE OF FRENCH DAIRY TO LIQUID MILK VALUE CHAIN by William Loveluck & Pierre-Marie Aubert, The Institute for Sustainable Development and International Relations (IDDRI) Contact: pierremarie.aubert@iddri.org*
*Chapter 5 GOVERNANCE OF UK CATTLE TO BEEF STEAK VALUE CHAIN by Jennifer Gresham & David Barling, University of Hertfordshire (UH)*
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# Norwegian salmon value chain: how does it influence the EU markets?

**Research Findings Brief**

**August 2021**

## 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 salmon aquaculture value chain. The scope of the analysis includes farming and primary processing in Norway and export to EU markets for further processing into consumer products and distribution***

## Hybrid governance

***Third-party assessment and certification schemes enable new governance forms on top of the traditional model based on state-only regulations***

## 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) [1].

Atlantic salmon is the most consumed farmed fish species in the EU[2]. 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 implementing new technologies to ensure cost-efficient production.

## Governance of the Norwegian salmon value chain

*Governance analysis was applied as 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 Norwegian salmon value chain.*

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 (Olafsdottir et al., 2019a, Deliverable 5.1 Ch7). 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[3]. 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

[1] Iversen, A., Asche, F., Hermansen, Ø., and Nystøyl, R. (2020). Production cost and competitiveness in major salmon farming countries 2003–2018. Aquaculture, Vol. 522. https://doi.org/10.1016/j.aquaculture.2020.735089
[2] EUMOFA (2017 and 2020). Monthly highlights /The EU Fish Market. Source: https://www.eumofa.eu
[3] Vince, J., Haward, M. (2017). Hybrid governance of aquaculture: Opportunities and challenges. Journal of Environmental Management, Vol. 201: 138-144.

of innovation and industrial development, the success of salmon farming in Norway is based on close cooperation between industry actors, governmental bodies and research institutes.

## Challenges

***Main economic challenges for the salmon producers are mortality and additional costs for preventive measures, mitigation of salmon lice, diseases, algal blooms, and escapees***

Key uncertainties within the salmon farming industry relate to biomass development (growth and long production cycles), influenced by environmental, biological and political factors. The environmental challenges are reflected in the regulatory framework focused on aquaculture licenses, based on maximum allowable biomass and monitoring system to ensure sustainable growth. Companies address the biological challenges through the uptake of standards such as Aquaculture Stewardship Council and maintaining their reputation through corporate social responsibility initiatives. Political decisions heavily influence salmon aquaculture by regulating the location of farm sites and slaughter plants and their social impacts on communities. Limited availability of new licenses for salmon farming in Norway motivates Norwegian companies to operate and expand salmon production in other salmon producing countries (e.g., Chile, Scotland, US, Canada, and Iceland) ensuring continued growth and stable supplies of Atlantic salmon to markets.

The majority of farmed salmon in Norway is produced by large companies. Among them, MOWI is the largest Norwegian salmon producer dominating the global production of salmon with its 20% market share worldwide[4]. Norwegian salmon is mainly exported as a commodity and sold to the highest bidder on weekly spot markets. However, long-term contractual supplier-customer relationships also exist between the large aquaculture-producing companies and secondary processors and retailers in Europe.

## Seller-driven chain

***The value chain is driven by salmon producers who are in a favorable position while demand exceeds supply. Secondary producers and traders may suffer when spot price is high***

Some large integrated enterprises like MOWI strategically govern all steps in the value chain from feed provision, production, processing to final products. Furthermore, the expansion of Norwegian companies in other salmon producing countries where natural conditions are favorable, may further influence the power imbalance within the salmon value chain. The value chain is seller driven by the producers with strong bargaining power against the retailers who in turn maintain a lead position in accessing the consumers. Even though there are no barriers to entry in trade activities, prevailing price volatility may discourage new entrants as it constrains the margins of secondary producers and traders. Furthermore, against the backdrop of strong bargaining position of producers, the allegations that the Norwegian companies influence high spot price were investigated within the scope of unfair practices[5]. According to the interviewed stakeholders, however, such behavior was unlikely because they consider that single companies are not able to influence salmon prices in the long run (Olafsdottir et al., 2019a, b).

# Market competitiveness, efficiency and technical change in the Norwegian salmon industry

*The analysis of competitiveness, efficiency and technical change are tools to provide an in-depth understanding of the underlying factors driving the competitive advantage of salmon value chain actors in Norway.*

## Market power

***Reduction in price markup is assigned to the increased cost of salmon production rather than to the decrease in price of salmon***

The VALUMICS study on the "Assessment of price formation and market power along the food chains" (Svanidze et al., 2020) investigates market power of Norwegian salmon producers and finds that the so-called Lerner index[6] decreased after 2015 for the Norwegian salmon market. This reduction in market power could be assigned to the higher cost of salmon production rather

[4] MOWI (2020). Salmon Farming Industry Handbook. https://mowi.com/it/wp-content/uploads/sites/16/2020/06/Mowi-Salmon-Farming-Industry-Handbook-2020.pdf

[5] SeafoodSource (2019). More lawsuits filed as EC remains silent on Norwegian salmon price-fixing allegations. https://www.seafoodsource.com/news/business-finance/more-lawsuits-filed-as-ec-remains-silent-on-norwegian-salmon-price-fixing

[6] Lerner index is an estimated measure of a firm's output market power (the ability to charge markups of price over marginal costs), ranging from a low value of 0 (representing perfect competition where price is equal to marginal costs) to high value of 1 (representing monopoly).

## Producers' financial performance

***Certain degree of price markup over marginal costs is expected for the Norwegian salmon market due to the market and firm structure***

## Productivity growth

***Productivity might be increased by improvements in the efficiency of input use and technological progress. This especially holds for small and medium-sized producers***

## Scale efficiency

***Whereas large producers operate with optimal size of operations, small and medium-sized producers may increase their productivity by increasing their scales of operations***

than the decrease in firms' revenues[7,8]. The findings indicate that the Russian import ban imposed in August 2014 had a negligible effect on trade quantities since Norwegian companies could easily switch to other markets[9]. Subsequent to this, the devaluation of the Norwegian Krone and losses of biomass caused by outbreak of diseases, induced an increase in the price of salmon that should have naturally led to the increase of margin for producers. However, we rather observe the opposite effect, after 2015, suggesting that the increase in the production and processing costs was disproportionally higher compared to the increase in the salmon price. Therefore, there is room for further improvement with the future development of cost-efficient technologies that can effectively fight diseases and reduce production costs. However, this may again increase the Lerner index to pre-2015 levels.

Moreover, the limited number of production licenses in the hand of few larger actors may impede the exploitation of economies of scale and, therefore, increase the degree of market imperfections. To summarize, it is less likely that the salmon industry in Norway will ever be free from market imperfections (in terms of price markup); however, this can be mitigated in the Norwegian salmon industry by addressing those factors discussed above.

Another component of the study on scale/size efficiency investigates whether a firm operates at its "optimal size" (Čechura et al., 2020 Deliverable 5.6). The results indicate that Norwegian salmon producers operate on average almost with an optimal scale of operations. However, taking a closer look, the results suggest that the optimal size is a characteristic of the large producers only. Small and medium-sized enterprises operating with increasing returns to scale have a substantial potential to improve their productivity and profitability by increasing the scale of operations, however, licenses for increasing scale are limited in Norway. Assessing the efficiency of input use, the findings show that a considerable room for improvement exists with the potential of reducing costs further by 16% without any negative consequence for the level of production output. In addition, identified substantial systematic failures in the efficiency of input use might be caused by operational management issues and occurrence of biological hazards causing high mortality.

Furthermore, analyzing the developments in technical change (i.e., a change in the amount of output produced from the same amount of inputs), the technical regress (e.g. lack of technological progress), was identified as the predominant feature of large producers. However, the pace of technical regress was gradually decaying and turned to technical progress by 2017. This reversal indicates that the salmon producers have invested in new technologies to decrease production costs. On the contrary, small and medium-sized producers show strong positive technical change from 2014, suggesting that they have invested heavily to stay competitive on the market (Čechura et al., 2020).

# Salmon trade duration

*Trade duration analysis is a tool to assess the length of trade relationships, i.e. the speed with which firms enter and exit the salmon market and the risk associated with this activity. The trade survival rate indicates how likely the company's export activities survive over time with the same trading partner (e.g. importing company).*

The results of the VALUMICS study (Jaghdani et al., 2020, Deliverable 5.3) show that the survival rate between the Norwegian salmon exporters and main global importers is rather low. In particular, for most of the firms, the likelihood that the trade in salmon survives after two years is about 28%, and after five years is about 12%. This rate is slightly different between EU and Non-EU countries after five years which largely vanishes in the long run. Most trade relations die out after two-three years on average, independent of the importers' origin (EU–

[7] EYGM (2019). The Norwegian Aquaculture Analysis. https://assets.ey.com/content/dam/ey-sites/ey-com/no_no/topics/fiskeri-og-sj%C3%B8mat/norwegian-aquaculture-analysis_2019.pdf

[8] KONTALI (2019). The salmon farming industry in Norway 2019. Kristiansund, Norway. Retrieved from www.kontali.no

[9] Russia accounted for just 10% of the Norwegian salmon export according to "Russia's trade ban": https://www.seafoodsource.com/features/norway-s-seafood-exports-unscathed-by-russia-s-trade-ban

## Trade relationships

***The salmon supply chain does not depend on stable trading partners, but rather limited production and large demand are pushing Norwegian salmon export forward***

## Price formation

***The value chain governance structure defines which actor dominates price formation (retailers in France and processors in Poland)***

## Export price

***Salmon export price in Norway directly influences prices along the EU salmon value chain***

## Market integration

***Strong market integration implies that any changes in export price will influence prices along the EU salmon value chain.***

non-EU). As the trade partners are changing fast, at the same time overall trade quantity increases, this indicates that entry and exit in trade partnership are not very costly. Decomposing the results by type of exporting firm, after three years of trade, the rate of trade survival is higher for salmon wholesale and processing firms compared to the primary producers. This difference further widens as the duration of continuous trade increases. Furthermore, countries trading larger amounts of salmon are more often expected to stay longer in a trade partnership. To summarize, these results show that the salmon value chain does not depend on stable trading partners, but rather limited production and large demand globally are pushing Norwegian salmon export forward as the producers are able to easily sell salmon on export markets.

# Price dependencies between the European and Norwegian salmon markets

*The price transmission analysis is a tool to assess the level of market integration between exporting and importing markets. Furthermore, this tool helps understand to which extent price changes from Norway are passed through to the relevant markets and along the salmon value chain.*

Salmon markets in Norway, France, and Poland have particular importance for the global salmon value chains. Norway is the largest salmon-producing country, and Poland and France, besides being the primary hub markets for processed salmon, are the largest importing countries of Norwegian salmon. The organization of salmon market structures greatly differ between France and Poland. In particular, Norwegian enterprises directly own secondary processing plants in Poland, whereas in France, large retailers have a strong position and hold long-term contracts with Norwegian salmon producers.

Exploring the salmon price relationships between the export market in Norway and the wholesale and retail markets in France and Poland (Figure 1), Svanidze et al. (2021; 2020 Deliverable 5.5) find that the salmon export price in Norway influences price formation along the French and Polish salmon value chains. However, the opposite is not observed, emphasizing the high importance of price developments on the Norwegian salmon export market for the determination of prices in downstream markets in salmon importing/processing countries.

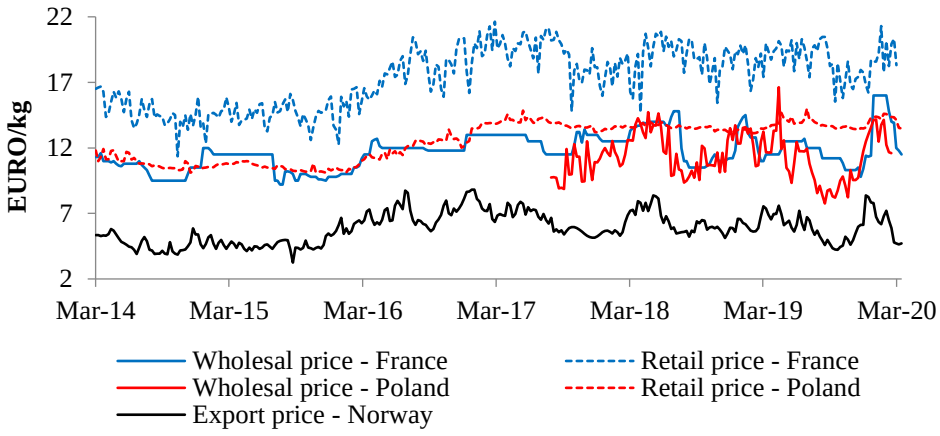


*Figure 1. Salmon prices in France, Poland, and Norway. Source: EUMOFA (2020), FranceAgriMer (2020)[10].*

More specifically, for the whole head-on-gutted (HOG) salmon, the domestic wholesale market in France and Poland absorbs on average 89% and 83% of the export price changes, respectively. In contrast, for the salmon fillet—a product with a higher degree of processing—

[10] FranceAgriMer (2020). Data base available at: https://www.franceagrimer.fr/

## Lead actors

***Retail sector in France and the secondary processing sector in Poland dominate the salmon trade business, reflected in the strong integration of these markets with the salmon export market in Norway***

price linkages are much weaker in both countries, with on average 55% and 75% of the export price changes being transmitted to the wholesale price of the salmon fillet in France and Poland, respectively.

Within the domestic salmon value chain, the French retail sector dominates price formation on the salmon fillet market. In contrast, in Poland, where the culture of salmon consumption is not as established as in France [11,12], the retail market does not play a role in determining the salmon fillet price on the domestic market. In particular, it is disintegrated with the wholesale market, which is exclusively focused on the re-export of the processed salmon.

Moreover, the retail price of salmon in France and the wholesale price of salmon in Poland demonstrate higher responsiveness to price information derived from the export market in Norway. In France (Poland), the retail (wholesale) price adjusts five times quicker to changes in the export price of Norwegian salmon compared to the wholesale (retail) price.

# Concluding remarks

Hybrid governance characterises the global Norwegian salmon value chain. Large integrated enterprises and their strategic development, including third party auditing and certification, has created a strong bargaining power against the supermarket chains who are the lead companies providing access to market.

At the producer level, technical improvements mainly driven by investments, are a considerable source of productivity growth especially in small and medium-sized producers. However, there is considerable room for further improvements in the efficiency of input use.

Furthermore, the analysis of the duration of the salmon trade suggests that the Norwegian salmon exporters do not sustain long-term contractual relationships with import markets. This could also signal low costs of entry and exit to a market due to the high demand which results in sellers' market of the commodity for the producers in the salmon value chain.

The main impact of the Norwegian salmon value chain on the European market is through the transmission of price shocks studied on the example of two major EU markets, France and Poland. Since the wholesale and retail markets in France and Poland are strongly integrated with the salmon export market in Norway, this also implies that Norwegian exporters' supply shocks and market environment will influence prices along the EU salmon value chain. Nevertheless, the magnitude of market response greatly depends on national value chain governance structures.

## Key Outcome of economic and governance analysis of the Norwegian salmon value chain and EU market

- ***Producer driven global value chain***
- ***Hybrid governance***
- ***Trading partners easily switched***
- ***Efficiency comes from scale***
- ***Productivity driven by technical efficiency***
- ***Export price in Norway influences price along the value chain***

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## Key sources for further information

This brief highlights results from the VALUMICS salmon case study analysis as reported in the deliverables and publications listed below To discuss the research presented in this brief, please contact respective authors:

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**Deliverable reports:**

Olafsdottir, G., Mehta, S., Richardsen, R., Cook, D., Gudbrandsdottir I. Y. Thakur, M., Lane, A. and Bogason S. G (2019) Governance of the farmed salmon value chain from Norway, Chapter 7. *In* Barling, D. and Gresham, J. (Eds.) (2019) **Governance in European Food Value Chains**. VALUMICS "Understanding Food Value Chains and Network Dynamics", funded by European Union's Horizon 2020 research and innovation programme GA No 727243. **Deliverable: D5.1**, University of Hertfordshire, UK, 237p. https://doi.org/10.5281/zenodo.4956324

Jaghdani T. J., Johansen, U., Thakur, M., Đurić, I. (2020). **Assessment of persistence of business/ trade relationships along the selected food chains of different European countries and sectors**. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. **Deliverable: D5.3**, Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Germany, 43 pages. https://doi.org/10.5281/zenodo.5161193

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Čechura, L., Žáková Kroupová, Z., Rumánková, L., Jaghdani, T.J., Samoggia, A., Thakur, M. (2020). **Assessment of Economies of scale and technical change along the food chain**. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243**. Deliverable: D5.6**, Czech University of Life Sciences, Prague, 169 pages. https://doi.org/10.5281/zenodo.5161347

**Published proceedings and articles:**

Jaghdani, T.J., Čechura, L., Ólafsdóttir, G., & Thakur, M. (2020). Market power in Norwegian Salmon Industry. des Landbaues e.V. (Society for Economic and Social Sciences of Agriculture) (GEWISOLA), September 23-25, Halle, Germany. https://doi.org/10.22004/ag.econ.305590

Olafsdottir, G., Mehta, S., Richardsen, R., Cook, D., Gudbrandsdottir, I.Y., Thakur, M., Lane, A. and Bogason S.G. (2019b). Governance of the farmed salmon Value Chain from Norway to the EU. Aquaculture Europe 44 (2): 5-19. https://valumics.eu/wp-content/uploads/2019/10/Valumics-AES-vol44-2-sept2019.pdf

Svanidze, M., Ólafsdóttir, G., Duric, I., and Thakur, M. (2021). Price Transmission along the Salmon Value Chain in France and Poland. Paper presented at the XVI EAAE Congress, July 20-23, Prague, Czech Republic.

*Disclaimer:*

*This brief and report reflect only the authors' view and the EU Funding Agency is not responsible for any use that may be made of the information it contains*

## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

Coordinating partner: University of Iceland, Dunhagi 5, Reykjavik, Iceland – https://www.valumics.eu

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VALUMICS
Food Systems Dynamics

H2020 VALUMICS Project

# Market orientation: Dairy value chain in Germany, France and UK

**Research Findings Brief**
**September 2021**

## 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 dairy value chain in Germany, France and the UK.***

## Producer Organizations

***Producer cooperatives and organizations dominate organizational structure on the upstream level of the EU dairy value chains.***

## The EU dairy sector

The EU dairy sector is one of the largest agricultural sectors accounting for more than 12% of the total agricultural output[1]. All EU states produce raw milk, but significant variations in delivered quantity and structure of producing farms are present (Figure 1). This sector is characterized by reducing number of producing farms from one side and increasing number in dairy herd size on the other. This is especially the case for the largest EU producers such as Germany, UK and France (Barling and Gresham, 2019). Most of the produced fresh milk is directly delivered to dairies and is further processed to some of the products such as cheese (37.7%), butter (29.4%), cream (11.9%), drinking milk (11%), and other products (10%) [2].

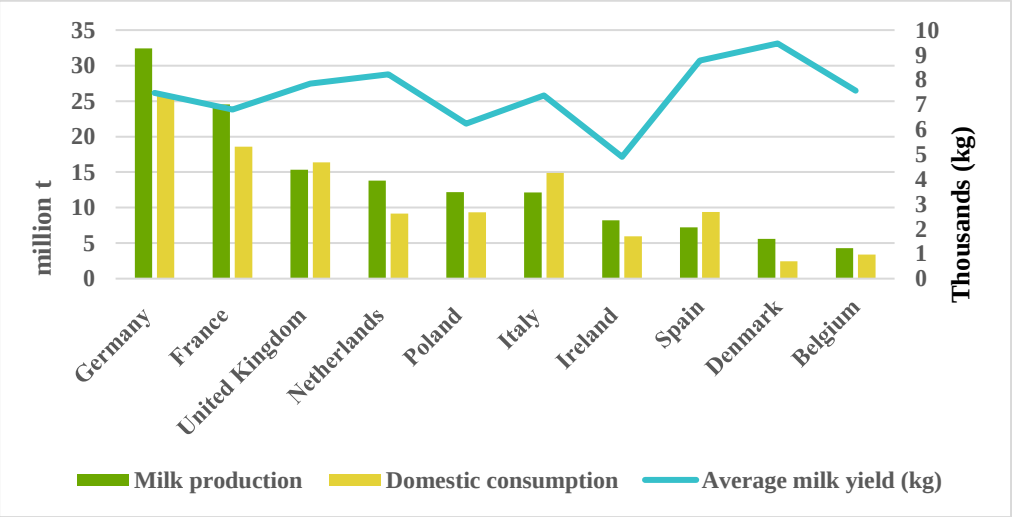


*Figure 1 Top 10 milk producers in EU-28 (2019)* Source: CLAL.it (2020)[3].

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 regulations of the Common Market Organization[1]. It should be noted that large cooperatives may hinder the position of milk producers that are in conflict with contradictory interests. As

[1] Augère-Granier, M-L. (2018). The EU dairy sector – Main features, challenges and prospects. European Parliamentary Research Service – EPRS, PE 630.345, December 2018. Source: https://www.europarl.europa.eu/RegData/etudes/BRIE/2018/630345/EPRS_BRI(2018)630345_EN.pdf
[2] EUROSTAT (2018). Milk products. Source: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Milk_products_2018data-01.jpg
[3] Clal.it (2020). Dairy market data available at: https://www.clal.it/en/?section=produzioni_popolazione

milk producers, they want to sell milk for higher price. On the other side, milk producers that are shareholders of a cooperative aim to keep low costs by reducing milk purchase price[4].

# Value chain governance

*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 dairy value chains.*

## Governance model

***Dual governance model present in all three countries. Captive model dominates on the upstream level and modular downstream.***

Concerning the relations along the value chain, several governance models are present and might reflect power relations and price-setting among value chain actors. According to the VALUMICS results related to value chain governance (Barling and Gresham, 2019, Deliverable 5.1), producers and processors usually have a dual pricing system. A higher price would be achieved if the pre-contracted volume is delivered, and a lower price would be paid if pre-contracted volumes are exceeded (e.g. in France and UK). Furthermore, the duration of the contracts between producers and processors significantly vary depending on the number of regional suppliers. If supply is limited, processors tend to provide longer contracts to producers and vice versa (e.g., Germany). Information asymmetries related to delivered milk quality is another factor that might bring some additional price-setting power in the hands of processors.

In France, milk production is highly concentrated and in the hands of a couple of companies and cooperatives that account for 94% of the total milk production. On the processing level, concentration is even higher where only two actors, Lactalis (company) and Sodiaal (cooperative), account for 20% of the total collected milk in France. Smaller private dairies usually pay higher prices compared to large cooperatives. On the other side, large cooperatives justify lower purchase prices because they need to collect milk from remote producers, thus having higher costs. Overall, according to VALUMICS findings (Loveluck and Aubert, 2019)[5], the governance of the French liquid milk value chain could be described as "bipolar", as both dairy processors and retailers usually drive it.

## Concentration

***Number of milk producers are decreasing while number of dairy cows per farm is increasing both in UK and Germany.***

***About 65% of the produced milk is delivered directly to private dairies and 35% to cooperatives.***

Concerning Germany, there are mainly two types of milk producers: small family-run farms mainly situated in the north and south of Germany and large producer cooperatives mainly concentrated on the eastern part of Germany. About 96% of milk is delivered directly to dairies. After 2015 and abolishing the milk quota in the EU, the number of milk producers significantly decreased (about 47% from 200 compared to 2016 – Duric, 2019[6]). Nevertheless, the number of dairy cows and milk production per cow has been continuously increasing since 2015. Overall, according to the VALUMICS findings (Duric, 2019)[6], the German liquid milk value chain governance consists of two parallel models: i) Captive model between dairy cooperatives and liquid milk producers, and ii) modular between retailers and dairy cooperatives and private processors.

Similar to Germany, the number of milk producers in the UK is decreasing while at the same time the number of dairy cows per farm is increasing. About 65% of the produced milk is delivered directly to private dairies and 35% to cooperatives. According to AHDB (2017)[7], the top nine dairies collect almost 80% of all available milk for processing. The three biggest cooperatives account for 35% of the total drinking milk output. Abolishment of milk quota in 2015 was followed by a significant increase in milk price volatility. Overall, according to VALUMICS findings (Barling and Gresham, 2019), depending on if the milk producers are aligned with retailers or not, there are two types of governance: i) captive model for non-retail-aligned producers and ii) modular or relational model for retail-aligned producers.

[4] European Milk Board (2012). Co-operatives Between Myth and Reality – What dairy co-operatives can do to strengthen the milk producers' position in the market and what they cannot do. European Milk Board, May 2012. Available at: http://www.europeanmilkboard.org/fileadmin/Dokumente/Positions_EMB/12-02_Positions/Cooperatives.pdf
[5] Loveluck, W. and Aubert, P.M., Chapter 4 "Governance of French dairy to liquid milk value chain", in Barling and Gresham (2019)
[6] Duric, I., Chapter 3 "Governance of German dairy to liquid milk value chain", in Barling and Gresham (2019)
[7] AHDB (2020). The Agriculture and Horticulture Development Board (UK). Available at: https://ahdb.org.uk/

# Pricing mechanisms

*The price transmission analysis is a tool to assess the level of transmission of price shocks between different levels of the value chain.*

The analysis for all three countries indicates that average raw milk prices are at the level of the EU-28 price average for the observed period (2005-2020). Compared to Germany and France, the UK raw milk prices are slightly lower on average and are among the lowest prices in the EU-23.

## Price formation

***Raw milk price changes are completely transmitted to consumer-ready dairy products in the long run.***

Concerning possible price margins obtained on the upstream level of the value chain, there are different patterns in price margin development observed between raw milk prices and wholesale prices of different dairy products in all three countries. In Germany and the UK, the price margin between raw milk prices and wholesale Skim Milk Powder (SMP) and cheese prices has constantly decreased in the last 15 years. Only in France, this price margin is on a constant level during the observed period.

The price transmission analysis indicates almost complete transmission of price changes from raw milk prices towards wholesale butter and cheese prices in Germany and the UK in the long run. On the other side, the results indicate almost complete transmission of price changes from SMP prices towards raw milk prices in Germany. In France, the transmission of price changes is way lower (only about 23% compared to 80-85% in Germany and UK, respectively). When it comes to short-run price dynamics, the results indicate faster adjustments of SMP prices towards the price disequilibrium than prices of butter and raw milk in France and the UK. In contrast, the wholesale cheese prices in Germany adjust much faster in the short run compared to butter and raw milk prices.

## Dominant marketing channel

***More than 80% of dairy products are sold through retailers.***

The domination of retailers characterizes the downstream level of the dairy value chain in all three countries as the primary marketing channel for selling dairy products (e.g., 87% of dairy products is sold through retailers in Germany). As liquid milk (fresh milk) has a very short shelf-life, retailers always keep milk prices on a very low level, putting significant pressure on processors price margins.

# Market competitiveness, efficiency and technical change in the dairy value chain

*The analysis of competitiveness, efficiency and technical change are tools to provide an in-depth understanding of the underlying factors driving the competitive advantage of German, French and UK dairy value chains.*

## Market power

***Considerable high mark downs are observed in German and French milk processing as compared to the UK.***

The VALUMICS study on the "Assessment of price formation and market power along the food chains" (Svanidze et al., 2020) investigates market power for the German, French and UK milk processing industries. The values of Lerner[8] indices suggest that the input market of the milk processing industry is characterized by a considerable high degree of market imperfections in Germany and France. On the other hand, the UK input market indicates a low degree of market imperfections. The opposite patterns can be observed for the output processing market. That is, a low degree of market imperfections is exercised in the German and French output market, and a higher degree of market imperfections is indicated on the UK output market, evaluated on the sample means. Moreover, the distributions of Lerner indices are relatively narrow and skewed toward smaller values in all countries, suggesting that only a small number of companies in all countries are characterized by a considerable high degree of non-competitive behavior on input and/or output processing market. Finally, we cannot observe a positive association between the

[8] Lerner index is an estimated measure of a firm's output (and analogically for input) market power (the ability to charge markups (markdowns) of price over marginal costs), ranging from a low value of 0 (representing perfect competition where price is equal to marginal costs) to high value of 1 (representing monopoly).

size and the Lerner indices in the majority of cases. The only exception is the French output market. In this case, the larger is the processing company, the higher is the Lerner index. The observed high values of Lerner indices for small processors indicate the operation in the niche market.

Another component of the study on scale/size efficiency investigates whether a firm operates at its "optimal size" (Čechura et al., 2020 Deliverable 5.6) (the study included the countries in VALUMICS consortium: Austria, Belgium, Czechia, Germany, Finland, France, Italy, Ireland, Romania, Spain, Sweden, the United Kingdom). The analysis revealed considerable heterogeneity in farm production structure and production technology. We found considerable diseconomies of scale that differ among the countries substantially. These findings suggest a significant space for productivity growth by increasing scale efficiency, i.e. the scale of farm operations. On the other hand, we found a technological regress in milk production in most of the countries. Then, milk production is characterized by high overall technical efficiency. In addition, the efficiency distribution is narrow and skewed to higher values, suggesting that most producers operate near the production frontier. The persistent part of overall technical efficiency shows little room for improvements up to 10% suggesting that we cannot observe considerable systematic failures in the efficiency of input use in most of the analyzed countries. Finally, total factor productivity shows an increasing trend in most countries. Two main drivers with opposite patterns were identified – technological change and scale efficiency. Since the technological change was predominantly negative, the scale component was the main source of productivity growth in milk production. In particular, the farms improved the scale efficiency by increasing the scale of operations. This finding supports the expectation that milk quota abolishment has led to farm size adjustments in the direction of optimal size.

### Scale efficiency

***Scale efficiency provides considerable space for productivity improvements in milk production.***
***Milk processing indicates optimal size of operations.***

### Technical efficiency

***High overall technical efficiency in milk production and processing.***
***Majority of milk producers and processors operates near to the production frontier.***

### Productivity growth

***Size adjustments in the direction of optimal size were the main source of productivity growth in milk production in the analyzed period.***

Milk processing is characterized by constant returns to scale; that is, the milk processors are scale efficient and produce in optimal size of operations. The overall technical efficiency is high for all analyzed countries, with only little room for efficiency improvements. Moreover, the efficiency distributions suggest that majority of milk processors are operating close to the production frontier. Finally, the results indicate technological progress in the majority of analyzed countries. That is, we may observe technological improvements in the analyzed period in the milk processing industry.

## Trade duration of selected dairy products

*Trade duration analysis is a tool to assess the length of trade relationships, i.e. the speed with which firms enter and exit dairy-product trade and the risk associated with this activity. The trade survival rate indicates how likely the export activities survive over time with the same trading partner (e.g. importing countries in this case).*

The results of the VALUMICS study (Jaghdani et al., 2020, Deliverable 5.3) show that for the period 2001-2019, Germany, France and UK are active producers and exporters of dairy products at the global market. However, considering the annual average of the size of milk production for the periods 2008-2019, Germany by 30 MT, France by 24 MT and UK by 14 MT are active producers in this market. They have a consistent level of production for that period. All 3 countries have a stable level of export of raw milk which mainly goes to EU countries. Germany exports 8% of its fresh milk products, France 5% and UK 5%. The production and export of cheese as the main non-fresh milk dairy product has a different pattern compared to milk production and export. For the period 2008-2019, Germany, by producing 2.17 MT, France by 1.92 MT and UK by 0.4 MT are active cheese producers. Their cheese export is almost consistent for the same period. Germany exports 52% of its fresh milk products, France 34% and the UK 34%. All these countries also important vast amount of cheese which is due to love of variety in this products. The main export of milk and cheese are to EU countries.

### Trade duration

***Stable and long-term raw milk and cheese trade with EU partners compared to non-EU.***

The results of the duration study on the country level aggregated milk and cheese export shows a stable milk and cheese trade relation at the country level. The aggregate of all trade relations for milk export shows that survival rate after two years is about 56%, after five years is about 44%, after ten years is about 38% and after eighteen years is about 35%. The trade duration of milk for France is more stable than Germany and more stable than the UK. In all cases, the trade

relationship with EU countries is more stable than non-EU countries. The same pattern on trade duration is observed by cheese export. However, the cheese trade is more stable. The aggregate of all trade relations for chasse export shows that survival rate after two years is about 62%, after five years is about 52%, after ten years is about 46% and after eighteen years is about 43.6%. Our study shows that as the size of milk and cheese trade increases, the possibility of trade duration also increases. As more spells are observed between partners, the possibility of trade termination is higher. To summarize, these results show that the milk and cheese value chain does depend on stable trading partners at the country level.

