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Editorial: Strategies of digitalization and sustainability in agrifood value chains

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Editorial on the Research Topic

Strategies of digitalization and sustainability in agrifood value chains

Nowadays, stakeholders of agrifood value chains are developing specific strategies regarding both their digital and sustainable transformations, some of them jointly implemented aim at the convergence of digitalization and sustainability (Piot-Lepetit, 2023). These strategies focus either on designing new activities within or outside current value chains or for some of their segments or on creating new value chains introducing new products to the market meeting specific consumers' expectations, especially regarding produce quality, food safety, or sustainable and transparent practices. Consequently, these strategies provide new ways for either doing business-as-usual or changing current business activities. In implementing these transformations, the use of digital tools and solutions strengthening sustainability is becoming an important part of agrifood value chain activities. All these transformations are changing the way stakeholders are working, collaborating, and communicating and, consequently, are reconfiguring entire agrifood value chains or part of them.

This Research Topic, focusing on *Strategies of digitalization and sustainability in agrifood value chains*, gathers together articles exploring several facets of the current reconfigurations of agrifood value chains induced by digital and sustainable transformations. These articles do not provide an exhaustive overview of the ongoing transformation of agrifood value chains but, by focusing on specific aspects, they highlight some of the achievable benefits without concealing the challenges faced that need to be overcome. Based on their research results, the contributors to this Research Topic also provide recommendations aiming at avoiding misalignment between expectations and outcomes when developing strategies of digitalization or sustainability, including considerations for reducing the digital gap between rural and urban areas or developing safe, sustainable, and resilient agrifood value chains.

Among the most important aspects of digital innovation for developing more sustainable practices, improvement in efficiency and productivity of production activities is one of the most expected. While investigating crop production, Ahmad et al. found that the use of Internet reshapes farmers production strategies, with a positive effect on their technical efficiency. However, its impact remains heterogeneous and dependent on farms' initial efficiency levels, with the most pronounced effects being for least efficient farms. For ginger producers in Pakistan, Gizachew et al. show that digital tool adoption significantly

enhances agricultural productivity and household income of smallholder farmers by means of access to digital infrastructure, availability of ICT (Information and Communication Technologies) resources, and tailored extension services focusing on farmers' digital literacy. However, improving efficiency and productivity cannot be achieved without the support of infrastructure. More specifically, Li show that rural broadband development has a significant role in enhancing agricultural total factor productivity (TFP), but only in some regions. Rural broadband development diminishes the costs of production and marketing information transmission but also fosters the development of innovating financial products easing agricultural credit constraints. It also reduces the digital gap between rural and urban areas, increases the share of farm-related loans, and improves farmers' income. However, these changes are heterogeneous, depending on the initial income level of the region where farmers are located. The construction of digital villages in China is another infrastructure having a positive impact on agricultural green TFP. Cai and Han found that by fostering agricultural technological innovation, enhancing human capital, and improving agricultural productive services, the impact of digital villages is substantial, but only up to a threshold defined by environmental regulations. Above this threshold, the positive effect of digital villages on agricultural green TFP is still present but only with a low intensity. The existence of a link between digital innovation impacts and regulations is confirmed by Chang et al. who point out the importance of government innovation-driven planning and government innovation-driven investments to develop efficient paths, especially because the effects are heterogeneous, varying by grain production zones, with a threshold constraining the expected multiplier effect.

