

RESEARCH ARTICLE

Agri-food sector and entrepreneurship during the COVID-19 crisis: A systematic literature review and research agenda

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Abstract

The related literature highlighted the impact of COVID-19 on agri-food entrepreneurship, the government measures and support on agri-food entrepreneurship, and the shift of agri-food entrepreneurship towards digitization, innovative ideas, and new market solutions. Agri-food entrepreneurship faces numerous challenges, but at the same time, the crisis can generate opportunities. The studies made so far indicate that COVID-19 can cause transformational changes to agri-food entrepreneurship, although further research is needed to clarify open issues.

KEYWORDS

agri-food sector, COVID-19, crisis, entrepreneurship, food policy

JEL CLASSIFICATION

Q13; M10; Q18

1 | INTRODUCTION

Pandemic is not an unknown phenomenon that occurred exclusively in modern societies as pandemics have been recorded since ancient times. Each pandemic causes significant changes in the economy (Elleby, Domínguez, Adenauer, & Genovese, 2020; Tasnim, 2020), in local and global policies (Blay-Palmer, Carey, Valette, & Sanderson, 2020; Reardon, Lu, & Zilberman, 2019; Rowan & Galanakis, 2020) in social behavior (Di Vaio, Boccia, Landriani, & Palladino, 2020) and citizens' mentalities as well (Altieri & Nicholls, 2020; Desa & Jia, 2020).

Like any pandemic, COVID-19 has had direct, collateral, short-term, and long-term impacts (Desa & Jia, 2020; Phillipson et al., 2020) on the agri-food system, locally and globally. Some of the pandemic impacts on agri-food are likely to become a habit and let this be why the change in tactics and policies applied to date. The pandemic has led us to focus more on the important role that food production and distribution play in the environment (Altieri & Nicholls, 2020; Di Vaio et al., 2020; Mishra, Bruno, & Zilberman, 2021), on climate (Mastronardi, Cavallo, & Romagnoli, 2020) and economic development (Mishra et al., 2021) and contributed significantly to the Common Agricultural Policy (CAP) reform

(Mastronardi et al., 2020). The pandemic provides an opportunity for agriculture and nutrition, which is not merely an agricultural imperative but also a global enterprise imperative (Mishra et al., 2021). Indeed, the COVID-19 crisis created a challenging environment but at the same time opportunities for entrepreneurship in the agri-food sector will be generated too.

This paper investigates the agri-food entrepreneurship during the pandemic crisis caused by COVID-19. It expands our current limited knowledge on the impact of COVID-19 on agri-food entrepreneurship entrepreneurial activities in the agri-food sector. This systematic literature review aims to strike at the heart of a timely academic and policy debate regarding the new trends and challenges on the agri-food sector and entrepreneurship in turbulent times. As the field research is ongoing and intensive, this literature review contributes to taking stock and looking forward by setting a future research agenda.

After this introductory section, the second section sets the theoretical background of the connection between agri-food entrepreneurship and COVID-19. The third section describes the methodological approach and strategy. The fourth section unfolds and discusses the findings. Finally, the fifth section focuses on the concluding remarks and future research avenues.

2 | THEORETICAL BACKGROUND

When the COVID-19 pandemic broke out, agri-food entrepreneurship was greatly affected by the pandemic crisis on food secure and food adequacy. Governments worldwide have been forced to take restrictive measures in global food supply chains, transport and labor force movement to reduce the disease's spread (Mishra et al., 2021). In particular, under these measures, in the first weeks of the pandemic, there was a considerable decline in labor productivity, higher labor and transportation costs, significant loss of income for farmers, food shortages and an increase in vulnerable products' prices such as vegetables and fruit for consumers (Ibidem). These measures have influenced and continue to strongly influence the structure of demand (Mastronardi et al., 2020) and, consequently, the entrepreneurial activity. Coordinated agricultural policy and programs are now needed so that the path to sustainable development is based on fair, green and healthy agri-food systems (Blay-Palmer et al., 2020).

In recent years there has been growing research interest in agri-food enterprises since the economic and monetary crisis of 2008. Although the economic crisis and the pandemic are not the same, they have equally affected income and demand. The pandemic has focused on agri-food security issues, such as good agricultural practices in the production of food that respects consumers' health and reduces the environmental footprint (Mishra et al., 2021), food processing and consumption worldwide as well as business models for the adoption of innovative technologies (Di Vaio et al., 2020). The pandemic has prompted us to reconsider the role of agriculture, how essential it is to the life on the planet and how it can continue to be, while at the same time improving the environment, climate and contributing to sustainable development.