# Concluding remarks

This research aims at getting an in-depth understanding of price dynamics and market imperfections for the three largest milk producers in the EU. Thus, the analysis considers dairy value chains in Germany, France and the UK. Understanding developments in these markets would greatly reflect the EU dairy sector in general.

The results indicate that milk producers face a negative price/cost ratio, in the long run, suggesting that they don't have strong bargaining power towards processors. One of the reasons might be that producers could act as shareholders of the cooperatives. They can be involved in milk processing and thus have completely different incentives for the purchased milk price level.

Concerning price dynamics along the value chain, the results indicate that changes in raw milk producer prices are almost completely transmitted towards wholesale butter and cheese prices. The short-run price dynamics show that raw milk prices are faster in adjusting the disequilibrium with the SMP prices than other dairy products.

The results of market imperfection analysis indicate a certain level of bargaining power at different levels of the dairy value chains in all three countries, especially between producers and processor.

Furthermore, the results indicate diseconomies of scale for most countries in milk production, suggesting considerable space for farm productivity growth. Moreover, scale efficiency improvements were identified as the main source of productivity growth in most countries in the analyzed period. This is in line with the expectation that milk market deregulation has been supposed to positively affect the farm size adjuments in the direction of optimal production size. On the other hand, the milk processors operate in optimal size. The overall efficiency in milk production as well as milk processing is high and do not provide considerable space for productivity improvements. Technological change was the main source of productivity improvements in milk processing. The milk and cheese trade duration analysis suggests that France, Germany, and UK exports are long-term and stable, especially with EU partners. This is mainly due to the perishability nature of dairy products and barrier-free trade possibilities inside the EU.

## Key Outcome of economic and governance analysis of the dairy value chains in Germany, France and the UK

- ***Milk producers don't have a strong bargaining power towards processors (there is a long-term negative price/cost ratio);***
- ***Dual pricing system between raw milk producers and processors;***
- ***Raw milk price changes are completely transmitted to consumer-ready dairy products in the long run;***
- ***Adjustments in the scale of operations provide considerable space for productivity improvements in milk production despite the fact that the size adjustments in the direction of optimal size were the main source of productivity growth in milk production after milk quota deregulation/abolishment;***
- ***The majority of milk producers and processors operate near the production frontier;***
- ***Technological change was the source of productivity improvements in milk processing;***
- ***Stable long-term trade with EU partners compared to non-EU (no intra-EU trade barriers and perishability of the end product play a crucial role).***

## Key sources for further information

This brief summarises results form the VALUMICS dairy case study on economic and governance analysis as reported in the deliverables listed below.

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- Czech University of Life Sciences Prague, *Contact*: Lukas Čechura, *cechura@pef.czu.cz*

**Deliverable reports:**

Barling, D., & Gresham, J. (Eds.) (2019). *Governance in European Food Value Chains. European Union's Horizon 2020 research and innovation programme GA No 727243. Deliverable: D5.1.* https://doi.org/10.5281/zenodo.4956324

Čechura, L., Žáková Kroupová, Z., Rumánková, L., Jaghdani, T.J., Samoggia, A., Thakur, M. (2020). **Assessment of Economics of scale and technical change along the food chain**. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243**. Deliverable: D5.6**, Czech University of Life Sciences, Prague, 169 pages. DOI https://doi.org/10.5281/zenodo.5161347

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**Published scientific papers:**

Čechura, L.; Žáková Kroupová, Z. Technical Efficiency in the European Dairy Industry: Can We Observe Systematic Failures in the Efficiency of Input Use? Sustainability **2021**, 13, 1830. https://doi.org/10.3390/su13041830

Čechura, L.; Žáková Kroupová, Z.; Benešová, I. Productivity and Efficiency in European Milk Production: Can We Observe the Effects of Abolishing Milk Quotas? *Agriculture* **2021**, *11*, 835. https://doi.org/10.3390/agriculture11090835

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# Market orientation: Wheat-to-bread supply chain in France and UK

**Research Findings Brief**
**September 2021**

## 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 wheat-to-bread value chain in France and the UK.***

## Global wheat price

***France (Euronext) is a "price leader" on the global wheat market.***

## Value chain governance

***Higher concentrations of value chain actors in UK compared to France.***

## Global wheat market dynamics

The global wheat export has grown significantly in the last two decades, reaching 203 million t (MT) 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 35% of the global wheat export growth. In contrast, the position of France and the USA in the physical trade of wheat globally has weakened over the last decade, as French and USA wheat exporters now need to compete with the Black Sea exporters that are serving the import markets at lower costs.

Despite the growing importance of the countries from the Black Sea region, wheat prices in France and the USA are benchmark world wheat prices as these countries are the most important wheat markets for trading wheat futures (Svanidze & Đurić, 2021). Thus, wheat futures determined on Euronext (France) or Chicago Board of Trade (CBOT)[1] are transmitted to other large wheat exporting markets such as Argentina, Australia, Canada, Kazakhstan, Russia, and Ukraine. The French Euronext futures market gained its importance as a global benchmark, especially after 2015 when the USA prices started following price developments on the Euronext (Ahmed, 2021)[2].

France is one of 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 downstream sector. This is especially the case for integrating large millers and industrial bakeries (Loveluck & Aubert, 2019)[3].

## Value chain governance

*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, which was 17% less than the five-year average previously due to rainfall shortages. The UK harvests less wheat than France (13.5 MT in 2019), but more wheat is milled into flour. In 2019,

[1] Also Kansas City Board of Trade (KCBT) and Minneapolis Grain Exchange (MGEX) play and important role for price formation in the USA.

[2] Ahmed, O. Assessing the current situation on the world wheat market leadership: Using the semi-parametric approach. Mathematics **2021**, 9, 115.

[3] Loveluck, W., and Aubert, P-M. (2019). Governance of French dairy to liquid milk value chain. Chapter 3 in David Barling and Jennifer Gresham (Eds.) (2019) Governance in European Food Value chains. VALUMICS "Understanding Food Value Chains and Network Dynamics", funded by European Union's Horizon 2020 research and innovation programme GA No 727243. Deliverable: D5.1, University of Hertfordshire, UK, 237p.

384 mills were controlled by 330 enterprises in France. The available data shows that approximately 5 MT of wheat are processed on French milling sites annually, which is mainly turned into 4 MT of flour for artisanal or industrial baking.´Furthermore, four enterprises with 32 milling units processed 50% of in-demand flour in 2019. According to the available statistics for 2019, approximately 2.5 MT of flour was used for baking purposes in France, with 56% used by traditional bakeries and artisanal pastry makers, 35% by industrial bakeries and pastry makers, and 9% by supermarkets.

In the UK, approximately 6.2 MT is used by the flour milling industry to produce 5 MT of flour. In 2018, 30 industrial enterprises were operating 51 mills. The four largest enterprises accounted for approximately 65% of UK flour production. In contrast to France, approximately 80–85% of the bread consumption in the UK is from industrial sources. The UK baking sector can be broken down into industrial plant bakeries, in-store bakeries, and craft bakeries, with 15% of flour consumed by non-industrial bakeries. This structure shows that the wheat-to-bread supply chain is more concentrated by considering the number of actors and their size of activities in the UK than France (Čechura and Jaghdani, 2021).

# Market competitiveness, efficiency and technical change in the wheat-to-bread value chain

*The analysis of competitiveness, efficiency and technical change are tools to provide an in-depth understanding of the underlying factors driving the competitive advantage of wheat-to-bread value chain actors in selected EU countries.*

The VALUMICS study on the "Assessment of price formation and market power along the food chains" (Svanidze et al., 2020) investigates market power for the milling and bakery industry in the UK and France. As far as the milling industry is concerned, both countries indicate a certain level of market imperfections. However, for France, a higher level of imperfections is evident. This might be a result of the value chain governance. Whereas milling enterprises trade directly with farmers in France, the value chain in the UK is characterized by more merchants and few milling sites.

## Market power

***Market imperfections are more pronounced on input market in milling industry. Small millers and bakers operate in niche markets to get higher mark up/down.***

Moreover, we can observe the highest values of market power indices in France. Then, comparing the input and output milling market, the output market shows low market imperfections in France. Only a little evidence for bargaining power can be found in the UK. This might be because more suppliers are available in France as compared to the UK. The analysis also revealed the differences in bargaining power for different size groups of millers. In particular, a certain level of bargaining power can be observed even with small and medium milling enterprises in both France and the UK. This might be the evidence that especially small companies concentrate the activities in niche markets.

The baking industry shows lower market imperfections in the input and output market for both France and the UK. In the UK, both the milling and baking industries are characterized by high concentrations. However, the bargaining power of the bakery industry in the UK with their flour suppliers is higher than the upstream millers' market power. Then, the output market is affected by the power of retailers and market demand. Additionally, industrial bakeries compete with rivals and artisan bakeries. As in the milling industry, smaller bakeries at the industry level show relatively high values of Lerner[4] index in both countries, indicating the operation in niche markets (Čechura & Jaghdani, 2021).

## Scale efficiency

***Scale efficiency provides considerable space for productivity improvements in cereal production. Milling and bakery industry indicate optimal size of operations.***

Another component of the study on scale/size efficiency investigates whether a firm operates at its "optimal size" (Čechura et al., 2020 Deliverable 5.6) (the study included the countries in VALUMICS consortium: Austria, Belgium, Czechia, Germany, Finland, France, Italy, Ireland, Romania, Spain, Sweden, the UK). The analysis finds an indication of diseconomies of scale for the majority of countries in cereal production. In particular, the results show increasing returns to scale, suggesting that farmers have a substantial potential to improve their

[4] Lerner index is an estimated measure of a firm's output market power (the ability to charge markups of price over marginal costs), ranging from a low value of 0 (representing perfect competition where price is equal to marginal costs) to high value of 1 (representing monopoly).

productivity by increasing the scale of operations. On the other hand, the food processing industry (milling and bakery) is characterized by constant returns to scale; that is, the food processors are scale efficient and produce in optimal size of operations.

The overall efficiency is high in agriculture as well as in food processing. This indicates that inputs are efficiently exploited. However, significant differences among the countries in the efficiency of inputs use were revealed. On average, 75% of farms can reduce costs up to 17% and 75% of processors up to 10% when operating on the technological frontier. Finally, the results foreshadow a potential gain of productivity by positive technological change (technological improvements), especially in bakeries, where the magnitude of technological progress is more pronounced than agriculture and milling industry.

### Technical efficiency

***High overall technical efficiency in agriculture as well as milling and bakery industries.***

## Wheat trade duration

*Trade duration analysis is a tool to assess the length of trade relationships, i.e. the speed with which firms/partners/countries enter and exit wheat trade and the risk associated with this activity. The trade survival rate indicates how likely the export activities survive over time with the same trading partner.*

### Trade duration

***France has a long-term wheat trade relationship only with the EU partners as there are no intra-EU trade barriers compared to non-EU trade.***

The results of the VALUMICS study (Jaghdani et al., 2020, Deliverable 5.3) show that for the period 2001-2018, France has produced on average 36,6 MT of wheat and exported 17.3 MT annually. The level of production and export varies during this period. Still, in 2002, 35.2% of the produced wheat was exported which is the minimum. In 2016, 62.7% of the produced wheat was exported, which is the maximum for the period. The eight leading importers of the French wheat are Algeria, Belgium, Netherlands, Morocco, Italy, Spain, Egypt and Portugal. These eight countries account for 67.8% (minimum) to 81.3% (maximum) of total wheat export in this period. Algeria is the main importer of French wheat. The survival rate between the French wheat export and the main global importers is rather high. In particular, for most firms, the likelihood that the wheat trade survives after two years is about 45%, after five years is about 32%, after ten years is about 26%, and after eighteen years is about 20%. This rate is clearly different between EU and Non-EU countries after the first year. About 75% of trade relations with non-EU partners die out after seventh years on average. The same rate is less than 45% for EU countries. Our study shows that as the size of trade increases, the possibility of trade duration also increases. As more spells is observed between partners, the possibilities of trade termination are higher. These results show that the wheat value chain does depend on stable trading partners at the country level specially with the EU partners.

## Concluding remarks

### Global wheat price

***The analysis confirms that, when it comes to global wheat price formation, the French market (i.e. Euronext commodity exchange) is the leading wheat market transmitting price signals to other exporting markets in Russia, Ukraine, Canada, the USA and Argentina***

The results of the analysis of market power along the French and UK wheat-to-bread value chains indicate a certain degree of market imperfections for milling and bakery industries in both countries. Higher market imbalances are identified for the French milling industry compared to the UK case. Similar results are obtained for the baking industry in both countries. The results indicate diseconomies of scale for most countries in cereal production, suggesting considerable space for farm productivity improvements by increasing the scale of operations. On the other hand, the food processors (milling and bakery) produce in optimal size of operations. The overall efficiency is high in cereal production as well as in the milling and bakery industry. On average, 75% of farms can reduce costs up to 17%. Furthermore, about 75% of processors can reduce their costs up to 10% when operating on the technological frontier. Technological change as another driver of productivity growth was pronounced, especially in the bakery industry.

The wheat trade duration analysis indicates that the lack of intra-EU trade barriers significantly contributes to the persistence of the long-term trade relations between France and other EU countries. Although France exports more wheat out of the EU, trade relations with non-EU partners are more unstable and last much shorter compared to the EU partners.

# Key Outcome of economic and governance analysis of the wheat-to-bread value chains in France and UK

- ***France pays an important role in setting the global wheat reference price;***
- ***UK has higher concentration of actors along the wheat-to-bread value chain compared to France;***
- ***Market imperfections are mainly present in milling industries (on input markets);***
- ***Small millers and bakers operate in niche markets to obtain higher markup;***
- ***Adjustments in the scale of operations provide considerable space for productivity improvements in cereal production;***
- ***Milling and baking industries indicate optimal size of operations and high overall technical efficiency;***
- ***France has more persistent trade relations with EU partners compared to non-EU (lack of intra-EU trade barriers plays the crucial role).***

## Key sources for further information

This brief summarises results form the VALUMICS wheat-to-bread case study on economic and governance analysis as reported in the deliverables listed below.

To discuss the research presented in this brief, please contact duric@iamo.de or respective authors:

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- Czech University of Life Sciences, *Contact*: Lukas Čechura, cechura@pef.czu.cz


**Deliverable reports:**


Čechura, L., Žáková Kroupová, Z., Rumánková, L., Jaghdani, T.J., Samoggia, A., Thakur, M. (2020). Assessment of Economics of scale and technical change along the food chain. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. Deliverable: D5.6, Czech University of Life Sciences, Prague, 169 pages. DOI https://doi.org/10.5281/zenodo.5161347

Jaghdani, T. J., Johansen, U., Thakur, M., and Đurić, I. (2020). **Persistence of supply chain relations**. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. **Deliverable: D5.3**, Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Germany, 114 pages. DOI https://doi.org/10.5281/zenodo.5161193

Pierre-Marie Aubert and William Loveluck (2019) Governance of French Wheat to Bread Value Chain, Chapter 9. *In*: Barling, D. and Gresham, J. (Eds.) (2019) **Governance in European Food Value Chains**. VALUMICS "Understanding Food Value Chains and Network Dynamics", funded by European Union's Horizon 2020 research and innovation programme GA No 727243. **Deliverable: D5.1**, University of Hertfordshire, UK, 237p. https://doi.org/10.5281/zenodo.4956324

Svanidze, M., Čechura L., Đurić, I., Jaghdani, T. J., Olafsdottir, G., Thakur, M., Samoggia, A., Esposito,G., and Del Prete, M. (2020). **Assessment of price formation and market power along the food chains**. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. **Deliverable: D5.5**, Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Germany, 114 pages. DOI https://doi.org/10.5281/zenodo.5161247


**Published scientific papers:**


Čechura, L.; Jaghdani, T.J.; Market Imperfections within the European Wheat Value Chain: The Case of France and the United Kingdom. Agriculture 2021, 11, 838. https://doi.org/10.3390/agriculture11090838

Svanidze, M., Đurić, I. (2021). Global Wheat Market Dynamics: What is the Role of the EU and the Black Sea Wheat Exporters? *Agriculture*, 11(8), 799. https://doi.org/10.3390/agriculture11080799


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## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

Coordinating partner: University of Iceland, Dunhagi 5, Reykjavik, Iceland – https://www.valumics.eu


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VALUMICS
Food Systems Dynamics

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

**Research Findings Brief**
**August 2021**

## 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[1]. 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 (*passata*), pulp/chopped tomato (*polpa*), tomato paste (*concentrato*), and whole tomato (*pelati*). Regarding the production method, 90% of tomato cultivation is conventional, 10% is organic production (IBO, 2020)[2].

## Governance of the north Italian processed tomato 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 north Italian processed tomato value chain.*

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"

[1] ANICAV (2018, 22 October). Pomodoro: ANICAV "Campagna 2018: annata negative per l'industria di trasformazione con calo delle produzioni e incremento dei costi industriali ("*2018 campaign: negative year for the processing industry with a decrease in production and an increase in industrial costs*"). Retrieved from http://www.anicav.it/news/2018/10/22/491
[2] Interbranch Organization North Italy Processing Tomato (IBO) (2017, 18 July). Report Conclusivo Campagna 2017, Parma.

model best describes the current governance form of the north Italian value chain (Samoggia et al., 2019a, Deliverable 5.1 Ch8).

## Dual-level governance

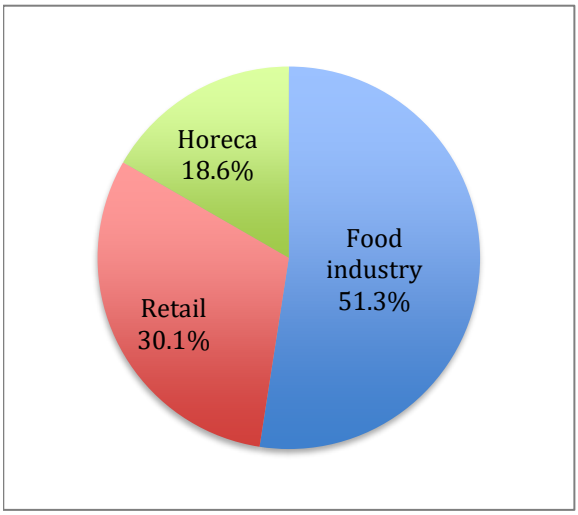
***Strong connection of producers and processors through IBOs. Retailers are becoming lead firms in relations to processors.***

At the first level, the governance relationship between tomato producers and processors is defined as relational, because the dependence between producers and processors is mutual. Both actors of the value chain are connected through the regional Inter-Branch Organization (IBO). The power inside the IBO North Italy Processing Tomato in terms of votes is equally distributed between producers and processors. Processed tomato is produced on a contractual basis. Tomato production and commercial relationships within the IBO North Italy Processing Tomato are regulated by general rules of a Framework Contract and specific contractual conditions set in detailed supply contracts. The framework contract regulates in detail production and delivery of produced tomatoes in the area of IBO North Italy processing tomato (programming of production, quality and safety characteristics of the produce, contract conditions and respect of production regulations). All negotiations between production and processing industry are channelled through the Producer Organizations (POs). Processors cannot contract with POs that have been excluded from the IBO North Italy Processing Tomato for not respecting the rules, and vice versa, POs cannot supply processors that have been excluded from the IBO North Italy Processing Tomato. Some of the companies are present both in the production and processing stage of the value chain and are registered as cooperatives or single private companies.

## Inter-Branch Organisations

***Producers and processors aim at strengthening market concentration and social collaboration through IBOs, ensuring higher competitiveness and sustainability through a mutual agreement that is beneficial for all***

***Figure 1.*** *Market Channels for the Processed Tomato of the IBO North Italy Processing Tomato*




Source: IBO North Italy Processing Tomato, 2017a

At the second level, governance relationship between processors and retailing may be defined as modular, where processors provide products to the pre-defined specifications of the "customers". Nevertheless, when it comes to private labels, the governance relationship between processors and retailers becomes captive – retailers being the lead firm and processors are suppliers. More than half of the processed tomato goes to food industry (51.3%), 30.1% goes to retail distribution, and 18,6% to HORECA (IBO North Italy Processing Tomato, 2019).

# Market competitiveness, efficiency and technical change in the Italian processed tomato industry

*The analysis of competitiveness, efficiency and technical change are tools to provide an in-depth understanding of the underlying factors driving the competitive advantage of processed tomato value chain actors in north Italy.*

The analysis of competitiveness, efficiency and technical change reveals certain degree of non-competitive behaviour in the input (the relation between farmers and processors) as well as in the output (the relation between processors and retailer) processing market. The market imperfections are, however, more pronounced in input processing market. In both cases, the

## Market power

***The market power imbalances have considerably changed in favor of farmers since 2010, especially after creation of the regional IBOs.***

distribution of estimated mark-up and mark-down indices suggest that only small number of companies are characterized by considerably high degree of non-competitive behaviour. Then, the analysis observes a significant change in 2010. In particular, the mark-down index dropped down by approximately 10% in this year and only slightly recovered in the years after that. The market power imbalances have considerably changed in favour of farmers (they get higher price for their products). On the other hand, the mark-up index experienced opposite pattern. As a result, the shift in the relation between the price for the raw material with respect to marginal revenue product was compensated by the shift in the relation between the price of processing product and marginal costs. That is, the market imperfections did not decrease in the period 2006 - 2018 but were reallocated within the Italian tomato value chain.

In addition, significant differences exist when considering the size of companies. Small companies have higher mark-down index in the input market as compared to medium, large and very large companies. This indicates that small companies may take the advantage of specialized products and niche markets. On the other hand, the distribution of mark-up index indicates higher mean values for large and very large companies which is in line with our expectations about higher bargaining power of larger companies.

In general, the results support the existence of a significant change around the year 2010 and may be explained by the evolution in the relation among tomato processing chain actors intervened since 2000's. Producers and processors were undergoing a time of crisis and developed strategies at chain level that in 2011 brought to the formalisation of a body (IBO) based on the concept of mutual cooperation. The system constantly faces some challenges and requires adjustments to consolidate the effectiveness of the established instruments. The current research support that there have been limitations in the market power imbalances and that market imperfections may be reallocated. Part of these achievements may be the result of mutual knowledge and awareness based on long-term relationship and acknowledgment of reciprocal dependency.

## Productivity growth

***Small tomato producers have taken the advantage to improve scale efficiency by increasing the scale of operations, resulting in growth of total factor productivity at the producer level.***

Technological change did not contribute significantly to the productivity dynamics. This holds for both producers and processors as well as different size distributions. Similar findings were observed for the processors' scale efficiency. Whereas tomato processors and medium and large tomato producers are characterized by almost optimal scale of operations (optimal size), small tomato producers have taken the advantage to improve the scale efficiency by increasing the scale of operations in period 2006 – 2018 and scale efficiency improvements represented the main source of total factor productivity growth on producer level. Then, even though considerable space for improvements exists on both producer and processor level we have not observed significant change in the dynamics of technical efficiency. In particular, the average overall technical efficiency on the producer level is 81% and on the processor level 76%. This suggests that the tomato producers and tomato processors operating on the technological frontier have significantly lower costs, approximately by 19 % and 24%, respectively, as compared to the sample average. Then, the decomposition of technical efficiency into persistent and transient part suggests that tomato processors as opposed to tomato producers are characterized by low level of systematic failures. The persistent technical efficiency of tomato producers accounts for 10 % and represent a considerable space for potential improvements in efficiency of inputs use.

# Pricing mechanism along the value chain

*Analysing the pricing mechanism at different levels of the value chain is a tool to understand price negotiations and power imbalances between different actors.*

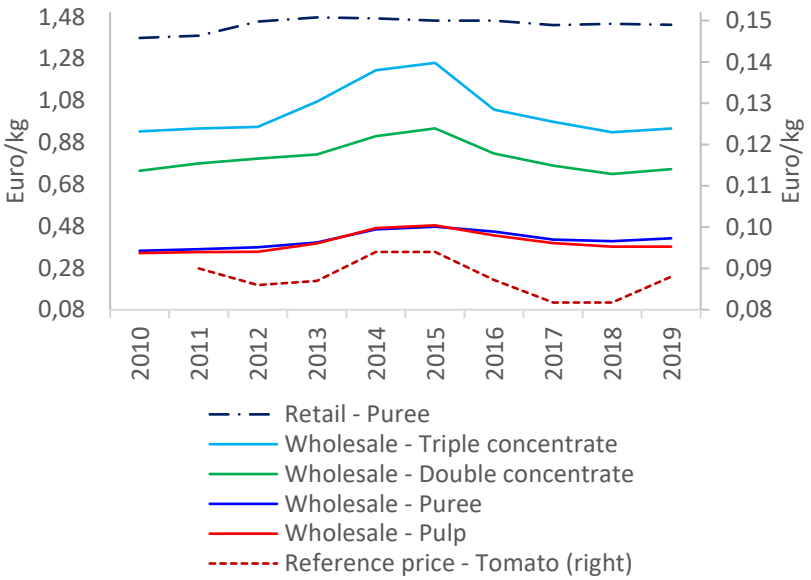
The price formation between processed tomato producers and processors is regulated through the IBOs, which coordinates the chain step, without themselves being involved in production, processing or trade between POs and processors. In particular, the role of the IBO is to streamline the price negotiation between POs and processors and ensure that the framework contract rules are applied in the price negotiation process. The price negotiations within the framework of the IBOs result in the determination of a reference price, which by itself is based on the historical developments in the actual producer prices of the processed tomatoes. The

## Reference price formation

***Regional IBOs provide an EU-unique framework of negotiating the annual reference price for processed tomatoes, resulting in fairer distribution of value between producers and processors.***

reference price serves as a starting point for individual negotiations between the POs and processors. Final price of raw tomatoes is adjusted depending on the quality and other attributes of the harvested tomatoes. At the global level, producers of processed tomatoes in EU receive higher prices compared to the USA and China. This price difference might be explained, among many factors, by the presence of IBOs in Europe. At the EU level, Italian producers also receive higher prices compared to Portugal and Spain, which are also large producers of the processed tomatoes in the EU.

***Figure 2.*** *Price of the final processed tomato products in Italy, 2010-2019*




Sources: IBO North Italy Processing Tomato for the producer price, Chamber of Commerce Piacenza for the wholesale prices, Italian National Institute of Statistics for the retail price of tomato puree.

## Unfair trading practices

***Reverse auctions of selling processed tomato products to retailers have become an unfair trading practice within the industry as retailers push for the lowest price, thus indirectly affecting the price setup of non-auctioned tomato products.***

At the wholesale level, prices of the processed tomato products (tomato puree, tomato pulp, double and triple concentrates) are highly correlated with each other, and also with the reference price of the processed tomato (Figure 1). However, at the retail level, price of tomato puree is rather weakly related with prices at the wholesale and producer level. We attribute higher degree of price relationships at the producer and wholesale level to the fact that individual contractual negotiations are guided by the reference prices at this stage of the processed tomato value chain. Thus, the role of the IBOs is of great importance for both tomato producers and processors to achieve fair distribution of value along the chain.

In contrast, some processed tomato is sold to retailers via reverse auctions (i.e. the seller with the lowest price offer wins). Within the auction system, retailers provide a certain starting price to processors and processors propose their selling price. In the second round of the auction, retailers usually take the lowest offer. This system, indirectly influence the price setup for the non-auctioned tomato products. Selling tomato products at auctions is increasingly discouraged. In 2019, Chamber of Deputies passed a law to ban the practice of auctions for the purchase of agricultural products[3]. Now, such law is to be voted in the Senate, the upper house of the bicameral Italian Parliament.

Due to the different market organization structures along the value chain, the price margin is fairly low between the producer and wholesale prices in Italy, whereas the margin between the wholesale and retail prices of the processed tomato products are much higher, being about three times higher at the wholesaler–retailer level compared to the producer–wholesaler level. This implies that as the processing ratio is high, a small increase in price of raw tomato could lead to a significant reduction in processors' profit4. In general, price formation under the IBO ensure higher competitiveness and sustainability of inter-value chain relations for both tomato

[3] Chamber of Deputies (2020). Sale at a loss, prohibition of double-bottom auctions and regulation of ethical production chains. https://temi.camera.it/leg18/provvedimento/sotto-costo-divieto-di-aste-a-doppio-ribasso-e-disciplina-delle-filiere-etiche-di-produzione.html.
[4] FAO (2017). Fruit and Vegetable Processing – agribusiness handbook. FAO Investment Division.

producers and processors through a mutual agreement that is beneficial for the participating actors; on the contrary, further legal efforts are required to achieve the fair distribution of value at the processor-retailer level along the chain.

## Concluding remarks

The results indicate that the upstream actors of the chain, i.e. producers and processors aim at strengthening market concentration and social collaboration through Inter-Branch Organization (IBO), ensuring higher competitiveness and sustainability through a mutual agreement that is beneficial for all.

This was confirmed by both price developments and margins obtained by producers and processors after 2011 and establishment of the IBO, and in the reduction of market power imbalances between them.

The results further indicate that price dynamics present at the producer and processing levels are not reflected at the retail level. One of the reasons might be that retailers are not part of the IBO, and the price-setting mechanism is entirely different at this stage of the value chain. The adoption of auctions for retail purchases pushes processors to squeeze their margins during the negotiation process.

Overall, the tomato processing case analysed in the present research shows that the sustainability, integrity and resilience of the chain are related to the managerial governance of the chain. Thus, chain actors can contribute to finding a balance between competition and collaboration, so to aim for all chain actors' higher level of competitiveness.

## Key Outcome of economic and governance analysis of the Italian processed tomato value chain

- ***Dual-level governance***
- ***IBOs play a crucial role in price setup and balancing of power between producers and processors***
- ***Market power switched towards producers***
- ***Efficiency of small producers comes from the increasing scale of operations***
- ***Unfair trading practices remain downstream of the value chain***

## Key sources for further information

This brief summarises results form the VALUMICS tomato case study on economic and governance analysis as reported in the deliverables listed below.

To discuss the research presented in this brief, please contact *duric@iamo.de* or respective authors:

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**Deliverable reports:**

Samoggia, A., Riedel, B., Del Prete, M., Bertazzoli, A., Ghelfi, R, Esposito, G., and Altomore, F. (2019) Governance of northern Italian tomato to processed tomato value chain, Chapter 8. *In* Barling, D. and Gresham, J. (Eds.) (2019) **Governance in European Food Value Chains**. VALUMICS "Understanding Food Value Chains and Network Dynamics", funded by European Union's Horizon 2020 research and innovation programme GA No 727243. **Deliverable: D5.1**, University of Hertfordshire, UK, 237p https://doi.org/10.5281/zenodo.4956324

Svanidze, M., Čechura L., Đurić, I., Jaghdani, T. J., Olafsdottir, G., Thakur, M., Samoggia, A., Esposito,G., and Del Prete, M. (2020). **Assessment of price formation and market power along the food chains**. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. **Deliverable: D5.5**, Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Germany, 114 pages. https://doi.org/10.5281/zenodo.5161247

Čechura, L., Žáková Kroupová, Z., Rumánková, L., Jaghdani, T.J., Samoggia, A., Thakur, M. (2020). **Assessment of Economies of scale and technical change along the food chain**. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243**. Deliverable: D5.6**, Czech University of Life Sciences, Prague, 169 pages. https://doi.org/10.5281/zenodo.5161347

**Publications and Proceedings**

Čechura, L.; Žáková Kroupová, Z.; Samoggia, A. (2021) Drivers of Productivity Change in the Italian Tomato Food Value Chain. Agriculture, 11, 996. https://doi.org/10.3390/agriculture11100996

Samoggia, A., Monticone, F. (2021, June 9-11). *Governance in the Italian processed tomato value chain: the case for an Interbranch Organisation* [Conference poster]. 10th AIEAA Conference, Rome, Italy.