Improving efficiency and productivity by fostering sustainable digital innovations is expected to improve rural farmer income, by either reducing costs or generating more revenues. While exploring how solar energy adoption can foster crop farmer incomes in Pakistan by means of improved water access, increased food production, reduced carbon emissions and lower energy costs by replacing fuel usage, Khan et al. highlight that this expected outcome cannot be achieved without government and agricultural extension interventions to support knowledge dissemination about digital technology and enhance financial accessibility of farmers to foster technology adoption. Similarly, Du et al. consider informatization as a vital element for the economic development and reshaping of rural areas. However, even though substantial efforts have been made to integrate informatization into rural areas and boost farmers' income, the authors point out persisting challenges hindering the full realization of its potential. Issues such as incomplete agricultural digitalization, insufficient market information platforms, and limited digital literacy of farmers have restricted the efficiency of informatization in rural areas. Moreover, disparities in financial support from local governments in China across regions act as barriers to rural digitalization. Investigating the impact and underlying mechanisms of rural-e-commerce service centers (RESCs) on income gains, Zhong et al. found that RESCs promote agricultural development, encourage entrepreneurship, and enhance government funding support. However, these positive impacts remain heterogeneous

based on regional and individual characteristics, with an income increasing effect significantly higher in eastern China and rural villages with migrant population and college-graduate cadres. The authors conclude that any intervention from policy makers should be adapted to the socioeconomic development levels of each region. Xu J. et al. confirm the need for specific policy tools to support the increase of local farmers' income through the development of digital technology applications. Exploring specialty agricultural farmers producing litchi, the authors show that they have widely adopted digital technologies in all aspects of their specialty agricultural operations. Indeed, specialty farmers face unique production risks such as high perishability and high climate dependence, are vulnerable to extreme fluctuation in temperature and humidity, and deal with consumers that expect high levels of freshness and flavor for specialty produces, which means they need to deliver to market immediately after harvest. Digital technology applications increase financial income, particularly among disadvantaged farmers and farmers in areas with rich specialty agricultural resources, by specifically enhancing farmers' production and transaction capabilities.

Improving digital literacy among farmers is becoming a crucial element for developing sustainable practices. Indeed, by exploring the mediating roles of subjective norms, behavioral attitudes, and perceived behavioral control, Lu et al. show the positive impact of digital literacy on the likelihood of farmers to engage in pro-environmental behavior (PEB), especially because digital technologies change farmers' cognition and attitudes. Thus, digital literacy cannot be ignored as it determines the extent to which farmers can access and utilize information. However, how differences in digital literacy impact farmers need further consideration to develop proper interventions. Beyond farmers, Yuan et al. highlight the importance of agricultural scientific and technological talent (ASTT) on the quality of local economic development. ASTT are professionals possessing specialized knowledge and skills in agriculture, actively engaged in agricultural scientific research, education, and application. However, the authors also point out that the current misallocation, either insufficient or excessive, of these ASTT resources among regions results in both an ineffective utilization of these talents and disparities in regional economic development. Additionally, Qun et al. exploring the nexus between agricultural science and technology innovation, agriculture resilience, and fiscal policies supporting agriculture illustrate the crucial role of advancements of agricultural technology in fortifying the agricultural sector. But at the same time, this improvement is conditioned by the enhancement of agricultural technological innovation capabilities, meaning by strengthening human, material, and financial aspects, developing fiscal policies that fully support agricultural technological innovation, and allowing technical innovation to be tailored to local conditions with specific strategies recognizing regional differences.

Moreover, digital innovation also supports the generation of revenue by changing agricultural product marketing strategies, especially by moving online. The development of these new marketing strategies encompasses several aspects that need consideration when aiming to become performing and expecting to reap their full benefits. Among them, Zhang explores the