A feature of the pandemic has been a switch from face-to-face to digital connections (Phillipson et al., 2020). Research by Mastronardi et al. (2020) has shown that online sales have increased significantly. The share of sales, which has been lost due to the closure of Farmers' Market (FM), has been replaced by an equal amount sold to non-profit organizations, such as episcopal curia, at reduced prices. However, this is difficult to implement in areas with weak internet and mobile devices and leads to further marginalization of rural citizens and communities (Phillipson et al., 2020). It is the right time to unveiled the industry revolution 4.0 (4IR) potential, making it centric concerning other aspects (Ciruela-Lorenzo, Del-Aguila-Obra, Padilla-Melendez, et al., 2020). One of the technologies of 4IR, as mentioned by (Cowie, Townsend, & Saleminck, 2020), is the smart grids that aim to control the practices of distribution generation, storage, consumption and flexible demand. According to sustainable and biological models, improving knowledge for innovation in production methods can guarantee food and nutritional safety and promote ecosystems and water resources (Barcaccia, D'Agostino, Zotti, & Cozzi, 2020). Technological change will be a fundamental feature for the food supply chain, from agriculture to food processing. Investments will include the use of advanced robotic systems that will dramatically reduce the need for workers and the technologically

advanced AFS with a capable workforce (Christiaensen, Rutledge, & Taylor, 2020). To effectively achieve nutritional goals, it is necessary to adopt a holistic approach to sustainable food systems (Barcaccia et al., 2020; Dupouy & Gurinovic, 2020). Indeed, entrepreneurship can act as a transformational agent towards sustainability (Apostolopoulos, Al-Dajani, Holt, Jones, & Newbery, 2018) and agri-food entrepreneurship can see the pandemic crisis as an opportunity for continuous improvement.

3 | METHODOLOGICAL APPROACH

The existing research relating to agri-food entrepreneurship provides limited studies which review the relevant research articles and form a research agenda based on such a review. In light of this, the systematic review, as a methodological approach, was chosen to build upon our existing knowledge by investigating both the theoretical and the empirically based on articles available (Webster & Watson, 2002), reveal research insights obtained through methodized categorically organized literature review (Armitage & Keeble-Allen, 2008) and the generating of interrelations between the thematic areas of published studies (Thorpe, Holt, MacPherson, & Pittaway, 2005). The articles investigated here are extracted only from peer-reviewed journals on the assumption that the application of this criterion excludes sanctioned studies (Jones, Coviello, & Tang, 2011; Podsakoff, MacKenzie, Bachrach, & Podsakoff, 2005).

The most widespread databases for searching the literature were EBSCOt, Emerald, Proquest, ScienceDirect, Scopus, Web of Science and Wiley. We used different keywords variously combined among them and in line with the aims of our research. Specifically, we combined "agri/agro-food entrepreneurship" OR "agri/agro-food enterprises" OR "agri/agro-food businesses" OR "agri/agro-food sector" AND "COVID-19." The AND and OR operators were used to make the research more comprehensive. All authors compared their results from the analysis and wrote the sections of this paper. Following the

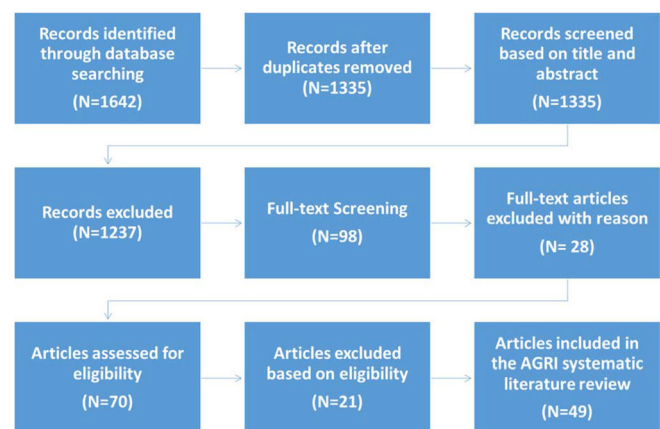


FIGURE 1 Screening and selection process of the research studies [Color figure can be viewed at wileyonlinelibrary.com]

TABLE 1 Classification and characteristics of agri-food entrepreneurship during the COVID-19 period

