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Guest editorial

Twin transition in agrifood: Digital and green transitions for sustainable, competitive, and resilient food systems

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The “twin transition” has been a key feature of the European policy discourse over the past five years. The idea that the widespread adoption of digital technologies in the European economic fabric would have made it more efficient, competitive, and sustainable made European policies stand out for their ambition (carbon neutrality by 2050) and the European Commission be considered for its strategic intent and apparent realism (Valatsas, 2019). The European Green Deal’s centrality was reinforced by the need to reignite the engine of growth and inclusion in Europe after the devastating effects of the Covid-19 pandemic. On the one hand, the contingencies that brought the world economy to a sudden and almost total halt in the first part of 2020 revealed once again the complexity of global value chains, the delicate interdependences among economies, and the risks entailed in the exponential propagation of problems linked to lack of environmental awareness. On the other hand, digital technologies functioned as an effective and reassuring link between the prospective routes towards sustainability for Europe and the previous European Agenda, which focused largely on significant increase in competitiveness, innovation and efficiency through industry 4.0 technologies (Reischauer, 2018; Coco *et al.*, 2024).

Agriculture, food processing, and all the complementary value chains that populate contemporary food systems were obviously key to the transition of the European economy towards the desired outcomes. It is widely accepted

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that food systems are responsible for a relevant share of negative effects on the environment. The IPCC estimated that 22% of global greenhouse gas emissions come from agriculture, forestry and land use (IPCC, 2023). According to FAO (2024), emissions from agrifood systems from the field to the table increased by 10% in the period 2000-2022. For agrifood systems, as for other highly polluting sectors, an accelerated transition to more sustainable ways of operating is needed to avoid catastrophic outcomes. Again, through virtualization, digitalization, better control of data and thus more efficient decision-making and forecasting, digital technologies were pictured as fundamental enablers of such a change in the sector's situation.

Agri-food systems, then, are victims of the environmental crisis that occupied the economic policy debate for the past five years. The vulnerability of agrifood systems to climate-related disasters is clearly perceived by operators and national and regional governments when facing the aftermath of floods, droughts, and extreme weather conditions, and by public opinion at large when the effects of climate change are manifested in the availability (or lack thereof) of food items and in the fluctuations in their prices (and thus their accessibility).

Public investment in the twin transition agenda followed suit. The European Recovery Plan – Next Generation EU anchored every single line of action to achieving high performances in digitalization and sustainability. Despite the apparent consensus on the direction to be taken, 2024 was also the year in which resistance to green policies and requests for the renegotiation of sustainability targets emerged vigorously. While calls for a radical revision of the targets of the European Green Deal emerged and continue to manifest throughout the European economy in almost every sector, agriculture was symbolically at the center of the political debate that preceded the recent European elections and the subsequent agreement to rethink the sustainability agenda.

Farmers and their tractors occupied squares, streets and cities at the beginning of 2024; the discontent has been creeping visibly into the agricultural sectors of the Netherlands, Ireland, France, Italy and almost all of Europe since 2021 and in the wake of the European elections.

While the analysis of the discontent and its implications is not the topic of this special issue, nor of the conference it summarizes, the protests play a relevant signaling function: assumptions and incentives continue to collide with obstacles to the adoption of more modern strategies and practices that could be conducive to better economic, social and environmental performances. Research in the social sciences, and especially in those that focus on agrifood systems, is called upon to provide a much-needed contribution to understanding the entity of such obstacles, their origins and determinants, and, above all, the ways to remove them, in order to advance

theoretical elaboration and, most of all, the contribution of research to solving pressing problems that require a collective mobilization and the responsibility to effectively connect theory and practice.

The scientific committee of the SIEA 2023 Conference, held at the Ca' Foscari University of Venice, was guided by the desire to direct the scientific debate on the twin transition towards the elaboration of a sound and rigorous body of knowledge that could be rapidly deployed at the service of society, the economy and the environment.

We received several submissions and accepted seven papers covering a wide range of issues underlying the realization of twin transition practices in the agrifood sector. This special issue is characterized by a remarkable interdisciplinary effort that underlines the relevance and timeliness of this topic for members of the SIEA community.

During the two days of the conference, the research community coalesced by SIEA shed light on the numerous areas where either constraints and bottlenecks to the twin transition might emerge, or where solutions become viable and allow to imagine their replication at scale. Often, constraints and resistance to transitions depend on the structure of value chains and on the existence of imbalances in the power some actors can leverage on, as is often the case for small and micro agricultural firms, which have to cope with a chronic shortage of resources and a misalignment with the pressures coming from retail operators or other actors. In many other cases, the delay in adopting technologies and approaches is not due to a lack of resources, but to a mismatch between the logics wired in the technologies and solutions, and those by which businesses operate. That is, digital technologies are often developed in and for large organisations and their deployment in small firms requires intense labor in “scaling down” the solutions. Moreover, sometimes technologies and approaches are born in sectors other than agriculture and food and require modifications and adaptations to be accepted. Thus, delays may be due to technical and operational mismatches rather than resource constraints or cultural issues. In addition, retail channels and final consumers can be the source of obstacles and constraints: resistance is often documented downstream in a variety of supply chains and can play a role in creating disincentives for operators.