aspects of e-commerce broadcasting, visual effects, and government cooperation. The author found that there exist four configurations for a good online marketing performance, each one being developed based on a multidimensional combination of strategies that can be adopted by small agricultural operators to scale their agricultural business and foster operators' acceptance of online marketing methods, so they can enjoy the dividends of developing e-commerce sales. While exploring virtual wine experiences, [Gastaldello et al.](#) clearly point out that virtual online experience, as a technology-based sustainable strategy for resilience of wineries in time of crises and beyond, has positive consequences, such as influencing purchase intentions and risk aversion or limiting carbon footprint by reducing transfers for reaching a specific winery. Another important element for a good marketing strategy is to identify valuable information aiming at establishing appropriate market prices aligned with consumer demand for the product but also at tailoring both products and messaging accordingly. [Nguyen et al.](#) investigate the factors influencing America consumers' willingness to purchase (WTP) turmeric products. They found that emphasizing on local, sustainable sourcing and clear communication of organic credentials to align with consumer expectations is of the utmost importance due to concerns about the quality and safety of the product, while communicating on the level of curcumin content in turmeric, the health benefit of a product, is not a significant factor influencing consumers' WTP when they are not educated enough about it. As part of a marketing strategy, food delivery is becoming important for meeting consumers' expectations. [Xu S. et al.](#) investigate the effects of antifood waste regulations on the choice of logistics strategies in on-line-to-off-line (O2O) supply chains. The authors found that antifood regulation is effective under a platform-charge logistic strategy but ineffective with a restaurant-free self-logistics strategy, implying that antifood regulation strongly influences the choice of the food delivery strategy in O2O supply chains.

Above all, there are important expectations regarding digital innovations for improving food quality, safety, and security but also sustainability, traceability, and transparency. The use of deep learning approach is explored by [Wen and He](#) as a way to enhance grading efficiency and improve grading accuracy over traditional manual detection recognition and classification techniques. As grading accuracy is very important for ensuring vegetable quality, the authors clearly explained how the use of deep learning reduces labor costs, while enhancing the performance and speed of vegetable grading. Additionally, fresh agricultural products are highly perishable and require reliable supply chains with faster production cycle, payback periods, and turnover, especially for micro-small and medium enterprises (MSMEs) facing challenges in accessing funding to meet market demand and maintain product quality. [Karyani et al.](#) illustrate how FinTech can become, by facilitating access to finance, a crucial element of the sustainability of fresh agricultural products in Indonesia. Besides, [Tian et al.](#) show that digitalization can effectively promote the coordinated development of green agriculture and food security through positive spatial spillover effects, with notable heterogeneity, by optimizing factor allocation efficiency, improving agricultural production methods, and fostering agricultural technology innovation. However, the

digital divide between developing and developed countries in the agricultural sector has negative consequences on international competitiveness and the ability to comply with international food safety regulations, especially the one related to maximum residue limits (MRLs) for contaminants. [Meziani et al.](#) show that reducing this digital divide improves international food safety and food security but also leads to more international competition, with a potentially perverse effect being an underinvestment in good and sustainable production practices by more digitally advanced countries. The authors also point out that the digital catch-up of less advanced countries is not sufficient to reduce health risks on international markets unless it is accompanied by strengthened official food control systems, which in turn encourage lowering MRLs rather than relaxing them as expected by producers or authorities.

From a consumer perspective, there is an increased demand for sustainable credence attributes on purchased products, especially regarding quality and safety issues, environmental and social sustainability, or business innovative practices. To satisfy this increasing consumers' demands toward more traceable, sustainable, innovative, safe, and high-quality products, blockchain traceability is an innovative digital tracking tool that meets these requirements and can support trustful practices, as explored by [Petrontino et al.](#) in the context of pasta value chain. However, such requests for more transparency cannot be implemented without changing stakeholder roles and involvement in agri-food supply chain networks (netchain), as it implies data and information sharing. [Otter and Robinson](#) found that primary stakeholder interests lead to competition in vertical and horizontal relationships of the netchain and low transparency efforts by intermediaries, especially due to the importance of trust and cooperation among stakeholders in sharing data and information. Regarding secondary stakeholders, policy-makers and governments, NGOs and technology providers excel in being drivers of digital transparency for more sustainability, with social media as a strong direct communication tool to reach netchain stakeholders and consumers. The authors also point out that the request for more transparency is becoming proportionally less related to a specific product and more related to information on firm (e.g., on practices and strategies), the business ecosystem, or the natural environment (e.g., weather and biodiversity data). Consequently, agrifood netchains are developing around a dyadic strategy, focusing on either product or data and information transactions, which in turn fosters new opportunities for value creation based on data and information sharing.

Author contributions

IP-L: Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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