Topic	Characteristics	Examples/source
AGRI1—The impact of COVID-19 on agri-food entrepreneurship	<ul style="list-style-type: none"> • Socioeconomic impact • Impact on the operation of enterprises • Changes in consumer conditions • Changes in consumer income • Obstacles to the agri-food chain • Uncertainty and insecurity 	Mahajan and Tomar (2021) Béné (2020) Phillipson et al. (2020) Elleby et al. (2020) Douwe van der Ploeg (2020)
AGRI2—The role of the government measures and support on agri-food entrepreneurship	<ul style="list-style-type: none"> • Export ban • Changes in the supply system and food processing • Barriers to the supply of products • Measures taken to support the food chain 	Deaton and Deaton (2020) Blay-Palmer et al. (2020) Rowan and Galanakis (2020) Savary, Savary, Akter, et al. (2020) Mausch, Hall, and Hambloch (2020)
AGRI3: Shift of agri-food entrepreneurship towards digitization, innovative ideas and new market solutions	<ul style="list-style-type: none"> • Changes in the business models of supply and sale products • Development of innovative working systems and product distribution • Utilization of the internet and other advanced technologies • Development of digital marketing • Creation of online platforms • Utilization of telework and e-commerce • Digital education and information exchange 	Cristobal-Fransi, Montegut-Salla, Ferrer-Rosell, and Daries (2020) Kumar, Padhee, and Kumar (2020). Di Vaio et al. (2020) Quayson, Bai, and Osei (2020) Liverpool-Tasie et al. (2020)

process presented in Figure 1 and after screening the results' reliability in terms of their significance for the literature review (Xiao & Watson, 2019), the final count was 49 relevant studies.

Following these studies' selection, they were subjected to content analysis to investigate them in depth (Weber, 1990) and based on the evidence provided by the investigated studies (Phillips, Lee, Ghobadian, O'Regan, & James, 2015) to support a subsequent thematic analysis (Table 1).

4 | ANALYSIS AND FINDINGS

4.1 | AGRI1: The impact of COVID-19 on agri-food entrepreneurship

Nineteen studies were collected under the AGRI1 category of studies highlighting the impact of COVID-19 on agri-food entrepreneurship (Aday & Aday, 2020; Ambrozek & Beatty, 2020; Béné, 2020; Billah, Rahman, & Hossain, 2020; Bochtis et al., 2020; Bruno, Sexton, & Sumner, 2020; Dai, Feng, et al., 2020; Douwe van der Ploeg, 2020; Elleby et al., 2020; Ghadge, Kara, Mogale, et al., 2020; Hobbs & Jill, 2020; Lakuma, Sunday, Sserunjogi, Kahunde, & Munyambonera, 2020; Mahajan & Tomar, 2021; Mastronardi et al., 2020; Mastronardi, Romagnoli, Mazzocchi, et al., 2019; Mishra et al., 2021; Phillipson et al., 2020; Shahidi, 2020; Yang, 2020).

COVID-19 has brought changes in the general view on agri-food and not only in consumers' attitude towards food. Four essential changes are gradually becoming apparent in agri-food, which has a more significant impact on the structure than on the volume of demand: consumer preferences (Aday & Aday, 2020; Lakuma et al., 2020; Mishra et al., 2021; Béné, 2020; Yang, 2020; Billah et al., 2020;) income (Béné, 2020; Phillipson et al., 2020) logistics barriers (Aday & Aday, 2020; Béné, 2020; Dai et al., 2020) and uncertainty (Lakuma et al., 2020; Phillipson et al., 2020). This outcome should not come as a surprise, as agricultural production is inherently inelastic in the face of such external shocks, which have affected demand and distribution channels more (Elleby et al., 2020) than primary production.

Disruptions in supply and demand have reduced a company's turnover, with a significant financial impact on affiliated companies and affiliated households, as it cannot provide its products to the latter (Phillipson et al., 2020). Out-of-home food consumption (e.g., restaurants) has been significantly affected, with businesses in this market-facing acute cash flow issues and staff layoffs (Phillipson et al., 2020). The impact on local rural economies depends on the extent to which businesses can reorient their activities from consumption out-of-home to in-home consumption (e.g., a switch from restaurants to home delivery) (Ibidem). During the quarantine, despite the contraction of agricultural activity, there was a sharp increase in food sales, as investigated in five central Italy farms. In particular, Short Food Supply Chains (SFSC) and local marketing channels not only proved to be more resilient but also had a significant boost (Mastronardi et al., 2020). After the ban on eating out-of-home food, there was an increase in sales, particularly of transformed products such as flour, eggs, oil, mozzarella, but even fresh products, as they now consumed more homemade food (Ibidem). It was very positive that farmers did not increase their agricultural products' prices, in contrast to the big supermarket chains, which led to a further increase in demand. Augmented direct sales, mainly to Solidarity Purchasing Groups (SPGs), ensure the liquidity required to carry on the business (Ibidem). In this respect, COVID-19 has benefited local markets and short supply chains and highlighted new forms of social innovations, including farm networking and cooperation between producers and

consumers and between farms and non-profit organizations (Ibidem). The most affected are agricultural enterprises due to the low access to inputs arising from transport restrictions (Lakuma et al., 2020). Thus, companies' inputs have become relatively cheaper due to a lack of demand and a shift from fresh agricultural products to dried (Ibidem).