The special issue launched during the conference was brought to its present form thanks to the work of authors, reviewers, and the editorial team. The final result effectively expresses how the demand for relevant and critical knowledge met a research community willing to actively participate in the process of increasing the sustainability and competitiveness of agrifood systems. Moreover, the final selection of the papers reflects the composite set of “entry points” and critical junctures we just mentioned and allows

to appreciate the existence of a variety of approaches to shed light on the complex problems connected to the twin transition.

In the opening research note, Gianluca Brunori tackles the interactions between digitalization and sustainability delving well below the surface of political claims and documenting how the interaction between the «physical world and the infosphere» could be the harbinger of advances in making agrifood systems more sustainable. The contribution is valuable in that it draws the attention of readers, scholars and policymakers to the systemic nature of the transition we are facing: the more sustainability problems are framed in a systems perspective, the more digital technologies will unleash their potential in connecting ends to ends (e.g. final consumers and producers, complementors and suppliers, firms and institutions) and providing feedbacks and feedforwards that allow for more effective and timely governance of food systems.

The work of Ingrassia, Bellia, Disclafani, Chinnici and Chironi addresses another relevant issue in transitions, namely consumer acceptance of novelty. Their work can be attributed to the larger debate on circular solutions to the sustainability crisis and considers eco-packaging as a potential avenue to solve pressing environmental issues in a variety of *supply chains*. The merit of the paper lies in clearly highlighting the determinants of consumer preferences, the way such novelties are framed, and the roots of resistance and skepticism, thus expanding our theoretical understanding of consumer behavior and informing policymakers to increase their effectiveness in promoting circular behaviors. Digital tools and channels are seen as crucial levers for synchronizing the transition of firms and the evolution of customers' behavior. In particular, e-commerce is seen as conducive to novel business models in which small producers of niche products or specialty items can avoid the pressures on margins made by large physical retailers. Online marketing and advertising are often seen as a more accessible tools to communicate and interact with consumers so to reinforce their propensity to buy certain items and “convert” their intentions into actual behaviors. Of course, when it comes to sustainability, the issue becomes central: while a number of consumers declare they are inclined to buy sustainable products in principle, they often do not do so due to a variety of constraints.

Palmieri, Covino and Boccia consider the relative importance of some factors over others in influencing consumers' willingness to buy organic food online, and the plausible interactions between green marketing campaigns and the revealed purchase behavior of organic food consumers on e-commerce websites.

Organic producers are the focus of another paper that addresses a different facet of the twin transition: the use of digital technologies to support decision-making in agrifood firms. Immersed as they are in ever-increasing

streams of data, and generating multiple data points through their operations, companies could become more efficient and sustainable by treating this data as a relevant input to sound decisions. Decision support systems are a family of technologies that will play a pivotal role in addressing the cognitive dimension underlying the transition of food systems to more sustainable states; however, their fit with the logics, resources, and processes of small-scale agricultural enterprises may be problematic and require adaptation efforts. The paper by Righi and Viganò deals with the factors influencing the motivations of organic farmers to equip their farms with such systems, revealing a wide range of intervention areas for research and policymaking.

Digital technologies then make assessing and measuring the environmental footprint of operations feasible and scaled adequately to fit the logic of small farms, which account for the vast majority of firms in many agrifood systems worldwide. Lifecycle assessment (LCA) allows firms to evaluate the performance of alternative solutions and processes in order to reconcile efficiency and sustainability, and to generate data that lend substance to claims of harm reduction and mitigation, or simply transition to sustainable strategies and processes. The paper by Pergola investigates the interaction between digital technologies and LCA methods and links it to the intention to use digital technologies among small farms in Southern Italy.

Benedetto and Forleo explored the potential of blockchain technology and other digital tools to enable the sustainable transition of the Vermentino di Gallura PDO (Protected Designation of Origin) Quality Agri-Food District in the Sardinia region. The authors shed light on the opportunities and criticalities underlying the implementation of the twin transition across the very different actors constituting the Vermentino PDO district, who participated in multi-stakeholder meetings. They highlighted the potential of digital tools to support integration within the wine supply chain as well as at the intersection of the wine and tourism value chains.

The paper by Mignani, Ferrara, Tomasi, Moretti and Cavicchi also addresses the need to undertake a twin transition path for the viticulture and wine sector, but from the perspective of Operational Groups (OGs) within the European Partnership for Innovation in Agriculture (EIP-AGRI). They pointed out that the participatory, multi-actor and bottom-up approaches underlying the OGs can be drivers of innovation. OGs can be seen as innovation intermediaries working toward more environmentally sustainable practices and disseminating current innovations that can better orient operators toward a digital and sustainable production system.

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