Čechura, L., Jaghdani, T.J.,& Samoggia, A. (2020, September). Imperfections in Italian Tomato Food Chain. Proceedings of The 60th Annual Meeting of the Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V. (Society for Economic and Social Sciences of Agriculture) (GEWISOLA), Halle, Germany http://ageconsearch.umn.edu/record/305591 DOI:10.22004/ag.econ.305591

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## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

Coordinating partner: University of Iceland, Dunhagi 5, Reykjavik, Iceland – https://www.valumics.eu

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VALUMICS
Food Systems Dynamics

# H2020 VALUMICS Project
# Role of the regional policies in multi-level governance of agri-food value chains: Emilia-Romagna

**Research Findings Brief**
**September 2021**

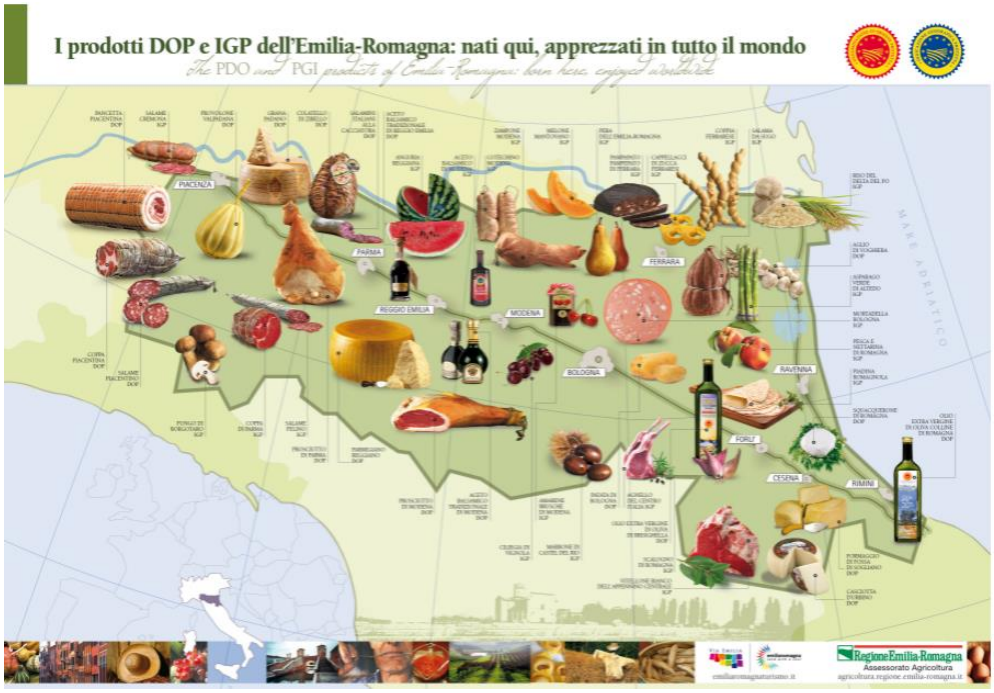
## Key Findings

***Analysis of multi-level governance of the tomato value chains showed a relevant role of the regional policies integrated to the national and European level with respect to key issues as fairness, integrity and collaborative sustainability initiatives***

## Multi-level governance

***Multi-level governance is a coordination process. Local capacity building is a crucial issue to improve quality and coherence of public policy***

This brief summarises results of the analysis of Italian policies, regulations and initiatives that impact agri-food value chains with specific focus on the Emilia-Romagna region. The policy issues covered are fairer trading practices, integrity (food safety and authenticity) and environmental and social sustainability. Analysis of the policies and 27 stakeholder interviews were carried out at regional level involving producers, manufacturers and retailers. Results show how regional policies may effectively support the national (and European) regulations. Regional policies identified in this brief refer to Emilia-Romagna region, located in north-east Italy, with about 4.5 million residents.




## Multi-level governance: a definition

The coordination process is at the basis of the territory's governance; it is necessary for the establishment of coordinated instruments, agreements, and contracts that local developers will respect. Multilevel Governance should be understood as multidimensional, with multiple players who can have overlapping capacities within the same policy area.[1] Within this framework, multilevel governance is to be understood as the exercise of authority and various relationships transcending across levels of government. Multilevel governance leads to different 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 institutional, financial, and informational aspects. Here, local capacity building and incentives to help increase the effectiveness of subnational levels of government are crucial issues for

[1] Samoggia, A. & Maccani, P. (2010) "Multilevel Governance and the Role of Regional Agencies in Territorial and Rural Development. A Snapshot of Three European Countries" , in *Strategic planning for local development. Case studies from small and mid-sized European cities"*, UN-HABITAT SIRP–Belgrade. https://www.bib.irb.hr/476080/download/476080.Strategic_planning_LGI_UNHabitat_English_-_book.pdf

improving the quality and coherence of public policy. The "horizontal" dimension refers to cooperation arrangements between regions, municipalities, or sectors within the same territory[1].

# Fairer trading practices: approaches and examples

## Stakeholders´ view on fairness

***Stakeholders support that a combination of voluntary codes and regulations is the most effective way to tackle UTPs. The greatest dissatisfaction with current EU position on UTPs was in the production sector.***

**Fairness:** a survey was carried out in Emilia-Romagna in the VALUMICS project to probe stakeholders´ view on Unfair Trading Practices (UTP). Stakeholders support that a combination of voluntary codes and regulations is the most effective way to tackle UTPs. The greatest dissatisfaction with current EU position on UTPs was in the production sector

The Italian legal framework includes specific regulations to support fair trading practices in the agrifood chain going further than the voluntary European Supply Chain Initiative and integrated by regional regulation in Emilia-Romagna. These laws pre date the EU's UTP Directive that in Italy and other member states has not been transposed into law yet.

**The policy instruments supporting fairer trading that have been analysed can be summarised in two categories:**

1. **Regulations dealing with unfair practices**
2. **Policy instruments supporting integration among the actors in the supply chain**

## Policies on unfair practices

***While policies dealing with unfair practices are mainly national or European, in the policy instruments supporting integration among the actors in the supply chain we find higher integration between regional and national level.***

The first group of policies mainly deals with issues that have to be avoided (e.g.: Abuse of economic dependence/bargaining power, Lack of written contract, Lack of clarity in contract offer, Terms unreasonably imposing or shifting risks, Unfair breaking off of negotiation, Unfair contract termination). The second group has a more proactive approach trying to increase the territorial cohesion among the actors of the chain through joint collaboration and specific instruments. **While policies identified related to the first group are mainly national, in the second group there is stronger integration between regional and national level.**

**Focus on Emilia-Romagna**

**Box 1**

At national level, among the rules dealing with unfair practices we find:

- ✓ 'Rules applicable to commercial transactions concerning the sale of farming and food products' (Italian law decree n. 1/2012, art. 62)
- ✓ General rules (not specific for agri-food chain) concerning subcontracting relationships in productive activities (Art. 9, Law 18.6.1998, nr.192)

As concerns policy instruments supporting integration among the actors in the supply chain we find a wide set of regulation, including:

- ✓ Supply chain agreements and framework contracts for agro-food chains' (Art. 9 and Art. 10. of Italian Law Decree 102/2005),
- ✓ "Supply chain contract" and "District Contract" (Art. 66 - Law n.289/ of December 27, 2002)

At regional level:

- ✓ Financial incentives for agri-food chain projects and to support investments of agro-industrial companies" (Regional Rural Development Programme 2014-20)
- ✓ "Criteria to recognize the regional agro-food producer groups and the Interprofessional Organizations (IO)" (Regional Law 24/2000)

Emilia-Romagna has **established criteria to acknowledge 'Interbranch Organizations' (IBO) for agro-food sectors, pursuant to a Regional Law (24/2000)** and also the EU law on Common Market Organisations. One of the objectives of this regional law is 'to increase valorisation of products in order to have an equal distribution of the value among the subjects of the food chain, considering the production costs'. **This is a further way of tackling the perceived unfair transmission of prices in agro-food chains that has troubled the EU**. The IBOs must include member companies from at least two of the three stages of the chain (production, processing and distribution). Among other activities, **the IBOs can devise model contracts** to be used among members.

**Emilia-Romagna's Regional Rural Development Plan** (RRDP 2014-2020) includes measures aimed at supporting food producers and other food businesses in ways, which, although not explicitly targeting UTPs, may help **strengthen the enterprises' bargaining power or shield them from unfair contractual practices.** For example, a measure on 'Agro-Food Chain Projects' allows the regional government to direct financial resources to 'projects'

linking enterprises along a value chain, where the participants enter into agreements covering their mutual obligations and responsibilities. An example is the Parmigiano Reggiano Chain Project, involving about 30 agricultural companies and 10 dairy companies in a cooperative consortium.

## Stakeholders´ view on integrity

- ✓ *agreement that current traceability requirements promoted food safety in value chains.*
- ✓ *support for the role of private standards in promoting food safety.*
- ✓ *less clear whether government endorsement of such standards would improve their effectiveness*
- ✓ *public funding for tackling food fraud was not sufficient*
- ✓ *national labelling schemes for locally produced food help to promote authenticity*

# Integrity: food safety and authenticity

**Food safety and authenticity:** according to the VALUMICS survey the majority of regional stakeholders were in agreement that current traceability requirements promoted food safety in value chains. There was also support for the role of private standards in promoting food safety. It was less clear from the results whether government endorsement of such standards was felt to improve their effectiveness. There was strong agreement that public funding for tackling food fraud was not sufficient. There was general agreement that national labelling schemes for locally produced food were helping to promote authenticity.

**Some national policies**

**Regulation on Food Safety at national level** mainly refers to the European regulation. In Italy some specific regulation concerns particular aspects, such as: use of pesticides, food supplements, dyes, residues of veterinary drugs and contaminants, addition of vitamins, minerals and similar substances, materials and articles intended to come into contact with food. As concerns **Authenticity**, the ICQRF (Department of Central Inspectorate for Quality Safeguarding and Anti-Fraud Of Foodstuff And Agricultural Products) has been designated by the European Commission as Food fraud contact point for Italy and "ex officio" Italian Authority for PDO / PGI products. Another measure (D.L. 15/09/2017 n° 145, G.U. 07/10/201) establishes the reintroduction of the obligation to indicate production factories on the label of packaged agro-food products. The measure concerns products of the following categories: tomato pulp, milk and cheese products, pasta, rice.

A unique logo for made in Italy products "The Extraordinary Italian Taste" has been developed as an institutional marketing instrument for promotion activities of Italian agro-food products through information and communication campaigns. Owner of the logo are the Minister of agriculture, food and forestry policies and the Italian Trade Agency (ITA). The logo can be used by public bodies, associations, professional organizations, consortiums, etc.

THE EXTRAORDINARY ITALIAN TASTE

## Stakeholders´ view on sustainability

- ✓ *Non-committal about effectiveness of corporate responsibility/sustainability programmes*
- ✓ *Collaboration among firms, a key to manage water stewardship and preventing food waste.*
- ✓ *Competition law should be reformed to make collaboration easier public funding for tackling food fraud was not sufficient*

**Focus on Emilia-Romagna**

**At Regional level,** Emilia-Romagna is the first region in Europe for number of **PDO and PGI products** (44), thanks also to the support of the Regional Rural Development Programme. The measure 3.1.01 of RRDP 2014-20 targets the agricultural and food processing actors of the production chains. The aim is to stimulate the subscription of new operators to the regimes of quality certification of the agricultural and food products, through financial contributions for the coverage of costs of certifications and analysis necessary for the subscription.

There is also **a brand registered by the Emilia-Romagna Region (Controlled Quality** (Qualità Controllata - QC) - Regional Law 28 October 1999, n. 28. Valorization of agricultural and food products with techniques respectful for environment and consumers' health). This brand can be used by companies working in the agri-food production, processing and distribution stages of the chain and that commit to respect a set of rules concerning quality from farming to the end consumer.

Qualità Controllata
Produzione integrata rispettosa dell'ambiente e della salute
LEGGE REGIONALE DELL'EMILIA-ROMAGNA 28/99

# Environmental and social sustainability

**Environmental and social sustainability:** respondents were non-committal on the effectiveness of corporate responsibility/sustainability programmes managed at firm or trade association level, whereas there was clear agreement that collaboration among firms was key to managing water stewardship and preventing food waste. Correspondingly, there was strong agreement that EU competition law should be reformed to make collaboration easier along food chains.

There was concern from stakeholders that waste and losses were not being adequately addressed at the national level, and ambivalence about whether policies like public procurement helped to

improve sustainability impacts. Linked to this, most respondents agreed that actors were not taking sufficient action to measure environmental performance in their chains. Most respondents were keen to improve levels of collaboration, which they saw as important for the successful implementation of sustainability practices.

## Promotion of PDO and PGI products

***Promotion of PDO and PGI products shows synergy among national and regional policies with respect to food safety, authenticity and sustainability.***

**National and regional policies**

Environmental and social responsibility represent a very wide thematic area and is not possible to summarize the related policies. Anyway, in some interviews of the Valumics survey, some actions and policy instruments emerged as relevant and strategic.

At **national level**, National Minimum Wages were seen to be an effective way to improve the living standards of low-paid food workers, and temporary and seasonal food workers were seen to be in need of specific legal protection.

At regional level, **Emilia-Romagna** has a Regulation (443/2011) aimed at promoting good commercial practices by means of **a voluntary code of conduct for retailers**. The code focuses on four principles, including **rights of the workers and the need for written contracts**. The initiative is strongly focused on **certified products of local origin** and makes the health of the agricultural work force more transparent along the value chain to the final consumer.

## Key sources for further information

To discuss the research presented in this brief, please e-mail following VALUMICS partners´ contacts:


- ART:ER - Attractiveness Research Territory), *Contact: gianandrea.esposito@art-er.it*
- Universita di Bologna, *Contact: antonella.samoggia@unibo.it*


*Deliverable:*


Barling, D., Sharpe, R., Gresham, J., Mylona, K. (2018). Characterisation framework of key policy, regulatory and governance dynamics and impacts upon European food value chains: Fairer trading practices, food integrity, and sustainability collaborations. The VALUMICS project "Understanding Food Value Chains and Network Dynamics" funded by EU Horizon 2020 G.A. No 727243. Deliverable D3.3, University of Hertfordshire, UK, 416 pages. https://doi.org/10.5281/zenodo.3458159



*Disclaimer:*

*This brief and report reflect only the authors' view and the EU Funding Agency is not responsible for any use that may be made of the information it contains.*



## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

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VALUMICS
Food Systems Dynamics

Research Findings Brief

July 2021

H2020 VALUMICS Project

# Profitability in the European food industries

## Statistical analyses

***This brief summarizes the key findings from an analysis of the main drivers of profitability in the European food industries. The analysis draws on accounting data for individual enterprises' Return on Assets (ROA)***

## Profitability: an introduction

Classical economic models of perfect competition assume that profits above or below "normal" returns 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 these 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[1], which in turn influenced the work of Michael Porter[2], 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.[3]

However, industry effects alone cannot explain variations in firm profitability, leading to a consideration of differences in firms' tangible and intangible resources for explaining variations in enterprise profitability. These "firm level effects" relate to the Resource Based View (RBV), which argues that firms with distinctive and superior (tangible and intangible) resources and capabilities achieve superior profitability.[4] In the RBV framework, resources include both tangible and intangible resources. Tangible resources relate to financial and physical factors of production while intangible resources include know-how and reputation.

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.[5] However, given the size and importance of the food industries in Europe, there is a 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 food manufacturing/processing sector selected. It seeks to understand the relative importance of firm and industry level effects in explaining variations in food industry profitability. This is supplemented with data from Eurostat's Structural Business Statistics (SBS) to consider the profitability of the European food industries as a whole.

[1] Bain, J.S. (1968) *Industrial Organization*. 2nd edition. New York: Wiley
[2] Porter, M.E. (1980) *Competitive Strategy: techniques for analyzing industries and competitors*. New York: Free Press
[3] Slater, S.F. and Olson, E.M. (2002) 'A fresh look at industry and market analysis', *Business Horizons*, 45(1), pp. 15-22.
[4] Barney, J.B. (1991) 'Firm resources and sustained competitive advantage', *Journal of Management*, 17(1), pp. 99-120.
[5] McGahan, A.M. and Porter, M.E. (1997) 'How much does industry matter, really?', *Strategic Management Journal*, 18(1), pp. 15-30.

# An Overview of Profitability of the European food industries

## Industry structure

***Production is fragmented with over 250,000 separate businesses operating in the EU food industry***

*The Eurostat's Structural Business Statistics (SBS) provide an overview of structure and performance at the sectoral level, presented according to the NACE (Nomenclature des Activités Économiques dans la Communauté Européenne) classification. Such data provide a comprehensive overview of the number of enterprises, turnover, gross margins, and number of employees in particular sectors for the EU and its Member States. Nevertheless, it does not allow for the interrogation of the performance of individual enterprises.*

Table 1 presents an overview of the structure and profitability of the EU28 food industry for the years 2012-2018. This indicates that the number of enterprises operating in the EU food industry changed very little during the period. Over a quarter of a million separate businesses operate in the EU food industry and the sector has not seen the consolidation that others have witnessed. During the period 2012-2018 total turnover grew at an average rate of about 2 per cent, which is in line with the EU inflation rate. Sales growth in real terms was therefore minimal, which is consistent with a mature market. On a year-to-year basis, turnover change varied from 0.3% and 7.3% per annum.

*Table 1: Overview of the structure and profitability of the EU28 Food Industry*

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|
| Number of enterprises | 265,382 | 264,306 | 268,301 | 265,853 | 265,411 | 259,691 | 265,094 |
| Turnover (million euro) | 916,000 | 939,000 | 950,000 | 957,000 | 960,000 | 1,030,000 | 1,026,034 |
| Gross profits (million euro) | 19,166 | 20,450 | 21,697 | 24,259 | 24,723 | 30,245 | n/a |
| Profits as % of turnover | 2.09 | 2.18 | 2.28 | 2.53 | 2.58 | 2.94 | n/a |

Source: Eurostat SBS database, n/a = not available

## Industry performance

***Compared to other sectors of European economies, especially services, the food industry is a low margin business. However, margins are relatively stable.***

It is possible to compare gross profits against gross turnover. Profits as a percentage of turnover for the years 2012 and 2017 fell between 2% and 3% (data for gross profits were not available for 2018). The average profit margin of 2.43% per year places the food industry into a low margin category, especially compared against the service sector. However, this is to be expected given the high level of competition and generally low barriers to entry that characterise the food sector.[6]

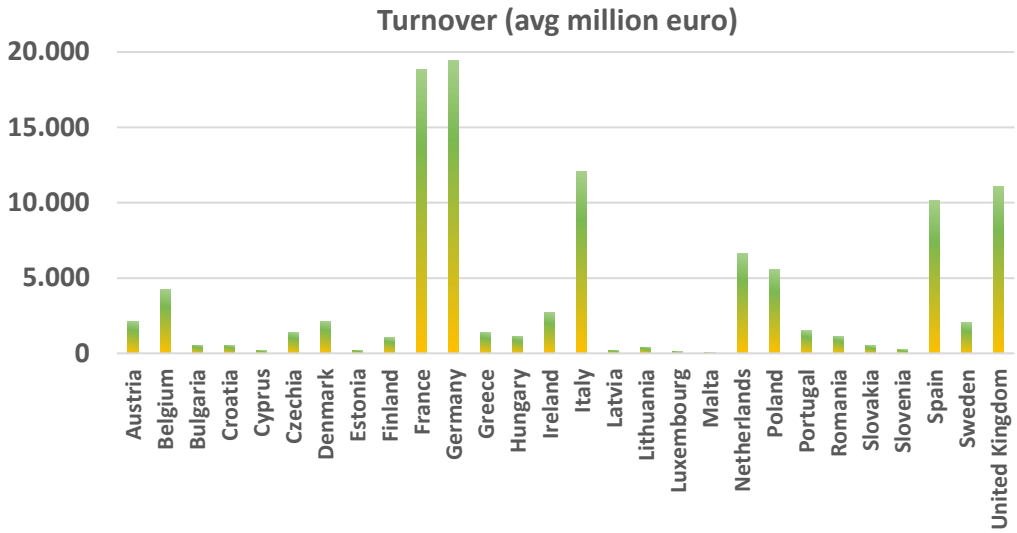
There are considerable variations in performance across the EU Member States. Considering data for the EU Member States from 2017, Figures 1 and 2 present information on turnover and gross margins, respectively. The figures cover the manufacture of food products, beverages, and tobacco. Figure 1 indicates that the five most important countries for this sector in terms of total turnover are France, Germany, Italy, UK and Spain.[7] This pattern has been stable over time. While the importance of agriculture and the food industry in the Member States in Central and Eastern Europe is generally higher, when measured in terms of their share of Gross Domestic Product, the size of food industries in terms of turnover is quite small by international standards.

[6] Gschwandtner, A. and Hirsch, S. (2018) 'What Drives Firm Profitability? A Comparison of the US and EU Food Processing Industry', *The Manchester School*, 86(3), pp. 390-416.
[7] For the period of the analysis, the United Kingdom was a Member State of the EU.

*Figure 1: Turnover for manufacture of food products, beverages, and tobacco by EU Member States, 2017*

## Turnover

***France, Germany, Italy, and Spain accounted for over 84 per cent of EU food industry turnover in 2017 (excluding the UK)***



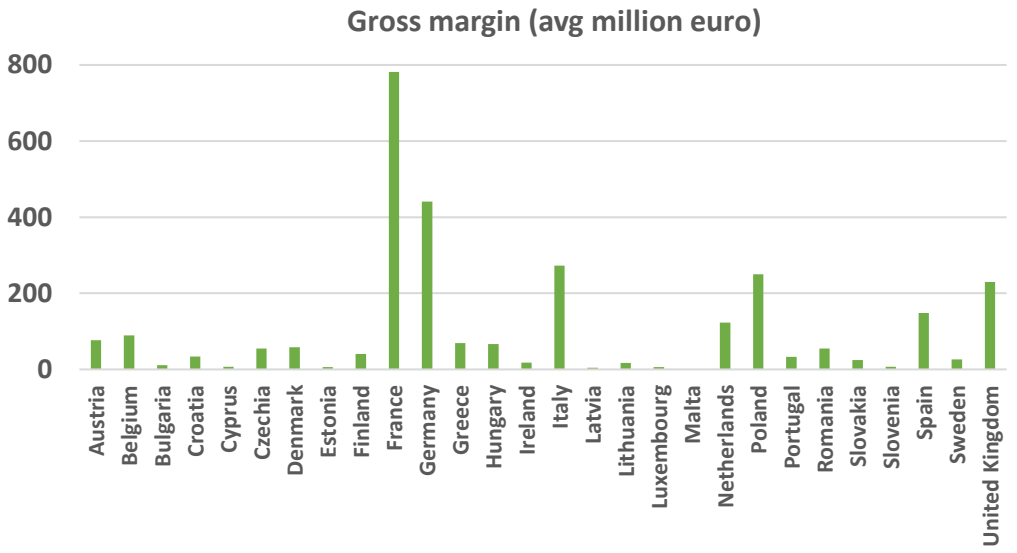

Source: own construction based on Eurostat SBS database

In terms of total gross margin, the same five countries are most important apart from Poland recording higher levels than Spain (Figure 2).

*Figure 2: Gross margin for manufacture of food products, beverages, and tobacco by EU Member States, 2017*

## Gross margin

***In terms of gross margin (cumulative), France, Germany, Italy, and Poland perform best.***




Source: own construction based on Eurostat SBS database

# Analysis of AMADEUS data on profitability in the European Food industries

*EU firm profitability data was sourced from Bureau van Dijk's AMADEUS database. AMADEUS is a pan-European data platform, which includes financial statement data and other operational data of companies in the EU countries.*

## Data analysed

***Accounting records for food industry enterprises for the years 20212 to 2017.***

The AMADEUS dataset comprises firms of all legal forms (e.g., limited partnership, private, publicly quoted on the market and cooperatives) and size. In AMADEUS, an industry is captured using NACE codes. To extract records from AMADEUS, we used 3-digit NACE codes for the manufacturing of food, including meat, fish, vegetable and animal oils and fats, dairy, milling and baking, animal feeds and processing and preserving of fruits and vegetables.

Data extraction from AMADEUS occurred during 2019 and given the availability of records for the previous 10 years, firm performance was traced back to 2010. However, data for the most recent years (2018 and 2019) was patchy as, for many firms, the information had yet to be updated. Therefore, the analysis focuses on the period 2012 to 2017. After cleaning the database for missing entries, the valid sample stood at 8,645 firms.

The analysis employed Hierarchical Linear Modelling (HLM). [8] The HLM method allows data to be classified into two or more levels. Following a review of the literature and the availability of the data in the AMADEUS database, we developed the structural model at level 1 (firm) and level 2 (industry/sector). The level 1 variables considered included a firm's market share, age, size of firm, short term debt risk and number of employees. For Level 2 (industry) we consider degree of market concentration (the market share of the four largest firms in that branch of the food industry) and industry growth, measured in terms of change in sales.

The models were estimated using the software HLM6 (Hierarchical Linear and Nonlinear Modelling).[9]

## Results

***Both industry and firm level factors affect food industry profitability***

The HLM analysis indicates that industry factors matter. Specifically:

- *Market concentration has a positive effect on return on assets.*
- *Growth of sales in an industry has a positive effect on return on assets.*

Firm level factors also matter. We find that:

- *Market share has a positive effect on return on assets.*
- *Firm age has a negative effect on return on assets*
- *Firm size has a positive effect on return of asset.*
- *Short-term risk has a negative effect on return on assets.*
- *Number of employees has a positive effect on return on assets, but it is not statistically significant.*
- *Market concentration positively moderates the relationship between market share and return on assets*

# Lessons for managers

*The results have practical significance to food industry managers. Specifically, the results suggest three main strategies for food industry companies to increase profitability:*

[8] For a technical discussion of the modelling, please see Aditjandra, P., Pang, G., Ojo, M., Gorton, M. and Hubbard, C. (2019) Report on statistical analysis of agribusiness profitability. VALUMICS "Understanding Food Value Chains and Network Dynamics", funded by European Union's Horizon 2020 research and innovation programme GA No 727243. Deliverable: D5.4, Newcastle University, UK, 48 pages.

[9] Raudenbush, S.W. and Bryk, A.S. (2002) *Hierarchical Linear Models Applications and Data Analysis Methods*. Second edition. Thousand Oaks, CA: Sage

## Size and market share

***Business size and market share matter, with larger firms, in average, achieving significantly higher returns.***

***1) Increase market share while increasing market concentration to achieve greater profitability.***

*One strategy to improve profitability focuses on market concentration and increasing market share. This is consistent with conventional economic models of markets, where profits are higher in the case of a monopoly than oligopoly, which in turn generates higher returns for firms than the case of perfect competition.*

*Market concentration is influenced by product attributes, the presence of economies of scale, barriers to entry, the degree of diversification of demand, the stage of development of the industry, industry history and policies. In some branches of the food industry, there is a tendency to relatively low market concentration. The main reasons include short shelf life (such as fresh products only having a limited shelf life), inability to realise economies of scale, fragmented production base and high storage and transportation costs.*[10]

*Although the food industry faces many adverse market concentration factors, enterprises in the food industry can also take some measures to improve market share. One way is mergers and acquisitions (M&A). Empirical evidence indicates growing market concentration at the EU level, and this has been replicated for firms in the USA.*[7]

## Debt and profitability

***Short term debt is associated with a lower return on assets***

***2) Enterprises should make long-term plans to reduce short-term debt risks and improve their profitability.***

*From the perspective of traditional accounting, short-term liabilities are one of the essential sources of corporate financing. Short-term lending can help companies increase cash flow, buy assets, expand production, quickly and effectively occupy the market, and maintain day-to-day operations. Long-term borrowing, on the other hand, is used more for product development, and projects with longer investment return cycles. Moreover, the interest rate for long-term borrowing is typically higher, which needs to be supported by projects with higher returns. If strategic investments or public offerings are needed, the board's equity will be diluted, and disputes often arise. Therefore, for enterprises, in order to expand cash flow, the best way is to carry out short-term borrowing. However, it is worth noting that short-term debt has to be repaid in a very short period of time, so liquidity problems often arise. If the company encounters operational difficulties, it may not be able to afford interest and principal payments, resulting in increased risk of default, or even bankruptcy/liquidation.*

*For food industry enterprises, short-term lending is more likely to have uncontrollable factors associated with it, because of turbulence in the economic environment and the pressures it places on short term liabilities. Ideally, food industry enterprises should have a longer-term plan for their capital and ensure sufficiently cash flow to cope with market fluctuations. Highly geared enterprises are exposed to a higher degree of risk and this is reflected in the ROA data.*

## Seek out high growth niches

***While margins are typically low in the food industry there are niches which register higher growth and offer better returns***

***3) Seek out high growth niches to maximise the effect of size on profitability***

*Overall, the food industry is a low margin business with sales for meat, dairy and wheat-based products like bread static or in decline. However, within the food industry there are niches that witness high growth and increasing consumer demand. For example, in many EU countries the demand for convenient, ready to eat vegan foods is growing. Our analysis indicates that the effect of having a high market share on firm profitability is magnified in branches of the food industry that demonstrate higher market growth. While gaining a high share of a particular market is beneficial for a company's profitability, effects will be greater in branches of the food industry that are growing.*

[10] Sexton, R.J. and Xia, T. (2018) 'Increasing Concentration in the Agricultural Supply Chain: Implications for Market Power and Sector Performance', *Annual Review of Resource Economics*, 10(1), pp.229-251

# Concluding remarks

Generally, the food industry is a low margin business and there is much interest in understanding what drives variations in businesses' return on assets. The literature identifies the importance of both industry and firm level factors, and we investigate both. Based on AMADEUS data between 2012 and 2017, our study finds that both industry and firm level factors are significant. Through the data analysis, we consider three strategies for managers in the European food industry who wish to improve profitability.

## Key findings of the analysis of European food industry profitability

- ***The European food industries are characterized generally by low margins***
- ***Both firm and industry effects explain variations in firm-level profitability***
- ***Larger firms in the food industry are generally more profitable***
- ***Lower returns are witnessed where there are many, smaller firms competing***
- ***Short term debt is associated with lower returns***
- ***While margins are generally low, growth niches exist which offer opportunities for higher profitability***

## Key sources for further information

This brief is compiled by Gorton, M.[a], Aditjandra, P.[a], Pang, G.[b], Ojo, M.[a], and Hubbard, C.[a] from: a) Newcastle University, and b) University of Birmingham, presenting results from analysis reported in VALUMICS Deliverable D5.4,

To discuss the research presented in this brief, please email: Matthew.Gorton@newcastle.ac.uk

**Deliverable report:**
Aditjandra, P., Pang, G., Ojo, M., Gorton, M. and Hubbard, C. (2019) **Report on statistical analysis of agribusiness profitability**. VALUMICS "Understanding Food Value Chains and Network Dynamics", funded by European Union's Horizon 2020 research and innovation programme GA No 727243. **Deliverable: D5.4**, Newcastle University, UK, 48 pages. DOI: 10.5281/zenodo.5087814

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# Food Consumption Behaviours in Europe

**Research Findings Brief**
**September 2021**

## About this Research

### Understanding consumer behaviour

***In order to achieve food consumption change, it is crucial to better understand the motivations and contexts behind consumer behaviour and how this relates to the rest of the food value chain.***

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[1]. 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.

## General Key Insights

### Intention-action gap

***"If you survey people at the entrance of the supermarket what the consumer would like to buy and then check what they bought at the exit, it won't match: what I think differs from what I do"***

***(interviewed stakeholder)***

**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 afore-mentioned report and summarised below:

- **Price** was identified as a key driver of food purchasing patterns. Behaviours do not seem to be necessarily driven by the cheapest price, but price considerations count among the main determinants of purchasing decisions.
- The **social context** and **habits** have a considerable influence in food consumption behaviour. 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 consumption behaviours.

[1] Leppänen, J., Neuvonen, A., Ritola, M., Ahola, I., Hirvonen, S., Hyötyläinen, M., ... & Lettenmeier, M. (2012). Scenarios for sustainable lifestyles 2050: from global champions to local loops. Report D4. 1 Future Scenarios for New European Social Models with Visualisations of the Project SPREAD Sustainable Lifestyles, 2050

## Price as a behavioural determinant

***Price consideration count as a main behavioural determinant of food purchasing decisions and suggests that monetary and economic instruments have a role to play in making behavioural shifts towards sustainable food consumption.***

## Pro-environmental considerations

***Environmental awareness still exists but is not at the top of the list of consumer considerations.***

## Shifting to plant based diets

***There is a necessary food consumption shift towards plant-based foods, while substantially limiting animal sourced foods.***

- **Environmental awareness** exists, but is not top of the list of consumers, as other factors seem to take precedence, such as price considerations, lack of time and food shopping habits.
- **Sustainability trends** are developing over time, including veganism and vegetarianism, local consumption and slow food movements, but have a limited impact in the mainstream food industry. Therefore, it is important to foster ways to boost their scalability.
- The **structure of current food systems** is not oriented towards sustainability. Most farmers and manufacturers perform for years within a "conventional" food production and consumption system, in which there are nearly no incentives for changing the direction of focus.