On the other hand, the prices of manufacturing companies' inputs have become relatively expensive due to the disruption of global supply chains (Lakuma et al., 2020). Survey data by Ghadge et al. (2020) examining the internal and external barriers of small and medium-sized cheese companies in the United Kingdom found that operating costs, including increased investment costs and increased product costs, are critical to business sustainability. Besides, internal barriers such as management and external barriers such as government regulations also significantly affect the implementation of sustainability practices (Ghadge et al., 2020). In the first lockdown in February, 80% of SMEs in China closed temporarily due to logistics blocks, labor shortages and declining demand (Dai et al., 2020). Between February and May, the lack of demand has become the most critical challenge, especially for export companies (Ibidem). The consequence of the lack of demand for some products is a reduction in suppliers, retailers, and producers' income and profitability (Béné, 2020).

Prices on European markets fell, suggesting a possible increase in imports. Elleby et al. (2020) research show the reduction of international meat prices by 7–18% in 2020, dairy products by 4–7% and a sharp decline in the price of biofuels, followed by their primary raw materials, maize and oily seeds. Hobbs (2020) and Bruno et al. (2020) show that the prices of some products in Canada and California have not changed. Ambrozek and Beatty (2020) show that food insecurity in the US has increased while Mahajan and Tomar (2021) suggest that in India, the supply of fruit, vegetables and oil has decreased by 10% with minimal impact on their prices. Although local supply chain disruptions and the income losses have led to increased food insecurity in many developing countries, global food consumption has remained largely unaffected due to the inelastic demand for most agricultural products (Elleby et al., 2020). The demand for products that strengthen the immune system (Mishra et al., 2021), are quality certified such as halal products (Billah et al., 2020) or the animal welfare products (Yang, 2020), has increased.

However, as income insecurity increases, home consumption is also likely to be adversely affected with consequent impact on all businesses (Phillipson et al., 2020). The survey (Bochtis et al., 2020) showed that 54% of workers' annual income of employees and 50% of the agricultural workforce are moderate to high risk. Seasonal workers or migrants working mainly in planting, sorting, harvesting, processing, or transporting crops to markets are absent from work due to travel restrictions or sickness (Aday & Aday, 2020). The most affected farms depend on seasonal/migrant labor, notably fruit and vegetable production (Mishra et al., 2021), horticulture and garden nurseries (Phillipson et al., 2020). The research by Lakuma et al. (2020) reports that micro and small businesses halted operation due to the inability to apply Standard Operating Procedures (SOPs), such as providing on-site accommodation to employees.

On the other hand, a study from Uganda reports a reduction of about three-quarters of surveyed companies in the number of employees (Lakuma et al., 2020). The measures to increase the sustainability and resilience of the agri-food sector are replacing seasonal migrant labor with domestic workers, implementing stringent sanitary measures to welcome seasonal migrant labor and regularizing irregular migrants (Bochtis et al., 2020). In Britain, its "Pick for Britain" campaign aimed to find 70,000 British to work in the field and during the harvest (Aday & Aday, 2020).

Restrictions on movement among regions and social distancing policies affect the food supply chain's operation through short-run shocks to supply and demand in agricultural and food markets (Mishra et al., 2021). Logistic barriers further weaken high-value goods due to their short shelf life (Shahidi, 2020). There are many reports where farmers have been forced to destroy their crops or leave their fields due to restrictive measures (Aday & Aday, 2020). Due to the supply chain disruption, the trucks for food distribution were reduced by 60% since the restrictive measures in France, dairy farmers in America discards 14 million liters of milk daily, in England 5 million liters of milk are at risk in 1 week. India tea plants were being lost due to logistical challenges (Ibidem). Besides, restrictive measures have affected the transporters of products by small and medium-sized enterprises (e.g., the time they are allowed to travel on the road) directly impacting a drop in profitability, affecting their income, purchasing power and access to markets (Béné, 2020).

