Editorial

Dynamics of Food Value Chains: Resilience, Fairness and Sustainability

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For farmers–growers, the routes to market can be complex as their produce moves through the food value chain to the final consumer. The workings, management and governance of food value chains, in turn, shape what is grown and where it is grown in agriculture, horticulture and aquaculture. The resilience of food chains to environmental, economic, societal, geo-political, pandemic and climate-related weather shocks is a key determinant of the food and nutrition security of the food supply to modern societies. The relationships between the major actors in the supply chains determine the share of the value of the final product that the farmers–growers and the other actors receive. Fairness, as an outcome in the distribution of value, and as a set of processes in how the distribution is determined, has attracted the attention of policymakers. For example, the European Union has introduced legislative measures to prohibit unfair trading practices between businesses in food value chains and greater transparency of price distribution, through market monitoring and reporting systems. The Fairtrade movement was based on the need to provide farmers–growers and their rural communities with adequate rewards for their production in cross-continental supply chains. Many food value chains are dependent upon low-paid, often precarious and immigrant labour, from harvests to packing, through to food service and retail, raising questions about social sustainability. The material and information flow through food chains, and their energy and environmental life cycle impacts serve to generate external environmental costs along the chain, as well as associated health benefits, costs and waste.

Scientific studies in this special edition of the journal provide theoretical approaches and tools for analysis, including methodologies for measurement and modelling, to improve the understanding of the dynamics of food value chains, in order to enhance their resilience, fairness and sustainability. In this collection of twelve articles, three broad themes of analysis are prominent: first, the nature and impacts of governance and public policies upon the dynamics of value chains; second, the development of the application of modelling and simulation methods to understanding these dynamics and, in turn, trying to predict their potential workings; finally, the deployment of economic models and the role of markets and market organisation, where value is primarily identified as an economic construct, to explain the drivers and interrelationships across the chains. The presented studies cover a range of food products, from processed tomatoes to dairy cow's milk, milk powder, farmed salmon, wheat and bread. The locations covered in this volume include local–regional areas in Northern Italy; the whole of France, the UK, Vietnam, Ireland and New Zealand; the wider area of farmed salmon in Norway exporting to the EU, and of Black Sea region wheat-producing countries, and their positions in global commodity markets, as well and international comparisons of national-level public policies.

Ten out of the twelve papers in this Special Issue are based on results from the European Union H2020 VALUMICS project (2017–2021), including 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 in European food value chains [1]. Furthermore, the simulation modelling of food value chain agents' decisions was developed with the aim to enable the evaluation of the impact of future policy interventions on fairness in terms of fair value distribution and employment in the food value chains. Finally, foresight scenarios and transition pathways to a more sustainable food system were explored, and policy implications were addressed. Particular attention was devoted to the analysis of the contribution of food systems to promoting fairness and fair value distribution in food value chains, promoting employment opportunities and fostering economic growth within the EU, while exploring pathways towards transforming food systems and ensuring more sustainable production and consumption, which supports the emphasis in the current scientific and high-level policy literature and the EU Green Deal [2] and Farm-to-Fork strategies [3].

The first theme, focusing on the governance analysis of food value chains, investigates the nature of the interrelationships between different groups of actors along food value chains, for example, between producers, processors–manufacturers and food retailers, with a focus on the buyer–supplier dynamic [4]. The global food value chain governance model is applied to the liquid cow's milk value chain in Vietnam [5]. Here, the value chain is defined as having evolved away from the technically unequal "captive" or buyer-dominated governance model to the more equal and fairer "relational" governance model. However, the producers see aspects of the more dependent "captive" model as beneficial to their interests and aspects of the relationship as having disadvantages. This provides challenges for state-led interventions aiming to balance the fairness in this chain [5]. Similarly, a study of contract farming in Vietnam shows how these contracts can provide small farmers with many medium- and longer-term benefits, such as operational support and access to higher value markets; however, in the shorter term, payments from the contracted buyers may be lower than from the existing spot market prices [6]. Fairness in food value chains should be conceptualised in terms of procedure as well as economic distribution [7]. Here, producers' perceptions are that the buyers' decisions on the pricing of their products are often unfair, and reflect a power asymmetry based on information asymmetries where the buyer has the upper hand in interpreting and deciding on the quality of the product they are purchasing. The role of the state is to design public policies that regulate buyer–supplier trading in ways that ensure greater fairness, which balances the power asymmetry. However, this is a complex policy challenge as there are different forms of power and information asymmetries in different food value chains [4]. The use of public policy to support the public procurement of more sustainable and healthy foods and their journey along the value chain from production to consumption is analysed in a cross-national study [8]. Here, the findings illustrate the importance of a supportive package or mix of policy instruments from across a range of complementary policy areas.

The second theme in the present Special Issue covers four papers with a focus on exploring the agro-food chain dynamics and system fairness by adopting various modelling approaches. The subjectivity and intangibleness of fairness perceptions make them difficult to operationalize in a quantitative model. One of the studies contributes to the definition of fairness as a concept and offers a systemic methodological approach to fairness. In an attempt to operationalise fairness for modelling purposes, the interorganizational fairness perspective is explored, first defining its dimensions, antecedents and consequences, and then defining the social construct of fairness in model operational terms and identifying quantifiable fairness proxy indicators. A profit margin is proposed for distributional fairness, and market power or bargaining power for procedural fairness [7]. The study presented in [9] adopts these proposed proxy indicators and demonstrates the applicability of simulation modelling approaches to explore distributive fairness, as profit margin and