# Country Specific Insights

Through focus groups, food consumption behaviours of European citizens were analysed in four EU countries: Germany, Italy, France and the United Kingdom. Below are the "top 5" insights on food consumption behaviours from each of these countries.

| | |
|---|---|
| **Germany** | • Sustainability related considerations still do not fit into citizens daily life routines and habits, mainly due to time pressure related to family and work.<br>• Status quo, personal taste and habits, together with health and prices are largely valued.<br>• Regional take precedence over organic food products.<br>• Similarly, less packaged products are preferred over organic ones.<br>• Convenience is preferred over sustainable products. |
| **Italy** | • Trust in familiar corporate brands and retailers is an important aspect when purchasing food.<br>• Taste is a key driver of food consumption.<br>• Seasonality is affiliated to healthy diets.<br>• Price is a key driver of food purchasing.<br>• Family food habits and preferences drive food selection. |
| **France** | • Health is the single most important factor driving food consumption choices, across all socio-economic and age categories.<br>• "Fair" products are positively perceived by consumers from all socio-economic categories.<br>• Price and accessibility are key factors in purchasing decisions, thus influencing their decision on selecting sustainable products.<br>• Many consumers doubt the trustworthiness towards organic products (and food products in general).<br>• Divergent conceptions of "sustainable" and "ecological" consumption exist among consumers. |
| **United Kingdom** | • Family, personal health and price concerns are the most important drivers.<br>• Mistrust towards organic products is widely spread.<br>• Knowledge or consideration about fairness is rather low.<br>• Perception that sustainability should be a responsibility of the government rather than consumers.<br>• Habits, brand quality and lifestyles are other relevant food consumption drivers. |

## Beef consumption determinants

***The motivations for beef consumption are around the 4Ns: it is generally natural, nice, normal and necessary. For male consumers, masculinity plays a role, it seems to be a matter of identity: 'in order to feel like a man, I need to eat meat'. And that's a barrier to change behaviours also in families where the husband holds the family hostage of fulfilling his masculinity needs.***

## EAT-Lancet Report: targets towards sustainable food systems

***"Global consumption of fruits, vegetables, nuts and legumes will have to double, and consumption of foods such as red meat and sugar will have to be reduced by more than 50%"*** [2]

# Food Consumption Insights per Food Category

By means of an extensive desktop research across the most relevant reviews and databases, insights on consumer food purchasing behavioural patterns as well as further contextual factors were collected for the following product categories: beef, dairy products, salmon, tomatoes and bread. With regard to the geographical scope, the work aimed at understanding consumption patterns at both European and national levels, the latter including Germany, the UK, France, Italy, Iceland, and the Czech Republic.

| | |
|---|---|
| **Beef** | • Price and marketing factors.<br>• Food characteristics related to health, quality and sensory attributes.<br>• Personal factors such as preferences, habits and socio-demographic background.<br>• **Trend:** changing dietary patterns towards more plant-based proteins. |
| **Dairy** | • Food characteristics such as health aspects, quality, country of origin and means of production.<br>• Personal factors including preferences, habits and socio-demographic background.<br>• Price and marketing factors.<br>• **Trend:** consumption of plant-based milk alternatives in the market. |
| **Salmon** | • Sensorial characteristics of food such as appearance and freshness.<br>• High prices contribute to lower fish consumption.<br>• The origin of the food product (including product labelling and certification schemes).<br>• Personal factors such as convenience, culture and traditions.<br>• **Trend:** blockchain technology enabling for consumers an increased traceability and transparency of the fish product they consume. |
| **Tomato** | • Sensory characteristics such as texture, appearance, colour, size, freshness, taste and smell.<br>• Origin of tomatoes, means of production and price.<br>• Personal factors such as convenience, lifestyles and health/wellness.<br>• **Trend:** consumers are increasingly supporting locally and organic produced tomatoes as well as new business models (e.g. farm boxes). |
| **Bread** | • Price and purchasing power of populations<br>• Changing lifestyles of consumers: modern lifestyles, including mobility, flexibility, cultural diversity, understanding of foreign cultures and culinary diversity are factors decreasing bread consumption.<br>• Health factors (e.g. perceptions of health and wellness from bread).<br>• **Trend:** consumers seeking quality bread from craft bakeries and new business models and innovations (e.g. 'from baker to consumer'). |

# Pathways towards a Sustainable EU Food Consumption

On basis of interviews with experts from the key food stakeholder groups, potential "pathways" or opportunities towards enabling more sustainable food consumption practices in the EU were identified. These are summarised below:

**1. Improve the engagement of consumers with producers.** Fostering a stronger communication channel between producers and consumers, with the potential of empowering

[2] Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., ... & Jonell, M. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet, 393(10170), 447-492

consumers to learn more about the impacts of food value chains, could help them to appreciate more what they eat and accordingly avoid unsustainable food consumption patterns.

## Bringing consumers and producers closer

***"The closer the relationship between producers and consumers, the stronger and more resilient the whole food chain"***

***(interviewed stakeholder)***

**2. Develop policies that trigger sustainable food consumption**. Developing and implementing top-down policy measures (e.g. regulations and incentives) could support thefood products.

**3. Use behavioural research evidence to improve public policy.** Besides focusing on improving production in food value chains, the public sector has the potential to drive strategic measures for improving or influencing sustainable food consumption at the consumer level, hence the demand side of food value chain. Relying on and considering behavioural insights and evidence when designing such policies holds a great potential to improve their practical implementation.

**4. Encourage retailers to demand more sustainable food production processes**. Retailers have an important role to play in the sustainability transition, due to their negotiation power in the whole food system. Increasing retailers' engagement, knowledge and understanding of their role in shaping food systems could propel the much-needed food sustainability transition.

**5. Start at the local level.** Food consumption behaviours float between individualistic and collective parameters, however, largely localised. As such, policies or action plans should reflect such characteristic of food consumption and start from local/national policies and then scale up to regional, European or broader levels.

**6. Enable work-life balance.** Nowadays, especially in metropolitan areas, lifestyles have become quite dynamic and in the context of food consumption, leaving very little room for citizens to plan their meals. Enabling a better work-life balance would support citizens to engage better with sustainable food consumption.

## Key sources for further information

This brief has been prepared on basis of the Valumics report 'Food consumption behaviours in Europe. Mapping drivers, trends and pathways towards sustainability.

To discuss the research presented in this brief, please contact the authors of the report or email mariana.nicolau@scp-centre.org

**Deliverable and Report**:

Nicolau, M., Esquivel, L., Schmidt, I., Fedato, C., Leimann, L., Samoggia, A., Monticone, F., Prete, D.M., Ghelfi, R., Saviolidis, M.N., Olafsdottir, G., Sigurdardottir, H., Aubert, P.M., Huber, E., Aditjandra, A., Hubbard, C., De, A., Gorton, M., Čechura, L., Bogason, G.S., Brimont, L., Odene, J. & Schamari, D. (2021). Food consumption behaviours in Europe. Mapping drivers, trends and pathways towards sustainability. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. Report based on Deliverable: D6.1, CSCP, Wuppertal, 87p. DOI: 10.5281/zenodo.5011691

Nicolau, M., L. Esquivel, I. Schmidt, C. Fedato, L. Leiman, A. Samoggia, F. Monticone, M. D. Prete, R. Ghelfi, N.M. Saviolidis, H. Sigurdardottir, G. Olafsdottir, L. Brimont, P.M. Aubert, E. Huber, , P. Aditjandra, C. Hubbard, Arijit De, J. Odene, D. Schamari, M. Gorton, L. Čechura, H.V. Viet, Bogason, S.G. (2020). Food consumption behaviour in Europe Mapping drivers, trends and pathways towards sustainability. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. Deliverable: D6.1, CSCP, Wuppertal, 214 pages.

*Disclaimer:*

*This brief and report reflect only the authors' view and the EU Funding Agency is not responsible for any use that may be made of the information it contains.*

## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

University of Iceland, Dunhagi 5, Reykjavik, Iceland – https://www.valumics.eu

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

VALUMICS
Food Systems Dynamics

H2020 VALUMICS Project

# Behavioural insights for sustainable food consumption

**Research Findings Brief**
**September 2021**

## Pathways towards more sustainable eating behaviours

***This research is about behaviourally informed strategic action plans […] with the potential to foster enjoyment, innovation and public acceptance on the way to more sustainable eating behaviours.***

## Behavioural insights

***It has been estimated that a large share of our daily behaviours is based on un-reflected routines****Error! Bookmark not defined.*.

## About this Research

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.

## Background

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[1]. 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).

## What do behavioural insights tell us?

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[2].

Taking the food market as an example, and particularly in retail stores, consumers have access to a large variety of goods and services. When making food purchasing choices, consumers must take in a lot of information ranging from the price, nutritional value, taste and origin of the product to its sustainability performance. Nonetheless, consumer behavioural studies show

[1] OECD (2017), Behavioural Insights and Public Policy: Lessons from Around the World, OECD Publishing, Paris.
[2] Thaler, H. R. & Sunstein, R.C. (2008). Nudge: improving decisions about health, wealth and happiness. Yale University Press, New Haven & London.
[3] Verplanken, B. & Wood, W. (2006). Interventions to break and create consumer habits. In: Journal of Public Policy and Marketing, 25(1), 90-103. American Marketing Association.

## Effective policies

***Behavioural insights support the design, implementation and evaluation of more effective policies[1].***

## Informed strategies

***Behaviourally informed strategies have greater potential in fostering sustainable behaviours that those focusing on information provision and awareness raising[6].***

## How?

- ***Simplify information***
- ***Frame the language***
- ***Change physical environment***
- ***Change default options***
- ***Influence social norms***
- ***Priming***

that, due to information overload and the inability to process all this information at once, consumers opt for easier decision-making processes that might take in only a few criteria, such as price, appearance and taste[4,5]. In turn, this might lead to food choices that in the long-term might not be in the best interests either of the consumer or of a sustainable development trajectory.

Hence successful attempts to influence behaviours in a desired direction, in this case to make them more sustainable, should go beyond strategies targeting knowledge, awareness as well as information provision, and focus on easing the adoption of intrinsically sustainable behaviour. This is particularly true when it comes to food consumption, which is largely habituative and un-reflected, and therefore prone to behaviourally-informed strategies.[6]

# Who can benefit from behavioural insights?

Behavioural insights can be utilized by actors and institutions that work with citizens and consumers. By supporting a better-informed decision-making process about how to most effectively intervene in the food system[7], behavioural insights can support policymakers, the food industry and Civil Society Organisations (CSOs) in effectively designing, implementing and evaluating interventions that promote heathier and more sustainable short-term and, most importantly, long-term food consumption[1]. Citizens and consumers can also benefit from this research, by identifying and addressing their own biases and engaging in the discussion that shapes the future of food policy.

# How can behavioural insights help?

Behavioural insights for sustainable food consumption aim to provide knowledge and strategies on how human behaviour can be changed towards this goal. Understanding their behaviours and decision-making patterns is pivotal for the success and effectiveness of policies, business innovations and other interventions. Such strategies are characterised by keeping all consumption options available, while making it easier, normal and more appealing to take the more sustainable road[8]. Below some key examples of behavioural insights are provided and contextualised on how they could support the shift towards more sustainable food consumption.

In the report itself, each behavioural insight is complemented with real-life examples of their implementation in practice.

**Simplifying information.** As highlighted, grocery shoppers tend to base their buying choices in retail stores on only a few factors. Hence simplified, salient information (e.g. labels and tags) tailored to concrete contexts increases the likelihood of influencing consumer behaviour[6]. Empirical evidence has shown the effectiveness of symbol (e.g. traffic-light) labelling of meat products to rate animal welfare[9]. Similar symbols could also be used to facilitate comparison of product sustainability. Simplified information of this sort – rather than rating individual products separately – seems most effective when applied to a range of products within the same category placed alongside each other[8].

**Framing the language.** An important premise of behavioural approaches is that communication matters and ways of communicating a message or problem will have an impact on the final

[4] OECD (2017a), "Using behavioural insights to incentivise environmentally sustainable food consumption", in Tackling Environmental Problems with the Help of Behavioural Insights, OECD Publishing, Paris.
[5] Barden, P. (2013), Decoded: the science behind why we buy, Chichester: Wiley
[6] Mont, O., Lehner, M. & Heiskanen, E. (2014). Nudging. A promising tool for sustainable consumption behaviour? Swedish Environmental Protection Agency. Report 6643.
[7] Shephard, D. (2018). Applying behavioural insights to organisations. Global case studies. OECD.
[8] Behavioural Insights Team (BIT) (2020). A menu for change. Using behavioural science to promote sustainable diets around the world.
[9] Tierwohl Initiative (n.d.). Available from: https://initi- ative-tierwohl.de/

## Wording matters

***Emphasizing enjoyment and pleasure in food consumption is key to supporting more sustainable alternatives.***

## Availability is key

***The greater the availability and prominence of more sustainable food options, the greater their potential uptake by consumers[8].***

## Social influence

***People are strongly influenced by what others do[2].***

outcome[2]. Choosing the right communication frame can enhance the acceptance and implementation of a suggested behaviour. Wordings such as "vegan", "vegetarian" or "healthy" may sound unattractive for those that don't consider themselves part of this consumer group. In this sense, emphasizing enjoyment and pleasure in food consumption is key to supporting more sustainable alternatives.

**Changing the physical environment.** The design of the physical space and disposition of food options where food consumption takes place matters. Evidence shows that the greater the availability and prominence of more sustainable and healthier food options, the greater their potential uptake by consumers ("perceived popularity of a product")[8]. The size of portions and plates also plays an important role both in motivating increased consumption of more sustainable food and in supporting the reduction of unsustainable consumption practices[6].

**Changing the default options.** Default options are pre-set courses of action that take effect if nothing is specified by the decision maker. If a choice has been marked as default by the choice setter, people will generally accept it as such and not engage in changing it[2] because the individual tends to conform to the status quo and perform daily activities without paying much attention to them; and because they perceive it as the optimum available[2,10]. Default choices can, therefore, serve as worthwhile nudges to increase the consumption share of the sustainable option. While changing the default option still leaves the final (purchasing) decision to consumers, the concept of 'choice editing' sees governments and businesses resetting the portfolio of (default) options by editing out choices that are less sustainable.

**Making it normal.** People are strongly influenced by what others do, in various ways: non-invasively through sharing and exchanging[2], through unconsciously copying the behaviours of people we socialize with ("behavioural mimicry")[11] or through peer pressure, by adapting behaviour to expectations[2]. Social norms are the behavioural expectations or rules within a society or group. In short, they are perceived as the right thing to do[12]. Accordingly, interventions based on social norms can readily replace unsustainable consumption patterns with more sustainable and beneficial practices[13]. Another way is to lead by example, exploiting the visibility and model role played by governments and recognised people in society. In addition, integrating desired choices (such as plant-based products) into people's habitual context of food purchasing and eating would contribute to normalizing it as a practice.

**Priming (using favourable external stimuli).** Priming captures people's tendency to react and perform in response to external stimuli. A contextual detail, regardless of importance, can prompt a specific behaviour or choice[2]. Reactions to an environment are the result of the emotional state the environment induces in the individual[14]. This effect can also be used to support sustainable food consumption behaviours, for example, by placing (visual, audio or olfactory) cues to remind people of the impact the purchase of sustainable products may have on the environment and/or other members of society.

# Conclusions and outlook

**Behaviourally-informed strategies as an opportunity to advance sustainable food consumption strategies, not as the one and only answer.** Behaviourally-informed policies or action plans should be conceived as a complementary approach to classic policies /

[10] Hansen, G.P., Schilling, M., Malthesen, S.M. (2019). Nudging healthy and sustainable food choices: three randomized controlled field experiments using a veg- etarian lunch-default as a normative signal, Journal of Public Health, fdz154

[11] Lakin, L.J. & Chartrand, L.T. (2003). Using noncon- scious behavioral mimicry to create affiliation and rapport. In: Psychological Science, 14(4), 334-339.

[12] Nyborg, K. et al., (2016). 'Social norms as solutions', Science, vol. 354, issue 6308, pp. 42-43.

[13] Goldstein, N.J., Cialdini, R.B. and Griskevicius, V. (2008) 'A Room with a Viewpoint: Using Social Norms to Motivate Environmental Conservation in Hotels', Journal of Consumer Research, 35(3), pp. 472-482.

[14] Biswas, D., Lund, K. and Szocs, C. (2019) 'Sounds like a healthy retail atmospheric strategy: Effects of ambient music and background noise on food sales', Journal of the Academy of Marketing Science, 47(1), pp. 37-55.

## The right moment is now

***There is great momentum at the present juncture in history for a change in food consumption behaviours.***

strategieswith the potential to foster enjoyment, innovation and public acceptance in the transition to more sustainable eating behaviour.

**There is no one size fits all solution.** A certain behaviour change approach can be tailored to address various food consumption behaviours. However, at the same time it is still important to keep in mind that behaviour change approaches work differently in different contexts and in view of different behaviours. Accordingly, it is crucial to understand the targeted behaviour, barriers and opportunities of the specific audience. In addition, measurement and evaluation of the results of interventions is equally important. Only in this way is it possible to understand what works and what might not work, and also to account for potential side-effects.

**The right momentum is now.** In view of the urgent need to meet sustainability and carbon targets, to which eating behaviours are a major contributor, there is great momentum today for change in food consumption behaviours. And the latest sustainable innovations from the food industry, think tanks and CSOs reveal a new world of untapped opportunities for more sustainable food consumption.

## Key sources for further information

This brief has been prepared on basis of the Valumics report 'Putting solutions on the table. A review of successful interventions to support more sustainable food consumption behaviours.

If you would like to learn more about the outcome of the research and/or the respective sources of information, please refer to the original report.

To discuss the research presented in this brief, please contact the authors or email mariana.nicolau@scp-centre.org

**Deliverable and reports:**

Nicolau, M., Xhelili, A., Leimann, L. & Fedato, C. (2021). Putting Solutions on the Table. A review of successful interventions to support more sustainable food consumption behaviours, Wuppertal 52p. DOI:10.5281/zenodo.5011817

M. Nicolau, A. Xhelili, L. Leimann, C. Fedato, G. Hollis, A. Samoggia, F. Monticone, M. D. Prete, R. Ghelfi, N.M. Saviolidis, H. Sigurdardottir, G. Olafsdottir, N.M. Saviolidis, P.M. Aubert, E. Huber, P. Aditjandra, C. Hubbard, Arijit De, M. Gorton, Z. Z. Kroupova, L. Čechura, E. Arroyo, C. Avila, S.G. Bogason (2020) Short analytical report of successful interventions for sustainable food consumption behavior. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. Deliverable: D6.2, CSCP, Wuppertal, 53 pages

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## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

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VALUMICS
Food Systems Dynamics

Research Findings Brief
September 2021

# H2020 VALUMICS Project
# Making sustainable food consumption a reality

## Evidence based actions

***'Recommendations' based on the VALUMICS research findings are put forward broadly to describe evidence-based actions whose deployment has the ability to support promoting and reaching more sustainable food consumption in Europe.***

## Intention-action gap

***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.***

## About this research

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 food purchasing and consumption patterns that are based on plant and fruit-rich diets with fewer animal-based products, locally sourced and organically produced food, and with less food waste and/or food packaging.

## Intention-action gap

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"[1]. 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[2]. 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[3] . 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"[3]. 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[4] and largely habitual and not subject to self-reflection[5]. The transdisciplinary character of food consumption behaviours requires a similarly transdisciplinary approach when looking at influencing behaviours towards more sustainable ones.

[1] EC (2020) Farm to fork strategy. European Commission.
[2] BEUC (2020) One Bite at a Time: Consumers and the Transition to Sustainable Food. Analysis of a survey of European consumers on attitudes towards sustainable food. June 2020.
[3] Vermeir et al. (2020) Environmentally Sustainable Food Consumption: A Review and Research Agenda from a Goal-Directed Perspective. Frontiers in Psychology, 1 July 2020, Volume 11, Article 1603.
[4] Lamory, N., & Laporte, C. (2016) The impact of culture on the food consumption process: The case of Sweden from a French perspective.
[5] Mont, O., Lehner, M. & Heiskanen, E. (2014) Nudging. A promising tool for sustainable consumption behaviour? Swedish Environmental Protection Agency. Report 6643.

# From intention to action

## Behavioural models as basis

***Behavioural models can be very helpful in mapping the context in which behaviours take place in order to help identify the critical barriers to and levers for change.***

Drawing from the research and insights of the latest and most compelling pieces of consumer evidence, including those of behavioural science the VALUMICS report 'From intention to action' puts forward **14 recommendations for supporting the shift towards more sustainable and healthier food consumption patterns**. Acknowledging the complexity of consumption behaviours and the variety of related determinants, the recommendations are built to ensure a systems-based approach to changing consumer behaviour. They call for various top-down and bottom-up interventions that would enable the transition towards more sustainable food consumption behaviours while accounting for consumer behavioural insights in order to increase the interventions' effectiveness and fostering their practical implementation.

The recommendations are addressed at policy makers at all levels (local, national, EU), civil society organisations (CSOs) and food industry and distribution actors ("food industry actors"), especially retailers and restaurants, that have a stake and are engaged in European food systems.

Policy makers | Food industry | CSOs

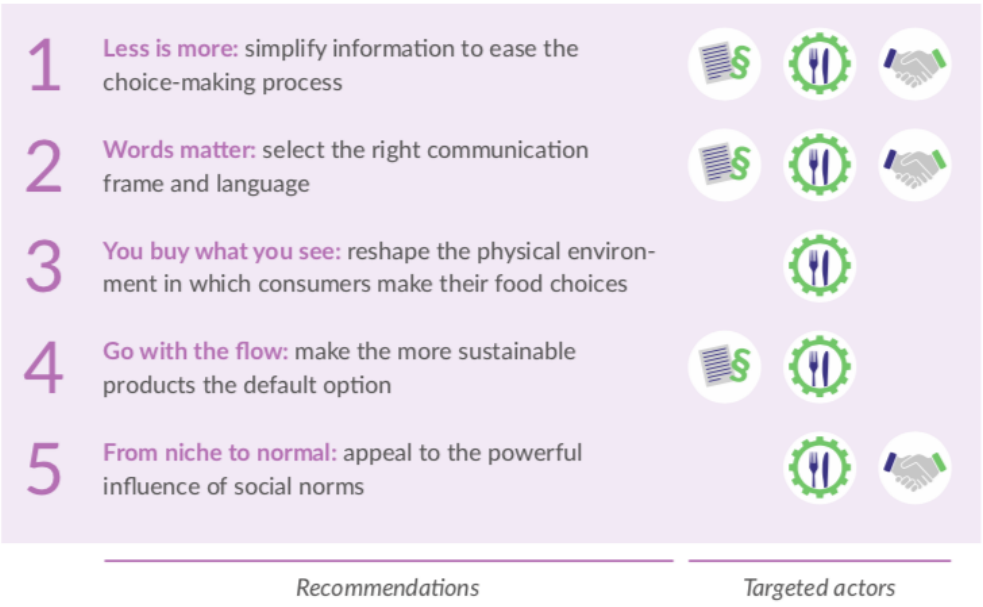
## Less is more

***In a jungle of information and labels, consumers have reported being overwhelmed by and confused as well as unable to understand and interpret the information behind each label[6,7,8].***

Based on the angle of influencing and shaping food choices, the recommendations are organised into four main clusters, namely, 'choice environment', 'choice expansion', 'choice editing' and 'beyond choice'.

### Choice environment

Brings together recommendations aiming to make it easier for consumer to adopt more sustainable food consumption patterns by applying changes in the choice making environment context and how products are presented. These recommendations could be appropriate in situations in which consumers have the tendency to accept the status quo and do not make food choices consciously and/or rely to a large extent on habits. Their implementation works best in controlled environments, e.g. shops/stores, restaurants and canteens, in which the degree of direct change to those environments is relatively easy by the targeted actors.




[6] Hartmann et al. (2019) Report on quantitative research findings on European consumers' perception and valuation of EU food quality schemes as well as their confidence in such measures. Bonn: University of Bonn.

[7] Daugbjerg, C., Smed, S., Andersen, L. M., & Schvartzman, Y. (2014) Improving eco-labelling as an environmental policy instrument: knowledge, trust and organic consumption. *Journal of Environmental Policy & Planning*, *16*(4), 559-575.

[8] Janssen, M., & Hamm, U. (2012). Product labelling in the market for organic food: Consumer preferences and willingness-to-pay for different organic certification logos. *Food quality and preference*, *25*(1), 9-22. A

## Local is relatable

***Shortening food supply chains and relying on localised sources and production of food has been regarded as one of the most promising approaches to ensuring a higher degree of sustainability in the food sector[9].***

## Show me the money

***Even though sustainable products are assumed to be on the radar of citizens and consumers, they are still largely avoided due to their high prices and related unaffordability.***

## Time for bolder actions

***The slow uptake of sustainable food consumptions calls for experimentation with the removal of food options considered unsustainable and unhealthy.***

### Choice expansion

Recommendations that aim to provide consumers with an expanded presence and assortment of more sustainable products that may also meet unmet needs. The offering and selection of new options is complementary to existing product assortments and local supply chains can promote citizen engagement to ensure a higher degree of sustainability in the food sector. Choice expansion recommendations are especially suitable for rectifying situations where consumers want to adopt more sustainable food consumption patterns but lack the possibility currently of doing so. This approach has limitations if the new options provided are and remain a niche market.


### Choice editing

Brings together recommendations that influence choice by reviewing and removing choice options / products with a poor environmental, social record and/or other negative outcomes. These recommendations are most appropriate in situations where consumers want to adopt more sustainable food consumption patterns but lack the knowledge, opportunity or social support to make decisions themselves and are happy to delegate. Choice editing recommendations work well for tackling issues largely at pre-purchase phase.

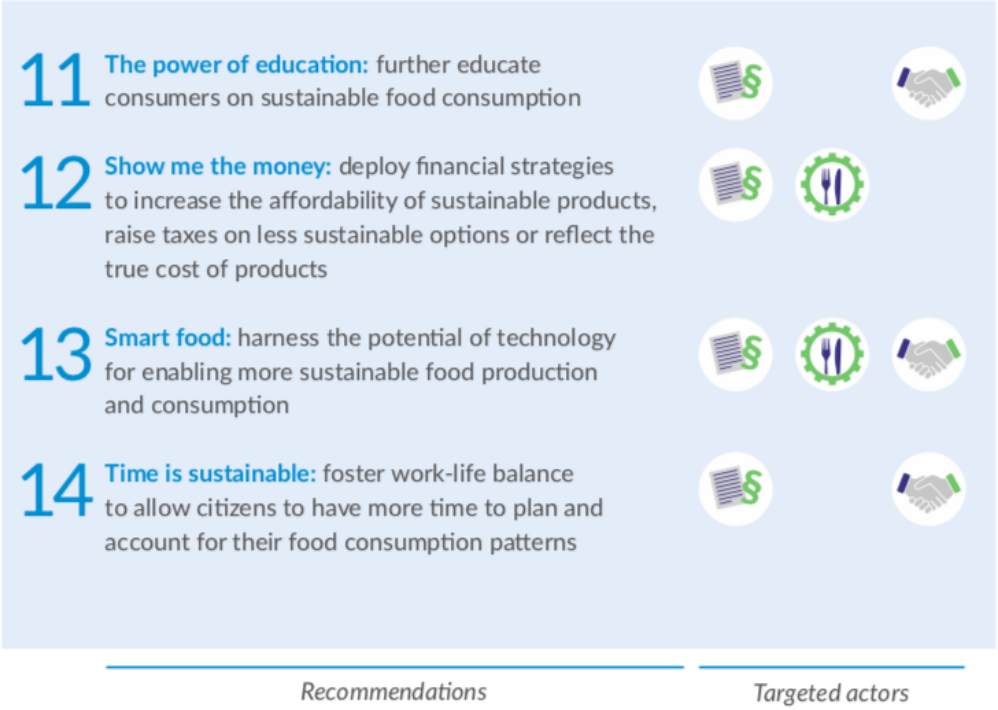

### Beyond choice

Recommendations that aim to intervene in and change broader aspects of the food system that have implications for the choice of food and generally food consumption patterns. Similarly, to the previous cluster, these recommendations look at enabling sustainable food consumption at phases preceding the purchase phase, by either creating the necessary pre-conditions for such choices or increasing the capability and motivation of consumers to participate in such patterns.

[9] Galli, F. & Brunori, G. (eds.) (2013) Short Food Supply Chains as drivers of sustainable development. Evidence Document. Document developed in the framework of the FP7 project FOODLINKS.

## Smart food

***Digital intelligence such as big data or data mining could be utilised to study and analyse consumer purchasing and based on this analysis, produce or offer a specific amount of a particular product or service.***




## Multi-stakeholder collaboration

***The recommendations target particular actors, but ultimately affect all stakeholders in a food chain. Thus, for the most effective implementation input, advice and collaboration from all stakeholders is highly recommended.***

# Further suggestions for each actor

### Policy makers

- Account for behavioural insights when designing, implementing and monitoring policies for a more effective outcome and impact.
- Review existing policies and action plans with the intention of reducing redundancies, unnecessary information provision and friction
- Implement and test unconventional policies that favour sustainable products and hold the potential to disrupt normal market operations and stretch our understanding of those.
- Further implement (financial) policies that would incentivize the innovation and production of products with better sustainability performance while disincentivising their alternatives.

### Food industry actors

- Support consumer intention and reduce confusion and potential reluctance towards sustainable products by increasing the transparency about the origin and composition of products and means of production. This could be achieved through easy-to-understand and more human-centric consumer communication efforts.
- Make it easier for consumers to select the more sustainable and healthier products by increasing their availability and accessibility in the food purchasing environment. Consider the gradual shift towards making the sustainable choice the default one, while phasing out the unsustainable alternatives.
- Invest and innovate to introduce more sustainable and healthier products while matching these with the latest socio-demographic factors. Moreover, harness the positive impact of technology and financial support that is given by policy makers.
- Collaborate and join efforts with other actors to support other activities and jointly advance sustainable food consumption.

### Civil society organisations (CSOs)

- Continue sharing the know-how and expertise on sustainable food topics and strive to expand these insights and learnings with the most up-to-date developments.
- As a neutral and impartial actor, be part of the conversation, bring stakeholders together and drive the co-creation of solutions.

## System based approach

***For a more effective outcome, the recommendations should not be seen as separate action points but rather as complementary and reinforcing one another.***

## Keeping track of progress

***To ensure the recommendations are contributing to their intended goals, it is necessary for the implementing actors to continuously monitor and evaluate their effectiveness and impact, throughout the entire chain also, and if necessary design responsive action***

- Continue working together with citizens as well as making them aware and further educate them about their role and potential for driving sustainable food consumption forward. Consider behavioural insights to make such activities more human-centric

# Relation to Farm to Fork

Looking further at their broader practical implementation, contribution and impact on current frameworks, the recommendations as a whole contribute to supporting the EU in achieving its targets and goals as defined in its Farm to Fork strategy and its specific future action plans. For example:

- 'proposal for a legislative framework for sustainable food system' – *all recommendations*;
- 'initiative to improve the corporate governance framework, including requirement for the food industry to integrate sustainability into corporate strategies' – *all recommendations, especially those targeted at food industry actors;*
- 'launch initiatives to stimulate the reformulation of processed food, including the setting of maximum levels for certain nutrients' – *recommendation 10 'Define thresholds';*
- 'set nutrient profiles to restrict promotion of food high in salt, sugars and/or fat' – *recommendation 10 'Define thresholds';*
- 'proposal for a harmonised mandatory front of pack nutrition labelling to enable consumers to make health conscious food choices' – recommendations 1 'Less is more' & 2 'Words matter';
- 'proposal to require origin indication for certain products' – *recommendation 1 'Less is more' & 7 'Local is relatable';*
- 'determine the best modalities for setting minimum mandatory criteria for sustainable food procurement to promote healthy and sustainable diets, including organic products, in schools and public institutions' – *recommendation 4 'Go with the flow'; 7 'Local is relatable' & 10 'Define thresholds'*;
- 'proposal for a sustainable food labelling framework to empower consumers to make sustainable food choices' – *recommendation 1 'Less is more' & 2 'Words matter';*
- 'review of the EU promotion programme for agricultural and food products with a view to enhancing its contribution to sustainable production and consumption – *recommendation 6 'Disrupt or disrupted?; 7 'Local is relatable', 12 ;Show me the money' & 13 'Smart food';*
- 'review of the EU school scheme legal framework with a view to refocus the scheme on healthy and sustainable food – *recommendation 4 'Go with the flow' & 11 'The power of education*[10]*'*


In line with F2F goals, the scientific community has also been calling for significant global dietary shifts, requiring the reduction of specific high impact foods consumption by more than

[10] Willett et al. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet, 393(10170), 447-492.