4.2 | AGRI2: The role of the government measures and support on agri-food entrepreneurship

Seventeen studies were collected under the AGRI2 category (Aleksiev, Ruschickaya, & Yurchenko, 2020; Barcaccia et al., 2020; Blay-Palmer et al., 2020; Christiaensen et al., 2020; Deaton & Deaton, 2020; Dupouy & Gurinovic, 2020; Fanzo et al., 2020; Gregorioa & Ancog, 2020; Hossain, 2020; Kennedy, Jafari, Stamoulis, & Callens, 2020; Ma, Peng, Soon, et al., 2020; Mausch et al., 2020; Popovic et al., 2020; Rowan & Galanakis, 2020; Savary et al., 2020; Singh et al., 2020; Sperling et al., 2020).

The export ban caused a reduction in world GDP to 13% in the first half of 2020, which suggests that the global food supply is affected by the exchange rate (Ma et al., 2020). The World Bank has stated that COVID-19 pandemic disrupts the domestic supply chain while the global supply chain remains unaffected (Ibidem). Domestic food supply was significantly affected by labor shortages, disruption of distribution systems, loss of income (Savary et al., 2020; Singh et al., 2020) as well as the massive loss of agricultural products that were impossible to transfer due to restrictive measures imposed by governments (Ma et al., 2020). For example, the food demand shocks in Southeast Asia were huge due to disruptions in the food supply chain, equivalent to a 1.4% decrease in GDP (Gregorioa & Ancog, 2020). The effects of COVID-19 on countries' food supply chain under civil unrest, political isolation, or underinvestment in public health are adverse. For example,

war-torn countries Yemen, Sudan and Syria are experiencing acute food insecurity (Ibidem).

On May 27, 2020, the European Commission presented a stimulus plan of € 750 billion to alleviate the shock caused by COVID-19 pandemic and, at the same time, opened a new path to innovation and sustainable business development, although with lack in specific details of supporting a techno-socio-economic ecosystem that will lead F&D companies beyond the COVID-19 pandemic (Rowan & Galanakis, 2020). Selected areas will focus on climate action, digitization, manufacturing, sustainable food production, security, and waste mitigation (Rowan & Galanakis, 2020).

Undoubtedly, the primary agri-food and the food industry sectors are of great strategic importance to Italy. The pandemic has shown how fragile and unsustainable the European Food Supply System is, as thousands of entrepreneurs who produce, grow plants, raise animals, fish and process food have been endangered, according to the Italian Minister of Agricultural, Food and Forestry Policies (Barcaccia et al., 2020). On April 24, 2020, the Chamber approved the "Cura Italia" Decree with a total budget of € 25 billion (decree no. 18/2020) to directly support companies and workers in the agri-food sector. The decree includes the coverage of interest expenses on bank loans, the increase of the advances of the Common Agricultural Policy (CAP) contributions to farmers from 50% to 70%, a measure worth more than € 1 billion alone and the increase of the Indigent Fund to ensure food distribution to the most deprived members of society. Undoubtedly, this is a robust economic measure that meets this purpose (Ibidem). The *Cura Italia* decree is followed by the € 55 billion decree-law "*Rilancio*," of which € 1 billion aimed at implementing measures to repair the damage suffered by the agricultural, fisheries and aquaculture sectors (Ibidem). The survey by Popovic et al. (2020) was conducted in March on 102 small and medium-sized agri-food enterprises and farm households from Western Balkan countries, including Serbia, Montenegro, Bosnia and Herzegovina and Albania. Liquidity was the most significant impact of the pandemic on agri-food enterprises, while on-farm households saw their revenue decline. The role of governance is significant in risk management analysis and design by offering state funding to overcome the problems of agri-food SMEs and farm households in these countries (Popovic et al., 2020).

Besides, to address the adverse effects of COVID-19, Russia has taken measures to support entrepreneurship, particularly farmers, agricultural engineers and enthusiasts of the digital economy, who have proven their effectiveness in times of crisis (Alekseev et al., 2020). From 1 April to June 30, 2020, the Ministry of Agriculture implemented a series of measures to limit cereals' export, except cereal grains. In particular, a quota of 7 million tonnes was set to export wheat and meslin, rye, barley, and corn (Alekseev et al., 2020).

Hossain (2020) study reports the data regarding the 21 member economies in the Asia-Pacific region, which belong to the non-political, non-profit, non-discriminatory intergovernmental organization APO (Asian Productivity Organization Members). The implemented policies emphasize the need for critical agricultural inputs, such as fertilizers and safe, quality seeds, to meet seasonal crop calendars. Indicative measures taken by some countries of APO member economies