procedural aspects of fairness capturing power asymmetries in food value chains, via mark-up, mark down or bargaining power (number of buyers/sellers). The steps involved in developing a conceptual model and functional specifications revealed similarities in the functioning of different case studies of food value chains (dairy, wheat, tomato and salmon), in terms of supply and demand and profit-driven businesses, despite differences in governance modes, strategic coordination and structure. The agent decisions and decision heuristics related to the management of product inventory, economic objectives and financial resource flows are common to all food value chains, allowing for the construction of a generic model. The main concepts of system dynamics and agent-based modelling are introduced, and the applicability of a hybrid of these methods is justified for a simulation modelling approach to assess the outcome of interventions through these operational indicators of interorganisational fairness in food value chains [9]. A different hybrid simulation modelling approach for improved decision making in production planning in the Norwegian Atlantic salmon supply chain is presented in [10]. The objective is process optimisation to mitigate risk and enhance resilience. An agent-based modelling captures the autonomous and interacting decision-making behaviour of the supply chain actors, while discrete-event simulation (DES) is employed to model the various production processes within the chain. Future scenarios for structural changes needed for the sustainable transition of food systems are described in [11]. A modelling exercise is applied to assess their effects on employment at the farm and processing industry levels in the French dairy sector. Furthermore, the study also assesses policy measures targeting supply, demand and market organisation, which contribute to a fair transition aimed at maintaining jobs in the farm and agro-food sector, restoring agro-biodiversity and developing food products compatible with healthy nutritional guidelines.

The final theme includes five papers in this Special Issue applying different economic methodological approaches aimed to measure fairness with a view to market organisation and considering market regulation and deregulation. An econometric modelling methodology to assess productivity, and technical efficiency was applied through a stochastic frontier input distance function and a four-step estimation procedure to the Italian tomato agro-food chain and European milk production. The result from the analysis of EU milk chains showed that the main driver of productivity growth was found to be the scale effect, and thus the findings supported the hypothesis that abolishing milk quotas had a positive effect [12]. The assessment of the Italian processed tomato chain revealed differences in the productivity and efficiency of tomato production and processing actors. Processors operate at optimal scales, while producers are characterised by economies of scale. Both stages of the value chain have potential for technical efficiency improvements [13]. The French and British wheat-to-bread chains were analysed with a mark-up and mark-down model and stochastic frontier analysis to estimate the degree of market imperfections at the milling and baking stages [14]. Results showed abuse of bargaining power and potentially unfair trading for the input market of the French baking sector, where large millers are in a dominant position. However, some small companies in the baking sector appear to benefit from competitive advantages, such as quality or niche markets.

Another approach of economic analysis to evaluate market efficiency is price transmission, with a focus on investigating price relationships and identifying price leadership, as presented in the following two papers: First, an analysis of monthly export data from New Zealand and Ireland in the Chinese and global markets of skim milk powder using a threshold cointegration model, along with asymmetric error correction models to examine spatial price dynamics and price, is presented [15]. Second, an investigation on world wheat price linkages and the identification of the current "price leaders" of the global wheat market is carried out. The results show that, regarding price formation in the world wheat market, the French price is more important for transmitting price signals to other wheat export markets compared to that of the USA. The results indicate that, despite being leaders in wheat export volumes, the Black Sea wheat prices in Russia and Ukraine adjust to price changes in France, the USA and Canada [16].

Finally, the various economic methodological approaches adopted to measure distributive and procedural fairness used a wide range of data, including price, export, income, revenues, contract, profit distribution, profit margin, production costs, number of suppliers/buyers and company size. The variety of data used suggests the richness of methods and issues addressed in the Special Issue to analyse food chain dynamics, resilience and fairness. Furthermore, it highlights the need to access a wide range of data pertaining to different steps in the supply chain, from primary to secondary data, and from current to time series and cross-sectional data. This poses a challenge as the lack of data and limited access to data on food chain actors impact on coordinated decision making in the agro-food system. Limited sharing leads to a lack of cooperation and ultimately results in fragmented research, policy and management governance analysis and decision making. Coping with governance issues and agro-food chain decisions based on shared data among different supply chain steps is challenging but crucial. This topic is currently at the top of the European Union's agenda [17]. They aim to introduce greater transparency into the way prices are reported throughout the chain, in addition to having banned unfair trading practices and improved producer cooperation. The Commission proposes the establishment of a dedicated regulatory framework regarding data governance, access and reuse between businesses, between businesses and government and within administrations. This entails creating incentives for data sharing, as well as establishing practical, fair and clear rules on data access and use. Digital technologies can support this process and may benefit citizens and businesses to ensure a fair and competitive economy, and eventually, an open, democratic and sustainable society.

To conclude, the results presented in this Special Issue provide insights into how different analyses contribute to the understanding of food values chain dynamics. The individual analyses provide evidence on performance and can provide justification for using, e.g., proxy indicators and simplification, in modelling approaches. However, it needs to be acknowledged that the complexity of the structures and governance of food value chains, the social impacts and environmental costs may not be adequately addressed by economic outcomes, and the roles of governance, procedures, strategic coordination and externalities need to be considered. A qualitative approach using interviews, as applied in governance analysis, provides insights into the factors influencing the type of interrelations between actors in the chain and identifies perceptions towards fairness, as exemplified by the study focusing on the governance and regulatory interventions of the Vietnamese milk value chain based on stakeholder interviews [4]. In particular, the feature paper on the public procurement of sustainable food highlights the importance of considering the complex policy multi-instrument setting. It supports the need for a conducive set of policy instruments to ensure the transformative potential of more sustainable and healthy food [7].

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