50% by 2050, on the risk of failing to meet UN Sustainable Development Goals (SDGs) as well as the Paris Agreement.

## Consumers at the centre

***If consumers are not accounted for or tailored according to their need or behavioural processes, these strategies risk being ineffective or losing momentum.***

# Conclusion and future outlook

When implementing these recommendations in practice as well as generally when developing further policy and strategic actions to enable the transition to more sustainable food consumption behaviours the following key insights and learnings could be considered and accounted for.

**Analysis and understanding of the food environment and broader food system.** Realising these recommendations effectively requires a detailed analysis of the food system aspect of focus, related environment and established operational structures.

**Multi-stakeholder and participatory processes.** The successful implementation of these recommendations is conditional on successful collaboration between food chain actors i.e. policy makers, food industry actors and CSOs as the most important ones.

**Scaling up current initiatives.** Without underestimating the importance of innovation and creativity, it is also recommendable to capitalise on existing resources and initiatives and find ways of scaling them up.

**Consider consumers' reality and bring them in as active partners.** It is important to reinforce the need to account for the reality of consumers' thinking and behavioural patterns as well as enable their participation in designing and shaping food frameworks.

**Change in degrees.** As urgent as the need for sustainable food consumption is, abrupt changes and strategies may potentially not survive the test of time or feasibility in current realities of the market. Changing in degree approach would ensure that the change is steady and sustainable.

## Key sources for further information

To discuss the research presented in this brief, please contact the authors of the report or email arlind.xhelili@scp-centre.org

Deliverable and report

Xhelili, A. & Nicolau, M. (2021). From intention to action: Multi-stakeholder recommendation for making sustainable food consumption a reality. Wuppertal. DOI: 10.5281/zenodo.5337036

Xhelili, A., Nicolau, M., Fedato, C., Leimann, L., Gorton, M., Saviolidis, N.M., Samoggia, A., Monticone, F., Sigurdardottir, H., Olafsdottir, G., Aubert, P.M., Huber, E., Hubbard, C., Bogason, S.G. (2020). Providing recommendations to key stakeholders towards more sustainable food consumer behaviour. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. Deliverable: D6.4, CSCP, Wuppertal, 49 pages

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## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

University of Iceland, Dunhagi 5, Reykjavik, Iceland – https://www.valumics.eu

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

# H2020 VALUMICS Project Environmentally Conscious Transportation and Logistics Modelling for Agri-Food Supply Chains: An Application to Norwegian Salmon

**Research Findings Brief**
**September 2021**

## Content

***The transportation sector is a major contributor to global carbon emission. Food products provide additional challenges for logistics and transportation due to their complex supply chain.***

***This brief discusses how an inter-modal logistics model could address environmental aspects by minimising fuel cost and carbon emissions, using real-world data from a globally integrated Norwegian salmon supply chain.***

## Salmon value chain

***Norway is one of the largest producers of salmon globally and exporting a significant volume to Europe where it is processed further in e.g Poland, Denmark, and France. Filleting and smoking are the main value-added processing activities***

## Introduction

Transportation has significant impact on food costs and the environment. It is a major contributor to carbon emissions, accounting for almost a quarter of the CO2 emissions in the EU, of which 30% is attributed to the food sector[1] (OECD/ITF, 2017). Logistics, in general, implies a high financial cost for manufacturers[2] (Fang and Natarajan, 2020), but greening supply chain management practices, including transportation, are complex, due to customer requirements, product specificities, cost pressures, and strict regulations[3].

Food products provide additional challenges for logistics and transportation due to their perishability, limited storage capacity, safety and traceability requirements[4]. At a global level, food supply chains have become increasingly complex encompassing multiple actors (e.g., producers, processors, wholesalers and retailers), hence transportation costs and related carbon emissions can be high, prompting a search for efficient management solutions.

To address these issues a logistics mathematical model is proposed, drawing on evidence from a real VALUMICS case study of a globally integrated food supply chain, i.e., a Norwegian salmon (Figure 1). The mathematical modelling aims to optimise the cost and effectiveness of logistics operations. It also allows for the integration and consideration of environmental aspects within transportation, processing and distribution operations.

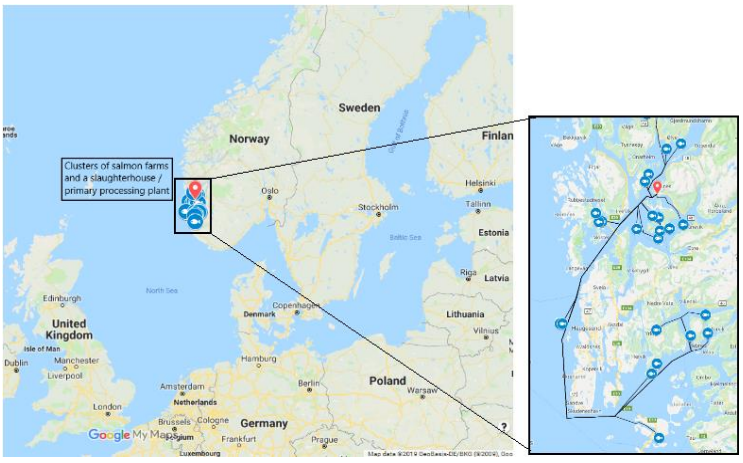


*Figure 1. Salmon farm's locations and links to a slaughterhouse/primary processing plant, before being exported; Source: SINTEF*

[1] OECD/ITF. ITF Transport Outlook 2017. Retrieved from Paris: https://www.oecd-ilibrary.org/transport/itf-transport-outlook2017_9789282108000-en
[2] Fang, F. and Natarajan, H.P. (2020) 'Sourcing and Procurement Cost Allocation in Multi-Division Firms', *Production and Operations Management*, 29(3), pp. 767-787
[3] Golicic, S.L., Boerstler, C.N. and Ellram, L.M. (2010) "Greening' Transportation in the Supply Chain', *MIT Sloan Management review*, 51(2), p. 46
[4] Azoury, K.S. and Miyaoka, J. (2013) 'Managing Production and Distribution for Supply Chains in the Processed Food Industry', *Production and Operations Management*, 22(5), pp. 1250-1268.

# The Logistic Model

## Multi-objective optimisation

***The model follows a multi-objective optimisation approach that captures the trade-off between total logistics cost and the environment***

## Stages of model development, validation and policy recommendation

***(i) mapping supply chain linkages and product flows, (ii) designing the mathematical model, (iii) data collection for parameters of the model and (iv) model validation and deriving policy recommendation.***

## Optimise overall supply network

***The results from the three models highlight that it is essential for any company to optimise the overall supply chain network system (from farms to retailers), as the total cost for model M is relatively much lower than the combined total cost of N1 and N2***

The model has two objectives. Firstly, to minimize total costs associated with transportation, fuel consumption, inventory holding, processing and residuals/waste. Secondly, to reduce CO2 emissions incurred by production at plants, transportation from suppliers to plants, and transportation from plants to customers. Constraints related to supply, processing capacity, storage capacity, demand, carbon emissions, inventory balancing, transportation capacity, and different modes of transportation between different types of plants and facilities are also consider within the model. Figure 3 illustrates the mathematical model function with input and output parameters.

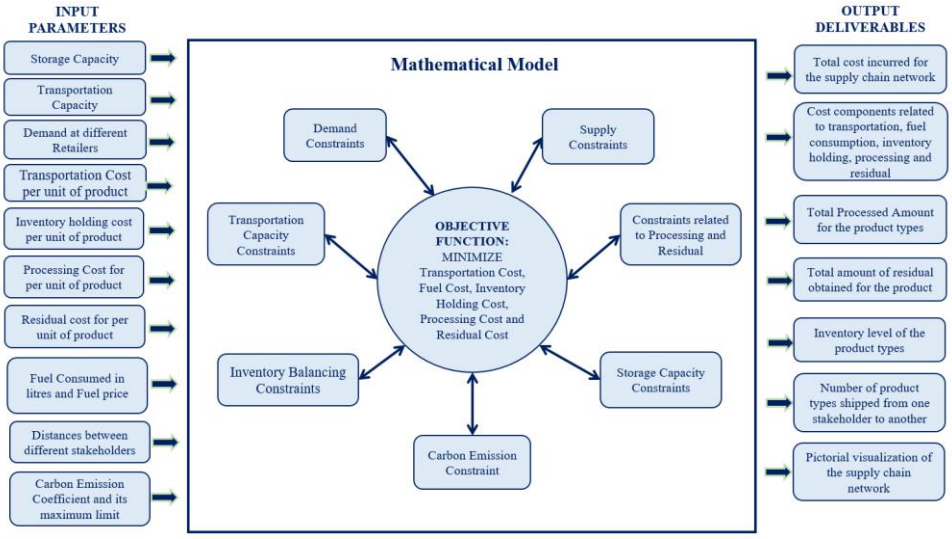


*Figure 3. Framework for our logistics model. Source: Authors' construction*

Before modeling, consultation with salmon supply chain actors occurred as a first step to map the supply chain linkages. This involved expert interviews with VALUMICS partners. Based on the mapping of the supply chain, a mathematical model was developed. However, given the complexity of the supply chain and the limited information that can be drawn from a single company which completely covers both the supply and the demand ends of the value chains, the model was divided into two stages (Model N1 and N2).

First, it optimises the supply chain network from salmon farms, abattoirs, primary processing plants, secondary processing plants and wholesalers so to meet the demand of the Secondary Processing Plants and Wholesalers for Fresh HOG (Head-on-Gutted) product (Model N1) (farm to wholesaler). Second, it addresses the supply chain from the secondary processing plants and wholesalers to retailers. The secondary processing plants process HOG into whole fillet, salmon by-products and some residual amount so to meet the demand of retailers (Model N2) (wholesaler to retailer).

An additional model (Model M) allows for the optimisation of the overall supply chain network where, for example, a Company X tries to meet the demand of retailers in different time periods (farm to retailer). A transportation scenario analysis was also conducted by considering options for various maritime transportation routes from primary processing plant to secondary processing and primary processing plant to various wholesalers[5].

# Key findings

- Environmental impact is generally measured by fuel consumption during operations and in the case of food chain, transportation and distribution are important contributors via the use of fuel-based vehicles, sea vessels and/or airplanes. The transportation scenario analysis

[5] All equations and mathematical formulation are thoroughly described in Section 2.4.1., Deliverable 7.1, VALUMICS project.

## Fuel cost and consumption

***Each model with different demand scenarios shows that the supply chain network is sensitive to fuel cost and consequently to fuel consumption and distances between actors.***

highlights the importance of adopting maritime transportation routes in terms of significantly reducing the total cost, fuel cost and overall carbon emission. Hence, shifting certain logistics operations from road to maritime transportation from the perspective of economic and environmental benefits is preferable.

- For short to medium distances (using vans, trucks, rails and sea vessels) that covers transportation trips to reach airport hubs and big cities, lowering CO2 emissions depends on the emissions ratio (the relative emissions impact of delivery vehicle when compared to personal vehicle, and mostly applied in urban logistics) and customer density.
- For long distance transport (air), environmental improvement can be mainly achieved through technological development and this has been well supported by research dedicated specifically to address EU aviation industry challenges.

## Key policy recommendations

Our mathematical models (N1, N2 and M) are developed for a planning horizon consisting of discrete time periods, aiding the possibility of studying demand and supply uncertainty and its consequences in the supply chain decision making. The models could be applied more widely to different food products across the food chain and be used by both practitioners and policy makers to identify changes in a specific supply chain network when different transportation routes are adopted. For example, to identify whether maritime routes can be adopted (or not) instead of road/rail transportation to address environmental concerns related to fuel consumption and carbon emissions. More specifically, practitioners could apply the models to manage their supply chain under various circumstances of demand and supply, and to identify the most cost-efficient transport options while reducing CO2 emissions. Policymakers could employ them for a better understanding of the costs and emissions associated with different food supply chains as well as the effects of particular policy interventions and market changes or developments.

Some specific recommendations on how CO2 emissions might be reduced while minimising costs are also made:

- A move away from road transport to moving goods by sea
- Long distance transport will usually be by air and improvements to emissions in this sector can mainly be achieved through technological advances.

## Options for improvement

***A move away from road transport to moving goods by sea wherever possible could significantly reduce both total costs and overall carbon emissions. However, judgements have to be made about the relative benefits of delivery versus personal vehicles (and their costs) on a case-by-case basis.***

## Key sources for further information

This brief is compiled by Carmen Hubbard from Newcastle University. It presents some key insights reported in VALUMICS Deliverable D7.1

To discuss the research presented in this brief, please email carmen.hubbard@ncl.ac.uk

References: **Deliverable Report**

Paulus Aditjandra, Arijit De, Matthew Gorton, Carmen Hubbard, Gu Pang, Shraddha Mehta, Maitri Thakur, Roger Richardson, Sigurdur Bogason, Gudrun Olafsdottir, Report on findings on transportation and logistics of selected food value chains: Salmon to fillet case study, VALUMICS, Deliverable VALUMICS "Understanding Food Value Chains and Network Dynamics", funded by European Union's Horizon 2020 research and innovation programme GA No 727243. **Deliverable: D7.1.,** Newcastle University, UK, 94 pages. https://doi.org/10.5281/zenodo.5105433

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VALUMICS
Food Systems Dynamics

**Research Findings Brief**
**September 2021**

H2020 VALUMICS Project

# Framework for risk and resilience in food value chains

## Objectives

***Development of a framework for risk and resilience in food value chains.***

***Using an agent-based hybrid simulation approach, analyse the resilience of food supply chains in the face of unforeseen disruptions.***

***In this work, we consider the case of the Norwegian Atlantic salmon aquaculture supply chain.***

## Industry stakeholders

***Based on case study interviews with representatives from a range of actors in the salmon supply chain, indications are that the Norwegian salmon supply chain is susceptible to upstream (supply side) risks and disruptions.***

## 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 mindset. Owing to these inherent characteristics of agri-food supply chains, 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, raw 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 globalization of operations and growing interconnectedness among nodes in agri-food supply chains have led to high levels of inter-dependency 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 though mitigation. Since resilience is a multi-disciplinary concept, several definitions of this phenomenon are available in diverse fields of scientific literature. However, for the purpose of the VALUMICS project, we use the definition of resilience developed considering food supply chain systems by Tendall et al (2015):[1]

*"Capacity over time of a food system and its units at multiple levels to provide sufficient, appropriate and accessible food to all, in the face of various and even unforeseen disturbances''*

Where:

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

[1] Tendall, D.M., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q.B., Krütli, P., Grant, M. and Six, J., 2015. Food system resilience: defining the concept. *Global Food Security*, *6*, pp.17-23.

- "Accessible" means physically and economically available.
- "Various and even unforeseen disturbances" means unexpected shocks (external or internal) which can occur within the food value chain (e.g. contamination, supplier bankruptcy, natural disaster, sabotage) and slower ongoing change (e.g. changes in policy, consumer tastes etc). The nature of disturbances in food value chains can be internal or external, cyclical or structural, sudden or gradual; they can consist of natural, political, social, or economic shocks.

## Supply side risks

***Examples cited by food value chain actors are e.g., contamination in feed, or the impact of a ban by the European Food Safety Authority (EFSA) on feed imports from South America to Europe.***

***Disruptions are often thought of as those solely arising from suppliers or production problems, whether caused by natural disasters, quality defects, financial or other reasons. However, as indicated in the salmon case, the most recent serious disruption experienced was due to a policy change by EFSA which had implications on the availability and price of feed material.***

# Agent-Oriented Simulation Framework

The development of the simulation framework in this task follows a multi-method approach. Multi-method refers to an approach that combines two or more mainstream simulation methods, and has seen increased adoption recently as a way to model complex supply chain systems. The issue examined in this task has multiple elements, therefore the use of the multi-method approach makes it possible to capture all of them in a single framework. The overall modelling framework is outlined in Figure 1.

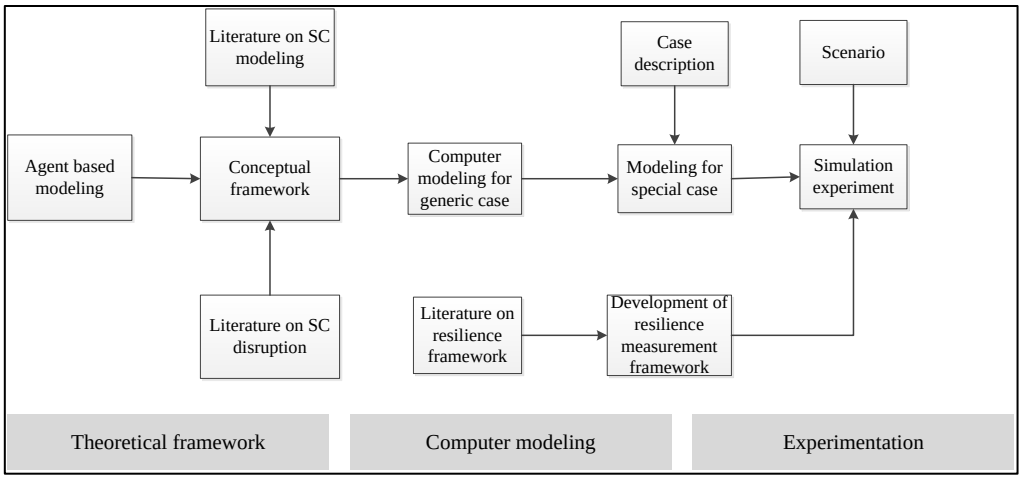


Figure 1. The overall modeling framework

## Methodology

***While the autonomous and interacting nature of the various supply chain actors such as suppliers, producers and customers are modeled using the agent-based approach, the processes within each member are captured using discrete-event simulation.***

With specific focus on the Norwegian salmon supply chain, the interaction between various actors such as feed suppliers and producers is modelled using an agent-based framework (ABM). Meanwhile, the various processes occuring within each supply chain member is modelled using a discrete event simulation (DES) approach. This hybrid simulation approach (Figure 2) enables insights to be obtained into the behaviour of the complex system.

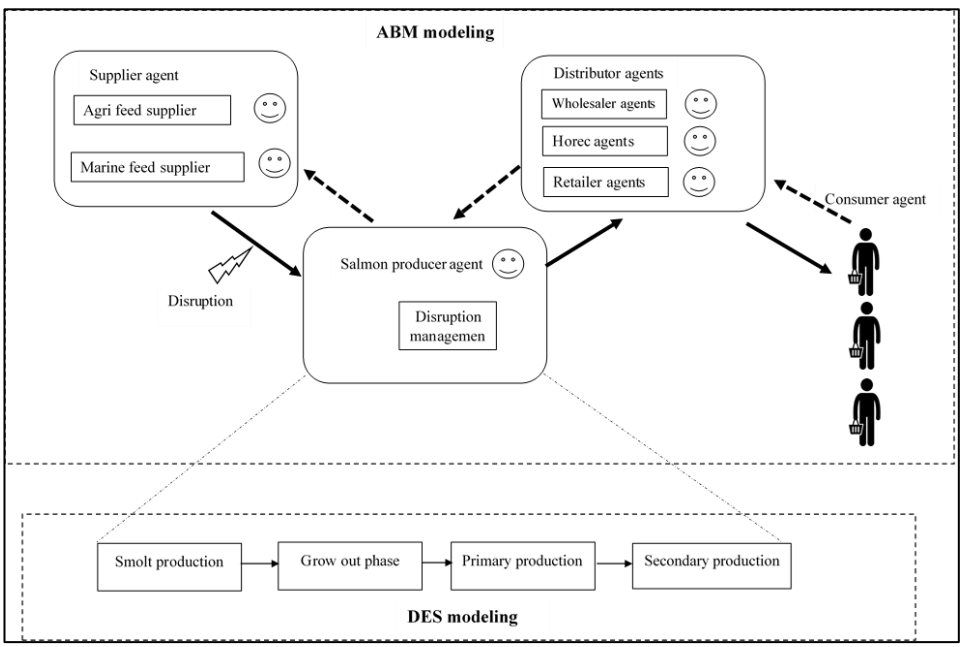


Figure 2. The hybrid simulation model of salmon supply chain

## Resilience modelling

***Agent Based Modelling is a powerful way to model the preferences and actions of heterogeneous members of a supply chain via autonomous agents, combined with the ability of DES (Discrete Event Simulation) to model the queueing behavior of internal production processes.***

***The resilience of a supply chain to a series of disruptions can be assessed and the impact of a range of approaches to increase resilience can be evaluated.***

## Impact of supply disruption captured

***Through an agent-based modelling approach, a virtual representation of a real-world scenario was developed, capturing the impact of a disruption in a complex food supply chain system that emerges due to interventions by decision makers in the chain.***

# Findings

The base-line performance of the supply chain under normal operations was established. The impact of a supply disruption, such as the EU ban on ethoxyquin in fish meal was assessed (Figure 3). Further experimental scenarios were developed to assess the impact of a range of proactive and reactive actions to deal with such a disruption. These included increasing the length of time from announcement to implementation of the ban on ethoxyquin in feed, increased safety stocks of feed at the salmon producer, reducing the proportion of feed sourced from outside Europe prior to the ban.


Figure 3. Simulation Results

# Conclusion

The results of this task illustrate the use of simulation modelling to increase the understanding of food system interactions. This enables both supply chain personnel within the system and food system regulators to assess the impact of policy-led interventions and other types of disruptions on the whole chain. The research also highlights the vulnerabilities in the chain as well as the approaches to increase the overall resilience of the chain.

## Key sources for further information

To discuss the research presented in this brief, please email Vincent Hargaden (vincent.hargaden@ucd.ie)

Thomas Vempiliyath, Vincent Hargaden (2020). Risk & Resilience in Food Value Chains. VALUMICS project "Understanding Food Value Chains and Network Dynamics" funded by European Union's Horizon 2020 research and innovation programme GA No 727243. Deliverable D4.6, University College Dublin, Ireland, 48 pages.

**Publications**

[1] Vempiliyath, T.; Thakur, M.; Hargaden, V. 2021. Development of a Hybrid Simulation Framework for the Production Planning Process in the Atlantic Salmon Supply Chain. Agriculture, 11, 907. https://doi.org/10.3390/agriculture11100907

[2] Vempiliyath, T., Hargaden, V. and Thakur, M. 2020. Hybrid Simulation to Analyse the Resilience of Food Supply Chains. Proceedings of the 2020vIISE Annual Conference. L. Cromarty, R. Shirwaiker, P. Wang (eds). pp. 748-753.

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VALUMICS
Food Systems Dynamics

H2020 VALUMICS Project

# Conceptual system model and operationalisation of fairness in food value chains

**Research Findings Brief**
**September 2021**

## Content

***This brief summarises the VALUMICS developments of a conceptual food system model with the objective to assess the impact of interventions influencing fairness in food value chains (FVCs).***

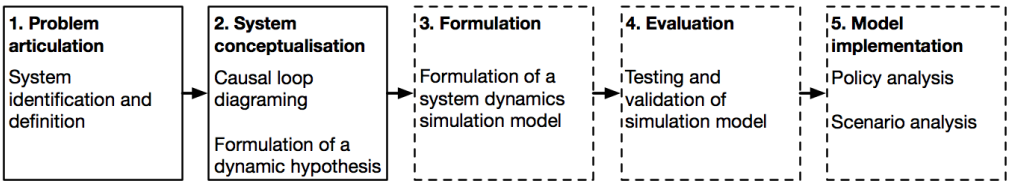
## System behaviour

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

Simulation modelling is one of the tools developed in the VALUMICS project to enhance the understanding of the functioning of food value chains (FVCs) with the aim to facilitate decision makers to evaluate the impact of different interventions in future scenarios towards fairer and sustainable food supply chains.

## Steps in the modelling work

A system thinking approach was applied for the conceptualisation of the simulation model developed in the VALUMICS project. System dynamics modelling approach is useful for studying changes over time in complex supply systems with the aim to build both the understanding of complexity needed to find effective policies and the confidence to use that understanding to take action[1].




The steps in the modelling are based on traditional system dynamics research design. The first step involves clearly defining the problematic or rather undesirable behavior of the system that is to be addressed and specify its boundaries. The second step, the system conceptualization, entails analyzing the underlying feedback structure of the system in an effort to formulate a dynamic hypothesis concerning the system's behavior. This causal theory of how behavior is generated in the system is presented as a mental model in the form of a Causal Loop Diagram (CLD). The system conceptualization is induced through system analysis. The resulting dynamic hypothesis is subsequently used to recreate the dynamics of the system using a mathematical simulation model in the following steps.

## Conceptual model

Supply systems are viewed as integrated downstream physical flows, upstream financial flows and decision chains that link these flows. Central to this idea is that supply systems are driven by profit and regulated by market dynamics[2]. The qualitative conceptual VALUMICS model was initially presented as a simplified causal loop diagram (CLD) based on supply, demand and

[1] Sterman, J. (2000). *Business dynamics: Systems thinking and modeling for a complex world*: Irwin/McGraw-Hill.
[2] Gudbrandsdottir I.Y., Olafsdottir A.H., Sverdrup, H.U., Olafsdottir, G., Bogason, S.G. Stefansson, 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: http://dx.doi.org/10.18461/pfsd.2018.1827

## Multidimensional feedback structure

***The multidimensional feedback structure of food supply chains, driven by profit and regulated by market dynamics, results in nonlinear behaviour that calls for a modelling approach, like system dynamics, that can capture the dynamics of systems with inherent feedbacks and delays.***

price. Each step in the supply chain (e.g. farming, processing and retail) is presented as a part of a food supply chain feedback structure describing the relationship between a supplier and a customer. The chain of agents, each aiming at maximizing profit and minimizing costs, therefore, adds up to a reinforcing supply system.

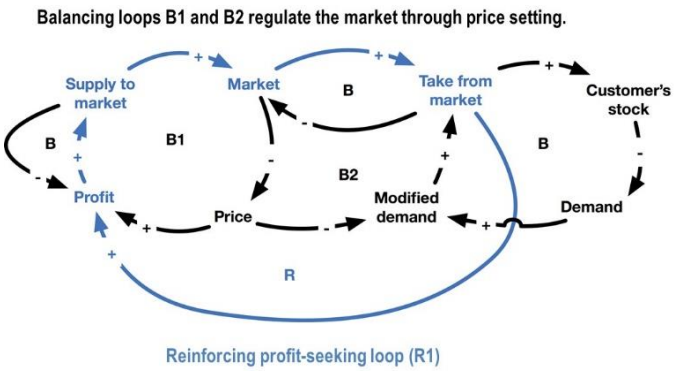



*Figure 1 A simplified model of the main drivers of the integrated supply system. (From: Gudbrandsdottir et al.,2018[2]).*

Studying the structure and dynamics of food chain systems in VALUMICS as integrated supply-, value- and decision chains, however, underscored the complexity of such systems[2]. Further analyses on governance, market power and trade relations in the VALUMICS case studies provided a more in-depth understanding of the behaviours of actors that influence decisions and external factors such as regulations and policy influencing the functioning on system.

# Problem description - Fairness in FVCs

## Unfair Trading Practices in FVCs

***Unfair Trading Practices (UTPs) are of concern in food value chains, as producers may be placed under pressure and have limited bargaining power***

Unfair trading practices within food supply chains are of increasing concern to European Union (EU) and member states' policy makers [3]. Findings indicate that their negative impact on SMEs in the EU food sector is affecting the competitiveness of the industry as a whole[4]. Although UTPs 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 pressure and have limited bargaining power in negotiations with larger purchasers, such as supermarkets or retailers[5].

As a counter measure, the EU Directive (2019/633) on UTPs aims at protecting weaker 'suppliers', primarily farmers, including their organisations (e.g. cooperatives) against their buyers, as well as suppliers of agri-food products which are further downstream. The Directive addresses aspects of procedural fairness which have a direct effect on distributive fairness as the fairness of procedures influence the resulting outcomes. The definition of UTPs in food supply chains emphasises the links between bad commercial conduct and imbalances in market power, which can lead to the imposition of additional risk, an extra cost burden and obligations on one actor or group of actors.

## Indicators of fairness

***The degree of fairness in inter-firm relations is a perception and therefore it is necessary to define quantifiable indicators for the simulation model.***

Supply chains are made up of a series of actors performing activities involved in bringing products from primary production, through processing and distribution, to the final consumer. Products move through the system by way of business transactions between sellers and buyers. The **price** negotiated in each transaction is therefore the central mechanism by which the different echelons of the supply chain are interlinked. When examining quantitative metrics for distributive fairness, the importance of price for agents in the FVC is acknowledged as part of their effort to maximize profit. Furthermore, the influence of market power with respect to creating opportunities for misuse of power in the form of UTPs is a topic of concern. Simulation modelling has been successfully used to develop and test policy interventions. However, the subjectivity and intangibleness of fairness perceptions make them difficult to operationalize in a quantitative model[6]

[3] DG IPOL (2015) Directorate-General for Internal Policies, Policy Department C, Citizens' Rights and Constitutional Affairs (2015) The general principles of EU administrative procedural law (PE 519.224), European Parliament.
[4] Wijnands, J. H., van der Meulen, B. M., & Poppe, K. J. (2007). Competitiveness of the European food industry: An economic and legal assessment 2007: Office for Official Publications of the European Communities.
[5] Fałkowski, J., C. Ménard, R.J. Sexton, J. Swinnen and S. Vandevelde (Authors), Marcantonio, F. Di and P. Ciaian (Editors) (2017), Unfair trading practices in the food supply chain: A literature review on methodologies, impacts and regulatory aspects, European Commission, Joint Research Centre.
[6] Gudbrandsdóttir et al., 2019.

## Procedural fairness

***Power asymmetries and environmental uncertainty pose challenges on actors´ decision making. Controls, collaboration, and information sharing, are factors which can be facilitated through strategic horizontal coordination (cooperatives, producer organisations PO) or vertical integration.***

## Quantitative indicators

***Outcomes in terms of the simulation modelling of distributive fairness in FVCs are the results of operational efforts and can be measured as gross profit margin. Degree of market power (a proxy for procedural fairness) can be assessed using the Lerner Index***

## Simulation model to test policy interventions with a focus on fairness

***The mental model for a generic food supply system served as a basis for the further development of the simulation model used to test policy intervention opportunities, specifically focusing on fairness.***

# Operationalisation of fairness

In an effort to measure fairness as a quantifiable output of a simulation model the factors related to interorganisational fairness (IOF) which contribute to procedural and distribute fairness were explored, drawing on fairness theory and related literature on governance and market power in FVCs (Gudbrandsdottir et al., 2021). The factors identified associated with interorganisational relationships were explained in the context of decision making (Figure 2). Power asymmetries and environmental uncertainty pose challenges on actors' decision making. Strategic coordination such as horizontal collaboration, producer organization and vertical integration can strengthen the bargaining power of e.g., farmers against their buyers.

Environmental uncertainty, the regulatory framework and market dynamics are factors of external constraints while internal constraints are associated with, for example, the firms' technology and knowhow. Outcomes in terms of the simulation modelling of distributive fairness in FVCs are the results of operational efforts and profit which can be measured by quantitative indicators.