are the following. India is intensively monitoring the agricultural supply chain to meet the low- to no-income populations' demands, allowing the sale of fruits and vegetables on open markets, providing meals at home through diet programs, and empowering 200 million women through the Jan Dhan financial inclusion programme. The Japanese government has announced a \$ 989 billion (20% of GDP) stimulus package (Hossain, 2020) to boost families' incomes, small business owners and Japanese companies. The Council of Agriculture (COA) of the Republic of China has allocated a special budget of \$ - 250 million to recover the agricultural sector, expand e-commerce and export marketing in the agri-food sector (Ibidem). The Turkish government supports farming with 75% funding for specific crop seeds in 21 provinces. Imports of important food or feed crops such as wheat, maize, sunflower, sunflower oil and rice are exempt or have a reduced customs tax (Hossain, 2020). The Canadian Community Health Survey reports that COVID-19 pandemic is an "income shock" for the population, increasing household food insecurity (Deaton & Deaton, 2020). This survey found that reinvestment in Canadian farms and food processing will boost the local rural economy and self-sufficiency. Another issue being discussed again above is the capacity of capital to flow smoothly to farmers. The Bank of Canada reduces interest rates while the federal government's base to Farm Credit Canada provides a flexible extension of credit to farmers, allowing them to defer loans to ensure production stability. Indeed, the Nutrition North Program ensures food availability at reduced prices in remote areas but depends on air transport (Ibidem). Some features for a seed security action are the support of all seed systems farmers might use, the diagnosis of problems and learning from the intervention, the evaluation of efficiency and the prediction of future trends, the digital innovation and the policies of strengthening seed systems (Sperling et al., 2020).

On November 28, 2019, the EU Parliament announced that climate change is a global emergency (Barcaccia et al., 2020). A few months later, COVID-19 pandemic occurred, and so now there are two global emergencies that we are called upon to deal with immediately (Ibidem). The pandemic may have created huge problems worldwide in the agri-food industry and beyond. However, it is now time to take action to create a more resilient and sustainable food system in future crises and perhaps even mitigate such crises that affect agriculture, food, health and climate at the same time. Achieving this requires a coordinated policy and cooperation of all actors at global, national, regional, municipal and local levels. First, we need to rethink our dependence on global food supply chains and move to short and local food supply systems to boost the incomes of rural families and small farmers, and at the same time to build agro-ecology awareness in agricultural production and the solidarity with these communities (Blay-Palmer et al., 2020). The strong commitments with small farmers, family farmers and SMEs along the food chain ensure their viability for broader social resilience (Blay-Palmer et al., 2020).

The European Union's agriculture and rural development policies are an important part of the EU's positive contribution to implementing the United Nations 2030 Agenda for Sustainable Development. At the core of the agenda are the Sustainable Development Goals (SDGs) agreed upon globally and must be achieved by 2030.

Initially, goal 2 is to eradicate world hunger (Kennedy et al., 2020; Mausch et al., 2020). The contribution of EU agriculture to achieving this goal is twofold: the standard agricultural policy guarantees safe, nutritious and sustainable food for all Europeans. At the same time, EU food exports contribute to third countries' food security. They provide incredibly favorable trade conditions in developing regions that support the development of their domestic agri-food industries. Of course, these countries face different food security and nutrition challenges as they are not homogeneous and the magnitude of problems currently encountered. In the quantitative research analysis by Kennedy et al. (2020), we observe countries range from high levels of hunger and undernourishment to those with high obesity and low levels of hunger. Kennedy et al. (2020) emphasize that to achieve SDG2, it is necessary to reinvest in agriculture, unleash the private sector, gender equality through women's right to education, and go local. Mausch et al. (2020) point out for the goal of "Zero Poverty" that, there should be more reliance on the private sector to defeat global poverty either through PPPs [public-private partnerships] or philanthropy. Through the "leave no one behind" and "do no harm" sentiments (Mausch et al., 2020) we have to consider global food security as "moral imperative" (Fanzo et al., 2020), in order to find solutions such as the Fairtrade voluntary redistribution mechanism, which boosts the incomes of participating producers through consumers who are willing and able to afford it (Mausch et al., 2020).

4.3 | AGRI3: Shift of AGRI-food entrepreneurship towards digitisation, innovative ideas, and new market solutions

Thirteen studies were collected under the AGRI3 category (Butu, Brumă, Tanasă, Rodino, et al., 2020; Ciruela-Lorenzo et al., 2020; Cowie et al., 2020; Cristobal-Fransi et al., 2020; Di Vaio et al., 2020; Fabeil, Pazim, & Langgat, 2020; Kumar et al., 2020; Liverpool-Tasie et al., 2020; Lucaci & Nastase, 2020; Morris & Bowen, 2020; Quayson et al., 2020; Tasnim, 2020; Yadav, Luthra, Garg, et al., 2021).