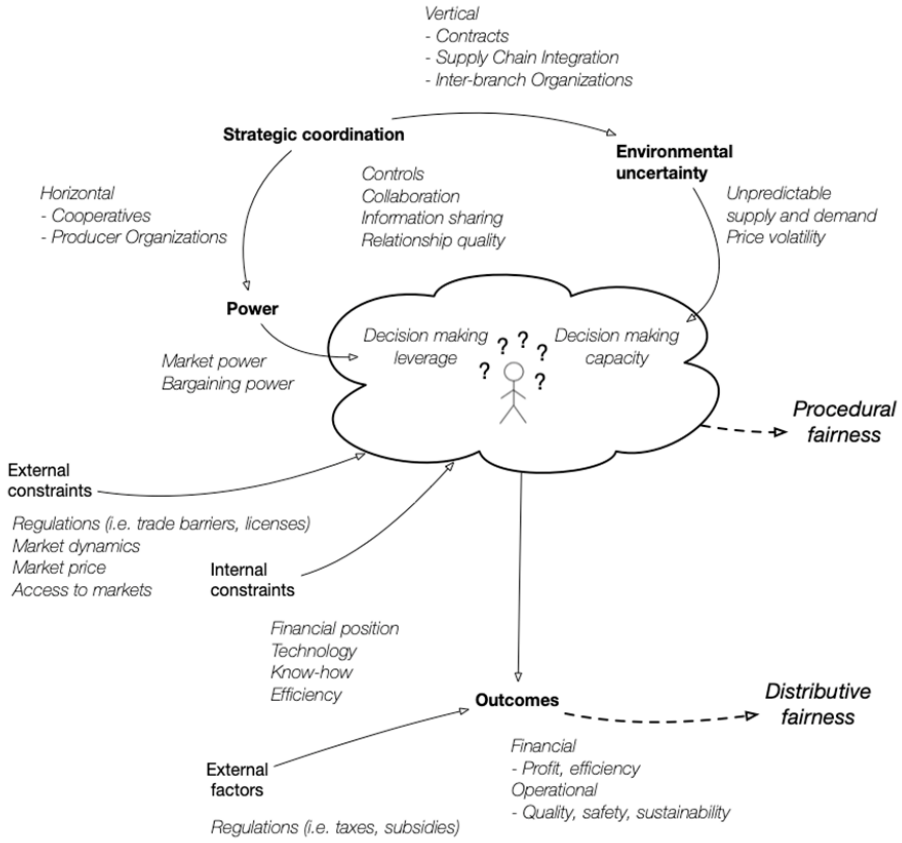



*Figure 2 Factors viewed in the context of organizational decision making (Source: Gudbrandsdottir et al., 2021)*

The operationalisation of distributive fairness through economic indicators in the simulation modelling was defined as the *gross profit margin* obtained by the various actors across the FVCs. The degree of market power (a proxy for procedural fairness) can be assessed using the *Lerner Index (*an estimate of market power measuring the price-cost margin through the difference between the output price of a firm and the marginal cost divided by the output price). The aim was not to determine an absolute measure of fairness using these indicators, but rather to ascertain transitions towards fairer outcomes.

## Simulation of agent decisions: what-if scenarios

### What if

- ***Volumes decrease /increase***
- ***Trade barriers: low /high /removed***
- ***CAP subsidies: low /high /removed***

A hybrid of system dynamics and agent-based modelling (ABM) is the approach for the simulation model. The main advantage of ABM is its ability to model the behaviour of agents in terms of decision rules, executed when special events occur, and in interactions with other agents. The aim is to use the model to identify the level of fairness within the system which emerges from the concurrent execution of these decision rules on behalf of multiple independent agents in the FVC. The decision-making and agents' behaviours were explored through the VALUMICS case studies. The agents can be e.g. producers, collectors, processors, retailers and their attributes include for example production capacity, cost and number of suppliers and buyers. The decisions of the agents revolve around investments, capacity planning, sourcing raw material, price setting and price negotiations and transactions. External factors such as taxes and subsides are typical policy related interventions which influence the profitability of firms and can be tested in a simulation model as experimental factors. The aim is to use the model to identify the level of fairness within the system in future scenarios and assess the impacts of various "what if" policy interventions to transition the food system towards sustainability.

## Key sources for further information

To discuss the research presented in this brief, please email: go@hi.is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## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics


University of Iceland, Dunhagi 5, Reykjavik, Iceland – https://www.valumics.eu



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

VALUMICS
Food Systems Dynamics

H2020 VALUMICS Project

# Implementation of system dynamics and agent-based modelling simulation of fairness in food value chains

**Research Findings Brief**
**September 2021**

## Content

***This brief summarises the VALUMICS implementation in software of a hybrid system dynamics and agent-based model with the objective of assessing the impact of interventions influencing fairness in food value chains.***

## Hybrid system dynamics / agent-based model

***Techniques such as agent resource mapping and decision tables are used for system analysis, resource flows and agent rules definition***

This brief explains the steps carried out in the development and implementation phase of the hybrid system dynamics and agent-based model following the initial conceptualisation phase of the simulation model developed in the VALUMICS project (Olafsdottir et al, 2019, Deliverable D5.2). The conceptualisation was extended using agent modelling techniques and implemented as a software tool. The resulting analyses using this software tool on the VALUMICS case studies can provide a more in-depth understanding of the behaviours of actors that influence decisions and external factors such as regulations and policy influencing the functioning on system. The problem to model had been defined earlier in the conceptualisation phase, about concerns of unfair trading practices (UTPs) associated with power asymmetries in food value chains. Quantifiable indicators were defined for fairness along case study food value chains. Distributive fairness is indicated by the distribution of actors' gross profit margins; procedural fairness by the Lerner Index estimate of market power. (Gudbrandsdottir et al., 2021)

## Modelling framework

System Dynamics (SD) applies a top-down view using feedback loops and can capture volumes and financial flows. Agent-based simulation models (ABM) are typically built from the bottom up by identifying real-world actors, modelling them as agents in the system and defining their behaviours and decision-making, including how they interact with other agents and their environment. In the VALUMICS model a hybrid of system dynamics and agent-based modelling is used. SD allows for modelling and investigation of feedback loops and flows of product, information and money. Agents sit within these flows and feedback loops and affect them by their decision making. The main advantage of ABM is its ability to model social interactions: it can therefore contribute to exploring the impact of cooperation, competition and collaboration within supply chains. The behaviour of agents is defined in terms of decision rules, executed when special events occur, and in interactions with other agents.

The aim is to use the model to identify the level of fairness within the system which emerges from the concurrent execution of these decision rules on behalf of multiple independent agents in the food value chain (FVC). The decision-making and agents' behaviours were explored through the VALUMICS case studies. Cognitive maps were used to visualise the stakeholder's perception of the system, actors, quantitative variables and linkages, and so aid in problem formulation. This analysis is further extended using techniques such as agent resource mapping and decision tables for system analysis, resource flows and agent rules definition. Figure 1 shows an example cognitive map for the VALUMICS French wheat to bread FVC case study.

## Goal

***To experiment on and test various what-if policy and market interventions and to inform development of transition pathways towards more environmentally sustainable and socially fair food value chains***


*Figure 1. Cognitive map for French wheat-to-bread FVC*

These were extended using a rigorous software engineering agile approach of technical design, implementation in program code, and testing/validation. Once parameter values for the case study under investigation have been chosen, multiple runs of the model then simulate the behaviour of the full system of agents over time; statistical analysis of outcomes of these runs (average, min, max, etc.) inform users of the model of what can be expected in different scenarios. Agents at each tier may be of Category I, II or III (small, medium, large). The user may vary agent parameters or indeed environmental parameters such as level of CAP subsidy to investigate the effects of policy and other interventions on transition pathways towards more environmentally sustainable and socially fair food value chains.

## The technical design methodology

***Flows (financial and material) are shown on the left using System dynamics methodology while the attributes and behaviours of a typical agent are on the right, together with the environmental factors it interacts with (Figure 2)***

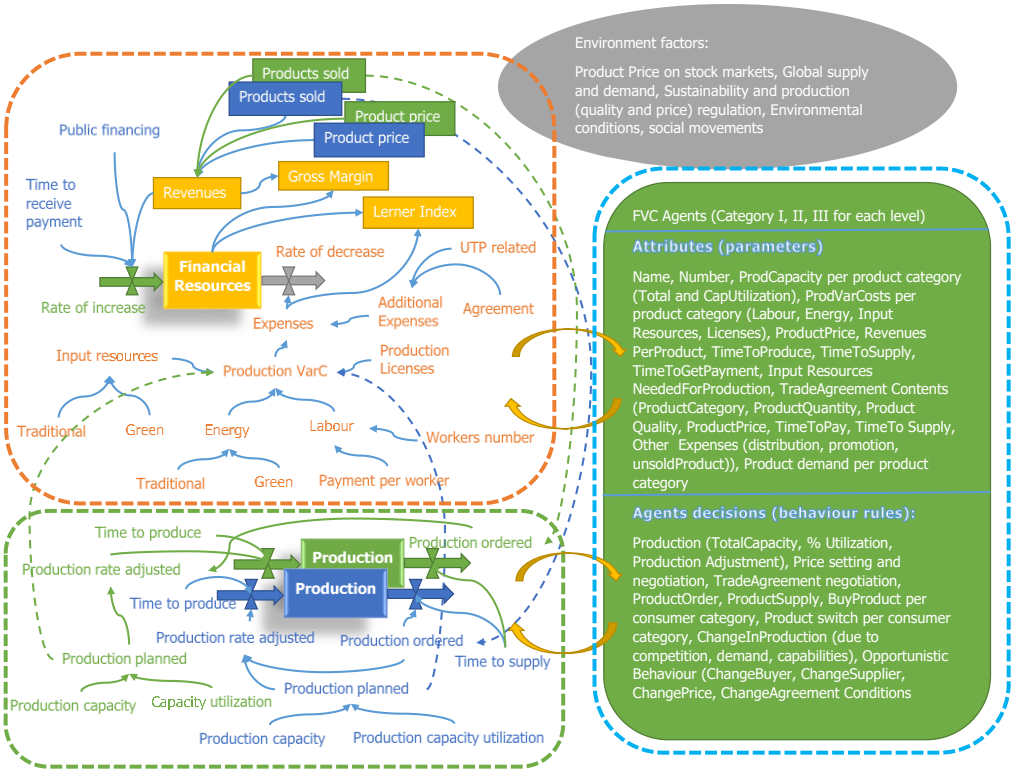


*Figure 2. Hybrid SD/ABM simulation modelling overview*

.

## Model inputs and outputs

***Input parameters to the model include levels of production and demand, exchange rates, levels of subsidies and other data. Outputs include jobs levels and value-added distribution.***

## Experimental environment variables

***The aim is to allow adjustment of other entry/environment variables, such as the level of CAP subsidies, fiscal policies, changes in UTP regulation or the world wheat price.***

# Model inputs and outputs

The major input variables for the model are:

- total volume produced and total volume demanded
- currency exchange rates, wheat protein levels and levels of trade barriers
- production volumes per agent:
  - 'farmland',
  - 'land productivity' and
  - 'farm capacity utilisation'.

The model also provides means for experimenting with:

- public financing interpreted as additional income e.g., CAP subsidies
- world price uncertainties' effects on price formation along the FVC, giving input variables connected to 'global market price' (Euronext, Chicago) and to 'average campaign price'
- time delays connected to production and financial flows if regarded as proxies for UTPs
- input variables can include 'other expenses imposed by one actor on another'

The output variables to be analysed are:

- the structure of the chain, e.g., the number of each category of actor active at each tier of this FVC (to analyse how many agents have decided to stop producing the type of product);
- the total number of jobs provided along the chains by the remaining actors (examine the evolution of the number of workers employed and the number of workers laid off);
- the value-added distribution (observe the evolution of gross margins).

The simulation output related to value distribution can exhibit product price evolution and evolution of revenues and profit margins for each category of the included actors.

## What if scenarios

***Hybrid approach of qualitative and quantitative modelling and simulation to address fairness in FVCs from the perspective of socioeconomic sustainability***

# Agent decisions and behaviour exploration: what-if scenarios

The model is intended to assess the impact of policy interventions (e.g., level of subsidies, changes in supply and demand, trade shocks), described as input variables to the simulator as above. These are implemented as a policy scenario simulator for policy experimentation and optional recommendations.

- Testing how a change in volumes produced/consumed may impact the whole of the food value chain in terms of
  - structure of the chain,
  - total number of jobs and
  - value-added distribution along the chain
- Different "scenarios" connected to production and external financing
  - "industry-led" market
  - "artisan-led" market
  - changing level of CAP subsidies ("public financing")

## Model development

***An agile iterative approach was used for:***

- ***Conceptualisation***
- ***Functional specification***
- ***Formulation and Implementation***
- ***Testing***
- ***Use of model***

## User interface

***The hybrid simulation model allows the user to enter parameter values and view output. Parameter values can be saved for reuse or modification to generate a new scenario.***

## VALUMICS food value chain case studies modelled

***The French wheat-to-bread food value chain***

***The North Italian region raw tomato to processed tomato value chain***

***The Norwegian farmed salmon to fillets value chain***

# Hybrid SD/ABM stages of development

The hybrid SD/ABM work was first carried out for a generic FVC; this was then specialised to three VALUMICS case study FVCs: French wheat to bread, North Italian region raw tomato to processed tomato, and Norwegian farmed salmon to fillets. The major stages of the model development were:

- Conceptual specification of the model: (iterative process)
  - Information audit on qualitative and quantitative information
  - Work with domain expert partners on problem structuring and definition
- Functional specification of the model (iterative process)
  - Qualitative modelling with partners, using cognitive and agent mapping
  - Qualitative and quantitative information gathering using decision tables
- Formulation and Implementation: Technical specification and program code (agile approach)
  - Agent decision procedural description, conditional factors and what if questions
  - Developed through flowcharts leading to pseudocode and thence program code
- Testing of the model: validation and verification by subject matter experts
- Use of the model: parameter setup and running of scenario simulations.

# User interface: Dashboard

Figure 3 shows part of the top-level dashboard interface for entering parameter values for the example of the French wheat to bread FVC. These can be saved for reuse or modification (to a greater or lesser extent) to generate a new scenario.

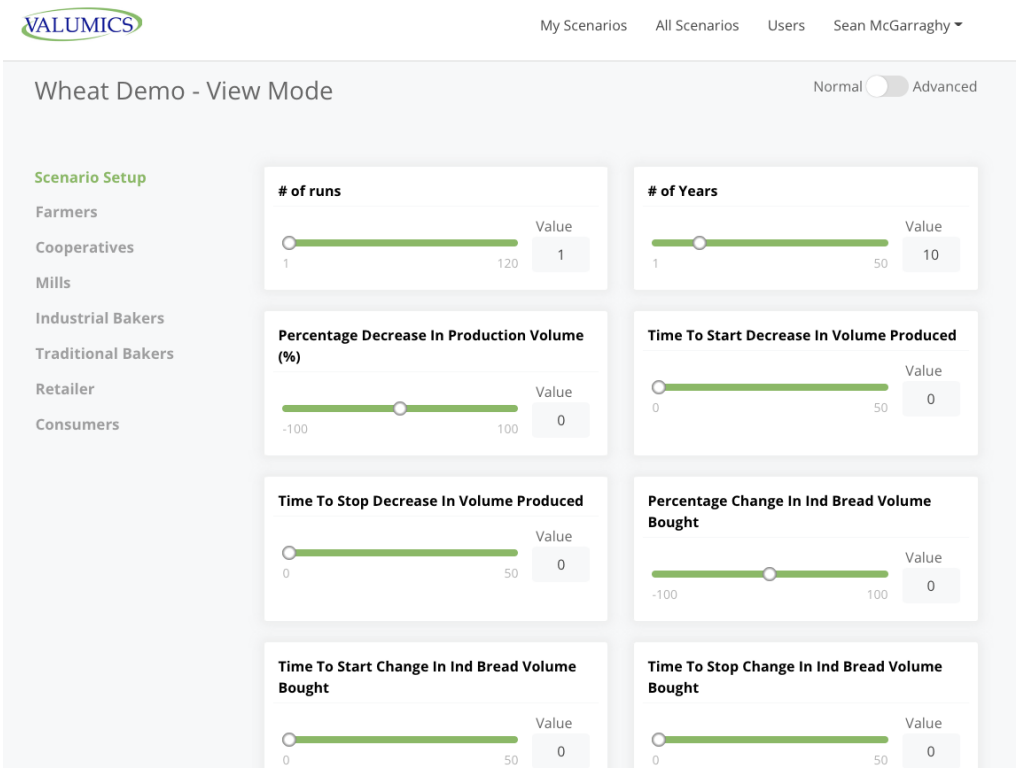


*Figure 3. Excerpt from top-level dashboard interface for the French wheat to bread FVC*

Figure 4 shows an example of output from the model for the French wheat to bread FVC. Computed values may be exported as comma-separated values (csv) or as pdf files, and graphics may also be exported as pdf files.

## Simulator

***This simulator aims to provide insights about the factors that influence actors' decisions connected to changes in supply and demand.***

## Exploiting the models

***Further development and exploitation of the VALUMICS models is planned for policy work and publications, extending the existing models to enrich agent behaviour, and further adapting the generic base model to the salmon value chain and other FVCs.***

## Lack of research data

***Problems include:***

- ***The "legal entity" scale***
- ***Firms operating in multiple sectors***
- ***Extensive information exists on agricultural producers, less so on prices in food processing stages of the food value chain.***


*Figure 4. Excerpt from model output for the French wheat to bread FVC*

# Conclusions

The system analysis work was an iterative development in the conceptualisation phase and through further technical analysis the model was implemented as a policy scenario simulator for a generic four-echelon FVC, then specialised to the VALUMICS case study FVCs: French wheat to bread; North Italian region raw tomato to processed tomato; and Norwegian farmed salmon to fillets (ongoing). A rigorous software engineering approach was used in this development. (McGarraghy et al., 2019, McGarraghy et al., 2021, Esposito et al., 2021).

# Exploitation of results, limitations and data gaps

All models are simplifications but can be useful when enriched with reliable data. The lack of data turned out to be a major limiting factor in the model building in VALUMICS; and high-impact assumptions needed to be made when data gaps were encountered, especially concerning firm level data and particularly for non-farmer actors. Secondary data from different European level data, national level data and regional level data was available on e.g., Eurostat, FAOSTAT, Euro monitor databases and national databases, while FADN and Amadeus databases were used for micro data respectively on farm and company level:

- Secondary data from different databases have different structures caused by divergent product classifications, time periods covered, commodity aggregations, and geographical reach. At the farm level the FADN data was detailed and possible to reconstruct to meet the

## Market transparency

***EU regulatory measures to improve market transparency in the agri-food supply chain is set to provide information for these intermediate steps***

modelling and analysis needs in VALUMICS. However, at the processing industry level, the data available does not provide physical volumes passing through the processing industries; thus, it is difficult to link biophysical flows and socio-economic outcomes.

- Other limitations constraining the research and development of the model were the facts that data is aggregated at the national level and that no data is available regarding the share of differentiated vs commodified / standardised production.
- Data is available at the firm level for specific firms; however, it is often incomplete (e.g., few data on business expenses) and big firms are often over-represented in the sample.
- Another factor causing difficulties is that firms are classified based on their sector of activity. For firms operating in more than one sector, all data values are assigned to the dominant sector. Also, some of the food processing is also realised by retailers (e.g., cutting and packing meat) so it is difficult to separate their main business from the processing activities.

## Key sources for further information

To discuss the research presented in this brief, please email: sean.mcgarraghy@ucd.ie or go@hi.is

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- University College Dublin, UCD-NUID *Contact*: sean.mcgarraghy@ucd.ie
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- Universita di Bologna, (UNIBO) *Contact: antonella.samoggia@unibo.it*
- Attractiveness Research Territory (ART-ER), *Contact: gianandrea.esposito@art-er.it*
- Assist Software SRL (ASSIST), *Contact: catalin.trufin@assist.ro*

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## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

University of Iceland, Dunhagi 5, Reykjavik, Iceland – https://www.valumics.eu


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VALUMICS
Food Systems Dynamics

H2020 VALUMICS Project

# Anticipatory scenarios for sustainable, resilient, efficient and fair food value chains on the basis of contrasted paradigms

**September 2021**

The VALUMICS work on anticipatory scenarios and synthesis for sustainable, resilient, efficient and fair food value chains is here summarised.

## Objectives

***To identify policy options, business strategies and practices for policy makers, corporates actors and primary producers that support the sustainability, resilience and adaptive capacity of European food value chains and food system;***

***To develop future scenarios aimed at countering the identified sustainability issues by testing a broad range of options.***

Anticipatory **long-term (2050) target scenarios were created that all fulfil the objectives of being sustainable, efficient, fair and resilient, but relying on contrasting worldviews or paradigms with their underlying assumptions** and **consequent governance systems and actor behavioral patterns.** The aim was to enlighten a broad range of options to reach the objectives (not to compare, which scenario is 'best' and not to predict which is most probable), available to be implemented in potentially distinctive spatiotemporal contexts, and to be combined in varied mixtures.

The scenarios were formed around two archetypic axes used in several forecasting exercises: *leadership* of food system actors from private (market-led) through public (regulatory) to civil-society actors (voluntary collaboration), and *connectivity* from local through regional (such as EU) to global. The focus was on three plausible, internally coherent combinations: ***Market-led Global***, ***Public-led Regional*** and ***Civil-society-led Local*** scenarios.

### The Anticipatory Scenarios

**Market-led Global scenario** describes a world where governance is based on market-led mechanisms and consumer transparency. Food, feed and inputs are produced globally in regions with comparative advantage regarding sustainability and traded as highly processed to equalize distribution of value-added, reduce transportation costs and emissions, and recycle residues locally within the production and processing regions. Sustainability is incentivized economically and based on competition rules, trade systems, food value chain (FVC) transparency through intelligent packages and branding/identity-differentiation of actors on the 'market-place of attention'. Open markets enable fair competition and efficient resource use.

**Public-led Regional scenario** describes a future where regional (sub-global) public institutions have a strong role in regulating and supporting FVCs and networks. Food consumption is based on primary production in Europe with areas specialized for production of different commodities according to comparative advantage regarding sustainability and traded as highly processed in the regions of the primary production within Europe. The responsibility of creating sustainable, efficient, fair, and resilient FVCs is handed over to the regional governance systems and to the governments subsidiary to that, and to other public institutions that ensure their function with a strong regulatory frame.

## Future Food Systems

***In the global market-led scenario open markets enable fair competition and efficient resource use. The fairness of the distribution of the value-added and market consolidation are managed through international agreements as well as corporate social responsibility (CSR), brands and full transparency of the supply chain among actors including consumers.***

***In the public-led scenario strong public institutions regulate profit distribution and prices, working conditions and fair competition.***

***In the civil society-led scenario social norms and local agreements form the basis for fairness. Loose national legislation leaves space to co-operatives to agree on local rules of action, and there are community-level accounting systems for work distribution based on participants' competence and capabilities.***

**Civil society-led Local scenario** describes a world where inclusive cooperation across FVC within and among local communities initiated and led by the civil-society shapes local food production, short supply chains and food provision and consumption practices. Community supported agriculture (CSA) and industry (CSI), urban agriculture, fishing, hunting and gathering are central parts of food provision based on local resources and decentralized energy systems where actors and households are energy producers. Food producers and consumers are self-organized to cooperatives across the FVC, governing production and consumption tightly together. Proximity is the means to transparency, and local currencies based on exchange of services and products may appear.

# Future Food System Options

In this first WP8 deliverable report, the overarching food system and FVC scenarios as well as initial visions from VALUMICS case studies for specific commodity chains were presented. They were deepened, tested and iterated in the following project tasks, and the paths to them were identified. The required changes were identified focusing on the available leverages and potential lock-ins. The scenarios were evaluated for socio-economic, physical and technological feasibility, and iterations were implemented. Subsequently, the scenario pathways were tested using quantitative simulation models and the final version of the plausible scenarios were reported through project reports and policy briefs.

In order to confront intransigent food consumption habits, several levers for change were proposed to reshape the food environment including through environmental labelling, retail choice editing and public procurement. With respect to market organization, a number of policy mechanisms were put forth that would seek to level the playing field between sustainable and conventional producers, including restrictions and "sustainability agreements".

## Conclusions

For Europe to meet its ambitious climate and biodiversity targets while addressing fairness within food value chains, ambitious transformations will need to be made by actors at all levels of the FVC, from farmers to processors to retailers and consumers. The created target scenarios on contrasting ways to achieve these objectives revealed a broad range of plausible alternatives and complementary means to achieve resilience, efficiency and fairness to be drawn from in FVCs of various spatio-temporal contexts.

## Key sources for further information

To discuss the research presented in this brief, please email Helena.Kahiluoto@lut.fi

**Deliverable**

Kahiluoto, H. Sandström, V., Kuisma, M., Rimhanen, K., Barling, D. (2020). Anticipatory scenarios for sustainable, resilient, efficient and fair food value chains on the basis of contrasted paradigms. VALUMICS project "Understanding Food Value Chains and Network Dynamics" funded by European Union's Horizon 2020 research and innovation programme GA No 727243. Deliverable D8.1, LUT University, Lappeenranta, Finland, 48 pages.

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**H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics**

Coordinating partner: University of Iceland, Dunhagi 5, Reykjavik, Iceland – https://www.valumics.eu

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VALUMICS
Food Systems Dynamics

# H2020 VALUMICS Project Policy Brief

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

June 2021

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 pulses - 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 (FVCs) and thus raises significant economic questions (especially within the animal and feed sectors) which often constitute a roadblock in discussions. In this context, the VALUMICS Workshop Series, held from November 2020 to January 2021, aimed to address head-on the issues at hand in specific food value chains (dairy, legumes, wheat) in order to identify the broader conditions of a protein transition.

## 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 feed production while substantially increasing the consumption and production of legumes (for feed and food).***

- Over 20 actors, all with a stake in the European food system – from policy makers to agrifood businesses and civil society – agreed on the need for the transition while pointing out key political and socio-economic challenges to support its concrete operationalization within FVCs. To this end, the collective discussion investigated three main questions: (i) how can this transition be economically viable and fair (ii) what are the relevant policy levers to be implemented (iii) 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 European and third countries, while making competition rules more favourable to address sustainability and fairness issues; **(iii)** succeeding in making the CAP reward the best environmental practices and support the production of protein crops.

- The protein transition will depend on the collective action of actors within food value chains: policy makers and economic actors can no longer pass the buck to each other or wait for consumers to drive the change. Every actor of the system needs to move in the same direction to create cumulative effects and ultimately overcome the macro socio-political lock-in of our food system.

# INTRODUCTION
# A GENERAL DIRECTION OF TRAVEL

## Protein Transition

***The protein transition will require:***

1. ***A considerable reorganisation of food value chains,***
2. ***Key policy changes to make such value chain transformations feasible and viable,***
3. ***Collective action by value chains actors to drive the transition.***

## The workshops

***Three Food Value Chains (FVC) in focus for the workshop discussions***

***- Plant proteins,***
***- Wheat,***
***- Dairy.***

***Focus on three questions***

***- Reorganisation challenges?***
***- Policy changes required?***
***- Actions needed to kickstart the process?***

A number of recent high-level publications investigating sustainable food system scenarios all point towards the same general objectives to keep the EU food system within planetary boundaries by 2050 (even though minor differences remain on certain aspects).[1] Besides radically cutting the level of food waste and losses, they highlight the need to strongly reduce animal proteins and favour an increase in the consumption and production of pulses. This "protein transition" is of key importance from an environmental perspective for several reasons : (i) to limit the ecological footprint of animal and feed productions (in terms of GHG emissions, imported deforestation, land use, etc.); (ii) to deliver on key ecosystem services provided by pulses and legume fodder[2], in particular a better management of reactive nitrogen in agrifood landscapes whose overuse is currently responsible for many of the environmental challenges we have to face[3]. The issue has recently found growing resonance in the political agenda, and more specifically in the Farm to Fork Strategy which lays out the policy framework to accompany the transformation of the European food system[4].

While the long-term direction of travel of the protein transition has gathered consensus among the VALUMICS Workshop Series Participants, this brief sheds light on three key questions addressed during the workshops: **(i)** What are the specific challenges associated to the reorganisation of key food value chains (section 1)? **(ii)** What are the key policy changes required to trigger those transformations (section 2)? **(iii)** What sort of collective action is needed to kickstart this process (section 3)? The discussions focused on three value chains of key importance for the protein transition: plant proteins, wheat and dairy. These have indeed been investigated in more depth in the broader context of the VALUMICS project and are of central importance in today's EU food system functioning.

**Box 1: The VALUMICS Workshop Series**

The VALUMICS Workshop Series took place between November 2020 and January 2021 and brought together stakeholders from the European food system community with the overarching aim of developing a policy roadmap for the sustainable transformation of food value chains towards 2030. Over the course of six virtual meetings, representatives from policymaking, businesses, research and civil society were invited to collectively identify and explore the main obstacles, trade-offs, and levers towards the protein transition, while making especially clear socio-economic implications. The issues pertaining to three specific value chains - wheat, dairy and legumes - were discussed in detail. While describing a common strategic direction, the process itself did not strive for collective consensus on the path to follow. Rather, it deliberately acknowledged and made explicit key dilemmas and tensions where both deliberative dialogue and further evidence are still needed.

[1] Bryngelsson D., Wirsenius S., Hedenus F., *et al.* (2016). How can the EU climate targets be met? A combined analysis of technological and demand-side changes in food and agriculture. *Food Policy*, 59, 152-164, Buckwell A. & Nadeu E. (2018). *What is the Safe Operating Space for EU livestock*. Brussels, RISE Foundation, Karlsson J.O., Carlsson G., Lindberg M., *et al.* (2018). Designing a future food vision for the Nordics through a participatory modeling approach. *Agronomy for Sustainable Development*, 38 (6), 59, Willett W., Rockström J., Loken B., *et al.* (2019). Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, Clark M.A., Domingo N.G.G., Colgan K., *et al.* (2020). Global food system emissions could preclude achieving the 1.5° and 2°C climate change targets. *Science*, 370, 705-708.

[2] Nemecek et al. (2008). Environmental Impacts of Introducing Grain Legumes into European Crop Rotation, *European Journal of Agronomy*, 28 (3).

[3] Sutton M.A., Howard C.M., Erisman J.W., *et al.* (2011). *The European nitrogen assessment: sources, effects and policy perspectives*. Cambridge University Press

[4] EC (2020). *Farm to Fork Strategy. For a fair, healthy and environmentally-friendly food system*. Brussels, European Union, 22 p.

# CHALLENGES TO TRANSFORM SPECIFIC FOOD VALUE CHAINS

## Legume Sector

***Key issues pertain to the development of better adapted seed varieties able to deliver stable yields and incomes, the scaling up of collecting & processing capacities, and industry innovations in products and processes to develop new consumer outlets.***

The development of the legume sector faces a dual challenge: to make legumes more economically profitable for producers and more attractive to consumers. This raises issues at all levels of the food value chain. First, the seed industry will need to provide better seed varieties, with a more stable and productive yield (including a better resistance to recurring pests) and adapted to the evolving pedo-climatic context. However, few incentives today exist to invest in such varieties given the structure and size of the market and the tough competition compared with American soyabean productions[5], which raises questions regarding trade and competition policies (see below). Furthermore, the integration of protein crops into the business model of arable farms (which favour more profitable crops, in particular wheat) will require that they either be granted a higher value on the market or be subsidized through public incentives, specifically for the ecosystem services they render. At the processing level, the feed industry will have to find ways to valorise protein crops – and thus a larger diversity of raw materials - to meet higher sustainability criteria. Finally, the food industry will have to open up new markets based on innovative plant-based products appealing to consumers. Developing the collecting and processing facilities needed at all stages of the supply chain will require substantial investments.

## Wheat Sector

***A decrease in the demand for feed would have a moderate impact on employment levels in the feed sector but could lead to changes in the overall production of wheat, thus raising questions regarding the economic balance of arable farmers***

In the wheat sector – and more generally for cereal production – an overall decrease in the feed demand will necessitate the emergence of new farm business models. Indeed, wheat and primary cereals are key commodities for most arable farmers, that support the overall economic balance of the farm. In order to maintain a stable income for farmers and at the same time reduce areas cropped with primary cereals, an increase of farmgate crop prices seems necessary. Such a change will in turn affect the whole feed value chain up to the livestock sector, resulting in a likely price increase for animal products. On top of that, the reduction in volumes in the feed industry is also likely to lead to a decrease in the employment level in the sector. At the industry level, socio-economic changes will mainly concern the feed industry, whose overall importance compared to other sub-sectors is rather limited as it represents only 3% of the total number of jobs and around 5-7% of the total turnover of the food industry. How the feed industry will handle such a decrease while, in the same time, continue to improve its overall performance (in terms of feed input-output ratio, traceability…) remains an open question.

## Dairy Sector

***Reducing the volumes consumed and produced while maintaining jobs will only be possible if the quality – and thus the labour intensity – of the production increases at each stage of the value chain.***

Finally, decreasing the production of dairy is a sizeable challenge in a context where the end of dairy quotas in 2015 has led to a continuous increase in production in most EU countries and at the EU level. At both farm and processing levels, the sector is more and more polarized, with small farms and dairies producing differentiated milk and dairy products, and large farms and dairies turning towards the production of commodified products. At the processing level, the bulk of the production is clearly handled by large companies, although the sector is still mainly composed by a vast number of SMEs. While companies from 0 to 19 employees represent 85% of the total number of enterprises, they only represent 24% of all jobs at the EU level and, depending on the countries, 2 to 5% of the value created in Germany, the Netherlands, France or Ireland (Eurostat). A decrease in volumes could thus mean either that large facilities continue to process the same amount of milk and most SMEs just disappear; or that fluxes passing through SMEs *vs* large facilities are rebalanced, favouring at the same time a re-territorialization of agrifood chains and a greater labour intensity of the production (hence providing more jobs overall) – but raising in the same time significant questions regarding stranded assets and price competitiveness on export markets (in a context where the EU exported 28% of its production in 2018).

[5] On this point, the question of genome editing/new breeding techniques (NBTs) has been put on the table as a way to deliver more productive and resistant yields, but this constitutes a controversial discussion at the European level (the regulatory framework on GMOs currently prohibits the use of NBTs in Europe).

# THREE ISSUES OF POLICY CHANGE

## Policy Challenge 1

***Public intervention is needed to support changes in food practices, notably by acting on consumers' food environment. To this end, policy-makers must mobilize a wide array of policy tools (public procurement, marketing regulation, education, regulatory incentives towards retailers, etc.).***

Given the intertwined challenges at play in each food value chain, the protein transition will require cross-cutting changes at three complementary levels of the policy framework. Firstly, while there are indications that evolutions in consumer perceptions are already happening in Europe[6], public intervention is clearly needed to support changes in food practices[7], notably by acting on the consumer's food environment[8]. FVC actors have pointed out the importance of public procurement policies to align cafeteria menus on sustainable healthy diets as well as the role of public education to raise awareness amongst younger generations. In this respect, local governments and citizen organizations have a key role to play in developing local initiatives (while advocating for changes at the EU level). Beyond that, other options pertain to marketing regulation, fiscal measures or the provision of more adequate information on sustainable healthy diets, notable through harmonized dietary guidelines at the EU level.[9] While some of these measures were once considered to be part of the F2F strategy, they have eventually been dropped and generate intense debates between stakeholders. Moreover, the potential role of retailers in guiding consumers towards more sustainable options (e.g., by increasing the availability on shelves of alternative products while reducing the offer of unsustainable options) is also a matter of discussion. In a competitive context where retailers risk losing clients and market shares, such market moves will likely remain limited without regulatory incentives or obligations.

## Policy Challenge 2

***Levelling the playing field and harmonizing market rules is of absolute necessity for EU actors to raise their level of sustainability and fairness without being at risk of losing market shares or profitability.***

Secondly, the issue of market organization is also key to enable the transition. European food value chain actors currently operate in a context characterised by strong competition, both on the internal EU market and internationally. Getting to a sufficient level of price competitiveness is absolutely required for them to thrive in such a context. However, given that fiscal, social and environmental rules are not fully aligned between countries, this often result in a "race to the bottom". Levelling the playing field and harmonizing market rules is therefore of absolute necessity for EU actors to raise their level of sustainability and fairness without being at risk of losing market shares or profitability. This holds true not only at the international level, but also on the Common Market.

This issue raises several questions, in particular with respect to the criteria on which to base standards. For instance, would a climate metrics based on carbon footprint be sufficient? Would it be necessary to go beyond standards based on intrinsic quality of products to also reflect production process and methods (PPMs) in order to better account for key environmental and social issues?10 Given the international context of discussions on trade, it is unlikely that such changes could be approved in a near future through a multilateral process.

Competition rules and how they are currently applied in the EU are also a matter of reflection, as they have previously proved to limit the potential coordination between value chain actors in favour of greater sustainability.[11] Adjusting them to enable an alignment between actors on key

[6] de Boer J. & Aiking H. (2018). Prospects for pro-environmental protein consumption in Europe: Cultural, culinary, economic and psychological factors. *Appetite*, 121, 29-40.

[7] Scientific experts mandated to advise on how best to implement the Farm2Fork strategy indicated that changes in the consumer's food environment (beyond the sole provision of information) was clearly needed to foster changes in food practices. See on this: Chief Scientific Advisors (2020). *Towards a Sustainable Food System. Moving from food as a commodity to food as a common good*. Brussels, European Commission – Scientific Advice Mechanism.

[8] According to the HLPE (High-Level Panel of Experts on Food Security and Nutrition), the food environment is defined as 'the physical, economic, political and socio-cultural context in which consumers engage with the food system to make their decisions about acquiring, preparing and consuming food." (HLPE, 2017)

[9] Capacci S., Mazzocchi M., Shankar B., *et al.* (2012). Policies to promote healthy eating in Europe: a structured review of policies and their effectiveness. *Nutrition Reviews*, 70 (3), 188-200.

[10] Gaines S.E. (2002). Processes and Production Methods: How to Produce Sound Policy for Environmental PPM-Based Trade Measures Symposium: Trade, Sustainability and Global Governance. *Columbia Journal of Environmental Law* (2), 383-432.

[11] Bos J.M., van den Belt H. & Feindt P.H. (2018). Animal welfare, consumer welfare, and competition law: The Dutch debate on the Chicken of Tomorrow. *Animal Frontiers*, 8 (1), 20-26.

## Policy Challenge 3

***Aligning the CAP with the Green Deal and Farm to Fork objectives will prove critical to enhance the environmental sustainability of food production.***

sustainability and fairness criteria is needed and discussions have already begun on this question in order to align competition rules with the Green Deal.[12]

Finally, a sustainable transformation of the European food system will not be possible without significant changes at the level of agricultural policies. Aligning the CAP with the Green Deal and Farm to Fork objectives (in terms of reduction in GHG emissions but also fertilizer application and pesticide use, etc.) will indeed prove critical to enhance the environmental sustainability of food production. To this end, a major question pertains to whether the definition of the ecoschemes as per pillar 1 will be ambitious enough in all member states to meet the F2F objectives. Although the current negotiations may foster incremental evolutions in the right direction, there seems to be a significant gap between the ambition of the F2F and the concrete measures that are being implemented through the CAP. In addition, policy tools that could support specific productions in a targeted manner (i.e., coupled subsidies and quotas) could be mobilized to support protein crops or limit animal productions; their use vis-à-vis WTO rules would indeed be justified through the environmental objectives they fulfil.

# CONCLUSION: A MATTER OF COLLECTIVE ACTION

## Collective Action

***The protein transition will depend on the collective action of actors within food value chains: policy makers and economic actors can no longer pass the buck to each other or wait for consumers to drive the change. Each and every actor of the system needs to move in the same direction to create cumulative effects and ultimately overcome the macro socio-political lock-in of our food system.***

The considerable challenges underlying the protein transition often lead FVC actors to pass the buck and designate one another as responsible for making the first move and driving the change. This is a result of the (real or perceived) risks – be they economic or political - associated to engaging in long-term strategic changes. In the case of private businesses (producers, processors, retailers), unilateral action to change production or supply may jeopardize their economic profitability. On the other hand, decision-makers can suffer from political backlash or private actors' opposition when proposing ambitious policies. As a consequence, both public and private actors turn to consumers who, in turn, condemn their reluctance to change the food system in which they are embedded. To overcome this unfortunate deadlock, simultaneous action must be taken at all levels of the food system to foster a cumulative effect towards change. Value chain actors and policymakers will have to raise their ambition to respond to citizens' pressure by working at two levels: firstly, by developing niche initiatives within specific value chains and connecting them together to reinforce their joint impact (e.g. structuring domestic supply chains for protein crops, promoting the integration of plant-based meals in schools at the municipal level); and secondly, by collectively exerting pressure on the current political and economic framework in which they operate.

## Key sources for further information

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**Box 2: Participants to the VALUMICS Workshop Series**

This document is the outcome of a workshop series dialogue carried out from November 6th 2020 to January 12th 2021 in the framework of the VALUMICS project, to which the following stakeholders took part and contributed:

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VALUMICS
Food Systems Dynamics

H2020 VALUMICS Project

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

**Research findings and Policy brief**

**September 2021**

## Combining environmental and social objectives

***The recent Farm2Fork strategy highlights the importance of carrying out a "just transition" of the European food system that brings "environmental, health and social benefits, offer(s) economic gains (… and) a sustainable livelihood for primary producers".***

## Methodological developments

***An innovative methodological framework based on two original models has been developed to explore under what conditions the transition of the French dairy and wheat value chains may be both environmentally sustainable and socio-economically viable in terms of farm income and farm and agroindustry employment.***

## Introduction

Given the current ecological crisis, European food value chains must undergo profound transformations to become more sustainable. However, meeting environmental objectives must also go hand in hand with creating a socially fair and economically viable food system. The recent Farm2Fork strategy highlights the importance of carrying out a "*just transition*" that brings "environmental, health and social benefits, offer(s) economic gains (… and) a sustainable livelihood for primary producers"[1]. Key socio-economic challenges concern the improvement of farm income and the preservation of jobs in the agricultural and agri-food sectors.

In this context, an innovative methodological framework (based on two original models - MoFOT and an Agent-Based Model) was developed as part of VALUMICS WP7 and WP8 to explore a central question: under what conditions may the transition of the French dairy and wheat value chains be both environmentally sustainable *and* socially fair and economically viable? To this end, the modelling work assesses the socio-economic impacts and policy implications of two contrasting "transition pathways" of the food system:

- A *global market-led scenario* which focuses exclusively on resolving climate issues, without questioning the general market dynamics of concentration/specialization processes underway in the food system. Decarbonization is carried out by the strictly necessary modifications in the political framework and the technical-economic organization.
- A *local policy-led scenario* which sets more ambitious and comprehensive objectives from the outset on all issues at stake (climate, biodiversity, health, employment) and envisages important shifts in the economic strategies of value chain operators.

The impacts of these distinct scenarios on three socio-economic challenges are assessed: (i) agricultural income, (ii) agricultural employment, (iii) and employment in the agri-food sector. Comparing the two scenarios helps to identify a certain number of key policy issues to ensure the deployment of a just transition of the food system.

## An innovative methodological framework

The effective inclusion of socio-economic issues in the dialogue on the sustainable transformation of the European food system is currently obstructed due to considerable methodological difficulties. Indeed, the models with the ability to capture socio-economic impacts are only capable of understanding marginal changes to the food system: in other words, they cannot deal with scenarios involving biophysical breakthroughs, although such scenarios are necessary if we are to achieve carbon neutrality. Conversely, models that provide a robust

[1] European Commission. (2020). *Farm to Fork: For a fair, healthy and environmentally friendly food system.*

representation of the biophysical transformations that would keep the food system within planetary boundaries are unable to capture the socio-economic impacts. Furthermore, most biophysical models are incapable of accurately capturing the challenges of preserving biodiversity in agricultural landscapes, and generally focus on the challenge of decarbonization alone[2]. As a result of these methodological difficulties, the debate is dominated by single-issue visions (most focusing on climate), that are far removed from the concept of sustainable development, which by definition is a multi-issue subject.

In this context and in order to ongoing debates, two original models were developed that combine biophysical modelling of the food system with an understanding of market dynamics from two complementary angles: that of value chain actors' economic strategies at every link in the chain; and that of the policies that influence market balances, targeting supply, demand or the ways in which the two come together. The first model, MoFOT, analyses the evolution of two sectors of the French food system: dairy and the COP (Cereals, Oilseeds and Protein crops) sector. These were chosen for their importance in the functioning of French agriculture: representing 70% of the Utilized Agricultural Area (UAA), 52% of value creation in agriculture, and 40% of value creation in the food industry. The Agent-Based Model (ABM) was developed specifically for the French wheat-to-bread value chain.

Starting from the same indicative decarbonization pathway at the scale of French agriculture, the two methodological frameworks explore two contrasting scenarios for the French food system to reach a common climate goal. At the biophysical level, they take as a starting point (for both scenarios) the projections for agriculture contained in France's National Low-Carbon Strategy (SNBC), published in 2020 by the Ministry of Ecology[3], which aims to halve greenhouse gas (GHG) emissions from the agricultural sector by 2050. These projections are based on a physical/agronomic representation of French agriculture, on a 5-year time scale, in terms of surface area, livestock, yields and associated production.

## Two different transition pathways

***The socio-economic impacts and policy implications of two contrasting "transition pathways" of the food system were assessed:***

***- The global market-led scenario focuses exclusively on resolving climate issues, without questioning the general market dynamics of concentration/specialization processes underway in the food system.***

***- The local policy-led scenario sets more ambitious and comprehensive objectives on all issues at stake (climate, biodiversity, health, employment) and envisages important shifts in the economic strategies of value chain operators.***

## Contrasted transition pathways of the French food system

The global market-led scenario is primarily based on a policy framework in which climate issues prevail over all others, and in which the transition depends first on supply side policies, without any notable interventions on market organisations or on the demand. Such a scenario is likely to increase the polarisation of the food system at all levels—from the producer to the consumer—, between highly sustainable but poorly accessible niche markets and modes of production based on price competitiveness. This results in the continued concentration of supply to achieve efficiency gains and to reduce production costs. In terms of demand, the shift towards lower meat consumption continues, but very unevenly within the population; the consumption of highly processed foods with no direct link to their agricultural origin remains stable, or even increases.

On the contrary, the local policy-led scenario takes the European Farm to Fork Strategy announcements seriously and assumes ambitious changes at all levels in modes of production and consumption: accompanied by ambitious mechanisms, demand shifts in favour of more local, seasonal, and minimally processed products, while animal protein intake continues to diminish. In terms of production, the agricultural link is encouraged within relative despecialisation processes that also help to slow the pace of concentration and to rediversify agricultural systems and landscapes. At the level of the agri-food sector, a less concentrated "Italian style" system is established, giving VSEs and SMEs growing importance in the overall

[2] Searchinger T.D., Wirsenius S., Beringer T., *et al.* (2018). Assessing the efficiency of changes in land use for mitigating climate change. *Nature*, 564 (7735), 249-253.; Lóránt A. & Allen B. (2019). *Net-zero agriculture in 2050: how to get there?* Brussels, Report by the Institute for European Environmental Policy, 41 p.

[3] MTES. (2020). Stratégie nationale bas-carbone : La transition écologique et solidaire vers la neutralité carbone.

economic structure of the sector. The labour intensity of production is higher here, being less standardized and more connected to agricultural production

*Table 1. Overview of the assumptions for each scenario (source: authors)*

| Component | Variable | Local policy-led scenario | Global market-led scenario |
|---|---|---|---|
| Dietary practices | Dietary composition | Sharp reduction in proportion of animal protein from 63% to 50%, increase in fruit and vegetables | Small reduction in animal protein intake (from 63% to 55%), stagnation in fresh fruit and vegetable intake |
| | Product type | Decrease in proportion of ultra-processed food, increase in proportion of local and region-specific food | Continued increase in proportion of ultra-processed foods, limited emphasis on local production |
| | Willingness to pay | Slight increase | Decline |
| Organization of agrarian systems | Level of farm concentration | Stabilization | Continued concentration |
| | Level of farm specialization | Re-diversification | Specialization continues |
| | Level of crop-livestock connection and of territorial specialization | Relative reconnection of crop and livestock farming on territories (or even on the farms) | Territorial specialization stabilizes at the 2015 level |
| Agro-industrial complex | Relative importance of the $AFI_{Upstream}$/$AFI_{Upstream\text{-}Downstream}$/ $AFI_{Downstream}$ | $AFI_{Upstream\text{-}Downstream}$ become more important, employment intensity increases in some sectors | Continued strong separation of $AFI_{Upstream}$ / $AFI_{Downstream}$, employment intensity decreases due to specialization |
| | Relative importance of small/medium/large entities in processing agri-food volumes | Rebalancing of the relative importance of small businesses in terms of employment and total output | Continued polarization of the agri-food complex; |

## Contrasted socio-economic impacts

**Agricultural employment**

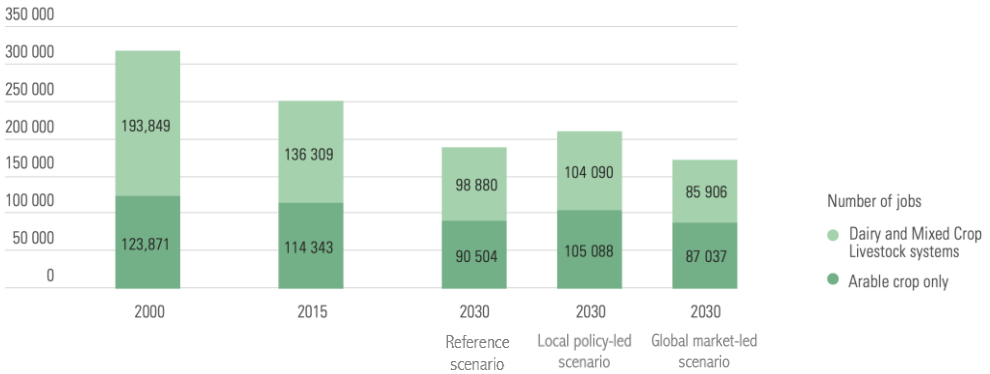
The first major result is that the local policy-led scenario could maintain more jobs than a continuation of the current trend by reducing the rate of farm loss, without a decline in income – despite the reduction in total production. About 28,000 farms and 20,000 jobs could be maintained in the sectors studied (dairy and arable crops) compared to the current trend. This is possible due to the evolution of the global context, which is more favourable to the development of new strategies for diversification and for more upmarket products.

On the other hand, in the global market-led scenario – that is, in a context where price competitiveness is strengthened, and political support focuses only on the mitigation of climate change - the majority of strategies would lead to a highly significant reduction in the number of jobs through a reinforcement of capital/labour substitution, with major risks for income levels. The increase in labour productivity is the main factor of competitiveness in this context. It is estimated that the global market-led scenario would lead to the loss of 9,500 farms and 16,500 jobs compared to current trends.

### Impacts of the global market-led scenario

- ***a 10% reduction in agricultural jobs compared to current trends, due to continuing concentration and an increase in the capital intensity of farms***
- ***a risk of income loss for farmers in the absence of compensation, especially because of increased debt levels***
- ***and job losses in the agri-food sector reaching 12% of current jobs.***

*Figure 1. Change in job numbers in farming systems in 2030*




*Source: RICA, processed by IDDRI*

## Impacts of the local policy-led scenario

- ***agricultural employment is 10% higher compared to the business-as-usual trends, despite a drop in volumes produced***
- ***farm income is maintained without increasing the price of agricultural raw materials***
- ***jobs in the agri-food industry increase by 7% while offering more diversified and less processed foods.***

**Farm income**

The local policy-led scenario puts the emphasis on obtaining good value from production while reducing costs. Investments and supply costs are limited in "self-sufficient" type systems, but labour income is high compared to the level of production, and the monitoring of new standards can lead to significant costs for the farmer. Having a high premium is then fundamental to ensuring a farm's economic viability. The share of value added dedicated to labour remuneration increases from 48% to 58% for the dairy sector and from 51% to 64% for the arable sector. If wages remain constant, dairy farms would generate a surplus of 0.55 billion euros, which represents an increase in wages of 28% (from 1.2 to 1.5 times the minimum wage), or the hiring of 24,000 workers at constant wages (1.2 times the minimum wage).

Contrastingly, in the global market-led scenario, the dominant strategy is to increase competitiveness through a reliance on economies of scale and high-volume production. The increase in production capacity leads to significant investment needs which take up a large part of the expense account (amortization and depreciation). The viability of the system then depends on maximizing the volume produced per AWU (Annual Working Unit), which makes it possible to limit wage costs. The proportion of value added dedicated to labour remuneration falls from 48% to 38% for the dairy sector, and from 51% to 45% for the arable sector. At constant wages, dairy farms will have to mobilize an additional 0.54 billion euros to ensure the transition and to finance the major investments – according to our reconstruction. This corresponds to a 6% increase in milk prices or a 25% increase in subsidies.

**Employment in the agri-food industry**

The local policy-led scenario shows an increase in the labour requirement of the agri-food industry. By placing greater value on products derived from artisanal producers who implement strategies of differentiation, combined with an increase in investment for secondary and tertiary industrial processing, this scenario forecasts an increase in the number of jobs in the agri-food industry for the COP sector (6%), and in the dairy sector (12%).

The global market-led scenario shows the opposite trend. The increased specialization of the French agro-industrial complex leads to a reduction in the number of agri-food jobs in the COP sector (10% decrease) and the dairy sector (11% decrease). This decline in the number of jobs is the result of two trends. Firstly, there is a decrease of between 5% and 10% in the employment intensity of all sub-sectors compared to 2015, due to the large-scale adoption of strategies of concentration and economies of scale. Secondly, the product mix evolves towards industrial sectors that are characterized by lower employment intensities because they are less linked to production in VSEs and SMEs.

# Policy conditions

All in all, the modelling results demonstrate that a climate-focused transition pathway based essentially on a change in supply-side policies but with minor interventions on demand and market organization, would have significant socio-economic impacts. In contrast, the results of the local policy-led scenario for the two sectors studied make credible the hypothesis of a just transition of the food system. The economic viability of such a scenario depends, however, on a simultaneous transformation of supply, demand and market organization - and therefore on major policy changes in these three areas.

**In terms of demand,** the current consumption dynamics in France and Europe carry encouraging yet weak signals for transition issues (a reduction in the consumption of animal proteins, an increase in the share of organic food, demand for local products). However, changes in the average food basket mask disparate food practices, partly related to the increasingly insecure situation of more and more consumers, for whom any increase in the food budget (whether in euros or in time) would be inconceivable. Substantial interventions are therefore needed to accompany practice changes and to make healthy, sustainable food more accessible. Although many possible measures have been under discussion, sometimes for a number of years, their widespread deployment now comes up against strong opposition, especially in the name of "consumer freedom".

## Key policy challenges

***The economic viability of a "just transition" of the food system will depend on major policy changes :***

- ***a proactive approach to demand at the national level, mobilising a wide range of tools and making the healthiest and most sustainable choice the most obvious one for consumers***

- ***a convergence of visions between European Union member states, to ensure the implementation of national strategic plans in the context of the Common Agricultural Policy setting comparable objectives and production conditions for producers***

- ***an ambitious approach to international trade to foster and accompany the adoption of ambitious production standards.***

**In terms of market organisation,** the challenge is twofold. First, it is necessary to create more convergence between the different member regarding how best to decarbonize the European food system. This will prove necessary to avoid increasing competitiveness gaps, given in particular the differences that already exist between member states. Although this is a complex task, the existing institutional frameworks can help to organise such discussions. But beyond this, the challenge is also to harmonise production conditions with non-European producers or, failing that, to at least temporarily protect the European market in order to avoid "carbon leakage" or limiting the potential for development of key sectors for the transition, such as protein crops, which are currently struggling to expand due to almost unbeatable competition from American soya (from both North and South America). The ongoing discussions on the carbon border adjustment mechanism could help to address these issues, but there is no doubt that they will prove difficult to resolve. More generally, as the leading exporter and importer of food products in the world, the European Union could and should be a source of proposals to implement ambitious standards towards more sustainable modes of production and consumption, and to advance these issues not only in the bilateral agreements it signs, but also at the level of the WTO.

**In terms of policies to support the agricultural sector,** the ongoing reform of the Common Agricultural Policy should help to align the member states' visions at the agricultural level through an accountability mechanism for the national strategic plans organised at the Council level; to be truly effective, it should nevertheless be accompanied by binding targets for states, an option so far rejected by the Council and the Parliament. At the food processor level, the development of environmental labelling, which is currently being tested in France, and the implementation of nutritional labelling throughout Europe should be encouraged as a follow up of the F2F: not only do they have an impact on consumer choice, but they are also a powerful means of transforming supply itself, through the explicit benchmark they provide for producers, which then helps to produce positive competition between economic operators.

The above-mentioned policy changes are largely a European matter. Therefore, they require an alignment of views on the transformation of the European food system among Member States in the European Council, which can only happen if there is a simultaneous push by the Commission, the Parliament and civil society. The establishment of a legislative framework for a sustainable food system, anticipated by the "Farm to Fork" strategy by 2023, may provide the opportunity for such an alignment - in a context where the current negotiations on the post-2020 CAP show significant divergences.

## Key sources for further information

To discuss the research presented in this brief, please email pierremarie.aubert@iddri.org

Aubert, P.-M., Gardin, B., Alliot., C., (2021). Vers une transition juste des systèmes alimentaires : enjeux et leviers politiques pour la France, Iddri.

Aubert, P.M., Huber, E. (2021). Final set of scenarios, including transition pathways and modelling work used to test their plausibility. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. Deliverable: D8.3, The Institute for Sustainable Development and International Relations (IDDRI), Paris, 53 pages. DOI 10.5281/zenodo.5515867

Aubert, P.-M.; Gardin, B.; Huber, É.; Schiavo, M.; Alliot, C. Designing Just Transition Pathways: A Methodological Framework to Estimate the Impact of Future Scenarios on Employment in the French Dairy Sector. Agriculture 2021, 11, 1119. https://doi.org/10.3390/agriculture11111119

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## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

Coordinating partner: University of Iceland, Dunhagi 5, Reykjavik, Iceland – https://www.valumics.eu

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# Transition pathways towards more sustainable salmon aquaculture

**Research Findings and Policy Brief**

**September 2021**

## Transition pathways and governance

***This brief summarises key findings from exploration of transition pathways for salmon aquaculture based on integration of Multi Level Perspective framework and an adapted Global Value Chain governance framework for the salmon value chain***

## Farmed salmon

- ✓ ***Efficient sea-based production system***
- ✓ ***Salmon an important source of nutrients in healthy diets***
- ✓ ***Demand more than supplies***
- ✓ ***Producer driven value chain***

## Key challenges

- ✓ ***Sea lice, disease, escape, eutrophication, algal blooms, climate change,***
- ✓ ***Public image***

## Sustainability transitions of food systems

An understanding of the dynamics of sustainability transitions, how they come about and evolve, drivers of change and structural inertia, can assist policy makers in their quest to bring about wide-ranging system transformations. Various transition theory frameworks have been developed and applied, but the Multi-Level Perspective (MLP)[1] is one of the more prominent ones and has been applied to various integral socio-technical systems including food. While the MLP framework includes policy as one dimension of the socio-technical regime, the role of power and politics in shaping transitions of socio-technical systems, mainly in the form of resistance to change has been under-theorized.

In order to focus more on actors' motivation or resistance to change, this study incorporated elements of governance analysis based on an extended GVC governance model[2] which was adapted to salmon[4] and applied with the MLP framework thus resulting in an integrated theoretical framework for analysing transitions.

## Salmon aquaculture and governance

Sea-based salmon aquaculture is one of the most advanced and most efficient animal-based food supply chains. Salmon is a rich source of protein, healthy fats and micronutrients necessary in the promotion of healthy diets. There are, however, several local environmental impacts associated with sea-based salmon aquaculture, such as sea lice, escapements, disease, eutrophication, and algal blooms as well as carbon emissions from the whole value chain e.g., in relation to feed production and transportation of feed and products.

The governance structure of a value chain provides information about interfirm relations and power dynamics within the chain. The Global Value Chain (GVC) governance model[3] was used in the VALUMICS project to study the governance forms in food value chains, including the salmon aquaculture value chain. The governance of the global salmon value chain is a hybrid of national state led governance and voluntary third-party certifications and the inter-firm relationships can vary from free market exchanges to a hierarchy governance of integrated firms. The large integrated salmon firms are typically owned by the producers who drive technical innovation. Structural changes through mergers and acquisitions provide large producers an advantage of scale and they appear to have a strong bargaining power against the supermarkets, the lead firms in the value chain (Olafsdottir et al., 2019a,b; D5.1).

The powerful position of aquaculture producers and the mutual dependencies of business actors, aiming to maximize their profit, and the government, depending on businesses to provide jobs, tax payments and economic growth, highlights the importance of considering the role of power and resistance or motivation to change in transition studies.

[1] Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy*, *36*, 399–417. doi:10.1016/j.respol.2007.01.003
[2] Gereffi, G., & Lee, J. (2016). Economic and social upgrading in Global Value Chains and industrial clusters: why governance matters. *Journal of Business Ethics*, *133*(1), 25–38. doi: 10.1007/s10551-014-2373-7
[3] Gereffi, G., Humphrey, J. & Sturgeon, T., (2005). The governance of global value chains. Review of International Political Economy, 12(1), pp.78–104.

## Stakeholders´ views

***Industry and expert interviews and focus groups were conducted which provided information about the farmed salmon value chain in the context of the MLP framework.***

## Current regime

***Governance structure affords flexibility and capacity for adjustment through incremental improvements***

## Power asymmetries and vested interest in current regime

***The governance structure of the farmed salmon value chain points to power asymmetries. Large integrated producers are in a powerful position in the chain and are heavily invested in the traditional form of sea-based salmon farming***

## Landscape pressures

- ✓ ***Climate change***
- ✓ ***Supply & demand***
- ✓ ***Global crisis***

# Integrated framework for analysing transitions

The findings from the study as depicted in Figure 1 highlights the most prominent macro-trend developments and pressures (the socio-technical landscape), the current state of the value chain (the socio-technical regime), and the various solutions (niche-innovations) currently under development. The previous governance analysis of the farmed salmon value chain[4] the interactions between the different levels and specifically the reactions of the current regime to landscape pressures were placed in a value chain governance perspective and looming niche-innovation breakthroughs.

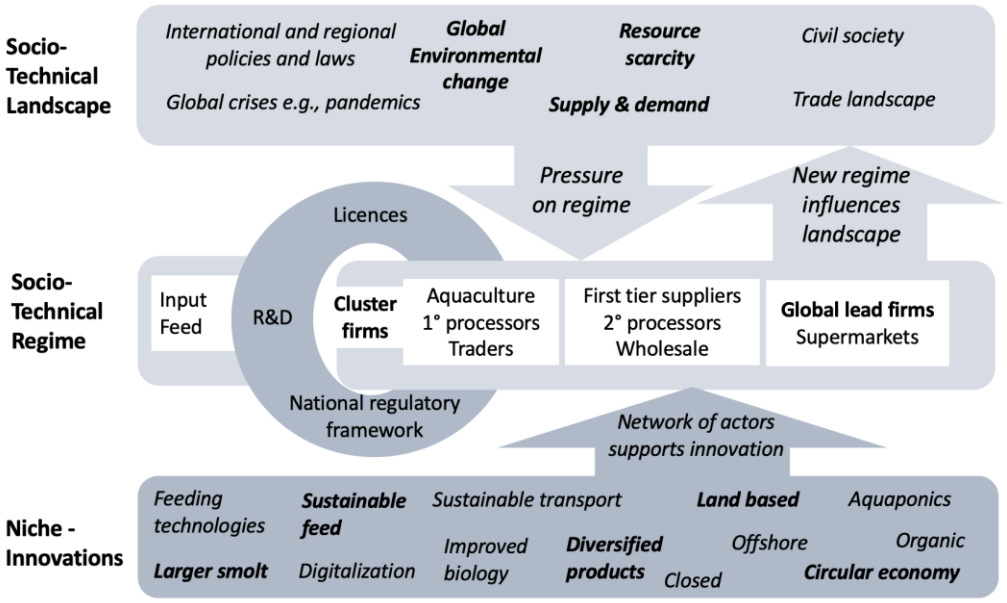


**Figure 1.** Summary findings through the integrated framework (based on existing frameworks[1,2,4] ) Source: Gudbrandsdottir et al., 2021

In terms of innovation and industrial development, the success of salmon farming in Norway is based on close cooperation between industry actors, governmental bodies and research institutes which contribute to a strong cluster. The hybrid form of governance, which is a mix of traditional state-based regulations (such as licenses) and voluntary instruments (such as certifications), indicates flexibility and ability to adjust. There are powerful value chain actors and networks of actors with vested economic interests in sustaining the current regime. Specifically, large integrated producers are in a powerful position in the chain, and they are heavily invested in the traditional form of sea-based salmon farming. Their hybrid governance structure also makes it easier for them to adjust to landscape pressures through incremental adjustments (symbiotic niches) to the prevalent technology of open net pens.

# Concluding remarks on transition pathways

Although landscape pressure, specifically related to global environmental change and changing consumer preferences, seems to be reasonably high and on the rise, it continues to be offset by the resistance to change by powerful actors in the regime and their ability to adapt and align their production network enough to alleviate some of the pressure. Furthermore, competitive niche-innovations, such as land based, and offshore farming systems, do not seem to be sufficiently developed to compete with the highly efficient traditional sea-based farming systems. Therefore, a gradual transformation towards more sustainability within the current regime with, mainly, regime driven innovations and refinements is the most likely future.