The COVID-19 pandemic has had a profound effect, as mentioned above, on people's lives and business activities in rural areas. In particular, agricultural enterprises have had a significant impact on rural areas' development due to the socio-economic contribution through employment, suppliers, customers and business competitors. The role of agricultural enterprises in Europe's prosperity and preserving the regions' cultural heritage is huge (Lucaci & Nastase, 2020). It is, therefore, necessary to reconsider the business models that will revise the following dimensions: environmental, economic, technological, educational and social (Di Vaio et al., 2020). The key to the necessary changes is agricultural market reforms and digital solutions to connect farmers to markets, create safety nets and ensure reasonable working conditions and decentralized food systems, especially for vulnerable communities (Kumar et al., 2020). That is why the UN Agenda 2030 must review its objectives and place great emphasis not only on promoting the SBM of large and small enterprises in the space sector (space agencies, governments, etc.) and SMEs from non-space sectors

(i.e., startups and incubators) but also in the adoption of a subversive technology through an organic vision of culture to ensure, among other things, the quality of human life and environmental entrepreneurship (Di Vaio et al., 2020). In a survey of 15 agricultural enterprises in Wales only eight respondents had adopted renewable energy production as a form of diversification (Morris & Bowen, 2020), because while there are natural resources and opportunities for the rural economy to diversify into renewable energy, there are many obstacles, such as the cost of conserving renewables (Ibidem). Indeed, to achieve global environmental and business sustainability, politicians, researchers and companies must develop common principles to ensure the responsible implementation of all AI technologies. Besides, scholars, professionals, and institutions must be environmentally conscious of implementing a public-private partnership network to properly manage social change in the face of the digital revolution (Di Vaio et al., 2020).

The research in India by Kumar et al. (2020) examined that horticultural farmers were more affected than farmers in harvesting and selling crops because of the pandemic. For an agri-food business to be prepared for the risks of future crises, it is prudent to form an emergency team consisting of company chiefs, who will formulate cross-functional solutions (Di Vaio et al., 2020). Every business's priority is employees and consumers' safety and, if possible, to ensure it through smart working mode such as teleworking and e-commerce (Ibidem). Kumar et al. (2020) survey the farm-to-market linkages carried out by Haryana State's horticultural department, which brings together nearly 81 farmers producer companies (FPCs) to gather the fruits and vegetables of member farmers in order to sell them to the final consumers. The continued support of e-commerce and delivery companies can ensure the continuity of agricultural supply chains (Kumar et al., 2020).

On the contrary, Butu et al. (2020) identified the percentage of consumers who ordered fresh vegetables directly from producers in the Suceava region of Romania after enforcing the state in an emergency. Shortly before the restrictive measures were imposed, 12% of respondents chose the online purchase of fresh vegetables directly from producers. After that, 60% have stated that they intend to adopt this purchase system from short food supply chains (SFSCs) following the COVID-19 crisis. The trend towards the digital transformation of SFSCs seems to provide a viable solution to the pandemic as conventional agricultural production's reliability has been called into question (Ibidem).

In developing countries, the recovery strategy of small and medium-sized enterprises is quite tricky. Fabeil et al. (2020) examine two micro-enterprises' prospects in Sabah's rural area in Malaysia. The interviews reveal that, in order to ensure the continuous operation of the business, entrepreneurs should, among other things, use digital marketing through mobile applications and social media, such as Facebook and WhatsApp, and to make transactions for the sale of goods such as "collect on-demand" or "cash on delivery." Even developed countries such as France, Belgium, the Netherlands have made such alternatives, to support agricultural businesses and promote local agri-products, such as creating online platforms (Lucaci & Nastase, 2020). However, as Cristobal-Fransi et al. (2020) shows, using online platforms is more problematic with fruits than with oil

and wine products due to their vulnerability and sensitivity to temperature, storage and transport. Although these cooperatives are aware of the value of their online presence, they need to enhance and promote Internet interaction, connectivity, and users' ability to share content and knowledge through Web 2.0 techniques (Ibidem).

Yadav et al. (2021) claim that the management of the globalized sustainability is based on the cooperation of multi-tier system with government mechanisms but also with non-profit organizations (NGOs) based on various IoT technologies (Blockchain, Robotics, Big data analysis and Cloud computing). Initiatives such as RFID and BDA technology will help managers predict crop yields and demand pattern (Yadav et al., 2021). Besides, partially or wholly dependent on paper-based work must implement planning software such as SAP to enhance, among other things, collaboration, communication, and visibility of all supply chain partners (Tasnim, 2020). This configuration will help administrators set up policies for maintaining quality products, improving packaging standards, minimizing transaction costs, and reducing inventory and waste (Tasnim, 2020; Yadav et al., 2021). On the other hand, small farmers in developing countries involved in global value chains are more complicated. Blockchain examples have been identified by Cellulant Agrikore in Nigeria and AgroCenta in Ghana, Africa, using technology to directly connect smallholder farmers to markets and development partners for a broader online market. Besides, digital training and information exchange systems such as Cocalink, MergeData, Esoko and Farmerline will facilitate plant doctors' work by sharing disease data between smallholders and experts. IEEE Smart Villages ensure the sustainable renewable energy services of rural communities with limited electricity access to provide reliable, cheap, and sustainable power for any technological innovation. A project that combines the Big Data Analytics and the Internet of Things (IoT), called "Transforming Africa's agriculture: eyes in the sky, smart techs on the ground" supports the use of drones for farming through the adoption of Precision Agriculture (Quayson et al., 2020). Finally, private-sector platforms are being developed that operate as one-stop shops for farmers to secure inputs, training, credit and a guaranteed market (Liverpool-Tasie et al., 2020).

Indeed, the adoption of artificial intelligence technology which requires the simultaneous active participation and cooperation of all smallholder farmers (Quayson et al., 2020), contributes to the redefinition of the agri-food business model, and leads to their distancing as it affects the social dimension and consequently achieving some SDGs (Di Vaio et al., 2020). Key steps in agri-food development and prevention of future crises are encouraging farmers to join in companies and organizations in order to guide digital and direct marketing solutions and encouraging agri-tech startups to cope with FPCs, FPOs and smallholders in order to jointly improve input and output supply chains (Kumar et al., 2020). According to Kumar et al. (2020), small dairy farmers associated with vendor-driven milk markets suffered significant losses in India. In the future, it is essential to create a local milk network in each area to connect vendors with organized dairies, processors, and input suppliers through digital platforms. Also, Butu et al. (2020) claim that producers should immediately adapt their business activity towards digital transformation, implement innovative

solutions for direct distribution of products to consumers addressed to SFSCs, improve customer communication, and create attractive product presentations online.

5 | CONCLUDING REMARKS AND FUTURE RESEARCH AVENUES

COVID-19 created a challenging environment for the agri-food sector and entrepreneurship, but at the same time, entrepreneurial opportunities have been generated. COVID-19 provided a boost to short supply chains in the agri-food sector and agri-food enterprises with new technologies and digital aspects in their core were privileged in competition. Agri-food enterprises relying on transportation for their inputs were under challenging positions due to travel restrictions. Simultaneously, there was a forced change from fresh to dried agri-food products affecting agri-food entrepreneurial activities. Many of the sector's contemporary problems are not new, and in many countries, the agri-food sector and agri-food supply networks are fragile and unsustainable. COVID-19 experience aggravated those critical conditions, but it shows that decentralized networks worked better during the crisis. In light of this, the institutional framework and government support's role was crucial in securing agri-food operations and maintaining entrepreneurial activities in the sector for the market's continuous supply with agri-food products. Governments took measures and released funds to support the enterprises. However, agri-food entrepreneurship has to change and modernize by adopting new digital technologies and innovations, allowing them to operate better even in turbulent periods.

To this extent, this paper expands our current knowledge by examining 49 studies and maps the new challenging environment for agri-food entrepreneurship forced by COVID-19. Moreover, it sets a discussion platform in agri-food entrepreneurship in turbulent times by classifying research trends. Furthermore, this is not without research limitations as the research production is ongoing, and there might be new aspects revealed as COVID-19 crisis is ongoing. However, it was an opportunity to take stock and look forward by setting some emerged research avenues. Thus, this study highlights the following fertile areas of future research; (a) Agri-food entrepreneurship and COVID-19 by taking into account spatial dimensions, (b) The impact of COVID-19 on entrepreneurial activities in relation to the adapt of new digital technologies and new market solutions, (c) Food supply chains and agri-food entrepreneurship in times of crisis, (d) Government support measures and funding during COVID-19 targeting agri-food enterprises by comparing different approaches between countries, (e) Food security and agri-food entrepreneurship during COVID-19, (f) COVID-19 crisis as an opportunity for a transition to sustainable agri-food entrepreneurship and a shift of the agri-food sector towards the UN Sustainable Development Goals, (g) Comparative analysis between the COVID-19 and post-COVID-19 period through the lens of the impact on agri-food entrepreneurship, (h) Permanent changes caused by COVID-19 to the entrepreneurial activities and adoption of new business models in agri-food enterprises. As presented above, a wide range of research areas

need further research as the COVID-19 crisis revealed weaknesses and strengths in the agri-food sector. It forced changes to agri-food entrepreneurial activities.

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