[4]Olafsdottir, G., Mehta, S., Richardsen, R., Cook, D., Gudbrandsdottir, I.Y., Thakur, M., Lane, A. and Bogason S.G. (2019b). Governance of the farmed salmon Value Chain from Norway to the EU. *Aquaculture Europe 44* (2): 5-19.DOI: https://doi.org/10.5281/zenodo.5494436

## Niche-innovation development

***Competitive niche-innovations (e.g., land-based on-growing) are currently insufficiently developed to compete with highly efficient sea-based net pen systems***

From a food system perspective, salmon constitutes a healthy source of animal protein with relatively lower environmental impact compared to other animal protein sources. No niche so far can resolve the reliance of farmed salmon on feed ingredients from plant or marine-based proteins, and alternative feed sources come with their own drawbacks and possible unintended consequences. For salmon aquaculture to grow sustainably, livestock pressures on the environment due to feed provision would have to be achieved concurrently. Moreover, no single niche innovation as identified here adequately addresses the various sustainability challenges of the farmed salmon value chain. In addition, most of the policy-making focus has been on the production-side while there are several opportunities to address large sustainability challenges along the entire value chain e.g., through value-added activities and reduced reliance on air freight at the transportation stage.

## Policy Recommendations

✓ ***Broadening stakeholders' perspectives, in particular policymakers and NGOs, and reframing aquaculture challenges in a food system perspective is important for transitioning the industry towards more sustainability. The whole salmon value chain and its role in the wider food system must be considered when assessing sustainability outcomes***

✓ ***Seafood has an important role to play in sustainable and healthy diets due to its nutritional profile and its relatively lower environmental footprint than most of livestock production. Integration of fish in food policy especially in relation to the protein transition, i.e., reducing the amount of animal proteins in diets, is crucial.***

## Key sources for further information

This brief highlights results from the VALUMICS salmon case study analysis as reported in the deliverables and publications listed below. To discuss the research presented in this brief, please contact respective authors:

*Contributing VALUMICS partners and authors:*


- University of Iceland, *Contacts*: Gudrun Olafsdottir, go@hi.is,; Nina Maria Saviolidis nms@hi.is; Ingunn Yr Gudbrandsdottir iyg1@hi.is; Sigurdur G Bogason sigboga@hi.is
- SINTEF Ocean, Norway, *Contact*: Maitri Thakur, maitri.thakur@sintef.no


**Deliverable report:**


Olafsdottir, G., Mehta, S., Richardsen, R., Cook, D., Gudbrandsdottir I. Y. Thakur, M., Lane, A. and Bogason S. G (2019a) Governance of the farmed salmon value chain from Norway, Chapter 7. *In* Barling, D. and Gresham, J. (Eds.) (2019) Governance in European Food Value Chains. VALUMICS "Understanding Food Value Chains and Network Dynamics", funded by European Union's Horizon 2020 research and innovation programme GA No 727243. **Deliverable: D5.1**, University of Hertfordshire, UK, 237p. https://doi.org/10.5281/zenodo.4956324


**Scientific publicationsArticles and on-line webinars:**


Gudbrandsdottir, I.Y., Saviolidis, N.M., Olafsdottir, G.; Oddsson, G.V., Stefansson, H., Bogason, S.G. (2021). Transition pathways for the farmed salmon value chain: industry perspectives and sustainability implications. Sustainability 13, no. 21: 12106. 2021, https://doi.org/10.3390/su132112106

Olafsdottir, G., Mehta, S., Richardsen, R., Cook, D., Gudbrandsdottir, I.Y., Thakur, M., Lane, A. and Bogason S.G. (2019b). Governance of the farmed salmon Value Chain from Norway to the EU. Aquaculture Europe 44 (2): 5-19. DOI: https://doi.org/10.5281/zenodo.5494436. Available at: https://valumics.eu/wp-content/uploads/2019/10/Valumics-AES-vol44-2-sept2019.pdf

Gudbrandsdottir, I. Y, Saviolidis, N.M., Olafsdottir, G., & Bogason, S. G. (2021). *Transition pathways for the farmed salmon value chain.* Online presentation at: https://valumics.eu/final-event/



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# Exploring the governance and fairness in Vietnam's milk value chain

**Research Findings and Policy Brief**

**September 2021**

## Key message

***This brief presents the main outcomes from a study of exploring governance and fairness issues in Vietnam's milk value chain, and the policy implications for upgrading the supply chain.***

## Research methods

***This study uses the global value chain governance model and a qualitative framework. Data is collected from existing literature and from exploratory interviews.***

## 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 and potential fairness in the long term. Vietnam has various regulatory interventions and these have positive and significant influences on the fairness, welfare, sustainability, and governance in the milk supply chain. However, not all farmers have benefitted from these policies and measures regarding fairness and welfare should be diverse, gradual, and inclusive.

*Source of picture: Vinamilk (2021)*[1]

## 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, has been reconstructed from a planned system to a socialist-oriented market system with a competitive market. Since then, the dairy sector has developed dynamically and become one of the most important agri-food sectors with providing diverse dairy products for the domestic market, creating jobs and incomes for farmers, and gradually replacing imported dairy products. In 2018, Vietnam is the sixth biggest milk producer in Asia and the second-largest producer in ASEAN with the dairy production of about one million tonnes, and an average growth rate of

[1] Vinamilk (2021). https://www.vinamilk.com.vn/

14.4% between 2010 and 2018[2]. The dairy revenue reached over €4 billion in 2018, accounting for an average growth rate of 13.6% from 2013 to 2018[3]. Vietnam's milk consumption has increased and reached 2.6 billion litres in 2018, accounting for about 10% of the total food expenditure[4]. In 2018, the local dairy production covered only 40% of its domestic demand, with the rest of demand met by imports. Vietnam also exports dairy products to 43 countries, mainly infant milk formula, with the value of over €110 million in 2018[5]. Although Vietnam's milk sector has experienced rapid growths in milk production, demand, and trade, dairy farmers have still faced various internal disadvantages and external challenges.

## Milk value chain analysis

The milk value chain in Vietnam is primarily created from core actors of farmers, cooperatives, processors, distributors, and retailers (Figure 1). The additional actors include input suppliers, importers, exporters, government, and associations. Most dairy farmers participate in farming contracts and/or cooperatives as they cannot directly sell raw milk to retailers and end-users. Therefore, dairy cooperatives and contract farming have expanded quickly, along with the emergence of nuclear dairy farms of large enterprises. In 2018, there were approximately 300,000 cattle in Vietnam of which the number of cows producing milk stood at 200, 000 heads, and accounting for an average growth rate of 9% over the period 2010-2018[2].

There are over 60 milk processing and trading enterprises in 2019 with over 300 dairy product brands in Vietnam. The largest local dairy companies are Vinamilk, TH True Milk, Moc Chau milk, IDP, and Nutifood and the biggest foreign dairy enterprises are FrieslandCampina, Nestle, and Abbott[6]. The concentration level of the milk processing enterprises is relatively high with the largest four dairy companies (7% of the industry) accounting for over 79% of the drinking milk market share[7]including Vinamilk (55%), TH True Milk (11%), FrieslandCampina Viet Nam (7%), and Moc Chau (6%). Vinamilk is also in the top 50 biggest dairy companies in the world, ranking 36th in 2020[8].

Distribution and retail systems of the milk value chain in Vietnam consist of (1) *Traditional sale channels:* grocery store, wet shop, firms' distributor with retail points; (2) *Modern channels:* supermarket and convenience store; (3) *Online shopping channels:* Social networks (Facebook, Zalo), e-commerce shop, website; (4) *HoReCa channels:* hotels, restaurants, and canteens; (5) *Export markets:* Exporting or investment in foreign markets. The large dairy firms can have all types of these sale channels.

### Characteristics of the milk value chain in Vietnam

- ✓ ***Core actors are farmers, cooperatives, processors distributors, and retailers.***
- ✓ ***Most dairy farmers participate in farming contracts and/or cooperatives as they cannot directly sell raw milk to retailers and end-users.***
- ✓ ***Concentration level of the milk processing enterprises is relatively high.***
- ✓ ***Large dairy firms have various types of sales channels and export market.***

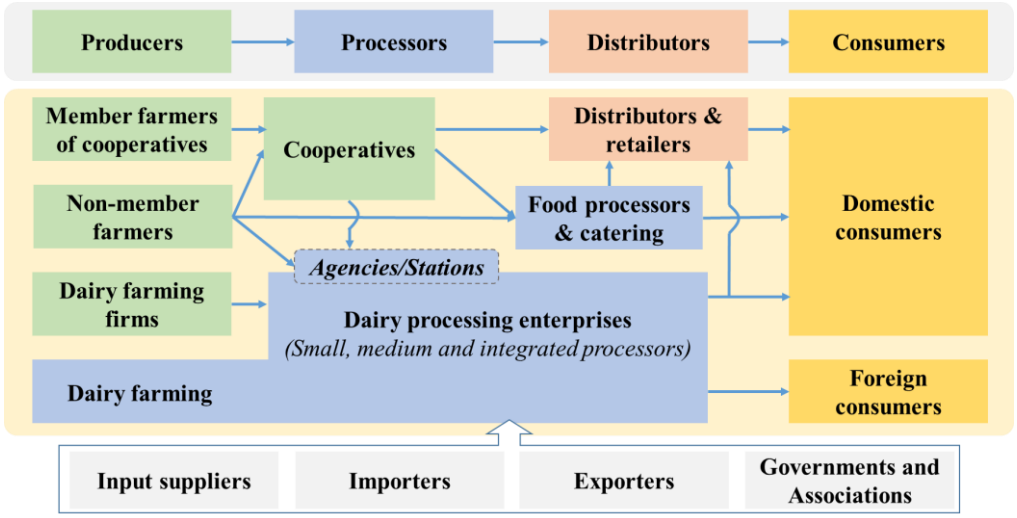


*Figure 1: The milk value chain in Vietnam*

[2] General Statistics Office of Vietnam (GSO, 2019). http://www.gso.gov.vn
[3] Babuki (2019). Vietnam's dairy market in 2018. https://babuki.vn
[4] VIRAC (2019). Vietnam Dairy Industry In-depth Report. https://viracresearch.com
[5] Nhu Huynh (2019). Vienam's dairy sector is winning and penetrate to the world market. https://vietnambiz.vn
[6] Nongnghiep (2019). Rapid increase in export of dairy products. https://nongnghiep.vn
[7] Minh An (2019). How will Vinamilk expand if they acquire GTN successfully? https://vietstock.vn
[8] Tran, V.N. (2021). Vinamilk ranks higher in top 50 biggest milk producers in the world. https://tuoitre.vn

# Governance of the milk value chain

## Global governance of Vietnam's milk value chain

Three types of dairy value chain governance are identified in Vietnam, i.e. relational model, captive model, and hierarchy model based on the global value chain governance model[9].

### Governance models

✓ ***Vietnam's milk value chain is structured alongside three governance models, i.e. relational model, captive model, and hierarchy model.***

✓ ***The global governance model of Vietnam's milk value chain has progressed through three stages since the reform in 1986.***

*Relational value chain:* Dairy farmers in an area with sufficient farming conditions may participate in a dairy cooperative with both activities of raising dairy cows and processing milk products taking place at small and medium scales. These processors only require basic quality and safety standards of raw milk. The transaction is complex since it needs trust, social and spatial proximity, family and ethnic ties to control the mutual dependence. Member farmers sell their raw milk to the dairy cooperative through a simple contract.

*Captive value chain:* Big dairy processors demand more stringent quality standards of both raising cows and milk quality. In other words, it is the high ability to codify in the form of detailed instructions for standards that requires more knowledge, skills, technique and technology, and financial capital. Thus, dairy farmers need supports, interventions, and commitment to purchase from the dairy firms. Farmers can produce higher-quality milk with the support and guide of firms. They benefit from higher prices for the higher-quality milk. As the result, dairy farmers depend on the lead processing firms and become captive suppliers. Dairy farmers and processing firms usually have a tight and official contract with clear terms of quality standards, price, quantity, support, penalty, and others.

*Hierarchy value chain:* The most upgrading, modern, and high-technology milk value chain is the hierarchy governance model where a large firm integrates almost all of the key activities such as cattle feed production, milk farming, dairy processing, and dairy products distribution. Dairy farming in this governance model usually has quality certifications with a higher specificity in comparison with other models. Meeting high quality standards (such as Global GAP and EU Organic) and achieving effective production require complex and expensive processes and practices that cannot be applied by small and scattered milk farmers.

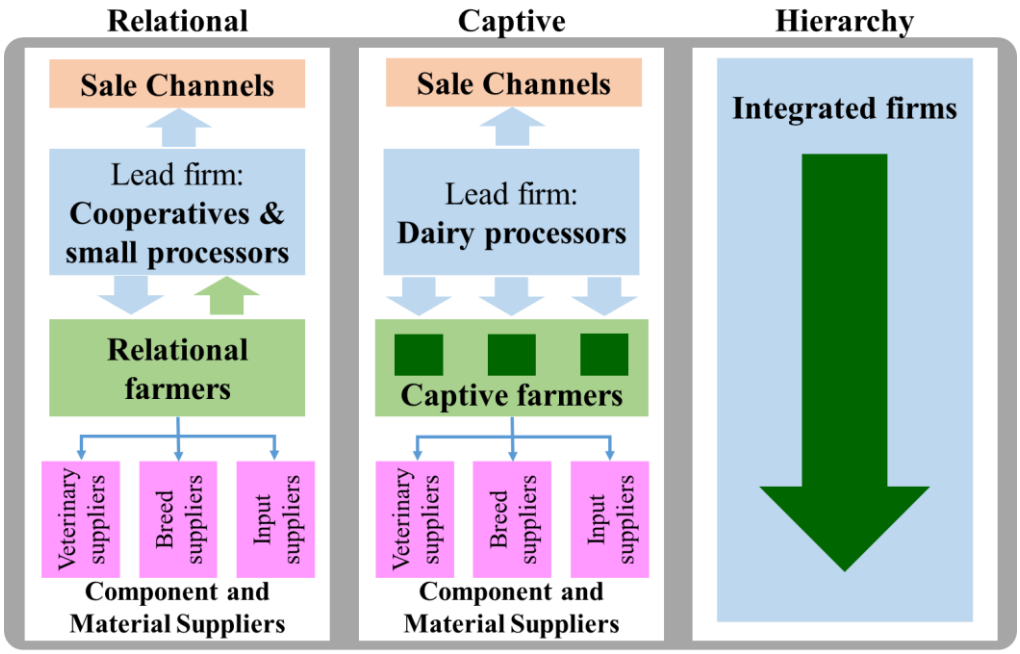


*Figure 2: Three types of cow milk value chain governance in Vietnam*

## Evolution of the milk value chain governance

Vietnam's dairy sector has progressed through three phases of building, expanding in breadth, and developing in-depth since the reforms. Accordingly, the governance models of the dairy value chain have positively changed and upgraded. *The first phase of building:* The key goal of

[9] Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of international political economy*, 12(1), 78-104.

Vietnam in this period was to meet people's basic demand for food and reduce poverty. The private and commercial dairy actors are appeared and developed. The value chain governance models are mainly market, modular, and relational. *The second phase of expanding in breadth:* Dairy farms and firms were quickly built and expanded over the country, enlarging from small subsistence farms to large-scale farms, with the support and promotion of policies under the national industrialization and modernization strategy. Large dairy state-owned enterprises are equitised, foreign dairy companies are established, private large dairy farms and firms are grown and modernized. The governance models are mainly modular, relational, and captive. *The third phase of developing in-depth*: Vietnam's dairy sector has developed in a sustainable and modern way in this period. Leading firms start merging and acquiring, building large-scale farms with high technology, modern management, and sustainable quality standards. The main governance models in this period are relational, captive, and hierarchy.

# Fairness: Price and contractual arrangements

## Fairness for farmers

✓ ***Milk farmers in Vietnam are 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 and potential fairness in the long term.***

### Fairness in the captive governance model

The contract between dairy firms and farmers is annually signed and renewed in main terms of quantity, quality standard, price, payment, and processes. The transaction milk quantity needs to reach the registered amount, and farmers need to supply the quantity stipulated in the contract. The milk prices are different and depend on the milk quality. The quality standards are measured for three main criteria such as total solids, fat content, and somatic cells. The best-quality milk gets the highest price that is usually higher than the market price; the average-quality dairy gets a medium price which is similar to the market price; and the lowest-quality milk gets the lowest price that is relatively lower than market price. The price is weekly determined by the dairy firm after collecting milk and testing quality, and then the firm pays farmers accordingly. It is supposed that the lowest price is just equal to the production cost, hence there is no profit for farmers. It is also difficult and rare for small-scale farms to achieve the best quality. In general, the contract in the captive governance model can bring more stable and higher prices for farmers, but they are the weakest link in this model, they have no power to negotiate, hence they are at the mercy of the leading firms. Farmers do need to improve milk quality and enhance capacity to successfully benefit from this type of model.

### Fairness in the relational governance model

Cooperative contracts with open and flexible terms and conditions can be characterised by higher levels of farmers' power and fairness in the relational governance model. The milk price is discussed and determined by both processing cooperatives and members, hence benefits are shared and ensure an appropriate income for farmers. The milk quality standard is at the basic level and it is controlled by two criteria: no dilution and no antibiotics. The quality testing is not very strict. Although the quality testing in this model is less stringent than that in the captive model, it is guaranteed by the high level of trust and the cohesion between cooperatives and farmers. There is only one contract price for all milk quality grades in the relational governance model. It is usually similar to the medium price of leading firms. This price mechanism is stable and good for dairy farms, especially for those of small-scales and lower milk quality.

***In summary***, the contract terms in the captive model are more standard, obligatory, and obvious than those in the relational model while the fairness and power of farmers in the relational governance model seem to be higher than those in the captive governance model. 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 more benefits and potential fairness in the long term.

## Policy impact

***Vietnam's regulatory interventions have positive and significant influences on the fairness, welfare, sustainability, and governance in the milk supply chain. However, not all dairy farmers can benefit from policies and schemes.***

# Regulatory interventions

Vietnam has become a socialist-oriented market economy with the core goals of enhancing social welfare, fairness, democracy, and civilization since the reforms. The changes in political and economic systems have led to the development of the agricultural sector and the dairy value chain in particular. To achieve these targets, Vietnam's government has implemented a series of policies, projects, and programmes to develop dairy sectors and support milk farmers. The

## Implications

✓ ***Not all farmers have benefitted from supporting policies, hence measures regarding fairness and welfare should be diverse, gradual, and inclusive.***

✓ ***The main measures can be cooperative and contract farming, farm scales, product diversity, milk quality and certification, science and technology, access to market and information sources.***

regulatory interventions have significantly and positively affected fairness, welfare, governance, and sustainability in Vietnam's dairy value chain and these interventions can be categorised into seven groups as follows:

- Developing the dairy sector in general
- Enhancing the capacity of dairy farmers and cooperatives
- Increasing the income, welfare, and poverty reduction of farmers
- Linking: cooperative and contract farming
- Improving dairy safety, human nutrition, and milk demand
- Promoting the transparency and openness of information
- Protecting the environment and animal welfare

## Policy Implications and Recommendations

Under the high pressures of globalisation, climate change, and changes in consumer behaviour, Vietnam's milk value chain has been notably upgraded in a more sustainable and modern way. The government's regulatory interventions have also had considerable influences on the fairness, welfare, sustainability, and governance in the milk supply chain. However, not all dairy farmers have benefited from these supporting policies and schemes. Thus, the regulatory interventions on enhancing of the fairness and welfare to dairy farmers should be diverse, gradual, and inclusive. The main and potential measures can be recommended as follows:

- Enhancing linkage by contract farming and dairy cooperatives
- Increasing milk cow farm scales
- Diversifying dairy products with the higher value added
- Improving and certifying milk quality
- Upgrading science and technology in milk cow raising and dairy processing
- Enhancing the access to the market and information sources.

## Key sources for further information

To discuss the research presented in this brief, please email: viet.hoang@ueh.edu.vn

**VALUMICS country report from Vietnam**

Hoang, V., Nguyen, A., Hubbard, C., & Nguyen, D. (2021). Investigation of Governance and Fairness in the Milk Value Chain: An Exploratory Study in Vietnam. ***A supplementary country report to Deliverable 5.1*** VALUMICS "Understanding Food Value Chains and Network Dynamics", funded by European Union's Horizon 2020 research and innovation programme GA No 727243. University of Economics Ho Chi Minh City, Vietnam. 32 p.

Barling, D. and Gresham, J. (Eds.) (2019) Governance in European Food Value Chains. VALUMICS "Understanding Food Value Chains and Network Dynamics", funded by European Union's Horizon 2020 research and innovation programme GA No 727243. Deliverable: D5.1, University of Hertfordshire, UK, 237p. DOI 10.5281/zenodo.4956325

**Published scientific papers**

Hoang, V. (2021). Impact of Contract Farming on Farmers' Income in the Food Value Chain: A Theoretical Analysis and Empirical Study in Vietnam. *Agriculture*, 11, 797. https://doi.org/10.3390/agriculture11080797

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# Milk Consumption Behaviour Analysis in Vietnam

**Research Findings or Policy Brief**

**September 2021**

## Summary

This research is an international perspective from Vietnam contributing to the research on food consumption behaviors within the Valumics project. The study identifies the key drivers and barriers to sustainable and fair milk consumption and proposes an intervention design to improve food consumption patterns through focus groups and a food consumption behaviour model. The key findings show that health aspects and taste are the most important drivers of milk consumption while milk price and the place of purchase are the strongest restrictions. Consumers' habits, family structure, and lifestyles are the key backgrounds of milk product selection. Marketing and promotions may enhance incentives in food consumption. Most consumers pay attention to the price. Young consumers prefer the taste and convenience of food while quality is essential to older people. However, consumers seem to insufficiently understand and pay little attention to environmental and fairness aspects when shopping and consuming milk products. The analysis of milk consumption behavior in Vietnam were based on the COM-B behavior change model which defines *capabilities, opportunities and motivations* as key levers of change[1].

## Introduction

***This brief presents the main findings from the study of analysing milk consumption behaviour and the implications for sustainable and fair consumption patterns of milk in Vietnam***


[1] Michie, S., M. M. v. Stralen and R. West (2011). "The behaviour change wheel: A new method for characterising and designing behaviour change interventions." Implementation Science 6(42): 11 pages. Available at http://www.implementationscience.com/content/pdf/1748-5908-6-42.pdf

# Overview of Vietnam's milk market

## Milk consumption

***Vietnam's consumption of milk and milk products has quickly grown. However, average milk consumption per capita is much lower than the global average.***

Vietnam's milk consumption has significantly increased in recent decades due to increases in living standards, GDP per capita, and health care. People also pay more attention to nutritional, healthy, and environmental aspects of milk and milk products. Vietnamese people consume about 2 billion liters of milk per year, of which 30% is fresh milk and 70% is reconstituted milk. Average milk consumption was over 26 kg per capita in 2018 which was much lower than the global average. The consumption of milk products accounts for about 10% of the total food expenditure of Vietnamese people[2]. The current main markets of milk and milk products are in urban areas. However, the consumption of milk and milk products in rural areas has also increased, by 6.6% in volume and 7.9% in value in 2018[3].

Consumers purchase milk and milk products through three main distribution channels. First, traditional channels consist of specialized milk shops, wet shops, and grocery stores that sell milk. Second, modern channels are convenience stores and supermarkets. Third, online channels include milk firms' stores and online shops. Vietnam's domestic production can meet only 40% of its local demand in 2018 while the rest depends on imported sources, mainly raw milk in the form of reconstituted milk[4]. The milk import value is over EUR 815 million in 2018 with an annual average growth rate of 3.9% from 2010 to 2018[5].

# Key drivers of milk consumption

## Dominant drivers

***Health aspects and taste are the most important factors while high price and scarce retailers are the main barriers to sustainable food consumption***

Health aspects were the strongest drivers of milk and milk products consumption. Health aspects were identified by various factors such as the quality (nutrition, ingredients, certification), appearance (freshness, good looking), information (information on label and communication), firm brand name, and the place of purchase. Trust has a key impact on health aspects when consumers purchase and consume milk. Besides health aspects, taste, smell, and convenience were reported as the critical drivers of food choices, especially for young consumers.

The price factor garners the most interest and attention of consumers. It is regarded as a restriction in milk choice. Consumers prefer a reasonable price, especially certified milk products. They cannot afford too high a price for certified milk while a low price may imply low quality by end-users. Different consumers prefer different retail channels depending on what kinds of foods they purchase. Certified milk products (e.g., Organic, Fair Trade, the Global Good Agricultural Practice – Global GAP) are usually sold in modern retail systems such as supermarkets, convenience stores, and milk shops.

Habits, family structure, and lifestyles are background factors in milk shopping and consumption behaviour. They usually buy and use the types of products based on their habit and lifestyles. Thus, new, and certified milk products may encounter difficulties when launching. The consumption behaviour is also different among people living alone and those living with their family. Religion is also mentioned when consumers select milk.

Marketing, communication, and promotions are factors that are more important when launching new and certified milk products while conventional products are often consumed according to habit and health aspects.

Environmental sustainability and fairness information is made available through packaging. However, consumers pay little attention to environmental sustainability and fairness aspects because the price of environmentally friendly products is usually high and fairness as a term is new and confusing to consumers

[2] Tran, P.L. (2019). 4 healthy habits to drink milk for family. https://www.mcmilk.com.vn/tag/thoi-quen-uong-sua/
[3] Babuki (2019). Dairy market in Vietnam in 2018. https://babuki.vn/thi-truong-sua-nuoc-viet-nam-nam-2018/
[4] Huy Linh (2019). Vietnam with domestic demand for milk. http://thoibaonganhang.vn/viet-nam-voi-nhu-cau-sua-tieu-dung-trong-nuoc-87932.html.
[5] General Statistics Office (GSO, 2019). http://www.gso.gov.vn

## Selection of milk products

***Consumers usually choose conventional milk products with brand names rather than organic products***

### Selection of products

The choice experiment of milk products showed that consumer select conventional milk products more often than organic milk products. Conventional milk products with famous brands such as Vinamilk, TH True Milk, Da Lat Milk are the most popular and most chosen by participants. The selection pattern enhanced the analysis of the drivers of consumer behaviour in the previous section.

## Trends towards sustainable food consumption

## Trend

***Sustainable and fair food consumption is increasing due to informational campaigns and growing education and awareness***

Participants generally understood environmental aspects of food consumption as consuming milk products that are farmed and processed without causing harm to the environment. Consumers also thought that these aspects are associated with consuming certified organic and Global GAP milk products. Consumers considered fairness aspects of food consumption as financial benefits for farmers and workers in producing high-quality products.

Though Vietnamese consumers may pay less attention to sustainability and fairness aspects, the media and informational campaigns have significantly affected consumers' awareness leading them to boycott brands associated with negative behaviour in relation to environmental and fairness issues. They tend to switch to other brands with more ecological and fairness credentials. Young generations take increasing care of environmental and fairness aspects of food consumption because they have more education, awareness, and understanding of sustainability and fairness as concepts.

The shopping experiment of choosing food baskets (milk and other foods) showed that most consumers choose the baskets based on taste, convenience, health, and habit. Young and single people often selected food baskets based on convenience. Older consumers or people with families tended to choose healthier and fresher food baskets. With a detailed explanation of sustainable and fair concepts, most consumers planned to find more information about and to consider shifts to sustainable and fair food consumption patterns, depending on their income and budget.

## Barriers to sustainable food consumption

## Barriers

***People's trust, knowledge, and information of fair and sustainable products are insufficient. Thus, they are not willing to pay higher prices for these foods***

The main barriers to sustainable and fair food consumption patterns were price, trust, knowledge, and information. The prices of sustainable and fair foods are higher than those of traditional foods and significantly high in terms of most consumers' incomes. Consumers' trust, knowledge, and information of sustainable and fair foods were insufficient. Therefore, they were not willing to pay much higher prices for sustainable and fair foods.

Additionally, taste and smell, habits and hobbies, place of purchase, and lifestyle were also barriers to sustainable and fair milk consumption. The appetite of consumers is familiar with the current milk taste and smell thus it is difficult for them to switch to new organic products that are good for their health and the environment but with different tastes and smells. Eating and drinking habits are difficult to change. In addition, sustainable milk products are not commonly sold through popular distribution channels, making it difficult for consumers to access.

## Interventions and policy implications

The study showed that consumers change their milk consumption behaviour over time due to various factors such as food quality and safety scandals, new products, health problems, family structure variations, living conditions, education and awareness, and policies. Older people change their habits over time for various reasons while younger consumers can simply follow the new food consumption trends towards a more sustainable and fairer pattern based on modern communication means (Google, Facebook, Zalo), increasing knowledge and awareness, and easier market information access (offline, online). Environmental pollution, climate change,

health issues, and social norms have also significantly influenced consumers to take growing care in healthy and sustainable food consumption.

Interventions in milk consumption behaviour patterns were designed and proposed based on the COM-B behaviour change model, explored drivers, and identified barriers. The intervention design includes capabilities, opportunities, and motivations as follows:

## Interventions

***Interventions based on enhancing consumers' capabilities, increasing their opportunities, and their motivations to act can change their consumption towards more sustainable and fairer patterns.***

- ✓ In terms of *capabilities*, sustainable and fair food consumption should be encouraged and supported by reducing the prices of the certified products (Organic, Global GAP, Fair Trade) for increased affordability. Unsustainable consumption should be restricted by taxation, fees, and other market regulations. In addition, minimum wage and other allowance can be increased to enhance the real income and expenditure budget for more sustainable products.
- ✓ Various interventions to increase *opportunities* are available in terms of (1) Quality: Firms have to ensure product quality by adhering to the standards of certifications (2) Communication: advertising and communication should be effective and transparent so that consumers can access, understand, and trust. (3) Diversity: Taste, smell, and appearance of sustainable foods need to be more diverse and suitable for end-users; (4) Segmentation: Food firms should build a particular segment for sustainable and fair products with an appropriate marketing strategy; (5) Distribution: sustainable milk products should be widely distributed through different retail channels; (6) Cost and price: The prices of sustainable foods should be reduced at a reasonable level through innovations, effective farming management, and shorter supply chains.
- ✓ In terms of *motivations*, consumers could be motivated to engage in more sustainable and fairer food consumption patterns by (1) Increasing their awareness of the value and benefit of purchasing and consuming these products; (2) Enhancing consumers' knowledge and information on sustainable foods; (3) Improving consumers' trust in sustainable and fair firms, brands, and products; (4) Showing appreciation to the consumers who are willing to buy and use sustainable foods; (5) Constraining them from buying and using unsustainable foods.

## Key sources for further information

To discuss the research presented in this brief, please email viet.hoang@ueh.edu.vn


***Deliverable report***

Hoang, V., Nguyen, A. (2021). Food Consumer Beaviour Analysis: An International Perspective from Vietnam ***A supplementary country report to Deliverable 6.1*** VALUMICS "Understanding Food Value Chains and Network Dynamics", funded by European Union's Horizon 2020 research and innovation programme GA No 727243. University of Economics Ho Chi Minh City, Vietnam. 32 p.

Nicolau, M., Esquivel, L., Schmidt, I., Fedato, C., Leiman, L., Samoggia, A., Monticone, F., Prete, M. D., Ghelfi, R., Saviolidis, N.M., Sigurdardottir, H., Olafsdottir, G., Brimont, L., Aubert, P.M., Huber, E., Aditjandra, P., Hubbard, C., Arijit De, Odene, J., Schamari, D., Gorton, M. Čechura, L. Viet, H.V., Bogason, S.G. (2020). Food consumption behaviour in Europe Mapping drivers, trends and pathways towards sustainability. The VALUMICS project funded by EU Horizon 2020 G.A. No 727243. **Deliverable: D6.1,** CSCP, Wuppertal, 214 pages

***Scientific paper***

Hoang, V.; Nguyen, A.; Hubbard, C.; Nguyen, K.-D. Exploring the Governance and Fairness in the Milk Value Chain: A Case Study in Vietnam. Agriculture 2021, 11, 884. https://doi.org/10.3390/agriculture11090884



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## H2020 VALUMICS – Understanding Food Value Chains and Network Dynamics

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